Tuesday, December 03, 2013

07:15-08:15 AM  •  SPSC30  •  Room: E350  •  Controversy Session: Fibroid Therapy: UAE vs Focused US
07:15-08:15 AM  •  SPSP30  •  Room: E351  •  Hot Topic Session: Lung Adenocarcinoma - Evolving Concepts
08:30-10:00 AM  •  MSAS31  •  Room: S105AB  •  Standards of Ethics in Practice: Evolution, Purpose, Structure, Compliance (Sponsored by the Associated Sciences)
08:30-10:00 AM  •  MSEC31  •  Room: S100AB  •  Essentials of Cardiac Imaging
08:30-10:00 AM  •  MSQO31  •  Room: S406B  •  Quality Improvement: Safety at Work
08:30-10:00 AM  •  MSRO31  •  Room: S103AB  •  BOOST: Gastrointestinal-Anatomy and Contouring (An Interactive Session)
08:30-10:00 AM  •  MSRO34  •  Room: S103CD  •  BOOST: Breast-Anatomy and Contouring (An Interactive Session)
08:30-10:00 AM  •  RC301  •  Room: E450A  •  High-Resolution CT: A Pattern-based Approach (An Interactive Session)
08:30-10:00 AM  •  RC303  •  Room: N226  •  Cardiac Perfusion Imaging
08:30-10:00 AM  •  RC304  •  No Course RC304. See Series VSMK31 Musculoskeletal Radiology Series: Ultrasound
08:30-10:00 AM  •  RC305  •  No Course RC305. See Series VSNR31 Neuroradiology Series: Brain Tumors
08:30-10:00 AM  •  RC306  •  Room: E451A  •  Temporal Bone Imaging
08:30-10:00 AM  •  RC307  •  No Course RC307. See Series VSGU31 Genitourinary Series: Prostate Cancer 2013-Review of the Disease and the Ro...
08:30-10:00 AM  •  RC308  •  No Course RC308. See Series VSER31 Emergency Radiology Series: Leveraging Technology for State-of-the-Art Pract...
08:30-10:00 AM  •  RC309  •  No Course RC309. See Series VSGI31 Gastrointestinal Series: Pancreas - Inflammation and Neoplasm
08:30-10:00 AM  •  RC310  •  Room: S405AB  •  Second and Third Trimester Obstetrical Ultrasound
08:30-10:00 AM  •  RC311  •  No Course RC311. See Series VSNM31 Nuclear Medicine Series: Non-FDG PET Radiotracers in Oncology
08:30-10:00 AM  •  RC312  •  Room: E350  •  Acute Abdominal Vascular Diseases
08:30-10:00 AM  •  RC313  •  No Course RC313. See Series VSPD31 Pediatric Radiology Series: Chest/Cardiovascular Imaging I
08:30-10:00 AM  •  RC314  •  No Course RC314. See Series VSIK31 Interventional Radiology Series: Venous Disease
08:30-10:00 AM  •  RC315  •  No Course RC315. See Series VSBR31 Breast Series: Emerging Technologies in Breast Imaging
08:30-10:00 AM  •  RC316  •  Room: E450B  •  The Aging Radiologist: How to Cope, When to Quit (Sponsored by the RSNA Professionalism Committee) (An Interac...
08:30-10:00 AM  •  RC317  •  Room: S504CD  •  MR-Guided High Intensity Frequency Ultrasound (HIFU)
08:30-10:00 AM  •  RC318  •  Room: S104A  •  Imaging of Irradiated and Abileted Tumors
08:30-10:00 AM  •  RC320  •  Room: S504AB  •  Role of Stereotactic Ablative Radiotherapy (SABR) and Interventional Radiology in the Management of Oligometastas...
08:30-10:00 AM  •  RC321  •  Room: S102D  •  Medical Physics 2.0: Nuclear Imaging
08:30-10:00 AM  •  RC322  •  Room: E261  •  Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques-Incorporation of Imaging as ...
08:30-10:00 AM  •  RC323  •  Room: S404AB  •  Minicourse: Current Topics in Medical Physics-Radiation Dose Reduction in Medical Imaging
08:30-10:00 AM  •  RC324  •  Room: S402AB  •  Mentored Case Approach to Pediatric Cardiovascular Disease 2: Cardio Disease (An Interactive Session)
08:30-10:00 AM  •  RC325  •  Room: E353A  •  Quantitative Imaging: Functional MRI (fMRI)
08:30-10:00 AM  •  RC326  •  Room: N229  •  Quantitative Imaging: A Revolution in Evolution (In Association with the Society for Imaging Informatics in Me...
08:30-10:00 AM  •  RC327  •  Room: S403A  •  Hot Topics in Malpractice Litigation 2013: Communication of Radiologic Findings and Common Medicolegal Issues ... 
08:30-10:00 AM  •  RC329  •  Room: E353B  •  HCC Diagnosis Using LI-RADS (An Interactive Session)
08:30-10:00 AM  •  RC330  •  No Course RC330. See Series VSIN31 Radiology Informatics Series: Natural Language Processing: Extracting Infor...
10:30-12:00 PM  SSG07 • Room: S102D • ISP: Health Service, Policy and Research (Economic Analyses and Utilities)
10:30-12:00 PM  SSG08 • Room: S402AB • Informatics (3D, Quantitative and Advanced Visualization)
10:30-12:00 PM  SSG09 • Room: S504CD • Molecular Imaging (Subspecialties)
10:30-12:00 PM  SSG10 • Room: E450B • Musculoskeletal (Interventional II)
10:30-12:00 PM  SSG11 • Room: N229 • Neuroradiology (Advances in Intracranial CT and MR Angiography)
10:30-12:00 PM  SSG12 • Room: S209A • Neuroradiology (Imaging of White Matter and Demelicating Disease)
10:30-12:00 PM  SSG13 • Room: S403A • Physics (Quantitative Imaging I)
10:30-12:00 PM  SSG14 • Room: S403B • Physics (Multi-energy CT)
10:30-12:00 PM  SSG15 • Room: S404AB • Physics (X-ray Imaging)
10:30-12:00 PM  SSG16 • Room: S104A • Radiation Oncology and Radiobiology (Genitourinary)
10:30-12:00 PM  SSG17 • Room: E353A • Vascular/Interventional (Ablative Therapies)
12:15-12:45 PM  CL-MIE-TUSA • Room: S503AB • Recurrent Brain Tumors v/s Radiation Necrosis: PET MRI as a Rescue
dicussion (12:15-12:45 PM - Tuesday Posters and Exhibits (12:15 - 12:45pm)
12:15-12:45 PM  CL-MNS-TUA • Room: S503AB • Nuclear Medicine - Tuesday Posters and Exhibits (12:15 - 12:45pm)
12:15-12:45 PM  CL-PSD-TUA • Room: S101AB • Pediatric Radiology - Tuesday Scientific Posters and Exhibits (12:15 - 12:45pm)
12:01-12:00 PM  EPT06 • Room: South Building Hall A Booth 3314 • Siemens Healthcare: Leading. With MAGNETOM. Innovations for MRI
12:15-12:45 PM  LL-CAS-TUB • Room: Lakeside Learning Center • Cardiac - Tuesday Posters and Exhibits (12:15 - 12:45pm)
12:15-12:45 PM  LL-CHS-TUB • Room: Lakeside Learning Center • Chest - Tuesday Posters and Exhibits (12:15 - 12:45pm)
12:15-12:45 PM  LL-ERS-TUB • Room: Lakeside Learning Center • Emergency Radiology - Tuesday Posters and Exhibits (12:15 - 12:45pm)
12:15-12:45 PM  LL-GIS-TUA • Room: Lakeside Learning Center • Gastrointestinal - Tuesday Posters and Exhibits (12:15 - 12:45pm)
12:15-12:45 PM  LL-GUS-TUB • Room: Lakeside Learning Center • Genitourinary/Uroradiology - Tuesday Posters and Exhibits (12:15 - 12:45pm)
12:15-12:45 PM  LL-HPS-TUA • Room: Lakeside Learning Center • Health Services - Tuesday Posters and Exhibits (12:15 - 12:45pm)
12:15-12:45 PM  LL-INS-TUA • Room: Lakeside Learning Center • Informatics - Tuesday Posters and Exhibits (12:15 - 12:45pm)
12:15-12:45 PM  LL-MKS-TUA • Room: Lakeside Learning Center • Musculoskeletal - Tuesday Posters and Exhibits (12:15 - 12:45pm)
12:15-12:45 PM  LL-MSE-TU • Room: Lakeside Learning Center • Multisystem/Special Interest - Tuesday Posters and Exhibits (12:15 - 12:45pm)
12:15-12:45 PM  LL-RSOS-TUB • Room: Lakeside Learning Center • Emergency Radiology - Tuesday Posters and Exhibits (12:15 - 12:45pm)
12:15-12:45 PM  LL-ROSA-TUB • Room: Lakeside Learning Center • Musculoskeletal - Tuesday Posters and Exhibits (12:15 - 12:45pm)
12:15-12:45 PM  LL-VIS-TUB • Room: Lakeside Learning Center • Vascular/Interventional - Tuesday Posters and Exhibits (12:15 - 12:45pm)
12:15-12:45 PM  LL-VIS-TUB • Room: Lakeside Learning Center • Vascular/Interventional - Tuesday Posters and Exhibits (12:15 - 12:45pm)
12:30-02:00 PM  ICIA32 • Room: S401CD • 3D Interactive Visualization of DICOM Images for Radiology Applications: Hands-on Workshop
12:30-02:00 PM  ICII32 • Room: S501ABC • Meaningful Use: Experience from Private Radiology Practices
12:30-02:00 PM  ICIV32 • Room: S401AB • Display Technology
12:45-15:01 PM  CL-MNS-TUB • Room: S503AB • Nuclear Medicine - Tuesday Posters and Exhibits (12:45pm - 1:15pm)
12:45-15:01 PM  CL-PSD-TUB • Room: S101AB • Pediatric Radiology - Tuesday Posters and Exhibits (12:45 - 1:15PM)
12:45-15:01 PM  LL-BAS-TUB • Room: Lakeside Learning Center • Breast - Tuesday Posters and Exhibits (12:45 - 1:15pm)
12:45-15:01 PM  LL-BTH-TUB • Room: Lakeside Learning Center • Orthopedic Imaging - Tuesday Posters and Exhibits (12:45 - 1:15pm)
12:45-15:01 PM  LL-CHS-TUB • Room: Lakeside Learning Center • Chest - Tuesday Posters and Exhibits (12:45 - 1:15pm)
12:45-15:01 PM  LL-ERS-TUB • Room: Lakeside Learning Center • Emergency Radiology - Tuesday Posters and Exhibits (12:45 - 1:15pm)
12:45-15:01 PM  LL-GIS-TUB • Room: Lakeside Learning Center • Gastrointestinal - Tuesday Posters and Exhibits (12:45 - 1:15pm)
12:45-15:01 PM  LL-GUS-TUB • Room: Lakeside Learning Center • Genitourinary/Uroradiology - Tuesday Posters and Exhibits (12:45 - 1:15pm)
12:45-15:01 PM  LL-HPS-TUB • Room: Lakeside Learning Center • Health Services - Tuesday Posters and Exhibits (12:45 - 1:15pm)
12:45-15:01 PM  LL-INS-TUB • Room: Lakeside Learning Center • Informatics - Tuesday Posters and Exhibits (12:45 - 1:15pm)
12:45-15:01 PM  LL-MKS-TUB • Room: Lakeside Learning Center • Musculoskeletal - Tuesday Posters and Exhibits (12:45 - 1:15pm)
12:45-15:01 PM  LL-MSE-TUB • Room: Lakeside Learning Center • Multisystem/Special Interest - Tuesday Posters and Exhibits (12:45 - 1:15pm)
12:45-15:01 PM  LL-NRS-TUB • Room: Lakeside Learning Center • Neuroradiology/Head and Neck - Tuesday Posters and Exhibits (12:45pm - 1:15pm)
12:45-15:01 PM  LL-OBE-TUB • Room: Lakeside Learning Center • Obstetrics/Gynecology Posters and Exhibits (12:15 - 12:45pm)
12:45-15:01 PM  LL-PHS-TUB • Room: Lakeside Learning Center • Physics - Tuesday Posters and Exhibits (12:15 - 12:45pm)
12:45-15:01 PM  LL-RSOS-TUB • Room: Lakeside Learning Center • Emergency Radiology - Tuesday Posters and Exhibits (12:45pm - 1:15pm)
12:45-15:01 PM  LL-VIS-TUB • Room: Lakeside Learning Center • Vascular/Interventional - Tuesday Posters and Exhibits (12:45 - 1:15pm)
01:30-03:00 PM  MSAS33 • Room: S105AB • Process Engineering to Optimize Work Flow Processes in Radiology: A Case Study Approach (Sponsored by the Asso...
With advances in CT technology, thinner slices of the whole lungs in a single breath hold has become routine. With the improved...
resolution, more small nodules, and increasingly more nodules that are partly or entirely ground glass in opacity are detected that ever before. This has become particularly evident through the many single are lung cancer screening with low dose CT cohort studies, and the NLST. As nodules have been resected internationally, the need to redefine these largely adenocarcinomas are was needed, resulting in a multisociety effort published in 2011; the details of this revised pathologic classification with imaging correlation be discussed and illustrated. In addition, it has been recognized that part solid nodules (mixed ground glass and solid components) carry a higher risk than pure ground glass nodules, and the latter higher risk than the more ubiquitous solid nodules. Managing these part solid and non solid nodules, together referred to as 'subsolid nodules' should therefore be different. In early 2013 the Fleischner Society published new recommendations for how to manage solitary and multiple subsolid nodules detected on CT as a complement to their earlier recommendations for managing indeterminate lung nodules which dealt with solid nodules. The details of the subsolid nodule management recommendations will also be discussed. Recommended reading: 1) Recommendations for the Management of Subsolid Pulmonary Nodules Detected at CT: A Statement from the Fleischner Society. Radiology. 2013 Jan;266(1):304-17 http://radiology.rsna.org/content/early/2012/10/10/radiol.12120628.full 2) International Association for the Study of Lung Cancer/American Thoracic Society/European Respiratory Society International Multidisciplinary Classification of Lung Adenocarcinoma. J Thorac Oncol. 2011 Feb;6(2):244-85 http://www.ncbi.nlm.nih.gov/pubmed/21252716

SPSH30A • The Revised Lung Adenocarcinoma Classification: Justification and Radiologic-Pathologic Correlation

William D Travis (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

SPSH30B • The Radiologist Approach to Lung Adenocarcinomas: Imaging Technique, Reporting, and Management Recommendations

David P Naidich MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

Standards of Ethics in Practice: Evolution, Purpose, Structure, Compliance (Sponsored by the Associated Sciences Consortium) (An Interactive Session)

Tuesday, 08:30 AM - 10:00 AM • S105AB

MSAS31 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Claudia A Murray
Richard Duszak , MD
Ann Obergfell , JD

LEARNING OBJECTIVES
1) Recognize the need for ethics that promote appropriate patient treatment, acceptable standards of care and adherence to regulatory compliance. 2) Develop a framework for continually improving a practice’s clinical and business operations. 3) Understand concepts fundamental to radiology coding and reimbursement. 4) Institute simple steps to ethically balance needs of patients with those of other parties.

Case-based Review of Nuclear Medicine: PET/CT Workshop-Head and Neck Cancers (In Conjunction with SNMMI) (An Interactive Session)

Tuesday, 08:30 AM - 10:00 AM • S406A

MSCC31 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Director
John A Parker , MD, PhD
Rathan M Subramaniam , MD, PhD *

LEARNING OBJECTIVES
1) To understand what the surgeon, radiation oncologist and oncologist want from a head and neck PET/CT. 2) To understand the normal variant FDG uptake in Head and Neck. 3) To understand the neck spaces, tumor spread and value of PET/CT in staging. 4) To understand the value of PET/CT in post therapy assessment and follow up of head and neck cancer patients.

ABSTRACT
This lecture will cover the essential information that allows a surgeon, radiation oncologist and oncologist to care for head and neck cancer patients in a multidisciplinary settings. It will emphasise the PET/CT clinical paradigms, normal variants of FDG uptake, neck spaces and tumor spread, and value and pitfalls of PET/CT in therapy assessment and follow up of head and neck cancer patients.

Essentials of Cardiac Imaging

Tuesday, 08:30 AM - 10:00 AM • S100AB

MSES31 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

MSES31A • Evaluation of Coronary Artery Bypass Grafts

Smita Patel MBBS (Presenter)

LEARNING OBJECTIVES
1) To discuss CTA technique for coronary artery bypass graft (CABG) imaging. 2) To review the surgical anatomy of conduits used for CABG and their CT appearance. 3) To review post CABG complications.

MSES31B • Quantification of Coronary Stenosis by CTA – Accuracy, Difficulties, and Functional Significance

John W Hoe MD (Presenter) *
ABSTRACT
The accuracy of coronary CTA to detect significant coronary artery stenosis (=>50%) compared to invasive angiography, has been well established. In clinical practice, quantification of degree of the stenosis of the coronary artery is expected from referring physicians. Coronary CTA does not perform as well when compared to quantitative coronary angiography (QCA), which is usually used as the gold standard. This is due to difference in spatial resolution. Other factors affecting accuracy of quantification include presence of positive remodeling and interobserver variation in assessing stenosis at invasive angiography or when compared to QCA. Coronary CTA, even if performed with latest generation scanners, currently can only quantify stenosis in 90%-95% of patients to an accuracy of ±25%. Methods of reporting degree of stenosis should follow the broad categories recommended by the SCCT and will influence further management of the patient. Methods of quantifying stenosis include visual estimation, manual quantification using workstation tools as well as automated software that can quantify stenosis (QCCTA) and how to use there methods and their accuracy will be discussed. Assessment of stenosis is usually based on estimating % diameter stenosis (%DS), after comparison with a reference diameter proximal or distal to the lesion. Use of minimal luminal area (mm²) or percent area stenosis is another technique, which can also be used to help quantify coronary stenosis and may be more reproducible.

The accuracy of coronary CTA to assess for presence of myocardial ischemia compared to myocardial perfusion imaging is limited using current criterion of => 50% stenosis but is improved using criterion of >70%. New methods to improve prediction of functional significance of stenosis such as using contrast gradient measurements and computational fluid dynamics (CT-FFR) but these are still under investigation.

LEARNING OBJECTIVES
1) To understand the difference between diagnostic accuracy of coronary CTA for detection of coronary artery stenosis compared to invasive coronary angiography and quantification of coronary stenosis by coronary CTA compared to invasive angiography. 2) To understand the different methods available to quantify coronary stenosis by CTA and also that stenosis can be quantified by diameter stenosis as well as area stenosis. 3) To understand that coronary CTA cannot accurately grade stenosis severity with wide limits of agreement and reasons for this. 4) How to report stenosis seen on coronary CTA and what constitutes significant or severe stenosis. 5) To understand why prediction of myocardial ischemia coronary CTA is limited and what methods are available to try to overcome these limitations.

MSES31C • Cardiac Masses (CT/MRI)

Ruth P Lim MBBS,MMed (Presenter)

LEARNING OBJECTIVES
1) To review the pros and cons of CT and MRI in the work up of cardiac masses. 2) To discuss optimization of image quality including appropriate patient preparation, and potential challenges including arrhythmia. 3) To review neoplastic and non-neoplastic masses and their appearance at cross-sectional imaging.

ABSTRACT
Cardiac CT and MRI are now firmly within the clinical domain for a number of indications, including mass evaluation. This session aims to discuss the somewhat complementary role of these modalities for this indication. CT offers advantages of speed and relatively high spatial resolution, with clear depiction of macroscopic fat or calcification. MRI is particularly helpful when functional as well as anatomic evaluation is desirable, and offers superior soft tissue contrast without exposure to ionizing radiation. Patient factors may also influence the choice of the most appropriate modality. Sound knowledge of the principles of CT and MRI imaging are necessary to obtain diagnostic quality imaging, and cardiac-specific issues will be discussed, including the limitations that heat rate, rhythm and breath-holding capability may place on imaging parameters. Technical tips for MRI and factors influencing radiation dose for CT will be briefly discussed. Finally, pearls and pitfalls for interpretation will be discussed. Cardiac anatomy will be reviewed, with examples of potential mass mimics and don’t-touch lesions, where CT and MRI may play a problem-solving role. Some of the more common and distinctive non-neoplastic masses, and neoplasms will be reviewed, with discussion of imaging features that may help to suggest a benign or malignant etiology.
Employees in a radiology department are exposed to multiple risks, including injuries due to radiation exposure, poor ergonomics, or repetitive stress; those caused by wearing lead aprons or moving heavy equipment for portable studies; and needlesticks resulting in exposure to body fluids. Strategies to mitigate or prevent such risks include ergonomics initiatives for radiologists and technologists, appointment of a radiation safety officer to ensure compliance with radiation dose guidelines and policies, and use of equipment that prevents exposure to body fluids. In addition, there are regulations and guidelines from various government bodies on occupational radiation dose limits, handling of isotopes and chemotherapy agents, contact with patients with airborne infections, and needle stick injuries. A comprehensive radiation safety program was developed for a clinical radiology department to provide a framework for staff injury prevention. The important parts of a staff safety program are observational safety audits and walkabouts and a safety reporting tool for employees. Faculty education about workplace environmental risks and their consequences, compliance with policies and guidelines on occupational health and safety, and development of a culture that encourages surveillance, reporting, and prompt action will go a long way toward improving overall safety for all workers in a radiology department.

**MSQ131 – Risk Management 101 for Radiologists**

Ronald L Eisenberg, MD, JD (Presenter)

**LEARNING OBJECTIVES**

1. To master the basic elements of risk management in order to protect patients and yourself.

**ABSTRACT**

Risk management has been defined as encompassing 'clinical and administrative activities that [health care organizations] undertake to identify, evaluate, and reduce the risk of injury and loss to patients, personnel, visitors, and [the organization] itself.' A successful risk management must be both reactive (to incidents that have already occurred) and proactive (to prevent future occurrences). In essence, risk management deals with identification if legal risk, prioritization of identified risk, determination of proper organizational response to risk, management of recognized risk causes with the goal of minimizing risk (risk control), establishment of effective risk prevention, and maintenance of adequate risk financing.' This segment will discuss the various aspects of risk management so that you are better prepared to protect your patients, your imaging department, and yourself.

**BOOST: Gastrointestinal-Anatomy and Contouring (An Interactive Session)**

**Tuesday, 08:30 AM - 10:00 AM • S103AB**

**MSRO31 – AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5**

Co-Director
Fergus V Coakley, MD
Co-Director
Bruce G Haffty, MD
Theodore S Hong, MD
Mukesh G Harisinghani, MD

**LEARNING OBJECTIVES**

1. Achieve a basic understanding of the anatomy pertinent to the anorectal region and imaging appearance of ano-rectal tumors. 2) Understand strengths and limitations of imaging techniques, including MRI, PET-CT and CT, as they are used in delineating primary tumor and staging involved regional nodes. 3) Identify common sites of recurrence for anorectal tumors and recognize the imaging appearances of these recurrences. 4) Improve radiation therapy delivery through understanding the contouring recommendations for the gross tumor volume (GTV) and clinical target volumes (CTV) for anorectal tumors, both in the locally advanced and postoperative setting.

**ABSTRACT**

In this course MRI will be used to contour normal anorectal anatomy as well as tumors involving this anatomical region. Also patterns of spread of patholological lymph nodes will be shown, and MRI will be used to contour the regional nodal lesions. Cases will be presented and the participants will be stimulated to do the contouring themselves, and will have feed-back on their results.

**BOOST: Breast-Anatomy and Contouring (An Interactive Session)**

**Tuesday, 08:30 AM - 10:00 AM • S103CD**

**MSRO34 – AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5**

Co-Director
Fergus V Coakley, MD
Co-Director
Bruce G Haffty, MD
Renii S Butler, MD
Nina A Mayr, MD

**LEARNING OBJECTIVES**

1) Gain an understanding of the staging of breast cancer and appropriate imaging and diagnostic studies used in the staging of breast cancer focusing on nodal evaluation. 2) Gain an understanding of the various breast imaging techniques, controversies, emerging technologies and future directions in the imaging of breast cancer, focusing on nodal evaluation. 3) Gain an understanding and appreciation of identifying and contouring nodal target volumes and radiation management of regional nodes. 4) Gain an understanding of the controversies regarding nodal evaluation and management in the current era of neoadjuvant systemic therapy and sentinel nodal evaluation.

**ABSTRACT**

The management of breast cancer has undergone rapid evolution with the increased utilization of neoadjuvant systemic chemotherapy and hormonal therapy, and increased utilization of sentinel node evaluation. These issues have impacted on both the imaging and radiotherapeutic management of breast cancer, particularly with respect to the evaluation and management of the regional lymphatics. During this 90-minute session a diagnostic radiologist and radiation oncologist will provide an overview of the principles of staging, radiographic imaging and radiotherapeutic contouring and considerations in the management of breast cancer focusing on nodal evaluation and management. The speakers will review AJCC staging, controversies regarding imaging and staging studies in the evaluation of patients with breast cancer, and provide an overview of contouring of target and normal tissue structures and radiation field considerations in the management of breast cancer with special attention to imaging, contouring and management of the regional lymphatics in the setting of primary management, evaluation after neoadjuvant therapy, and in the setting of local-regional relapse. In this session, special attention will be given to current and evolving approaches to regional nodal evaluation and management.

**High-Resolution CT: A Pattern-based Approach (An Interactive Session)**

**Tuesday, 08:30 AM - 10:00 AM • E450A**

**RC301 – AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5**

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LEARNING OBJECTIVES
1) To define and illustrate the anatomic structures that form the basis of high resolution CT (HRCT) imaging of the lung. 2) To define and illustrate the anatomic basis of the most common imaging patterns detected on HRCT.

LEARNING OBJECTIVES
1) Identify common findings and patterns on high resolution CT of the lung. 2) Give focused differential diagnoses based on a combination of HRCT findings and clinical information. 3) Understand the role of HRCT in diagnosis in relation to clinical and pathologic results.

LEARNING OBJECTIVES
1) To understand the key relationship between high-resolution CT (HRCT) patterns and macroscopic histopathologic changes in diffuse interstitial lung diseases (DILD). 2) To learn the characteristic HRCT appearances of DILDs in which a confident (and accurate) radiologic diagnosis can be made. 3) To appreciate the importance of atypical and overlapping HRCT features in many DILDs.

LEARNING OBJECTIVES
1) Describe core exam preparation resources and better understand which resources are more effective. 2) Delineate alternative ways to prepare for the core exam during the first three years of residency. 3) Discuss successful strategies for the core exam physics preparation including the timing of the various components of the physics curriculum.

ABSTRACT
For several years now, program directors and residents have been planning the transition to the new curriculum and thinking about the new ABR core exam. This transition is now complete. The first core exam was administered in early October 2013 and the next exam is scheduled for June 2014. With so many resources available, trainees may feel overwhelmed by options on how to prepare for this exam. This session will discuss various successful preparation strategies utilized by residents who recently took the first exam.

LEARNING OBJECTIVES
1) Understand the major requirements of the Next Accreditation System. 2) Visualize these requirements in a helpful timeline format. 3) Understand how the timing of new reporting data may differ significantly from your conventional paradigm of resident evaluation. 4) Understand strategies for meeting the reporting timelines established by the ACGME.

ABSTRACT
The transition to the Next Accreditation System (NAS) of resident evaluation is well underway. While much of this new paradigm has been designed to streamline burdensome administrative and process-oriented evaluation, there are many new features that the program director must be aware of. One very important issue worthy of discussion is the timing of all of the various moving parts. A checklist of the major components of the NAS and a timeline of due dates will bring program directors up to speed on just how exactly they will have to change their schedules to meet ACGME-imposed timetables.

LEARNING OBJECTIVES
1) Describe ways to promote the development of professionalism skills during residency training. 2) Discuss the potential impact of unprofessional behavior on patient safety and the medical practice environment. 3) Describe the desirable professional attributes outlined in the Physician’s Charter that can strengthen your application for a radiology position and enhance your performance as a radiologist.

ABSTRACT
The traditional radiology residency curriculum consisted primarily of the acquisition of medical knowledge, the recognition of radiological findings, and the development of an appropriate differential diagnosis. While these skills are important to becoming a competent radiologist, they are not enough. This session will examine the humanistic qualities and professional skills that distinguish a truly great (and desirable) colleague/physician from the others. The negative impact of unprofessional behavior on patient safety will also be reviewed.

LEARNING OBJECTIVES
1) To define and illustrate the anatomic structures that form the basis of high resolution CT (HRCT) imaging of the lung. 2) To define and illustrate the anatomic basis of the most common imaging patterns detected on HRCT.
LEARNING OBJECTIVES
1) Discuss the current evidence supporting FFR guided revascularization. 2) Provide an overview of the technical background of Fractional Flow Reserve derived from a resting coronary CT angiogram. 3) Review the data validating FFRCT for the detection and exclusion of lesion specific ischemia by invasive FFR.

RC303B • Adenosine Stress/Rest CT
Ricardo C Cury MD (Presenter) *

LEARNING OBJECTIVES
1) To review the available evidence supporting the use of Stress CT perfusion. 2) To understand the importance of combining anatomy and physiology in the non-invasive evaluation of chest pain patients. 3) To describe the limitations and understand the future directions of Stress CTP.

ABSTRACT
A major limitation of coronary CTA is that the physiological significance of stenotic lesions identified is often unknown. Stress myocardial computed tomography perfusion (CTP) is a novel examination that provides both anatomic and physiological information. Multiple single-center studies have established the feasibility of stress myocardial CTP. Furthermore, it has been illustrated that a combined CTA/CTP protocol improves the diagnostic accuracy to detect hemodynamic significant stenosis as compared with CTA alone; this combined protocol can also be accomplished at a radiation dose comparable to nuclear myocardial perfusion imaging exams. Stress CTP is a modality with significant potential, particularly in the evaluation of chest pain patients, given the advantages of short exam time and comprehensive data acquisition. This lecture will summarize the current literature, indications, limitations and discuss future directions of Stress CTP.

RC303C • MRI
Matthys Oudkerk MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Understand that perfusion MRI can be implemented in every radiology department. 2) Learn how to differentiate normal from abnormal perfusion of the myocardium. 3) Compare the performance of perfusion MRI with other imaging modalities. 4) Identify indications and patient populations for perfusion MRI.

RC303D • Nuclear
Jack A Ziffer MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Review the range of temporal bone tumors by temporal bone anatomic subsite (EAC, middle ear, inner ear, facial nerve, internal auditory canal). 2) Develop a differential diagnosis for each subsite. 3) Become familiar with the typical imaging appearances of the more
common tumors of the temporal bone. 4) The participant should end up with an understanding as to when it is possible to make a histopathologic diagnosis of a temporal bone tumor based on CT and MR appearances and location.

ABSTRACT
In this portion of the temporal bone session the focus will be temporal bone tumors. A subsite specific discussion will review the tumors in each major area of the temporal bone including the external auditory canal, middle ear, inner ear, and intratemporal facial nerve. A differential diagnosis will be presented in each area with both benign and malignant tumors included. Tumor-specific imaging findings will be emphasized. Multiple cases of each diagnosis will be presented to give the participant exposure to the range of imaging manifestations seen. This location-based temporal bone tumor review will cover the following tumors by location:

- External auditory canal: Exostoses, osteoma, and squamous cell carcinoma.
- Middle ear: Glomus tympanicum paraganglioma, glomus jugulare paraganglioma, facial nerve schwannoma, middle ear adenoma, middle ear meningioma, and rhabdomyosarcoma.
- Inner ear: Intralabyrinthine schwannoma, endolymphatic sac tumor, and inner ear meningioma.
- Intratemporal facial nerve: Facial nerve schwannoma, facial nerve hemangioma (venous malformation), and perineural malignancy from the parotid gland.

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<th>No Course RC308. See Series VSER31 Emergency Radiology Series: Leveraging Technology for State-of-the-Art Practice</th>
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<th>Second and Third Trimester Obstetrical Ultrasound</th>
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| RC310 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5 |

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<th>RC310A • Support Structures</th>
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<td>Vickie A Feldstein MD (Presenter)</td>
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LEARNING OBJECTIVES
1) Understand normal development and anatomy of the placenta and umbilical cord. 2) Optimize sonographic techniques for correct assessment of the placenta and cord. 3) Enhance knowledge of common and clinically important abnormalities of the placenta and cord to improve skills for accurate detection by ultrasound. 4) Recognize abnormal placentation, detect placenta accreta, placenta previa, and vasa previa in effort to optimize clinical care and management.

ABSTRACT
Normal placental and umbilical cord development and anatomy will be reviewed. Sonographic manifestations of common abnormalities of the placenta and cord will be presented. Ultrasound (US) findings will be demonstrated, highlighted with pathologic correlation. Attention to the placenta, an often-overlooked crucial structure, is important in the optimal performance and interpretation of 2nd and 3rd trimester obstetrical US. Placental thickness, morphology and echotexture will be addressed. Retropubic hematomas, which may present clinically as abruption, pose risk to the fetus and impact management. Placenta previa, a placenta that overlies or is proximate to the internal cervical os, is the most common cause of bleeding in the 3rd trimester. US detection and suggested terminology regarding previa will be reviewed. Vasa previa is a rare, but clinically important condition related to placenta previa in which umbilical cord and/or fetal vessels are positioned between the presenting fetal part and cervix. Possible consequences of this condition, including hemorrhage and potential fetal exsanguination, are devastating. Improved outcomes depend upon accurate prenatal diagnosis and delivery by cesarean section. Placenta accreta refers to abnormal adherence of the placenta to the uterus with subsequent failure to separate after delivery of the fetus. Careful assessment of at-risk pregnancies is indicated as this condition may lead to massive obstetric hemorrhage. Prenatal diagnosis allows effective delivery management planning to minimize morbidity. Umbilical cord abnormalities can be found and have clinical implications. The most common abnormality of the cord is a single umbilical artery (SUA). Discovery of SUA prompts a search for any other detectable fetal malformation. Velamentous cord insertion, with attachment of the cord beyond the placental edge into the free membranes of the placenta, is associated with increased risk and this too can be detected by US.

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<th>RC310B • Fetal Genitourinary Anomalies</th>
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<td>Roya Sohaey MD (Presenter) *</td>
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LEARNING OBJECTIVES
1) Recognize the appearance of the normal fetal adrenal gland, kidney, bladder and genitalia in the first, second and third trimester. Anomalies of these structures will be shown and strategies for making accurate diagnoses of anomalies will be taught. 2) Current in utero and postnatal treatment plans for fetal genitourinary anomalies will be discussed, particularly for prenatal and postnatal workup and evaluation of fetal hydronephrosis. The Society of Fetal Urologists grading system of hydronephrosis will be reviewed and it's utility in clinical practice discussed.

ABSTRACT
Genitourinary (GU) abnormalities are common in fetal life and range in severity from idiopathic, as in most cases of pelviectasis, to lethal, as in renal agenesis. A systematic approach to evaluation of the GU tract is important in order to make an accurate diagnosis. The fetal kidneys should be documented in two orthogonal planes. The adrenal gland can mimic the kidney if only the axial plane is obtained. The fetal bladder should be seen filling and emptying during the study. The adrenal glands are often easily identified and the fetal genitalia should be assessed whenever GU anomalies are seen. The approach to the abnormal urinary tract starts with identifying both kidneys and evaluating renal echogenicity and morphology. If hydronephrosis is present then quantitative and qualitative assessment of the
whole collecting system, from calyces to urethra is performed. The anterior-posterior renal pelvis is measured and the SPV grade of hydronephrosis is estimated. If renal cysts are present then the differential diagnosis of multicystic dysplastic kidney vs renal cystic dysplasia (either primary or secondary) is explored. An abnormal fetal bladder is one which is either consistently ‘too small’ or ‘too large’, and the cause can be anatomic or physiologic. Adrenal masses can occur in utero or more often, the adrenal gland may be displaced by a suprarenal mass that is not adenar in origin, such as an extralobar pulmonary sequestration. Congenital adrenal hyperplasia presents as enlarged adrenal glands and is associated with ambiguous genitalia in female fetuses. Genitalia anomalies can be isolated or associated with syndromes and aneuploidy. Making an accurate diagnosis of fetal GU anomalies results in better prenatal counseling and post natal management. Some fetuses with GU anomalies may benefit from in utero intervention as well, such as bladder drainage. Most need prenatal and postnatal surveillance which is often determined by the prenatal findings.

**RC310C ● Multiple Gestations**

Anne M Kennedy MD (Presenter)

**LEARNING OBJECTIVES**

1) Determine choriornity and amniontornity and understand why it is important to do so in all multiple gestations. 2) Understand and diagnose specific complications of monochorionic twinning such as twin to twin transfusion syndrome and twin reversed arterial perfusion. 3) Recognize the indications for more frequent surveillance and intervention in complicated twin pregnancies.

**ABSTRACT**

The prognosis in multiple gestations is dependent on choriornity therefore it is essential that this be documented in all cases. The easiest time to do this is in the first trimester but we will review tips for diagnosis in the second and third trimesters as well. Specific complications of monochorionic twinning include twin to twin transfusion syndrome (TTTS) in which there is an arterovenous shunt from the donor twin to the recipient. The donor is oligohysemic and the recipient is polyhysemic. If it is not treated the outcome is death. Untreated TTTS has markedly improved prognosis. In twin reversed arterial perfusion (TRAP) there is an artery to artery anastomosis between the pump twin and the malformed co-twin which can become very large. It is important to recognize TRAP sequence early in pregnancy as the abnormalities in the malformed twin are lethal. The pump twin is at risk for hydrops due to the high output state. Early intervention prevents continued growth of the abnormal twin and protects the pump twin such that the patient has a good prognosis for one live birth. Multiple gestations are at risk for growth restriction and discordant growth; the incidence of fetal anomalies and maternal complications of pregnancy is also increased. Because of this multiple gestations are followed more intensively that singletons and, when monochorionic, surveillance for specific complications is increased. The prognosis for TTTS and TRAP is much improved with intervention but there is a finite window of opportunity in which interventional procedures can be performed thus appropriate referral is essential. Accurate diagnosis of choriornity and early recognition of complications in multiple gestations will result in better management and improved outcomes.

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**No Course RC311. See Series VSNM31 Nuclear Medicine Series: Non-FDG PET Radiotracers in Oncology**

**Tuesday, 08:30 AM - 10:00 AM**

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**RC311**

**Acute Abdominal Vascular Diseases**

**Tuesday, 08:30 AM - 10:00 AM ● E350**

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**RC312 ● AMA PRA Category 1 Credit™ ● ARRT Category A+ Credit:1.5**

**Dominik Fleischmann MD (Presenter) * 1.5**

**LEARNING OBJECTIVES**

1) Review the epidemiology of aortic side-branch dissections, which can occur as a complication of aortic dissection, or as isolated spontaneous dissections of the visceral or renal arteries. 2) Explain the pathophysiology of side branch malperfusion syndromes. 3) Present the key imaging features which distinguish between the two main mechanisms of side branch malperfusion: local obstruction versus inflow obstruction.

**ABSTRACT**

Dissections of aortic side branches is a common complication of Type A and Type B acute aortic dissection which substantially increases mortality. It is important to understand the pathophysiology and the two principle mechanisms of side branch malperfusion in aortic dissection: flow obstruction can be due to (A) local abnormalities, such as occlusive dissection flaps, blind ending false lumen with true lumen occlusion (‘windsock’), or frank thrombosis. Side-branch malperfusion may also occur due to (B) limited inflow: The classic situation is complete true lumen collapse in the upstream aorta, resulting in underperfusion of all downstream branches supplied by the true lumen. Wile local obstructions are most commonly treated by stent placement into the diseased side branch, inflow-lesions typically require surgical or endovascular repair of the upstream aorta. Spontaneous dissections of the celiac, mesenteric, or renal arteries are relatively rare events, and typically present with acute abdominal or flank pain. Dissections of side branch arteries can lead to ischemic complications or to frank rupture. Patients presenting with mesenteric or renal artery dissection require a thorough workup to identify genetic disorders (notably Ehlers Danlos IV), inflammatory conditions (vasculitis), and other entities such as fibromuscular dysplasia and segmental arterial mediolysis (SAM).

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**RC312A ● Aortic Branch Dissections**

**Sunday, 08:30 AM - 10:00 AM ● E350**

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**RC312B ● Symptomatic Aneurysms**

**W. Dennis Foley MD (Presenter) 1.5**

**LEARNING OBJECTIVES**

1) To detail the anatomic location and clinical presentation of symptomatic aneurysms. 2) To review appropriate imaging strategies using CT angiography. 3) To emphasize physiologic support and patient monitoring while in the imaging environment. 4) To utilise appropriate anatomic coverage in CT angiography procedures for both the diagnosis of symptomatic aneurysms and surgical and endovascular planning. 5) To detail the role of 2D and 3D image processing in the emergency situation for anatomic diagnosis and treatment planning.

**ABSTRACT**

Symptomatic aneurysms cover the spectrum of arterial aneurysms presenting with a) localized symptoms secondary to aneurysm expansion and possible rupture b) regional symptoms secondary to dissection and embolism and c) systemic cardiovascular dysfunction related to hypotension and organ dysfunction. Common clinical scenarios include aneurysm rupture – most commonly abdominal aortic, popliteal and abdominal visceral aneurysms as well as thoracoabdominal aortic dissection. Symptomatic aneurysms may also occur in patients with known arterial pathology including connective tissue disorders such as Marfan’s and Ehlers-Danlos syndrome and Takayasu aortitis/arteritis. Patients with suspected rupture of abdominal aortic or iliofemoralopopliteal artery aneurysms may initially be evaluated by sonography. However, in all circumstances, CT angiography due to its robust implementation and high-resolution imaging of the vasculature and regional anatomy that allows for planning of endovascular and surgical intervention is the preferred technique. CT Angiographic protocols appropriate to the suspected anatomic location of the aneurysm that provide an adequate roadmap for endovascular or surgical intervention are employed. Extended coverage is particularly important in patients with suspected
thoracoabdominal aortic dissection or aneurysms associated with peripheral embolism. Cardiac gating should be utilized in any patient with a suspected type A aortic dissection or rupture of an ascending aortic aneurysm. Aortic, cardiac and coronary artery imaging are integral to the evaluation and management of these patients. A particular subset of the “symptomatic aneurysm” is post-trauma aortic disruption, usually thoracic in which diagnosis of traumatic aneurysm is critical and the aneurysm is associated with additional sites of soft tissue and skeletal trauma. Guidelines for endovascular or surgical intervention or non invasive management with serial CT Angiographic imaging will be discussed.

RC312C • Mesenteric Ischemia

Iain D Kirkpatrick MD (Presenter)

LEARNING OBJECTIVES
1) Discuss the various categories of mesenteric ischemia (arterial occlusive, embolic, venous thrombotic, and nonocclusive), and the pathophysiologic basis behind the imaging findings in each case. 2) Understand the basis behind modern CT protocols for mesenteric ischemia, particularly the biphasic examination with CT mesenteric angiography. 3) Demonstrate techniques to rapidly analyze a mesenteric CT angiographic dataset. 4) Review the CT signs of mesenteric ischemia and their sensitivity and specificity. 5) Evaluate the current literature on mesenteric ischemia and discuss optimal diagnostic criteria.

ABSTRACT
Acute mesenteric ischemia (AMI) is a life-threatening condition said to affect up to 1% of patients presenting with an acute abdomen, and it carries a mortality rate ranging between 59-93% in the published literature. Time to diagnosis and surgical treatment are the only factors which have been shown to improve mortality, and evidence shows that the clear test of choice for AMI is now biphasic CT. Water is preferably administered as a negative contrast agent, followed by CT mesenteric angiography and then a portal venous phase exam. Diagnostic accuracy is significantly improved by analysis of the CT angiogram for arterial stenoses or occlusions, evidence of emboli, or angiographic criteria of nonocclusive ischemia. It is the use of CT angiography in addition to routine portal phase imaging which has pushed the sensitivity and specificity of the test to >90% in recent published articles. Other nonangiographic CT findings that are relatively specific for AMI in the appropriate clinical setting include pneumatosis intestinals, portal or mesenteric venous gas or thrombosis, and decreased bowel wall enhancement. Bowel wall thickening, mesenteric stranding, ascites, and mucosal hyperenhancement are more nonspecific findings which may also be seen. Nonocclusive ischemia may be the most difficult form to diagnose, and findings of shock abdomen can aid in identification. Knowledge of the patient’s clinical history is critical not only for the selection of an appropriate study protocol but also for interpretation of the imaging findings in context.

RC312D • CTA of Gastrointestinal Bleeding

Jorge A Soto MD (Presenter) *

LEARNING OBJECTIVES
1) To review the appropriate implementation of CT angiography in the evaluation of patients presenting with acute lower intestinal bleeding. 2) To describe the technical details that are necessary for acquiring good quality CT angiography examinations. 3) Illustrate the characteristic CT angiographic findings of active or recent bleeding with specific examples of multiple etiologies.

ABSTRACT
Acute gastrointestinal bleeding is a serious condition that may threaten a patient’s life depending on the severity and duration of the event. Precise identification of the location, source and cause of bleeding are the primary objectives of the diagnostic evaluation. Implementation of colonoscopy in the emergency setting poses multiple challenges, especially the inability to adequately cleanse the colon and poor visualization owing to the presence of intraluminal blood clots. Scintigraphy with technetium 99m–labeled red blood cells is highly sensitive but also has some limitations, such as the inability to precisely localize the source of bleeding and determine its cause. Properly performed and interpreted CT angiography examinations offer logistical and diagnostic advantages in the detection of active hemorrhage. A three-phase examination (non-contrast, arterial and portal venous) is typically performed. Potential technical and interpretation pitfalls should be considered and will be explained. The information derived from CT angiography helps direct therapy and select the most appropriate hemostatic intervention (when necessary): endoscopic, angiographic, or surgical. Precise anatomic localization of the bleeding point also allows a targeted endovascular embolization. The high diagnostic performance of CT angiography makes this test a good alternative for the initial emergent evaluation of patients with acute lower intestinal bleeding.
ABSTRACT
Satisfying activities after retirement from active radiology practice.

LEARNING OBJECTIVES
1) Therapeutic options for palliation of painful metastases to bone. 2) Patient selection for MR guided focused ultrasound palliation of painful bone metastases. 3) Results of Phase III pivotal study of ExAblate MR guided focused ultrasound for palliation of painful bone metastases. 4) Technical aspects of successful patient treatment. 5) Immediate post-treatment imaging-based assessment of results. 6) Future applications of MR guided focused ultrasound for the management of osseous metastatic disease.

ABSTRACT
Cancer patients commonly have metastases to bone; as the survival of cancer patients is prolonged by more effective therapies, the prevalence of patients with metastases to bone is also increasing. Bone metastases are often painful, and often diminish the quality of life. Radiation therapy (RT) is the standard of care for the treatment of bone metastases, but a significant subset of patients do not respond to RT. MR guided focused ultrasound non-invasively achieves localized tissue ablation and provides a proven method of pain relief in patients who do not respond to radiation therapy. MR imaging provides a combination of tumor targeting, real-time monitoring during treatment, and immediate verification of successful treatment. The results of the pivotal Phase III trial that led to FDA approval of the ExAblate MR guided focused ultrasound device for the palliation of painful metastases to bone will be reviewed. In particular, patient selection, the technical aspects of successful patient treatment, and post-treatment assessment of results will be described. Concepts for future development of this technology with regard to the management of osseous metastatic disease will also be presented.

ABSTRACT
Focused ultrasound uses a large area array, typically outside the body, that is geometrically or electronically focused to a point. Such focusing provides amplification of the ultrasound intensity, thereby allowing heating of tissue to the point of coagulation at the focus, without damage to the intervening tissue. Treatment of tissues deep in the body requires image guidance such as MR thermometry. The concept behind MR thermometry is straightforward: changes in hydrogen bonding with temperature result in a change in the proton resonant frequency, seen in the phase of gradient echo images. Temperature standard deviations less than 1°C are readily achievable and thermal dose maps are easily calculated. Considerations for focused ultrasound include patient positioning and target access, good coupling, near field and far field effects, long treatment times for sizable ablation volumes, and, in the case of the brain, phase aberrations from the skull. Considerations for MR thermometry are motion of the target tissue or motion of other organs such as occurs during respiration. In addition, metallic hardware from prior surgeries reduce the visualization on MR temperature maps. Further, there is little visualization of temperature rises in adipose tissue, and in some cases the FUS equipment prevents the use of local coils. Nonetheless, recent developments in MRgFUS are overcoming these challenges.

ABSTRACT
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ABSTRACT
The largest area of FUS application has been of uterine fibroids. These benign tumours are extremely common and responsible for huge expenditure each year. FUS can provide a completely non-invasive way of treating women with fibroids in an outpatient manner with negligible complications and very minor post-operative pain. Selecting appropriate patients is vital and will be discussed together with methodological considerations. Improved technology can now speed up fibroid treatment with ablation spots up to 7 cm in length that can be rapidly moved from one point to another minimizing heating in front of the focal spot whilst treating multiple areas. Current follow-up studies suggest that if a nonperfused volume of greater than 60% is achieved symptomatic response is well over 80% at one year and that the recurrence rate for further fibroid related treatment is 11% at two years. Because of the outpatient non-invasive nature of the procedure FUS becomes highly cost-effective Percutaneous destruction of liver tumours in a completely non-invasive manner would change therapy to the liver radically. FUS holds out such a prospect but the technological improvements required to our current machinery are substantial. The barrier of the FUS absorbing rib cage is hard to overcome and to date MR guided focused ultrasound has only been able to reach lesions that are not covered by ribs. The movement produced by respiration presents a significant problem currently addressed by controlled ventilation during FUS. Technological improvements are slowly being implemented to address these areas. New endorectal MR guided transducers which can ablate areas of the prostate under accurate MR targeting and thermal control are in phase 1 studies treating low risk prostate carcinoma and looking at safety and early efficacy. These results will be discussed. A brief
Imaging of Irradiated and Ablated Tumors

Tuesday, 08:30 AM - 10:00 AM • S104A

**RC318** • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

**RC318A • Imaging of Recurrent Disease in the Irradiated Head and Neck**

Christopher P Hess MD, PhD (Presenter) *

**LEARNING OBJECTIVES**

1) Illustrate the limitations of CT, MRI and PET in the evaluation for residual and recurrent malignancy in the head and neck. 2) Review typical imaging changes that result from radiation and common pitfalls. 3) Develop a structured approach for interpreting studies in the post-radiation neck.

**URL's**

http://www.radiology.ucsf.edu/research/meetings/rsna

**RC318B • Imaging after Ablation of Hepatic and Renal Tumors**

Steven S Raman MD (Presenter)

**LEARNING OBJECTIVES**

1) Background on ablation and histopathological changes. 2) Understanding hepatic ablation related changes chronologically: Differences between heat, cold and electroporation on CT, MRI and US. 3) Understanding renal thermal ablation changes chronologically: Differences among heat, cold and electroporation on CT, MRI and US.

**RC318C • Imaging after Irradiation of Pelvic Malignancy**

Antonio C Westphalen MD (Presenter)

**LEARNING OBJECTIVES**

1) Recognize recurrent rectal, cervical, and prostate cancer. 2) Identify benign findings that can mimic recurrent disease. 3) Describe common complications associated with radiation treatment.

**ABSTRACT**

It has been a notion that once distant metastases occur, cancer is typically widely disseminated. Hellman and Weichselbaum from University of Chicago have proposed the state of oligometastasis where the metastatic disease is limited in number and site. There is clinical evidence to suggest that local aggressive therapy such as surgical resection may prolong survival and may even achieve a cure. Most recently, non-surgical therapies such as stereotactic ablative radiotherapy and image-guided ablative therapies for oligometastases have emerged, appearing to yield promising results based on multiple retrospective studies and single arm clinical trials. There are certain controversies with regard to the use of local aggressive therapy for oligometastases based on evidence from the literature.

**RC320 • SABR for Visceral Oligometastases**

Simon S Lo MD (Presenter)

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**RC320B • SABR for Spinal Oligometastases**

Arjun Sahgal (Presenter) *

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**RC320C • Interventional Radiology in the Management of Oligometastases**

Sandeep Vaidya MD (Presenter)

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**RC320D • Controversies in the Management of Oligometastases**

David Palma MD, FRCPC (Presenter)
LEARNING OBJECTIVES

Medical Physics 2.0: Nuclear Imaging

Tuesday, 08:30 AM - 10:00 AM • S102D

RC321 • AMA PRA Category 1 Credit ™: 1.5 • ARRT Category A+ Credit: 1.5
Co-Director
Ehsan Samei, PhD *
Co-Director
Douglas E Pfeiffer, MS *

RC321A • Nuclear Imaging Perspective

Douglas E Pfeiffer MS (Presenter) *

LEARNING OBJECTIVES

1) Understand the history and development of nuclear imaging. 2) Become introduced to the advances of hybrid imaging. 3) Understand the impact of equipment development on medical physics support.

ABSTRACT

Nuclear imaging has not received the attention or development enjoyed by other imaging modalities. Nevertheless, our understanding of nuclear imaging and development of protocols and hybrid systems has led to new requirements for testing and other medical physics support. This presentation will discuss these developments and the impact they have had on the medical physics support needed by nuclear imaging departments.

RC321B • Nuclear Imaging 1.0

Osama R Mawlawi PhD (Presenter)

LEARNING OBJECTIVES

1) Learn acceptance testing and commissioning of gamma cameras/SPECT and PET-CT systems. 2) Describe routine quality control procedures and their frequencies. 3) Become familiar with ACR accreditation of planar, SPECT, and PET systems. 4) Learn about various potential image artifacts of gamma camera, SPECT and PET systems.

ABSTRACT

The aim of this lecture is to provide the audience with an overview of the current medical physics testing procedures that are performed on gamma cameras, SPECT and PET systems. The lecture will be divided into 3 main parts; the first part will describe the tests performed for acceptance testing of these systems while the second part will describe the routine quality control and assurance tests and their frequencies. The last part of the lecture will focus on the ACR accreditation process and the necessary phantom imaging for gamma cameras, SPECT and PET systems. Throughout the lecture, examples of potential image artifacts will be presented.

RC321C • Nuclear Imaging 2.0

Jeffrey Nelson (Presenter)

LEARNING OBJECTIVES

1) Become familiar with new physics metric and analytics in nuclear imaging. 2) Determine testing implication of emerging technologies in nuclear imaging. 3) Envision the clinical implementation of new physics metrics and analytics.

ABSTRACT

Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques-Incorporation of Imaging as a Biomarker in RT

Tuesday, 08:30 AM - 10:00 AM • E261

RC322 • AMA PRA Category 1 Credit ™: 1.5 • ARRT Category A+ Credit: 1.5
Co-Director, Moderator
Robert Jeraj

LEARNING OBJECTIVES

1) Anatomical imaging in treatment response (RECIST, volumetrics). 2) PET in treatment response assessment (PERCIST etc) with uncertainties. 3) MRI in treatment response assessment. 4) Imaging biomarkers.

RC322A • Introduction to Biomarkers

Robert Jeraj (Presenter)

LEARNING OBJECTIVES

1) Imaging biomarkers and surrogate endpoints. 2) Prentice's criteria vs real world. 3) Imaging biomarker characteristics. 4) Imaging biomarker validation and qualification.

RC322B • PET Assessment/Uncertainties

Paul E Kinahan PhD (Presenter) *

LEARNING OBJECTIVES

1) Understand the advantages and disadvantages of PET/CT as a biomarker for radiation oncology. 2) Understand sources of bias and variance in PET/CT imaging, both in data acquisition and analysis. 3) Understand the limitations of functional PET/CT techniques currently being used to evaluate treatment effect.

RC322C • MRI Assessment/Uncertainties

Edward F Jackson PhD (Presenter)

LEARNING OBJECTIVES

1) Understand the physical principles of functional MR techniques currently being used to evaluate treatment effect. 2) Understand selected applications of each of these techniques to the assessment of radiation therapy. 3) Understand current limitations of each of the
Minicourse: Current Topics in Medical Physics-Radiation Dose Reduction in Medical Imaging
Tuesday, 08:30 AM - 10:00 AM • S404AB

RC323 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Mahadevappa Mahesh, MS, PhD *

ABSTRACT
This mini-course will include discussions on how to reduce radiation dose and clinical management in the areas of CT, Fluoroscopy and Radiography (CR and DR). Discussion will include dose-reducing strategies applicable due to technological advances, and also include practical steps on how to manage patient and staff safety clinically.

RC323A • CT Dose Reduction and Clinical Management
Mahadevappa Mahesh MS, PhD (Presenter) *

LEARNING OBJECTIVES
1) To identify various radiation dose reduction strategies in CT. 2) To assess impact of technological advances on reducing CT dose. 3) To describe ways to optimize radiation dose in CT.

ABSTRACT

RC323B • Fluoroscopy dose reduction and Clinical Management
Pei-Jan P Lin PhD (Presenter)

LEARNING OBJECTIVES
1) To identify that there are two basic schools of fluoroscopy operation logic design (FOLD). Discussion of FOLD enables us to understand how the modern fluoroscopy systems are able to (1) lower radiation dose to the patient, (2) maintain the image quality required and (3) provide a wider dynamic range of patient thickness. While equipment based reduction of patient dose is effective, there is a need to monitor the overall radiation dose as the patient receives various types of radiological examinations. A hospital wide radiation monitoring (HWRM) is ever increasing as public-at-large becomes aware of potential radiation injuries from some of the radiological examinations. A sample monitoring system that is designed to monitor various patient dose data generated from CT and RF equipment will be discussed.

RC323C • CR and DR Dose Reduction and Clinical Management
Charles E Willis PhD (Presenter)

LEARNING OBJECTIVES
1) Appreciate why dose reduction efforts are necessary in projection radiography using CR and DR. 2) Identify the meaning of vendor-specific receptor exposure indicators and the new standardized receptor exposure indicators, and their indirect relationship to patient dose. 3) Assess the role of output indicators, DAP, KAP, and EAP, in estimating patient dose. 4) List simple operational methods for managing radiation doses in clinical radiography.

ABSTRACT
Computed Radiography (CR) and Digital Radiography (DR) are key technologies that enable the electronic practice of radiology. Both CR and DR are capable of producing acceptable diagnostic quality images over a wide range of exposures. A combination of traditional and new methods is necessary to manage the concomitant radiation dose to patients undergoing projection radiography examinations.

Mentored Case Approach to Pediatric Cardiovascular Disease 2: Cardiac Disease (An Interactive Session)
Tuesday, 08:30 AM - 10:00 AM • S402AB

RC324 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Director
S. Bruce Greenberg , MD
Director
Rajesh Krishnamurthy , MD *
Rajesh Krishnamurthy , MD *
Frandics P Chan , MD, PhD *
Laureen M Sena , MD

LEARNING OBJECTIVES
1) Understand the morphology, treatment, and long term complications of treated and untreated congenital heart disease via an interactive mentored-case approach with audience response system. 2) Highlight appropriateness of MRI and CT with regard to technique, pitfalls, indications and critical imaging findings that affect management for common imaging scenarios, including conotruncal anomalies, single ventricle, cardiomyopathy and myocarditis. 3) Provide an opportunity for general radiologists, pediatric radiologists and cardiac imagers who have limited exposure to this area in their workplace an opportunity to refresh their pediatric cardiovascular imaging skills in a focused manner.

Quantitative Imaging: Functional MRI (fMRI)
Tuesday, 08:30 AM - 10:00 AM • E353A

RC325 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Director
RC325A • Quality Assessment and Quantitation of Language and Motor fMRI
James T Voyvodic PhD (Presenter)

LEARNING OBJECTIVES
1) Understand the major sources of variance in fMRI results. 2) Be aware of post-processing approaches for reducing variance and improving reproducibility. 3) Understand the quality assessment methods used to measure sources of variance within individual patient scans. 4) Appreciate how to evaluate whether a particular patient fMRI scan meets the quality assessment criteria necessary for obtaining quantitative fMRI measurements within clinically useful reproducibility margins.

ABSTRACT
Many different variables affect clinical fMRI mapping of language and motor function, including behavioral task performance, head motion, tissue pathology, physiological variables, scanner performance, and software analysis methods. In order to achieve reproducible quantitative clinical fMRI results it is important to assess each of the major sources of variability, and to reduce unwanted signal variability where possible. This presentation will focus on identifying specific quality assessment criteria necessary to obtain reproducible quantitative fMRI results. It will also discuss the quantitative precision that can be expected for clinical fMRI results if the quality assessment criteria have been met. By establishing objective quality assessment criteria and validated reproducibility constraints, clinicians should be able to evaluate the quantitative confidence (i.e. margin of error) of the fMRI results for individual patient scans. Such guidelines are essential to enable quantitative measurements of the laterality, location, and spatial extent of clinically important functional brain areas. http://hawking.biac.duke.edu/RSNA

RC325B • More Quantitative fMRI Paradigms for Presurgical Mapping of the Visual System
Edgar A Deyoe PhD (Presenter) *

LEARNING OBJECTIVES
1) Review the functional organization of the human visual cortex. 2) Become familiar with state-of-the-art methods for presurgical mapping of the visual system with fMRI. 3) Learn of new methods for visualizing and interpreting fMRI brain maps of the visual system. 4) Become aware of interpretational issues such as neurovascular uncoupling that can significantly affect interpretation in a presurgical mapping context.

ABSTRACT
The complexity of MRI technology and the wealth of new information it provides can leave clinicians hard pressed to stay abreast of the latest developments and applications, especially since the field continues to evolve at a brisk pace. The goal of this session will be to review several clinically relevant aspects of fMRI methods and their use in mapping the visual system to aid diagnosis of vision-related CNS diseases and to assist treatment planning, delivery and followup. The session will include a review of fundamental organizational principles of the human visual system with an emphasis on those properties that may be particularly relevant for clinical applications. Some principles, such as retinotopic organization may be generally familiar, but the ability to map this organization in detail quantitatively in individual patients and its utility in specific clinical applications is likely to be novel. Unique methods will be described for visualizing this organization both within the brain and as it relates to the patient’s visual field and scotomata. The session will describe specific clinical applications of visual system mapping with fMRI and will present case studies to highlight such applications. Also, included is a description of methodology aimed at streamlining the clinical workflow and highlighting practical issues that should be considered to obtain high quality data with clinical patients. The overall goal is to show how it is possible to spend as little as 10 minutes of fMRI scan time yet obtain information that can be invaluable for diagnosis and treatment of patients with brain tumors, arteriovenous malformations, epilepsy and other pathologies that can impact central visual pathways.

RC325C • BOLD Cerebrovascular Reactivity Mapping as Applied to Brain Tumor fMRI
Jay J Pillai MD (Presenter) *

LEARNING OBJECTIVES
1) Understand the role of breath hold cerebrovascular reactivity (BH CVR) mapping in the assessment of neurovascular uncoupling potential. 2) Appreciate how neurovascular uncoupling may affect the reliability of BOLD fMRI activation maps. 3) Describe how BH CVR mapping can be performed in brain tumor patients.

ABSTRACT
The phenomenon of neurovascular uncoupling (NVU) is an important limitation of blood oxygen level dependent (BOLD) functional MRI (fMRI). One effective and practical method for assessment of risk of NVU is BOLD breath hold cerebrovascular reactivity (BH CVR) mapping. The BH CVR mapping, similar to MR perfusion methods, allows assessment of regional hemodynamic impairment that may result in NVU and thus may lead to false negative activation on task-based sensorimotor or language fMRI that may be used for presurgical mapping in patients with brain tumors and other resectable brain lesions. However, unlike MR perfusion imaging, which assesses static or baseline perfusion to brain tumors and peritumoral regions, BOLD BH CVR mapping enables a dynamic assessment of cerebrovascular response, and its results can be applied to any task-based activation map. This lecture will describe the technique of BH CVR mapping, some of its strengths and limitations, and include cases in which interpretation of clinical fMRI exams has been affected by the additional information provided by these maps.

Quantitative Imaging: A Revolution in Evolution (In Association with the Society for Imaging Informatics in Medicine)

Tuesday, 08:30 AM - 10:00 AM • N229

RC326 • AMA PRA Category 1 Credit ™ 1.5 • ARRT Category A+ Credit:1.5
Co-Moderator
Luciano M Prevedello MD,MPH
Co-Moderator
Adam E Flanders MD

LEARNING OBJECTIVES
1) Develop an understanding of what quantitative imaging is and how it may revolutionize the way we practice diagnostic radiology today. 2) Learn the research advances and the current clinical applications of this technology. 3) Appreciate the current challenges involved in using these tools clinically and understand the steps required for a successful clinical implementation.

ABSTRACT
Medicine has undergone a gradual evolution in which diagnostic imaging has become the centerpiece in establishing a clinical diagnosis and in assessing disease response. In recent years, the focus has changed such that for some disease categories (e.g. oncology) we now perceive medical imaging as a phenotypic expression of the genetic makeup of that disease. To that end, imaging now serves as a biomarker of genetic disease subtypes with features that may offer clues to understanding the natural behavior of the disease and specific changes that may occur as part of a therapeutic response. It is now well recognized that there is a substantial amount of objective information contained within diagnostic imaging studies that can be exploited beyond the level of simple measurements. The extraction of quantitative and semi-quantitative information from imaging studies that is both useful and reproducible is the challenge and opportunity for clinical research and radiologic reporting today and in the future. This session will explore the revolution and evolution of quantitative imaging; providing attendees with research advances, clinical applications, and the challenges of clinical implementation.
LEARNING OBJECTIVES
1) Be able to describe what is meant by quantitative imaging. 2) Understand existing issues in implementing quantitative imaging techniques in the clinical arena as well as in the research realm, and see how informatics tools may help. 3) Be aware of ongoing international efforts to address current challenges and to move quantitative imaging forward.

ABSTRACT
Quantitative imaging has rapidly evolved in recent years from a promising research activity to an essential clinical tool. Physicians consider the objective metrics obtained from imaging studies, in making critical patient management decisions. What is meant by quantitative imaging will be described using illustrative real-world use cases. Existing issues including technical as well as workflow challenges will be discussed. An introduction to imaging informatics tools and techniques such as standards, integration, data mining, cloud computing, ontologies, data visualization and navigation tools, and business analytics applications that may assist in filling current gaps in the clinical implementation of quantitative imaging will be given. An overview of activities of the RSNA’s Quantitative Imaging Biomarkers Alliance (QIBA), an international initiative whose goal is to optimize the potential of quantitative imaging, including a description of the data warehouse project will be provided.

LEARNING OBJECTIVES
1) To highlight limitations in current radiological quantitative imaging practice and identify opportunities for improvement through informatics. 2) To introduce Annotation and Image Markup (AIM) as a new standard for capturing and sharing quantitative imaging metadata. 3) To demonstrate new AIM-enhanced tools that can streamline and improve quantitative imaging assessment and workflow for the radiologist.

ABSTRACT
Radiology practice is increasingly a quantitative endeavor. Radiologists frequently need to measure the length of lesions to track treatment response or measure the size of structures to for diagnostic assessment. Current practices of quantitation are cumbersome; measurements are recorded as screen captures that cannot be processed by machine, and the numbers must be transcribed into a radiology report. It is currently exceedingly difficult to create structured databases of quantitative image information for discovery about how, say, change in tumor size over time relates to drug treatment. Quantitative imaging is currently at best a labor-intensive process and at worst error-prone. We have been developing informatics methods to streamline the electronic capture of quantitative imaging results as “image metadata” in structured format that can be easily processed by computers. Tools that we are producing will allow the radiologist to perform quantitative imaging assessment in their current routine workflow—measuring lesions on the PACS, while simultaneously their measurements will be captured and transmitted in standardized formats to applications that can automate accurate reporting, analysis, and decision support. In the future such tools will even help researchers to discover new ways that quantitative signals in images can improve assessment of treatment and prediction of disease course.

LEARNING OBJECTIVES
1) Understand the use of quantitative imaging outside of oncology. 2) Learn how to apply these QI techniques to current radiology practice.

Hot Topics in Malpractice Litigation 2013: Communication of Radiologic Findings and Common Medicolegal Issues in Body Imaging

Tuesday, 08:30 AM - 10:00 AM • S403A

LEARNING OBJECTIVES
1) Understand the importance of communicating radiologic findings to healthcare providers responsible for the care of patients. 2) Briefly review the American College of Radiology Communication Guidelines. 3) Review common medical legal pitfalls in body imaging, including suboptimal technique and search pattern.

ABSTRACT
Allegations of radiology negligence continue. This course will review a common but occasionally misunderstood source of malpractice allegation -- failure to communicate radiologic findings on exams that may have been interpreted correctly by the radiologist. The American College of Radiology Communication Guidelines will be discussed, and examples will be presented which illustrate potential communication breakdown between healthcare providers. The course will also discuss and illustrate common medical legal pitfalls in body imaging, including suboptimal technique and search pattern.

LEARNING OBJECTIVES
1) To highlight limitations in current radiological quantitative imaging practice and identify opportunities for improvement through informatics. 2) To introduce Annotation and Image Markup (AIM) as a new standard for capturing and sharing quantitative imaging metadata. 3) To demonstrate new AIM-enhanced tools that can streamline and improve quantitative imaging assessment and workflow for the radiologist.

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HCC Diagnosis Using LI-RADS (An Interactive Session)

Tuesday, 08:30 AM - 10:00 AM • E353B

LEARNING OBJECTIVES
1) Review underlying clinical scenarios that predispose patients to develop hepatocellular carcinoma. 2) Understand typical imaging appearances at MR imaging such that when characteristic imaging features are seen in the correct clinical setting, we can be certain that the diagnosis is hepatocellular carcinoma. 3) Describe variant features and secondary signs that are either suggestive of, or argue against, the diagnosis of hepatocellular carcinoma.

ABSTRACT
LI-RADS Principles
Cynthia S Santillan MD (Presenter)

LEARNING OBJECTIVES
1) To familiarize radiologists with the Liver Imaging Reporting and Data System (LI-RADS) and its associated lexicon, atlas, and reporting recommendations. 2) To review the categories for liver observations in LI-RADS. 3) To demonstrate how to access and use the algorithm for determining the category of a liver observation.

ABSTRACT

RC329C • LI-RADS Cases
Reena C Jha MD (Presenter) *

LEARNING OBJECTIVES
We will review LI-RADS categories, and criteria for classification by means of clinical cases. Classic and atypical cases will be presented with audience participation to reinforce the LI-RADS algorithm.

ABSTRACT

RC329D • Reporting LI-RADS Results
Mustafa R Bashir MD (Presenter) *

LEARNING OBJECTIVES
1) To discuss standards for liver lesion reporting, using the Liver Imaging Reporting and Data System (LI-RADS).

ABSTRACT
The Liver Imaging Reporting and Data System (LI-RADS) includes a reporting template for contrast-enhanced CT and MRI, and minimum reporting standards. This talk will discuss those reporting standards and provide tips for clear and concise reporting.

No Course RC330. See Series VSIN31 Radiology Informatics Series: Natural Language Processing: Extracting Information from Text Radiology Reports to Improve Quality

Tuesday, 08:30 AM - 10:00 AM

Change Management in Radiology

Tuesday, 08:30 AM - 10:00 AM • S404CD

RC332 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5
Michael N Brant-Zawadzki, MD
William T Thorwarth, MD
N. Reed Dunnick, MD

LEARNING OBJECTIVES
1) Participants will appreciate the importance of understanding the culture of an organization. 2) Participants will understand that strategic planning will not result in a successful outcome if it is not consistent with the culture of the organization. 3) Participants will learn techniques that can help modify organizational culture and make it more effective in addressing new issues. (This course is part of the Leadership Track)

ABSTRACT
Culture may be defined as the behaviors and beliefs of a social, ethnic or age group. It is the set of shared attitudes, values, goals and practices that characterize the group. Understanding the culture of our professional organizations is essential to effectively creating and implementing a strategic plan. Each of us is involved in many organizations including private practice groups, multispecialty clinics, university departments and a variety of professional societies which are linked by common interests. These include a interests related to a specific geographic region, an anatomic organ system, or an imaging or therapeutic modality. They may also be connected to a common goal such as education, research, reimbursement, regulation, government affairs, or radiology administration.

The pace of change in our society is quickening. This is true not only for communication and imaging technology, but also for the entire health care industry and the regulations that govern our behavior. American medicine has been criticized for being too expensive and having only average quality. Furthermore, a large number of unnecessary deaths have been attributed to medical error. If our field is going to respond effectively to these many challenges, we must understand the cultures of our various professional organizations in order to enable them to better implement needed responses.

Cardiac CT Angiography (A Practical Guide) (How-to Workshop)

Tuesday, 08:30 AM - 10:00 AM • E260

RC350 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Alison Wilcox, MD *

RC350A • Pre-, Peri-, and Postprocedural Care of Cardiac CT Angiography Patients
Bonnie Garon MD (Presenter)

LEARNING OBJECTIVES
1) Review preprocedural patient preparation including appropriate patient selection, beta blockade, contraindications and alternatives beta blockers. 2) Discuss how to manage nonstandard patients (atrial fibrillation, pacemaker, young adults). 3) Periprocedural issues including vasodilation, continued heart rate control, and breathing requirements. 4) Image acquisition including radiation dose reduction techniques, technique choice, and post CABG patient. 5) Postprocedural complications include contrast reactions and their management.

ABSTRACT
Cardiac CTA involve slightly more preparation than the standard CT acquisition. Heart rate control is the most important aspect that needs to be addressed prior to the patient arriving in the radiology department. Periprocedural issues mostly involved how to optimize technique while having the lowest radiation dose especially in the new age of dose reduction. Almost as important as heart rate management is how to treat postprocedural complications especially contrast reactions. This presentation will discuss these aspects and
include treatment options as well as their alternatives.

**RC3508 • Clinical Indications for Cardiac CT Angiography**

**Alison Wilcox MD (Presenter) * **

**LEARNING OBJECTIVES**
1) What is some of the history behind the indications for cardiac CTA. 2) What are the resources available to decide what the clinical indications are for cardiac CTA which may affect reimbursement and patient care. 3) Effectively deliver information to referring clinicians about the uses of cardiac CTA. 4) Discuss indications for cardiac in the ED. 5) Some examples of these clinical indications and how they can be applied in daily practice.

**ABSTRACT**
Although there are many studies the prove the usefulness and cost-effectiveness of cardiac CTA, there remains some skepticism in the medical community. Medicare and other private insurance company reimbursements have limited the use of cardiac CTA. Radiologists and referring clinicians need to be aware of the clinical indications for cardiac CTA and what resources are available to them to make these decisions. The resources are available both from radiology and cardiology groups, as well as from the government. This presentation will discuss those resources and provide examples of those indications. In addition a brief discussion of Cardiac CTA in the ED will be included as a potential use to improve patient care and reduce cost to the ED.

**RC350C • Nonatherosclerotic Disease Noted at Cardiac CT Angiography**

**Jabi E Shriki MD (Presenter)**

**LEARNING OBJECTIVES**
1) Enhance knowledge of normal and abnormal coronary and cardiac anatomy, with an emphasis on differentiating benign from significant variants. 2) Demonstrate the spectrum of nonatherosclerotic congenital and acquired diseases that may affect the coronary arteries. 3) Demonstrate the spectrum of non-atherosclerotic congenital and acquired diseases that may affect the heart.

**ABSTRACT**
A variety of non-atherosclerotic conditions are detectable on cardiac CT scans, including diseases of the heart, and disease processes which may affect the coronary arteries, or other vascular structures. Cardiac CT has a number of unique advantages in detecting non-atherosclerotic conditions, including congenital and acquired diseases. The focus of this presentation will be non-atherosclerotic conditions of the coronary arteries and of the heart. Variants of normal and abnormal anatomy of the coronary arteries will be discussed, including tips for identifying when coronary anatomic variants are significant. Acquired, non-atherosclerotic diseases of the coronary arteries will also be discussed. This presentation will also discuss the spectrum of non-atherosclerotic diseases of the heart which may be detected at cardiac CT, including congenital and acquired valvular and cardiac diseases. At the end of this exhibit, the viewer will have a better appreciation for abnormal coronary and cardiac anatomy and the broad spectrum of non-atherosclerotic cardiovascular diseases which may be seen at cardiac CT.

**CT/PET in the Abdomen and Pelvis: How and When (How-to Workshop) (An Interactive Session)**

**Tuesday, 08:30 AM - 10:00 AM • E353C**

**RC351 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5**

**RC351A • CT/PE: Value of Iodinated Contrast**

**Erik K Paulsonon MD (Presenter)**

**LEARNING OBJECTIVES**
1) Discuss the role of iodinated contrast as a complement to FDG-PET/CT. 2) Discuss appropriate/efficient utilization of PET/CT relative to routine CT or MR.

**RC351B • CT/PE: Metabolic Assessment in Reporting**

**Eric M Rohren MD, PhD (Presenter) * **

**LEARNING OBJECTIVES**
1) Discuss the role of metabolic parameters in response assessment using FDG-PET/CT. 2) Compare the use of anatomic and metabolic response evaluation systems in the evaluation of patients with malignancy.

**RC351C • Artifacts/Pitfalls/Incidentals**

**Terence Z Wong MD, PhD (Presenter) * **

**LEARNING OBJECTIVES**
1) Recognize and address common benign findings on FDG-PET / CT scans that can simulate malignancy. 2) Understand technical factors that can influence interpretation and quantification of FDG-PET studies.

**ABSTRACT**
Diagnostic accuracy of FDG-PET/CT scans can be degraded by potential technical artifacts during imaging acquisition as well as interpretive pitfalls encountered when evaluating regions of tracer accumulation. Technical artifacts occur relatively frequently due to the complexity of the PET and CT image acquisition and reconstruction; examples of important artifacts will be presented, along with potential solutions. Thoughtful design of PET/CT imaging protocols and attention to detail during image acquisition can reduce the incidence of artifacts. In addition, interpretive pitfalls due to false positive and false negative FDG accumulation is a major source of angst in interpreting oncologic PET/CT studies. Examples of common interpretive pitfalls will be presented along with approaches to distinguish malignant from benign FDG accumulation.

**RC351D • Select Issues in Abdominal and Pelvic CT/PET**

**Andrea G Rockall MRCP, FRCR (Presenter) * **

**LEARNING OBJECTIVES**
1) To know the indications for PET/CT in pelvic malignancy. 2) To recognize the typical findings on FDG-PET/CT in pelvic malignancies, including gynaecologic and urologic cancers. 3) To be aware of some new tracers that are being used in pelvic malignancy.

**Doppler US: Visceral, Extremity and Carotid Applications (Hands-on Workshop)**

**Tuesday, 08:30 AM - 10:00 AM • E264**
LEARNING OBJECTIVES
1) Understand basic concepts associated with abdominal, extremity and carotid Doppler. 2) Describe ultrasound techniques, protocols, and diagnostic criteria for evaluation of the carotid arteries. 3) Gain experience in Doppler techniques through personalized hands-on scanning of models with a variety of ultrasound machines. 4) Describe common pitfalls in Doppler examinations.

ABSTRACT
This hands-on course will focus on the details that constitute good Doppler technique in the evaluation of vascular flow, specifically within the neck, extremities and abdomen. Technical considerations for optimization of Doppler images will be discussed and the concepts will be applied to abnormalities commonly encountered in patients. Initial brief lectures will commonly begin by discussing common pitfalls in vascular imaging and then followed by basic concepts and techniques of renal Doppler. The majority of the session will give participants an opportunity to scan live models to improve technical skills in color and spectral Doppler. Faculty will be available at multiple stations using a variety of ultrasound machines. Participants will be encouraged to inquire about any areas of interest in the neck, abdomen, pelvis, or extremities during the hands-on component of the course.

URL’s
umhamper@jhu.edu

Hands-on HL7 Data Manipulation (Hands-on Workshop)

Tuesday, 08:30 AM - 10:00 AM  •  S401CD

LEARNING OBJECTIVES
1) Understand where radiology ordering, scheduling, and reporting workflows utilize HL7. 2) Develop a basic understanding of HL7 messaging principles. 3) Gain introductory hand-on experience with HL7 data manipulation. 4) Understand how HL7 can be used to build functionality in a variety of radiology workflows.

ABSTRACT
HL7 messaging is the foundation upon with many healthcare systems rely for interaction and data exchange. Many common radiology functions including order and report transmission are often dependent on HL7 to function. The goal of this hand-on refresher course is to introduce the attendee to HL7 workflows and some of the tools used to build HL7 interfaces and manipulate HL7 data. More importantly we hope to show why understanding HL7 can be helpful to radiology practices and show where HL7 can be used to build better radiology workflows.

Next-Generation Educational Content Creation: Screencasting and Video Editing (Hands-On)

Tuesday, 08:30 AM - 10:00 AM  •  S401AB

LEARNING OBJECTIVES
1) Assess the potential of online and mobile e-learning innovations to augment your residents’, medical students’, and staff’s educational curricula. 2) Acquire the domain knowledge to use already available content (e.g., PowerPoint presentations) to both create video content and deploy e-learning courses on modern web-based and mobile platforms. 3) Acquire the domain knowledge to use already available content (e.g., PowerPoint presentations) to electronic books (e-books), with or without digital rights management (DRM), and obtain an ISBN number for publishing.

ABSTRACT
1. From OpenCourseWare to the Khan Academy, and now to Coursera, e-learning has been dramatically improved over the last decade, changing education from the normal classroom into learning done at convenience, and also allows for more creative and engaging content during the typical lecture. Stanford Med recently published positive initial findings in utilizing video-based lectures in an interactive class setting. Leveraging this new way of learning, requires knowledge about the types of technology and platforms for these courses. 2. The workflow required to host an e-learning course can be summarized in 3 steps: (a) creating the educational content, (b) hosting the materials, and (c) making the materials available to the intended audience. E-content today typically consists of lecture slides along with video recordings captured by technology like TechSmith Camtasia (non-free) and Apple Quicktime (free). Once the materials are created and edited, one must choose a suitable hosting platform realistic to the skills and goals of the instructor with options that include coursesites.com, iTunes U, and YouTube / Google Hangouts. Students can then be invited to view the material or the content can be made available to the public. 3. Creating and publishing e-books is a great way to share your teaching material as an engaging interactive tool. Publishing in e-book format solves many logistical problems of conventional publishing and the e-book format has interactive features that paper books can’t match. We will review the process of creating your own e-book from assembling material to layout design to submitting for e-publication. Specifically Apple iBooks Author software will be used to demonstrate converting an existing Powerpoint presentation or journal publication into an e-book. In addition, the course will go over how to publish with or without DRM (copy-protection) and ways to obtain an ISBN for publishing for sale. Online resources will also be reviewed.

Breast Series: Emerging Technologies in Breast Imaging

Tuesday, 08:30 AM - 12:00 PM  •  Arie Crown Theater

LEARNING OBJECTIVES
1) Understand basic concepts associated with abdominal, extremity and carotid Doppler. 2) Describe ultrasound techniques, protocols, and diagnostic criteria for evaluation of the carotid arteries. 3) Gain experience in Doppler techniques through personalized hands-on scanning of models with a variety of ultrasound machines. 4) Describe common pitfalls in Doppler examinations.

ABSTRACT
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URL’s
umhamper@jhu.edu
**ABSTRACT**

**LEARNING OBJECTIVES**

1) This course will review the use of contrast enhancement in mammography- prior results with temporal evaluation and current results using dual energy technology. 2) Results of trials comparing contrast enhancement with standard breast imaging such as routine mammography, ultrasound and MRI will be discussed.

**ABSTRACT**

Contrast-enhanced digital mammography, now a clinically available product, continues to be a fruitful area of both basic and clinical research. This session will provide an overview of the physics of CEDM, its history, recent research results, current status and potential clinical applications.

**VSBR31-02 • Contrast-enhanced Spectral Mammography vs. Mammography and MRI - Clinical Performance in a Multi-reader Evaluation**

Eva M Fallenberg MD (Presenter) *; Felix Diekmann MD *; Corinne Balleyguier MD; Diane M Renz MD; Ritse M Mann MD, PhD *; Florian Engelken MD, MBBCh; Alexander Poellinger MD; Heba A Amer; Clarisse Dromain MD

**PURPOSE**

To compare contrast-enhanced digital mammography (CESM) to mammography (MG) and MRI on diagnostic accuracy of histologically proven breast lesions.

**METHOD AND MATERIALS**

The study was approved by Health Authorities and Ethics Committee. 90 consenting patients diagnosed with breast cancer were imaged with MG, CESM and MRI and underwent surgery. CESM was performed as a bi-lateral mammography starting 2 minutes after injection of 1.5ml/kg of an iodinated contrast agent (300 mg/ml) with a flow of 3ml/s. CESM images alone and MG images were interpreted by two blinded independent radiologists with an interval of minimum 4 weeks for memory wash-out. MRI was analyzed by another set of two independent readers. Per lesion sensitivity and specificity were evaluated across readers. BI-RADS 4 was defined as threshold for true positives. Gold standard was post-surgical histology.

**RESULTS**

105 malignant and 10 benign histologically proven lesions were assessed in this dataset. Average sensitivity were 84.1% (reader1) and 67% (reader 2) for MG, 90.2% and 88.8% for CESM and 91.1% and 90% for MRI, respectively. Specificity was 100% (reader 1) and 80% (reader 2) for MG, 81.8% and 90% for CESM and 71.4% and 50% for MRI.

**CONCLUSION**

CESM and MRI showed similar sensitivity for index cancer and multiple foci, both superior to MG. MG and CESM outperformed MRI in specificity.

**CLINICAL RELEVANCE/APPLICATION**

CESM is a reliable imaging technique, which may replace MRI in cases with contraindications and may replace MG due to superior diagnostic accuracy in symptomatic patients.

**VSBR31-03 • Contrast-enhanced Spectral Digital Mammogram versus Contrast-enhanced MR Mammography in the Assessment of Breast Carcinoma: Initial Clinical Experience**

Maha Helal MD (Presenter); Rasha M Kamal MD; Radwa Essam MBBS; Iman Godda MD; Sahar Mansour MD; Nelly Alieldin MD; El-Shaimaa M Sharaf MBBCh

**PURPOSE**

Evaluate the diagnostic performance of contrast-enhanced spectral digital mammography versus dynamic contrast-enhanced magnetic resonance imaging in the detection and staging of breast cancer.

**METHOD AND MATERIALS**

In this institutional ethics approved prospective study, we compared the performance of contrast based digital mammography with magnetic resonance imaging on 70 female patients. Standard digital mammogram was done in the mediolateral oblique and cranio-caudal projections followed by low (22-33 kVp) and high (44-49 kVp) energy exposures in the same projections. Sequential post contrast magnetic resonance imaging was set in the axial orientation and post processed using maximum intensity projection and multiplanar reconstruction images. Both examinations performed by IV injection of non-ionic contrast agent. Outcomes of the surgical specimen or ultrasound guided core biopsy were the gold standard of reference in all cases.

**RESULTS**

The study included 33 pathologically proved benign (47 %) and 37 (53%) malignant breast lesions. The areas of contrast uptake had been correlated with abnormalities seen on the conventional mammography. Both contrast enhanced digital mammography and magnetic resonance imaging were individually assessed in the same group of cases. Multicentric and multifocal carcinomas were detected by contrast mammograms in 29.7% (n=11) of diagnosed malignant cases, when only unifocal carcinoma was reported on conventional mammograms. In the contest of malignancy both modalities stood on the same land. Enhancement detection of some benign lesions (n=5) was limited in digital mammography. Statistical analysis yielded a sensitivity, specificity and accuracy of 93.7%, 66.6% and 80.6% compared to 93.7 %, 86.6% and 90.3% for contrast enhanced mammograms and magnetic resonance imaging respectively.

**CONCLUSION**

Contrast-enhanced digital mammogram is non-inferior to breast MRI in the contest of detection and characterization of breast malignancy.

**CLINICAL RELEVANCE/APPLICATION**

Contrast-enhanced mammography is an advanced application of digital mammography that had to be compared with breast MRI as it is more applicable and cost effective.

**VSBR31-04 • Contrast-enhanced Breast Tomosynthesis versus Dynamic Contrast-enhanced Breast MRI in the Diagnosis of Suspicious Breast Lesions on Mammogram**

Chen-Pin Chou MD (Presenter) *; Chia-Ling Chiang; Tsung-Lung Yang MD

**PURPOSE**

evaluate the diagnostic performance of contrast-enhanced spectral digital mammography versus dynamic contrast-enhanced magnetic resonance imaging in the detection and staging of breast cancer.

**METHOD AND MATERIALS**

In this institutional ethics approved prospective study, we compared the performance of contrast based digital mammography with magnetic resonance imaging on 70 female patients. Standard digital mammogram was done in the mediolateral oblique and cranio-caudal projections followed by low (22-33 kVp) and high (44-49 kVp) energy exposures in the same projections. Sequential post contrast magnetic resonance imaging was set in the axial orientation and post processed using maximum intensity projection and multiplanar reconstruction images. Both examinations performed by IV injection of non-ionic contrast agent. Outcomes of the surgical specimen or ultrasound guided core biopsy were the gold standard of reference in all cases.

**RESULTS**

The study included 33 pathologically proved benign (47 %) and 37 (53%) malignant breast lesions. The areas of contrast uptake had been correlated with abnormalities seen on the conventional mammography. Both contrast enhanced digital mammography and magnetic resonance imaging were individually assessed in the same group of cases. Multicentric and multifocal carcinomas were detected by contrast mammograms in 29.7% (n=11) of diagnosed malignant cases, when only unifocal carcinoma was reported on conventional mammograms. In the contest of malignancy both modalities stood on the same land. Enhancement detection of some benign lesions (n=5) was limited in digital mammography. Statistical analysis yielded a sensitivity, specificity and accuracy of 93.7%, 66.6% and 80.6% compared to 93.7 %, 86.6% and 90.3% for contrast enhanced mammograms and magnetic resonance imaging respectively.

**CONCLUSION**

Contrast-enhanced digital mammogram is non-inferior to breast MRI in the contest of detection and characterization of breast malignancy.

**CLINICAL RELEVANCE/APPLICATION**

Contrast-enhanced mammography is an advanced application of digital mammography that had to be compared with breast MRI as it is more applicable and cost effective.
To compare the diagnostic performance of contrast-enhanced breast tomosynthesis (CEBT) and dynamic contrast-enhanced breast MRI (DCE-MRI) for breast lesions detected on digital mammogram.

METHOD AND MATERIALS
The study was approved by institutional review board. Written informed consent was obtained from all patients. A total of 102 consecutive women suspected of having breast lesions on digital mammogram between March 2012 and December 2012 underwent both CEBT and DCE-MRI. For the dual-energy CEBT, a modified Selenia Dimensions (Hologic, Inc.) machine was used. Simultaneously 2D mammogram and 3D tomosynthesis were taken after injection with 1.5 mL iodine contrast agent per kilogram of body weight and of imaged between 2 and 6 minutes after injection. Contrast-enhanced images were taken in the suspicious breast (pre-contrast CC and MLO view) and contralateral breast (post-contrast MLO view). The lesion classifications on CEBT were finally determined based on findings on 2D mammogram, 3D tomosynthesis and post-contrast subtraction 2D and 3D images. Women were also evaluated at 1.5T (GE) or 3T MRI (Siemens) with dedicated breast coil. CEBT and DCE-MRI were interpreted by different radiologists.

RESULTS
Total 90 histological findings were available in 76 women (mean age 50.7 years, range 35-66 years). About 89% women did not have clinical symptoms. Ten women had two breast lesions in unilateral breasts. Four women had bilateral breast lesions. Of the 90 lesions, 67% had microcalcification on mammogram. The pathology revealed 46 benign lesions and 44 breast malignancies (21 carcinoma in situ, and 23 invasive breast cancers). The sensitivity/ specificity for CEBT and DCE-MRI were 97%/63% and 91%/63%, respectively.

CONCLUSION
Both CEBT and DCE-MRI showed similar diagnostic efficacy for women with suspicious breast lesions on mammogram, but CEBT was faster and easily accomplished diagnostic tool than breast DCE-MRI.

CLINICAL RELEVANCE/APPLICATION
CEBT may be an alternative tool for women who have suspicious breast lesions and cannot tolerate breast DCE-MRI.

VSBR31-05 • Benign Enhancement on Contrast Enhanced Dual Energy Digital Mammography
Maxine S Jochelson MD (Presenter) ; D. David Dershaw MD ; Janice S Sung MD ; Mary Hughes MD ; Elizabeth A Morris MD
PURPOSE
To describe the incidence, appearance and etiologies of non-malignant enhancing lesions depicted on contrast enhanced dual energy digital mammography (CEDM).

METHOD AND MATERIALS
In a retrospective HIPAA compliant IRB approved study, images and clinical histories of 100 consecutive women who underwent CEDM for either breast cancer staging or high risk screening were reviewed. The incidence of benign, focally enhancing lesions or diffuse parenchymal enhancement on CEDM, diagnosed by either biopsy, correlation with the clinical history or recent MRI findings, was determined.

RESULTS
CEDM was performed for staging of known cancer in 67/100 (67%) and for high risk screening in 33/100 (33%). 95/100 (95%) of patients had a breast MRI within 30 days of CEDM. Focal enhancement, subsequently determined to be the result of a benign process, was detected in 11/100 (11%) of women: 8/67 (12%) of women with cancer and 3/33 (9%) of screening patients. 3 patients demonstrated rim enhancing lesions: 3 corresponded to cysts on MRI (2 simple and 1 inflammed) and 2 to seromas at the site of recent intervention. 1 corresponded to a skin lesion on MRI. 5 other areas of focal enhancement underwent biopsy yielding radial scar, fibroadenoma, adenosin, PASH, and periductal inflammation. Diffuse background parenchymal enhancement was present in 26/100 (26%), all of whom had a similar pattern on MRI.

CONCLUSION
Focal non-malignant enhancement occurred in 11% of studies. Etiologies included cysts, seromas, a radial scar and a fibroadenoma among others. Half of them required tissue sampling to exclude malignancy. Appreciating the imaging appearance of these benign lesions may potentially prevent unnecessary biopsies in the future.

CLINICAL RELEVANCE/APPLICATION
Both focal and diffuse non malignant enhancement can be seen on CEDM. Recognition of the appearance of these findings may improve the specificity of this exam and limit unnecessary biopsies.

VSBR31-06 • Tomosynthesis
Mark A Helvie MD (Presenter) *
LEARNING OBJECTIVES
1) To understand the basic principles used in obtaining digital breast tomosynthesis (DBT) images. 2) To understand experimental and clinical trial data which form the basis for DBT clinical application. 3) To understand the potential benefits and areas of weakness of DBT compared to conventional mammography. 4) To understand the potential clinical applications of DBT and current regulatory status of DBT. 5) To understand future issues related to DBT.

ABSTRACT
DBT clinical trial data is emerging which will form the basis of clinical use. Because DBT has the potential to significantly change the practice of breast imaging, careful review of the results of these trials and implications for clinical practice is essential for informed decision regarding DBT.

VSBR31-07 • Implementation of Synthesized 2D Plus Tomosynthesis Images in Breast Cancer Screening: Comparison of Performance Levels with Full Field Digital Mammography Plus Tomosynthesis in a Population-based Screening Program
Per Skaane MD, PhD (Presenter) *; Randi Gullien RT *; Ellen B Eben MD *; Ingvid N Jebsen *; Unni Haakenaasen MD *; Ulrika Ekseth MD *; Mona Krager MD *
PURPOSE
To compare diagnostic performance of combined FFDM plus digital breast tomosynthesis (DBT) with synthesized 2D (C-view) plus DBT in breast cancer screening.

METHOD AND MATERIALS
Eight radiologists prospectively interpreted independently 12,271 screening examinations including FFDM plus DBT and C-View plus DBT. Both reading modes included standard CC and MLO views of each breast. A 5-point rating scale for probability of cancer was used in the image interpretation. All cases with a positive score (defined as 2 or higher) were discussed at an arbitration meeting before decision for final reading. The interpreted images (C-Views) do not require additional radiation exposure. Using analyses for binary data accounting for correlated interpretations and adjusted for reader-specific volume and performance levels and two-sided significance levels of 0.05, we compared performance levels when using C-view plus DBT with respect to positive scores, recall rates, and cancer detection rates with the corresponding FFDM plus DBT interpretations.

RESULTS
Interpretation of 12,271 independently interpreted examinations under the two modes resulted in 656 (656/12,271=5.3%) and 651 (651/12,271=5.3%) positive scores for the FFDM plus DBT and the C-view plus DBT, respectively. Following arbitration meeting, the recall rates were 297/12,271=2.4% and 270/12,271=2.2%, respectively. The cancer detection rate was 100/12,271=0.81% and 100/12,271=0.81% for FFDM plus DBT and C-view plus DBT, respectively. There was no significant difference in the cancer detection
CONCLUSION
Synthetically reconstructed 2D images applied in combination with DBT showed comparable results regarding positive predictive values and cancer detection rates with FFDM plus DBT.

CLINICAL RELEVANCE/APPLICATION
The use of synthetically reconstructed 2D images (C-View) in combination with tomosynthesis resulted in comparable performance to actual exposure generated 2D plus tomosynthesis.

VSBR31-09 • Features of Additional Breast Cancers Detected by Digital Breast Tomosynthesis after Normal Digital Mammography
Paula Martinez Miravete; Jon Etxano MD (Presenter); Pedro Slon MD; Paula B Garcia MD; Maite Millor MEd; Luis Pina MD, PhD

PURPOSE
To evaluate the radiological presentation and histology of breast cancers detected by digital mammography (DM) and additional cancers detected by complementary Digital Breast Tomosynthesis (DBT).

METHOD AND MATERIALS
From December 2010 to September 2012, we prospectively recruited 9300 consecutive patients with ACR density patterns II, III and IV in a enriched population that underwent both DM and DBT (COMBO mode). 165 patients with cancer were detected using the COMBO mode. Out of these 165 breast tumors, 105 were detected by DM and 71 by additional DBT. We retrospectively evaluated the features of the radiological presentation and histology of breast cancers detected by DM and breast cancers detected by DBT. For the statistical analysis we performed a Pearson’s Chi Square test with the SPSS 15.0 software.

RESULTS
Significant differences were found regarding the radiological presentation of both groups (p<0.05) were found in the rate of Invasive Ductal Cancers (DM: 35/105; 33%, DBT: 23/61; 41%) and Invasive Lobular Carcinoma (DM: 14/105; 13.3%, DBT: 13/61; 21.3%).

CONCLUSION
The additional breast cancers detected by DBT show different radiological presentation and histology than breast cancers detected by DM, being more common architectural distortions and tubular breast cancers.

CLINICAL RELEVANCE/APPLICATION
DBT is an emerging imaging technique capable to detect additional cancers not seen in conventional DM. The radiological presentation and histology of these additional cancers are different.

VSBR31-08 • Diagnostic Accuracy of Combination Synthetic Mammograms with Tomosynthesis vs. Combination FFDM with Tomosynthesis
Margarita L Zuley MD (Presenter); Andriy I Bandos PhD; Jules H Sumkin DO *; Victor J Catullo MD; Amy H Lu MD; Denise Chough MD; Marie A Ganott MD; Grace Y Rathfon MD; Luisa P Wallace MD

PURPOSE
To assess the diagnostic performance of combination synthetic mammograms and tomosynthesis (synthetic 2D+Tomo) to combination FFDM and tomosynthesis (FFDM+Tomo).

METHOD AND MATERIALS
IRB approval was obtained. 123 cases deemed challenging by 2 non-participating independent reviewers were chosen from our research database to create a stress test, including 36 biopsy verified cancers, 35 biopsy proven benign lesions and 52 recalled screening exams proven to be normal on recall and 1 year follow up. 5 academic women’s imagers performed a retrospective fully crossed and balanced multiple case reader study where each study was reviewed twice, once with the synthetic mammogram and then tomosynthesis and once with the standard mammogram and then tomosynthesis. Probability of malignancy (POM) on a 100 point scale and BI-RADS scores were recorded for the 2D study and then again with tomosynthesis for each mode. Data analysis was performed using random-reader analysis (DBM MRMC, v.2.33) based on the nonparametric area under the ROC curve (AUC).

RESULTS
The reader-averaged AUC for the FFDM+Tomo and synthetic 2D+Tomo modalities were 0.898 and 0.871 correspondingly (p=0.15). Four readers performed somewhat poorer albeit not significantly (p>0.05) with synthetic 2D+Tomo. The average difference of 0.027 was not statistically significant with 95% confidence interval from -0.013 to 0.067.

CONCLUSION
Synthetic 2D mammograms with tomosynthesis allowed similar interpretive performance to standard FFDM in combination with tomosynthesis and, therefore, may be an acceptable alternative for screening.

CLINICAL RELEVANCE/APPLICATION
Lowering radiation dose during tomosynthesis based screening is possible with synthesized 2D images.

VSBR31-10 • Addition of Tomosynthesis to Conventional Digital Mammograms: Effect on Image Interpretation Time of Screening Examinations
Pragya A Dang MD (Presenter); Phoebe E Freer MD; Kathryn L Humphrey MD; Elkan F Halpern PhD *; Elizabeth A Rafferty MD *

PURPOSE
To determine the impact of the implementation of a screening tomosynthesis program on real-world clinical performance by quantifying the differences in interpretation times of conventional screening mammography to combined tomosynthesis-mammography screening for multiple participating radiologists with a wide range of experience in a large academic center.

METHOD AND MATERIALS
Ten board certified radiologists read digital mammography alone or combined tomosynthesis-mammography screening examinations in batch mode for one four-hour uninterrupted sessions, as a part of routine screening practice. Number of examinations read during each session was recorded for each reader. The experience level for each radiologist was also correlated to the average number of cases read during the hour. The BI-RADS density and BI-RADS assessment category for each examination were collected. Analysis of Variance (ANOVA) test (SAS) was used to determine differences in the number of studies interpreted per hour for different radiologists, different techniques, and different experience levels of radiologists.

RESULTS
A total of 3,665 examinations (1,502 combined tomosynthesis-mammography and 2,163 digital mammography) were interpreted by 10 radiologists, with at least 5 sessions per radiologist per modality. An average of 23.8±0.55 (14.4-40.4) and 34.0±0.55, (20.4-54.3) examinations per hour, were interpreted by combined tomosynthesis-mammography and digital mammography, respectively. The average interpretation time for a combined tomosynthesis-mammography examination was 2.8 (1.5-4.2) minutes and digital mammography was 1.9 (1.1-3.0) minutes. The time taken to read a combined tomosynthesis-mammography examination was on average 0.9 minutes longer (47% longer) compared to the digital mammography alone examination. With the increase in years of breast imaging experience, there was a decrease in the overall additional time required to read combined tomosynthesis-mammography
examinations (p = 0.03, R² = 0.52).

CONCLUSION
Addition of tomosynthesis to mammography results in increased time to interpret screening examinations when compared to conventional digital mammography alone.

CLINICAL RELEVANCE/APPLICATION
Reliable estimation of differential interpretation time with tomosynthesis should prove useful in preparing for its impact on radiologists’ workload and resource allocation.

**VSBR31-11 • Diagnostic Performance of Digital Breast Tomosynthesis: Comparison with Breast Magnetic Resonance Imaging and Conventional Digital Mammography in Women with Known Breast Cancers**

**Won Hwa Kim** MD, MS ; **Jung Min Chang** MD (Presenter) ; **Ann Yi** MD ; **Woo Kyung Moon** ; **Su Hyun Lee** MD ; **Nariya Cho** MD ; **Hye Ryoun Koo** MD ; **Min Sun Bae** MD, PhD ; **Seung Ja Kim**

**PURPOSE**
To evaluate the diagnostic performance of digital breast tomosynthesis (DBT) compared with breast magnetic resonance (MR) imaging and conventional digital mammography (DM) in women with known breast cancers.

**METHOD AND MATERIALS**
This study was approved by the institutional review board and informed consent was obtained. Between March and October 2012, 176 consecutive patients with known breast cancer (mean age, 51.3 years; range, 22-78 years) underwent DM, DBT and MR imaging. All 176 index cancers and 12 additional cancer (6 ipsilateral and 6 contralateral) cancers were identified. Two radiologists independently interpreted the images from each examination without clinical information and evaluated probability of cancer (5-point scale) for all findings. Sensitivity, false-positive rates, and area under the alternative free-response receiver operating characteristic curve (AUC) were estimated with histopathology and follow-up data as a reference standard.

**RESULTS**
The mean invasive tumor size was 2.2 cm. Sensitivity for index cancers was the highest in MR imaging followed by DBT and DM (all P < .05; reader 1, 98%, 93%, and 85%; reader 2, 98%, 92%, and 85%). Sensitivity for additional cancer was the highest in MR imaging followed by DBT and DM (all P < .05; reader 1, ipsilateral, 67%, 33%, and 0%; reader 2, ipsilateral, 83%, 50%, and 17%; reader 1, contralateral, 100%, 67%, and 50%; reader 2, contralateral, 100%, 83%, and 67%). False-positive rate was the highest in MR imaging followed by DBT and DM (reader 1, 18%, 9%, and 7%; reader 2, 13%, 8%, and 7%). and was significantly frequent in MR imaging than DBT in one reader P = .033). The AUC for MR imaging, DBT, and DM were 0.946, 0.920, and 0.832 for reader 1 and 0.945, 0.912, and 0.828 for reader 2. The AUCs for DBT and MR imaging were significantly higher than DM P < .05); AUCs were not significantly different between DBT and MR imaging (Reader 1, P = .18; Reader 2, P = .12).

**CONCLUSION**
DBT showed lower sensitivity than MR imaging in detection of index and additional breast cancers, but false positives were less frequent with DBT than MR imaging.

**CLINICAL RELEVANCE/APPLICATION**
With DBT, comparable diagnostic performance to MR imaging and higher performance than DM was achieved. For additional cancer detection, DBT had limited diagnostic performance compared to MR imaging.

**VSBR31-12 • Comparison of Visibility and Diagnostic Accuracy of Cone Beam Computed Tomography, Tomosynthesis, MRI and Digital Mammography for Breast Masses**

**Margarita L Zuley** MD (Presenter) ; **Ben Guo** PhD ; **Marie A Ganott** MD ; **Andryi I Bandos** PhD ; **Víctor J Catullo** MD ; **Amy H Lu** MD ; **Amy E Kelly** MD ; **Maria L Anello** DO ; **Gordon S Abrams** MD ; **Denise Chough** MD

**PURPOSE**
To compare lesion visibility and diagnostic accuracy of cone beam computed tomography (CBCT) and tomosynthesis (DBT) to MRI and digital mammography (FFDM).

**METHOD AND MATERIALS**
IRB approval was obtained. From 04/16/2009 to 06/21/2011, 178 mass lesions in 151 consecutively consenting women underwent FFDM, DBT, CT and contrast enhanced MRI prior to percutaneous biopsy. 97 CBCTs were unenhanced (NC-CBCT) and 81 had contrast (CE-CBCT). DBT studies were unenhanced. Histopathology established truth. A nonparticipating radiologist marked each lesion location. A nonparticipating radiologist interpreted the images from each examination without clinical information and evaluated probability of cancer (5-point scale) for all findings. Sensitivity, false-positive rates, and area under the alternative free-response receiver operating characteristic curve (AUC) were estimated with histopathology and follow-up data as a reference standard.

**RESULTS**
100 benign and 78 malignant masses were included. Average size was 19.7 mm (median 14 mm, range 4-100 mm). Percentage of visible lesions differed (88% FFDM, 91% DBT, 82% CBCT [81% NC-CBCT sub-set, 84% CE-CBCT sub-set] and 93% MRI). For visualization, MRI was significantly better than CBCT (p = .01). Sensitivity, false-positive rates, and area under the alternative free-response receiver operating characteristic curve (AUC) were estimated with histopathology and follow-up data as a reference standard.

**CONCLUSION**
For masses MRI has the highest accuracy and visibility and was significantly better than CBCT but not DBT. CBCT accuracy and visibility improve with use of contrast but further improvements are necessary for use as an alternative to MRI, FFDM or DBT.

**CLINICAL RELEVANCE/APPLICATION**
Tomosynthesis may possibly be a viable alternative to MRI for breast mass evaluation.

**VSBR31-13 • Elastography**

**A. Thomas Stavros** MD (Presenter) *

**LEARNING OBJECTIVES**
1) To understand the elastic properties of normal and pathologic breast tissues. 2) To get an overview of the different ultrasound methods and technologies. 3) To learn about the clinical results obtained with the different methods. 4) To understand the role of elastography within the imaging protocol.

**ABSTRACT**
Real-time elastography (RTE) of the breast may easily and quickly integrate conventional breast imaging. Excitation is applied to the tissue and sophisticated algorithms are used to estimate their elasticity. Different technologies use direct mechanical or radiation force excitation. Qualitative scores and/or quantitative values are usually derived from the estimate of the effect on the tissue and help to differentiate soft benign lesions from malignancies. These are usually stiffer due to the secretion of collagen and fibronectin, and the surrounding edema. Fluid lesions almost always show a typical three-layered pattern on strain elastography. They have typical patterns even when radiation force technologies (ARFI and shear wave). These last allow a true quantitative evaluation of the acoustic modulus and promise to be the gold standard for the future applications. Clinical reports show a high diagnostic accuracy: increased specificity for atypical carcinomas and a very high specificity in benign lesions, including BI-RADS category 3 lesions. With the best cutoff point between elasticity scores 3 and 4, the true negative predictive value is over 90%. Most mistakes are linked to the histopathology of the lesions. In invasive carcinomas RTE clearly shows the peripheral infiltration improving the volume measurement; 3D elastography and tomographic
imaging may help in this respect. RTE scores and values are well reproducible. Indexes of intra-observer and inter-observer agreements are very good. Elastography scores have been introduced into the new BI-RADS edition. They upgrade BI-RADS 3 lesions and downgrade 4a lesions. In daily practice this results into earlier biopsies for cancers and reduced biopsies and longer follow-up intervals for benign lesions. Elastography is easy and quick; it may become part of the evaluation of all focal cancers. Still RTE score is only a complementary descriptor to BI-RADS and its interpretation requires some training.

**VSBR31-14 • BIRADS Classification for Real Time Ultrasound Elastography: More Comprehensive, Accurate and Action Oriented Results**

**Mukta D Mahajan MBBS (Presenter) ; Sonal Garg MBBS ; Mukund S Joshi MD ; Chander Lulla MBBS**

**PURPOSE**
1. To devise a BIRADS category of standardized breast reporting for Elastography of focal breast lesions based on the elastography score and distance ratio method of evaluating them. 2. To qualitatively assess the sensitivity, specificity, positive and negative predictive value of preset cutoffs of elastography score and distance ratio in assigning a BIRADS rating to them when compared with BIRADS grey scale ultrasound and histopathology. 3. To evaluate the efficacy of implementing this Elastography BIRADS scheme in the diagnostic pathway of evaluating breast lesions at our institution and thereby generate a protocol based guide to management. 4. To reduce the incidence of biopsies and diagnostic conundrums in assessing indeterminate focal breast lesions.

**RESULTS**
The data was analyzed using 2 cut offs for ES and 4 cut offs for DR to compute the most accurate scheme for BIRADS-EL categorisation. The sensitivity, specificity, PPV and NPV for BIRADS-EL was found to be 71.7%, 90.1%, 68%, 91.5%. This was found to be superior the existing methods of analysis. The area under the receiver operating characteristic (ROC) curve for BIRADS-US, ES, DR and BIRADS-EL was 0.888, 0.928, 0.938 and 0.956 respectively. After implementing BIRADS-EL as a part of diagnostic workflow and protocol, assessment of the number of biopsies that were successfully averted was analyzed. The data collected after its implementation was evaluated after 3 months, 6 months and 1 year and has shown consistent result as the study group.

**CONCLUSION**
The present study suggests that Elastographic BIRADS classification of focal breast lesions is more accurate than BIRADS grey scale ultrasound in differentiating benign and malignant lesions when both methods i.e. ES and DR are combined. This method of reporting cannot standardize elastography results and make them readily comparable with other modalities. Results obtained are action oriented and leave no ambiguity in inconclusive or indeterminate lesions thereby improving the quality of non-invasive diagnosis and reducing the incidence of ultrasound guided biopsies.

**METHODS**
We studied a total of 215 breast lesions in 112 women by B-mode ultrasonography and routine breast elastography. All the lesions were assigned an ultrasound BI-RADS category based on their imaging appearance. An Elastography score (ES) of 1 to 5 and distance ratio (DR) of 1 was assigned to each lesion based on elastographic assessment. BIRADS US category 4 and 5 lesions, ES 4.5 and DR = 1 or >1 lesion were biopsied. BIRADS US 3, ES 3 and DR 0.8 to 1 lesions were either followed up every 6 months for a period of 2 years or biopsied. BIRADS US 2, ES 1,2 and DR

**VSBR31-15 • Added Value of Shear-Wave Elastography in Evaluation of Breast Masses Detected on Screening Ultrasound**

**Su Hyun Lee MD ; Jung Min Chang MD (Presenter) ; Nariya Cho MD ; Hye Ryoung Koo MD ; Min Sun Bae MD, PhD ; Won Hwa Kim MD, MS ; Mirinae Seo MD ; Woo Kyung Moon**

**PURPOSE**
To prospectively validate the added value of shear-wave elastography (SWE) in evaluation of breast masses detected on screening ultrasound (US).

**METHOD AND MATERIALS**
This study was conducted with institutional review board approval, and written informed consent was obtained. From April to October 2012, B-mode US and SWE were performed for 207 breast masses detected on screening US (mean size, 1.0 cm) in 207 consecutive women (mean age, 45 years) prior to US-guided core biopsy. Ten radiologists performed the examinations and assessed the likelihood of malignancy and Breast Imaging Reporting and Data System (BI-RADS) category for breast masses using B-mode US alone and a combination of B-mode US and SWE, respectively. Radiologists were allowed to upgrade BI-RADS US category 3 masses to 4a when the maximum elasticity value (Emax) = 65 kPa, a cutoff value determined in a prior study, to achieve the best diagnostic accuracy in differentiating benign from malignant lesions. Twelve of the 207 breast masses (5.8%) were malignant and consisted of nine invasive ductal carcinomas, two ductal carcinomas in situ, and one tubular carcinoma. The AUC of B-mode US increased from 0.700 to 0.879 when SWE was added (P = .002). Considering category 4a or higher as a positive result for malignancy, the sensitivities were not different between B-mode alone and combined B-mode and SWE (91.7% [11 of 12], both). However, the specificity increased from 17.4% (34 of 195) to 73.8% (144 of 195) when SWE was added (P = .002).

**CONCLUSION**
Combined use of SWE and B-mode US can increase both the accuracy and specificity in differentiating benign from malignant breast masses detected on screening US.

**CLINICAL RELEVANCE/APPLICATION**
SWE can be valuable in reducing the considerable false-positive rate of screening ultrasound US examinations.

**VSBR31-16 • Volume of Peri-tumoural Stromal Stiffness (VPSS) Surrounding Invasive Breast Cancer as Measured by 3D Shearwave Elastography (SWE): An Imaging Biomarker for Risk of Systemic Spread?**

**Andrew Evans MRCP, FRCR (Presenter) ; Patsy Whelehan MSc * ; Sarah J Vinnicombe MRCP, FRCR ; Kim Thomson ; Lee Jordan ; Caroline Mitchie ; Colin Purdie ; Alistair M Thompson**

**PURPOSE**
3D SWE allows the VPSS around breast cancers to be measured. Vascular invasion (VI) is most commonly detected at the tumour/stromal interface and is strongly associated with nodal involvement. We hypothesised that the likelihood of VI and nodal involvement may vary with the VPSS and that these relationships may be stronger than those seen between these risk factors for systemic spread and other ultrasound (US) parameters such as mean stiffness on 2D SWE, grey scale diameter and grey scale volume.

**METHOD AND MATERIALS**
2 and 3D grey scale US and SWE were carried out on a series of 62 consecutive breast cancers treated by immediate surgery. The VPSS and other US features were measured prior to surgery and then correlated with the presence of vascular invasion and nodal status at histologic examination. Statistical significance was ascertained using chi square and chi square test for trend.

**RESULTS**
VPSS has a strong relationship to VI status (p=0.003) with none of the 17 patients with 3 of VPSS having VI, 13 of 36(36%) with a VPSS between 0.5 and 3cm3 having VI and 5 of 9 (56%) with a VPSS >3cm3 having VI. Grey scale diameter and grey scale volume had significant but weaker relationships with VI (p=0.02 and 0.03 respectively). A significant relationship was also found between VPSS and nodal status (p=0.04). Nodal positivity rates using the above VPSS cut-offs were 12%, 33% and 44% respectively. None of the other US parameters had statistically significant associations with nodal status.
CONCLUSION
VPSS has stronger associations with markers of systemic spread than other US parameters and may be helpful in patient selection for neoadjuvant chemotherapy.

CLINICAL RELEVANCE/APPLICATION
In women with breast cancer the volume of peritumoral stiffness seen on 3D shearwave elastography may help patient selection for neoadjuvant chemotherapy

VSBR31-17 • Shear-wave Elastography in Detection of Residual Breast Cancer after Neoadjuvant Chemotherapy
Su Hyun Lee MD; Jung Min Chang MD (Presenter); Nariya Cho MD; Hye Ryoung Koo MD; Min Sun Bae MD, PhD; Won Hwa Kim MD, MS; Miriniae Seo MD; Woo Kyung Moon

PURPOSE
To evaluate the accuracy of shear-wave elastography (SWE) in detecting residual cancer after neoadjuvant chemotherapy (NAC).

METHOD AND MATERIALS
This retrospective study was approved by our institutional review board and the requirement for written informed consent was waived. From January 2012 to February 2013, 71 women with stage II-III invasive breast cancers who received NAC and were imaged with B-mode ultrasonography (US), SWE, and magnetic resonance imaging (MRI) before surgery were included. Clinical tumor response was assessed using image findings from B-mode US and MRI and classified into two groups: 0: no residual tumor, 1: residual tumor. Quantitative elasticity values (maximum kPa) were acquired for primary lesions depicted on US. Pathological complete response (pCR) was defined as no residual invasive cancer cells. The quantitative SWE values were compared between the pCR and non-pCR group using independent samples t-test. The areas under the receiver operating characteristics curve (AUC), sensitivities, and specificities of B-mode US, MRI, and SWE for detecting residual tumor were compared, with histopathologic examination as the reference standard.

RESULTS
Of the 71 women, 15 (21.1%) achieved pCR. The mean size of residual invasive cancers was 2.1 cm (range 0.1-6.4 cm). The maximum SWE value was significantly higher in the non-pCR group (mean, 122.9 kPa) than in the pCR group (30.6 kPa) (P<0.001).

CONCLUSION
SWE was accurate in the detection of residual cancer after NAC. When combined with B-mode US, the accuracy improved to a level similar to breast MRI.

CLINICAL RELEVANCE/APPLICATION
In predicting pCR after NAC, SWE can offer valuable information. Addition of SWE to conventional imaging can be useful for surgical planning in breast cancer patients.
PURPOSE

To determine the capability of lung perfused blood volume (Lung PBV) imaging on dual-energy CT (DECT) for disease severity assessment in patients with acute pulmonary thromboembolism (APTE) patients.

METHOD AND MATERIALS

Twenty-one consecutive APTE patients underwent contrast-enhanced DECT and echocardiography at the onset. A normalized lung PBV (nLung PBV) image was generated by pixel analysis in each patient. In each patient, the overall perfusion (OP) and heterogeneity (H) indices were assessed as averages of mean and standard deviation of the nLung PBV value within ROIs placed over each lung field in both lungs. In this study, the disease severity of APTE was determined as CT angiographic clot burden score (CBS) according to past literatures and tricuspid regurgitation pressure gradient (TRPG). Then, all patients were divided into right heart (n=13) and non-right heart (n=8) dysfunction groups. To determine the capability of DECT indexes for disease severity assessment, CBS and TRPG were statistically correlated with both DECT indexes. To assess difference of each index between the two groups, all indexes were compared by Student’s t-test. To determine the capability for differentiating the two groups, feasible threshold values of CBS and the DECT indexes as having significant differences between the two groups were determined using ROC-based positive test. Finally, sensitivity, specificity and accuracy were compared to each other by using McNemar’s test.
Chest Pain among Those Judged to Be at Low to Intermediate Risk of Acute Coronary Syndrome?

RESULTS
CBS had significant correlation with OP index (r = -0.82, p < 0.05).

CONCLUSION
The Lung PBV imaging on DECT has a potential for disease severity assessment in APTE patients, and it is considered at least as valuable as clot burden score in routine clinical practice.

CLINICAL RELEVANCE/APPLICATION
The Lung PBV imaging on DECT has a potential for disease severity assessment in APTE patients, and it is considered at least as valuable as clot burden score in routine clinical practice.

VSER31-07 • Comparison of the Image Quality between Virtual Non Contrast Scans Obtained on Solid State Detectors and on the New Fully Integrated Digital Chip Detector that were Generated from Abdominal Dual Energy CT Exams in the Emergency Department

Adrian Reagan MD (Presenter); Patrick McLaughlin FFRRCSI; Savvas Nicolaou MD; Luck J Louis MD; Ana-Maria Bilawich MD; Sharon Gershony MD

PURPOSE
To determine the effect on noise reduction in VNC studies generated on solid state detector (SSD) and on the new fully integrated digital chip detector (FICD) and to determine whether virtual non contrast images provide similar quality to standard NC studies with the aim of eliminating the need for NC scans effectively reducing radiation dose in the acute setting.

METHOD AND MATERIALS
10 DECT studies were imaged on the SSDs and 10 on the new FICD using the 128 slice DS Definition scanner. Protocol parameters included 64 by 0.6 mm col. reconstructed to 1.5mm axial DECT images were loaded into the multimodality station within the liver VNC DE application class. 3mm axial VNC images were exported to pacs for analysis. Routine NCIs were obtained using 64 by 0.6 mm col., reconstructed to a thickness of 3mm axial slices using B30 kernel keeping CTDI vol the same as the DECT protocol. Noise was calculated via SD of ROIs in 5 tissues. Two Radiologists graded the quality of the NC and VNC image sets using a 5-point Likert scale. SNR was then averaged and the means were compared between the VNC data set imaged on the SSD and the VNC data set imaged on the new FICD. Analysis between VNC images and standard NC studies obtained on the FICD was also performed. A Mann-Whitney U test was used to compare the level of noise between VNC images done on SSD and VNC images done on the FICD. VNC images obtained on the FICDs were also compared with regular NCIs from the same detector. VNCIs performed on the FICD revealed a U-value of 0.05. The new VNC data when compared to the regular NC data obtained on the FICD revealed a U-value of 0.05.

RESULTS
VNC images obtained on the FICD demonstrated lower noise values compared to VNC data sets obtained on the SSD. No difference in noise values was found between the standard NC studies and the new VNC images. Subjectively VNC abdomen sets provided equal diagnostic quality compared to standard NC studies.

CONCLUSION
Findings suggest VNC image noise levels are reduced on the new FICDs. New VNC studies provide diagnostic images comparable to standard NC protocols.

CLINICAL RELEVANCE/APPLICATION
The new FICDs resulted in diagnostic VNC studies and thus represent a future dose reduction strategy in the elimination of non contrast studies in abdominal ED protocols.

VSER31-08 • QandA/Break

VSER31-09 • Multi-detector CT: One Stop Shop for the Assessment of Acute Chest Pain

Savvas Nicolaou MD (Presenter)

LEARNING OBJECTIVES
1) Discuss diagnostic imaging algorithm for the assessment of acute chest pain. 2) Discuss the benefits and Limitations of cardiac CT in the acute setting. 3) Review the optimization of the Cardiac CT in the emergency department. 4) Assess literature evidence of MDCT in diagnosis of acute coronary syndrome (ACS) with regards to cost, time to diagnosis and outcomes. 5) Discuss the role of a Triple-Rule-Out Protocol in evaluation of acute chest pain. 6) Discuss the characteristics of coronary lesions on MDCT that are associated with ACS. 7) Review new dose reduction techniques which maintain diagnostic quality available including prospective ECG gating, BMI-based tube voltage reduction and iterative reconstruction.

ABSTRACT
Chest pain is a very common presentation in the emergency department (ED), accounting up to 5.8 million visits a year and as the second leading complain in the ED. It is important to properly diagnose acute coronary syndrome (ACS) in these patients; 2-8% of patients with ACS are misdiagnosed and inappropriately discharged home which has been demonstrated to be associated with a doubling of mortality rate. It is vital to differentiate ACS from other serious causes of chest pain including pulmonary embolism and aortic dissection. Multidetector CT (MDCT) has been proposed to be an one-stop shop as it allows quicker time, low costs, and easy access, the ability to rule out ACS confidently using non-invasive visualization, and visualization of extracardiac findings.

VSER31-10 • Are Cardiac Risk Factors and Risk Scores Useful to Triage Patients Presenting to the Emergency Department with Chest Pain among Those Judged to Be at Low to Intermediate Risk of Acute Coronary Syndrome?

Jacob P Deutsch; Maria M Hannaway; Adrian T Estepa; Anand I Kenia; David C Levin MD; Ethan J Halpem MD (Presenter)

PURPOSE
To evaluate the predictive value of cardiac risk factors and risk scores for coronary artery disease (CAD) and adverse outcomes in an emergency department (ED) population judged to be at low to intermediate risk for acute coronary syndrome (ACS).

METHOD AND MATERIALS
IRB approval was obtained for this HIPPA compliant, prospective cohort study. The study cohort included consecutive patients who presented to the ED with chest pain over a 36 month period, were admitted to the observation unit, evaluated with coronary CTA (cCTA) and agreed to provide written informed consent. Cardiac risk factors, clinical presentation, ECG and laboratory studies were recorded with a standard template; TIMI and GRACE scores were tabulated. cCTA findings were reviewed by two experienced cardiac radiologists, rated on a 6 level plaque burden scale, and classified for presence/absence of significant CAD (stenosis = 50%). Adverse cardiovascular outcomes were recorded after 30 days.

RESULTS
Among 250 patients evaluated by cCTA, 143 (57%) had no CAD, 64 (26%) demonstrated minimal plaque (70% stenosis). Six patients developed adverse cardiovascular outcomes. Among traditional cardiac risk factors, only age (older) and sex (male) were significant independent predictors of CAD. Correlation with CAD was poor for TIMI (r = 0.12) and GRACE (r = 0.09-0.23) risk scores. Although risk factors, patient presentation, and risk scores were poor predictors of CAD and adverse outcomes, cCTA identified severe CAD in all subjects with adverse outcomes.

CONCLUSION
Among patients who present to the ED with chest pain and are judged to be at low to intermediate risk of ACS, traditional risk factors,
Coronary CTA is superior to traditional risk factors for triage of patients presenting to the ED with chest pain and who are judged to be at low to intermediate risk of acute coronary syndrome.

**LEARNING OBJECTIVES**
1) To understand the appropriate use of MRI in the abdominal emergency setting. 2) To discuss the protocol considerations for maximizing the diagnostic yield of MRI in imaging abdominal emergencies. 3) To illustrate relevant imaging findings for a range of abdominal emergencies to which MRI may be appropriately applied.

**METHOD AND MATERIALS**
The MR sequences obtained in 61 patients for the evaluation of pelvis and right lower quadrant were included in this study. Two board certified radiologists independently evaluated the different MR sequences for the visualization of the appendix. The frequency of visualization of the normal or abnormal appendix was documented for single shot fast spin-echo (SSFSE), T2 fast spin echo (FSE), T1 weighted gradient-echo (GRE) and inversion recovery sequences (STIR).

**RESULTS**
SSFSE without fat saturation in 3 planes was able to visualize the appendix in 90.9% of the cases (50/55). Amongst the 3 planes (axial, coronal and sagittal) of image acquisition with SSFSE, the coronal image acquisition was considered to be the best in the visualization of the appendix, followed by acquisition in axial plane. The frequency of visualization of appendix on T2 FSE sequences was 62.5% (10/16) without fat saturation and 26.6% (4/15) with fat saturation. In phase T1-weighted GRE (39.2%) sequence was found to be more likely to visualize the normal appendix, compared to out of phase T1-weighted GRE sequence (12.5%). Of the MR sequences evaluated in this study short tau inversion recovery (8.3%) and fat saturated SSFSE (4.7%) sequences were least likely to visualize the appendix.

**CONCLUSION**
All imaging protocols in patient with suspected appendicitis should include 3 planes SSFSE without fat saturation, T2 FSE sequence without fat saturation and T1 in-phase sequence. Fat saturated SSFSE, STIR and T2 FSE sequences are least effective in visualization of the normal appendix.

**CLINICAL RELEVANCE/APPLICATION**
This study allows a radiologist to choose the most optimal sequences in the visualization of the appendix in patients with suspected acute appendicitis.

**RESULTS**
Purposes were to determine the frequency of visualization of acute appendicitis in patients = 40 years old presenting to the ED with right lower quadrant pain.

**METHOD AND MATERIALS**
Study was IRB-approved, HIPPA compliant. Inclusion criteria selected total of 59 patients = 40 years old presenting to emergency room with possible acute appendicitis and evaluated with MRI as the primary imaging test between 8-2012 and 3-2013. Exclusion criteria excluded patients > 40 years old and patients without symptoms of acute appendicitis. All MR exams were performed with a fast, no oral/no intravenous contrast protocol, utilizing a combination of multiplanar, non-breath-hold, T2-weighted fast spin-echo (FSE) sequence with and without fat saturation and 26.6% (4/15) with fat saturation. In phase T1-weighted GRE (39.2%) sequence was found to be more likely to visualize the normal appendix, compared to out of phase T1-weighted GRE sequence (12.5%). Of the MR sequences evaluated in this study short tau inversion recovery (8.3%) and fat saturated SSFSE (4.7%) sequences were least likely to visualize the appendix.

**CONCLUSION**
MRI is a highly accurate test for the diagnosis of acute appendicitis in patients = 40 years old, with sensitivity and specificity of 100% in our study, utilizing a rapid imaging protocol without oral or IV contrast.

**CLINICAL RELEVANCE/APPLICATION**
MRI is highly accurate for diagnosing acute appendicitis in patients = 40 years old, providing a rapid, non-radiation based exam for evaluation of right lower quadrant pain in the emergency setting.

**Gastrointestinal Series: Pancreas - Inflammation and Neoplasm**

**Tuesday, 08:30 AM - 12:00 PM • N230**

**VSER31-11 • MRI in Abdominal Emergencies**

**Stephan W Anderson MD (Presenter)**

**LEARNING OBJECTIVES**
1) To understand the appropriate use of MRI in the abdominal emergency setting. 2) To discuss the protocol considerations for maximizing the diagnostic yield of MRI in imaging abdominal emergencies. 3) To illustrate relevant imaging findings for a range of abdominal emergencies to which MRI may be appropriately applied.

**METHOD AND MATERIALS**
The MR sequences obtained in 61 patients for the evaluation of pelvis and right lower quadrant were included in this study. Two board certified radiologists independently evaluated the different MR sequences for the visualization of the appendix. The frequency of visualization of the normal or abnormal appendix was documented for single shot fast spin-echo (SSFSE), T2 fast spin echo (FSE), T1 weighted gradient-echo (GRE) and inversion recovery sequences (STIR).

**RESULTS**
SSFSE without fat saturation in 3 planes was able to visualize the appendix in 90.9% of the cases (50/55). Amongst the 3 planes (axial, coronal and sagittal) of image acquisition with SSFSE, the coronal image acquisition was considered to be the best in the visualization of the appendix, followed by acquisition in axial plane. The frequency of visualization of appendix on T2 FSE sequences was 62.5% (10/16) without fat saturation and 26.6% (4/15) with fat saturation. In phase T1-weighted GRE (39.2%) sequence was found to be more likely to visualize the normal appendix, compared to out of phase T1-weighted GRE sequence (12.5%). Of the MR sequences evaluated in this study short tau inversion recovery (8.3%) and fat saturated SSFSE (4.7%) sequences were least likely to visualize the appendix.

**CONCLUSION**
All imaging protocols in patient with suspected appendicitis should include 3 planes SSFSE without fat saturation, T2 FSE sequence without fat saturation and T1 in-phase sequence. Fat saturated SSFSE, STIR and T2 FSE sequences are least effective in visualization of the normal appendix.

**CLINICAL RELEVANCE/APPLICATION**
This study allows a radiologist to choose the most optimal sequences in the visualization of the appendix in patients with suspected acute appendicitis.

**VSER31-12 • Efficacy of MR Sequences in the Optimal Visualization of the Appendix**

**Ajay K Singh MD (Presenter) ; Garry Choy MD, MS ; Mukesh G Harisinghani MD**

**PURPOSE**
The aim of this study was to determine the frequency of visualization of appendix on different MR sequences.

**METHOD AND MATERIALS**
The MR sequences obtained in 61 patients for the evaluation of pelvis and right lower quadrant were included in this study. Two board certified radiologists independently evaluated the different MR sequences for the visualization of the appendix. The frequency of visualization of the normal or abnormal appendix was documented for single shot fast spin-echo (SSFSE), T2 fast spin echo (FSE), T1 weighted gradient-echo (GRE) and inversion recovery sequences (STIR).

**RESULTS**
SSFSE without fat saturation in 3 planes was able to visualize the appendix in 90.9% of the cases (50/55). Amongst the 3 planes (axial, coronal and sagittal) of image acquisition with SSFSE, the coronal image acquisition was considered to be the best in the visualization of the appendix, followed by acquisition in axial plane. The frequency of visualization of appendix on T2 FSE sequences was 62.5% (10/16) without fat saturation and 26.6% (4/15) with fat saturation. In phase T1-weighted GRE (39.2%) sequence was found to be more likely to visualize the normal appendix, compared to out of phase T1-weighted GRE sequence (12.5%). Of the MR sequences evaluated in this study short tau inversion recovery (8.3%) and fat saturated SSFSE (4.7%) sequences were least likely to visualize the appendix.

**CONCLUSION**
All imaging protocols in patient with suspected appendicitis should include 3 planes SSFSE without fat saturation, T2 FSE sequence without fat saturation and T1 in-phase sequence. Fat saturated SSFSE, STIR and T2 FSE sequences are least effective in visualization of the normal appendix.

**CLINICAL RELEVANCE/APPLICATION**
This study allows a radiologist to choose the most optimal sequences in the visualization of the appendix in patients with suspected acute appendicitis.

**VSER31-13 • Diagnostic Performance of Noncontrast Abdominopelvic MRI for the Evaluation of Suspected Acute Appendicitis in Patients < 40 Years Old**

**Matthew Covington MD (Presenter) ; Shannon Urbina ; Lori Stolz MD ; Diego R Martin MD, PhD ; Dorothy L Gilbertson-Dahdal MD ; Sarah M Desoky MD ; Hina Arif ; Bobby T Kalb MD**

**PURPOSE**
Evaluate the sensitivity and specificity of MRI for the detection of acute appendicitis in patients = 40 years old presenting to the ED with right lower quadrant pain

**METHOD AND MATERIALS**
Study was IRB-approved, HIPPA compliant. Inclusion criteria selected total of 59 patients = 40 years old presenting to emergency room with possible acute appendicitis and evaluated with MRI as the primary imaging test between 8-2012 and 3-2013. Exclusion criteria excluded patients > 40 years old and patients without symptoms of acute appendicitis. All MR exams were performed with a fast, no oral/no intravenous contrast protocol, utilizing a combination of multiplanar, non-breath-hold, T2-weighted HASTE sequences without and with spectral adiabatic inversion recovery (SPAIR) fat suppression. The acquisition time for each exam was recorded. The MRI was interpreted the same day in a prospective fashion by the radiologist assigned to the clinical service that day. The results were classified as a) positive, b) negative or c) indeterminate for acute appendicitis. MRI results were also categorized for additional pathology or sources of pain. Each patient was followed up by either a) surgical findings or b) phone call follow-up at 1 week and 6 months after the ED visit and interrogation of medical records for subsequent clinical work-up. Statistical analysis included calculation of sensitivity, specificity, positive and negative predictive values.

**RESULTS**
59 patients received MRI for evaluation of right lower quadrant pain and 5 exams were positive for acute appendicitis (8.5%). When compared with gold standards of surgery (5/59) and phone call follow-up with medical records review (54/59), MRI demonstrated a sensitivity of 100%, specificity of 100%, negative predictive value of 100% and positive predictive value of 100%. Out of the 54 patients with negative MRI for acute appendicitis, an alternate diagnosis was offered in 22/54 (40.7%). The average exam time for each MRI was 15 minutes (range 12-22 minutes).

**CONCLUSION**
MRI is a highly accurate test for the diagnosis of acute appendicitis in patients = 40 years old, with sensitivity and specificity of 100% in our study, utilizing a rapid imaging protocol without oral or IV contrast.

**CLINICAL RELEVANCE/APPLICATION**
MRI is highly accurate for diagnosing acute appendicitis in patients = 40 years old, providing a rapid, non-radiation based exam for evaluation of right lower quadrant pain in the emergency setting.

**VSER31-14 • Panel/QandA**
Description of the art imaging modalities in diagnostic imaging of pancreatic diseases. 2) Illustrate diagnostic imaging findings useful for the differential diagnosis between pancreatic adenocarcinoma and non-neoplastic mimickers such as autoimmune pancreatitis and para-duodenal pancreatitis. 3) Understand the physiology of secretin and its application during secretin-enhanced Magnetic Resonance Cholangiopancreatography (MRCP). 4) Indication to secretin-enhanced MRCP its role in different clinical settings.

New diagnostic imaging modalities are applied in pancreatic diseases such as contrast-enhanced ultrasound, computed tomography (CT) perfusion, diffusion-weighted imaging and secretin-enhanced Magnetic Resonance (MR) imaging. These new diagnostic imaging modalities are helpful in different medical needs in pancreatic imaging such as the early diagnosis of pancreatic adenocarcinoma, differential diagnosis between pancreatic adenocarcinoma and non-neoplastic mimickers such as focal autoimmune pancreatitis and para-duodenal pancreatitis. MR imaging and MR cholangiopancreatography (MRCP) are useful in the diagnosis of cystic pancreatic neoplasms and in their characterization, by depicting internal features and the relationship between the neoplasm and the pancreatic duct system. Furthermore secretin-enhanced MR cholangiopancreatography (S-MRCP) is able to investigate ductal system abnormalities, such as those occurring in recurrent acute pancreatitis, chronic pancreatitis and acute pancreatitis. S-MRCP s also able to determine pancreatic exocrine reserve in severe chronic pancreatitis or in post-operative patients.

VSGI31-02 • Does Model Based Iterative Reconstruction (MBIR with VEO) Improve State-of-the-Art CT of the Pancreas at 80 kVp and 8 mL/s?

Wendy L Stiles MD (Presenter) ; Joseph M Collins MD * ; Alvin C Silva MD ; Amy K Hara MD * ; Marina E Giurescu MD ; Robert G Paden ; Donna Sterns RN ; Qing Wu ; Deborah Unger RN

PURPOSE
Improve CT imaging of pancreatic neoplasm, utilizing reduced acquisition energy (80 kVp), maximized iodine flux at 8 mL/s injection rate and a novel MBIR reconstruction algorithm.

METHOD AND MATERIALS
23 patients with known pancreatic neoplasm underwent multi-phase CT (15M, 8F; ages: 42-82 yrs). Radiation exposure parameters (kVp, noise index, mA, pitch) customized to body size; width of patient’s body on AP scout: Sm. = 30 cm, Med. 31-40 cm, Lg. 41-50 cm, XL =51 cm. By altering pitch, 83% of patients were imaged at 80 kVp to take advantage of iodine’s k-edge (33 keV). Maximum iodine flux (i.e. 8 mL/s) obtained by simultaneous injection of IV contrast (150 mL or 200 mL Omnipaque 350) at 4 mL/s in each arm with 18 or 20 gauge needles. Images were reconstructed with 3 different algorithms: filtered back projection (FBP), adaptive statistical iterative reconstruction (ASIR), and model based iterative reconstruction (MBIR with VEO, GE Healthcare). Signal-to-noise (SNR) and contrast-to-noise (CNR) ratio were compared on images processed with FBP, ASIR, and MBIR. Three experienced (> 7 yrs) abdominal radiologists independently compared overall image quality and lesion conspicuity (key findings) between FBR, ASIR, and MBIR on a scale from 0-4 (0 = worst, 4 = best).

RESULTS
Density of normal pancreas on arterial phase averaged 222.2 HU using 80 kVp acquisition energy at 8 mL/s IV contrast injection rate. MBIR statistically improved SNR and CNR compared to ASIR and FBP (p < 0.05). MBIR significantly improved quantitative and qualitative measures of all image quality and key findings related to pancreatic neoplasm. We achieved substantially greater enhancement of the pancreas than what has been reported previously by combining the advantages of a reduced acquisition energy 80 kVp and maximized iodine flux from injecting at 8 mL/s. Coupled with MBIR, this CT technique provides better images to evaluate pancreatic neoplasm.

CLINICAL RELEVANCE/APPLICATION
MBIR on images acquired at 80 kVp at maximized iodine flux sets a new standard for state-of-the-art pancreatic imaging, providing better images to discern pancreatic neoplasm.

VSGI31-03 • Studies of Multi b-values DWI in Assessing Chronic Pancreatitis at 3.0T MR

Chunshu Pan MD (Presenter) ; Li Wang ; Jianping Lu MD ; Chao Ma

PURPOSE
To assess the value of multi b-values DWI using biexponential model for diagnosis chronic pancreatitis. To investigate the value of parameters derived by biexponential model and monoexponential model in evaluating the atrophy of chronic pancreatitis.

METHOD AND MATERIALS
48 patients with chronic pancreatitis and 36 healthy volunteers underwent DWI with 9 b-values up to 1000 s/mm² on 3.0T MR system. ADCtot and D¹, D, f was calculated by monoexponential model and biexponential model respectively. Atrophy rate was determined by the maximum diameter of the duct divided by the average diameter of the pancreas. Mann-Whitney U test was used for comparing the difference of ADCtot, D¹, D, f between chronic pancreatitis and normal pancreas. Dependency of D¹, D, f on atrophy rate was characterized by using a Spearman rank-order correlation test.

RESULTS
Conclusions:

Multi b-values DWI could be helpful to assess the degree of fibrosis of chronic pancreatitis and pancreatic blood supply.

VSGI31-04 • Pancreatic Cancer

Koenraad J Mortele MD (Presenter)

LEARNING OBJECTIVES
1) To review the imaging features that allow diagnosis, staging, and management of pancreatic cancer.

ABSTRACT
Ductal pancreatic adenocarcinoma accounts for nearly 95% of all malignant pancreatic neoplasms and is the ninth most common malignancy. Prognosis is poor with a 5-year survival rate ranging from 1% to 5%. The majority of tumors are located in the pancreatic head and because of the involvement of the common bile duct, they present earlier than tumors arising in the body or tail of pancreas. MDCT is the imaging modality of choice for the detection and preoperative staging of pancreatic cancer.; On contrast-enhanced MDCT images, adenocarcinomas present as hypoattenuating lesions with respect to the surrounding normal pancreatic parenchyma. There are also some indirect signs for the presence of a tumor on CT without identification of the tumor itself. Maximum tumor conspicuity can be achieved during either the pancreatic parenchymal (40 seconds) or portal venous phases (70 seconds) of a dynamic contrast enhanced CT exam. The detection of hepatic metastases is critical in the preoperative staging of the patients since presence of metastatic foci within the liver makes the tumor unresectable. In the absence of obvious liver metastases, tumor resectability depends on the presence of local invasion or vascular IIN the absence of obvious liver metastases, tumor resectability depends on the presence of local invasion or
In a recent prospective study comparing EUS, CT, MRI and angiography in preoperative staging and tumor resectability assessment of pancreatic cancer, Soriano et al. reported that CT is the mainstay for pancreatic cancer staging, with the best figures in the evaluation of extent of primary tumor, locoregional extension, vascular invasion, and metastatic spread (with accuracies 73%, 74%, 83% and 88%, respectively).

**VSGI31-05 • Post-Whipple Imaging Surveillance in Patients with Pancreatic Ductal Adenocarcinoma: Association with Overall Survival in Multivariate Analysis**

Azadeh Elmi MD (Presenter) ; Janet E Murphy MD, MPH ; Seyed Mahdi Abtahi MD ; Shaunagh McDermott FFRRC SI ; Elkan F Halpern PhD * ; Mukesh G Harisinghani MD

**PURPOSE**

While it is common clinical practice to routinely image patients with pancreatic ductal adenocarcinoma (PDAC) after Whipple procedure, there is no consensus that close imaging follow-up improves overall survival (OS). We evaluated the role of routine imaging in patients with PDAC following Whipple.

**METHOD AND MATERIALS**

We identified 1007 patients, who underwent Whipple for PDAC between 2005 and 2011, of whom 229 (105 F; median age 68 years) had regular postoperative clinical follow-up at our hospital. Patients were assigned to two follow-up groups based on clinical chart review; imaging-surveillance (IS) group defined as routine imaging at scheduled intervals, vs. clinical (C) group who had imaging only triggered by either change in clinical status or change in CA19-9. Follow-up was obtained through hospital and Cancer Data Registry records.

Survival was calculated from date of surgery to death or last follow-up, with data censored as of March 13, 2013. Kaplan-Meier survival curves were compared using the log-rank test, and Cox regression models were used for multivariate analysis.

**RESULTS**

Patients were followed for a mean period of 24.35 months and visited every 2.44 months on average. Patients in IS group underwent significantly more imaging (4.41 vs. 2.08 scans per year, p=0.0083) but not more frequent follow-up visits. The most frequent imaging was CT of chest and abdomen at 3-4 month intervals. In univariate analysis, age, gender, neoadjuvant or adjuvant treatment did not show significant association with OS. Univariate associations with OS were detected with post-Whipple ECOG status, T-stage, N-stage, chemotherapy for metastatic disease, disease recurrence, new metastasis, and IS. In multivariate analysis, ECOG status, recurrence, and new metastasis were independent predictor of survival. Also, our predictor of interest, IS, was highly associated with longer survival in multivariate modeling, with a median OS of 30.4 vs.17.1 months for IS and C groups (log-rank p=0.002). The survival probability was 41.1% and 27.3%, respectively.

**CONCLUSION**

Routine imaging surveillance was associated with prolonged OS post-Whipple in this retrospective analysis of patients with PDAC in a multivariate model.

**CLINICAL RELEVANCE/APPLICATION**

Routine imaging follow-up after Whipple is associated with prolonged survival, a hypothesis-generating finding that should be studied prospectively and could ultimately impact surveillance guidelines.

**VSGI31-06 • Diffusion-weighted Imaging of Advanced Pancreatic Adenocarcinoma: Can Apparent Diffusion Coefficient Values Predict the Response to Chemotherapy?**

Marcello A Orsi MD (Presenter) ; Claudio Losio MD ; Francesco A De Cobelli MD ; Francesco Giganti MD ; Michele Reni ; Alessandro Del Maschio MD

**PURPOSE**

Chemotherapy is the only option to improve survival and quality of life of patients affected by advanced Pancreatic Adenocarcinoma (PA). Response to treatment is difficult to assess, as tumor regression is not usually measurable earlier than 2-3 months and markers early kinetics are not reliable. We investigated the role of diffusion-weighted imaging (DWI) in predicting PA response to chemotherapy.

**METHOD AND MATERIALS**

We studied 22 patients with unresectable PA (stage III and IV) candidated to a six-months multidrug gemcitabine-based regimen. All patients underwent baseline magnetic resonance imaging (MRI) of upper abdomen including respiratory triggered echo-planar DWI (b value: 0,600 s/mm²); 12 patients of this group were also studied with the same MRI protocol after one month of treatment. On axial images, mean Apparent Diffusion Coefficient (ADC) of the lesions were measured independently by two radiologists. Response was assessed using CT, PET-CT (Recist Criteria) performed at 6-8 months after treatment; patients who achieved partial response and stable disease were considered as Responders (R), the ones who developed progressive disease as Non-Responders (NR).

**RESULTS**

In our population we obtained 15 Rs and 7 NRs. Baseline lesional ADC was significantly lower in R group than in NR group (1,35±0.23 vs.1,68±0.17 x10⁻²mm²/s; p=0.003). A significant association of ADC with size of largest cyst was found.

**CONCLUSION**

Our preliminary results indicate that a higher baseline ADC probably linked with the pre-treatment intratumoral amount of necrosis, is associated with worst response to treatment. Increase of ADC after one month, probably linked with chemotherapy direct effects like membrane disruption and cytolysis, positively correlates with subsequent tumor reduction.

**CLINICAL RELEVANCE/APPLICATION**

Quantitative DWI could probably early identify patients affected by PA not responding to chemotherapy and be a promising tool in developing new therapies and guiding therapeutic strategies.

**VSGI31-07 • Cystic Pancreatic Tumors**

Douglas S Katz MD (Presenter)

**LEARNING OBJECTIVES**

1) To overview the differential diagnosis of cystic lesions of the pancreas with an emphasis on CT and MR, but with some US correlation. 2) To review the current literature of cystic pancreatic lesions, with an emphasis on areas of controversy as well as management issues.

**VSGI31-08 • Incidental Pancreatic Cystic Lesions: Relationship with All-cause Mortality and Incidence of Pancreatic Neoplasm**

Victoria Chernyak MD (Presenter) * ; Milana Flusberg MD ; Linda B Haramati MD, MS * ; Alla M Rozenblit MD ; Eran Bellin

**PURPOSE**

To assess relationship of incidental pancreatic cysts found on CT/MR and all-cause mortality, incidence of all pancreatic cancers and incidence of pancreatic adenocarcinoma (AdenoCA) and pancreatic ductal carcinoma (DCA).

**METHOD AND MATERIALS**

Cyst cohort included cases with CT/MR reports done between 11/1/01-11/1/11 and describing incidental pancreatic cysts. No-cyst cohort was frequency-matched on age decade, modality and year of initial study from a pool of patients without reported pancreatic cysts. Cases with diagnosis of any pancreatic cancer within 5 years of initial CT/MR were excluded. 10-year cumulative mortality, 10 year cumulative incidences of any pancreatic cancer and incidences of AdenoCA/ DCA were compared between cohorts. Reports in Cyst cohort were reviewed for number of cysts, size and location of largest cyst, presence of calcification, septations, enhancing component, main pancreatic duct (MPD) dilatation, regional lymphadenopathy (LAN).
RESULTS
There were 1,343 cases in Cyst cohort and 4,015 cases in No-cyst cohort with mean age of 70.1 (±15.3) and 69.6 (±15.6) years, respectively (p=0.32). 10 year cumulative all-cause mortality was 19.1% (95% CI 13.1-24.7) in Cyst cohort and 19.1% (95% CI 15.1-22.9) in No-cyst cohort (p=0.42). 10 year cumulative incidences of all pancreatic cancers were 1.7% (95% CI 0.6-2.7) in Cyst cohort and 0.3% (95% CI 0.1-0.5) in No-cyst cohort (p=0.42).

CONCLUSION
Incidental pancreatic cysts on CT/MR are associated with 5.2 times higher risk of pancreatic AdenoCA/DCA but not with increased all-cause mortality.

CLINICAL RELEVANCE/APPLICATION
Incidental pancreatic cysts do not affect all-cause mortality, but are markers of increased risk of pancreatic adenocarcinoma and ductal carcinoma.

VSGI31-09 • Is Mural Nodule a Predictor for Malignancy in Patients with Intraductal Papillary Mucinous Neoplasms of the Pancreas?

Seo-Youn Choi MD (Presenter) ; Seong Hyun Kim ; Kyung Mi Jang

PURPOSE
To evaluate whether the location and the distribution of mural nodules were important for prediction of malignancy in patients with intraductal papillary mucinous neoplasms (IPMNs) of pancreas.

METHOD AND MATERIALS
This retrospective study was approved by the institutional review board and informed consent was waived. This study included 44 patients with surgically resected 44 IPMNs (23 malignancy and 21 benignity) which had mural nodules on pathology and CT or MRI. Qualitative (morphologic type of IPMNs, location and distribution of mural nodules, presence of solid lesion, pancreatitis, irregular thick septum, and additional cystic lesion) and quantitative (maximal diameter of main pancreatic duct, the size of the largest cystic lesion and solitary mural nodule) parameters were compared between malignant and benign IPMNs using univariate and multivariate logistic regression analyses.

RESULTS
Of 23 malignant IPMNs, 17 (73.9%) lesions had mural nodules in main duct or both main and branch duct on location, whereas 15 of 21 (71.4%) benign IPMNs had mural nodule in branch duct on location (p =0.008). Multiple or diffuse mural nodules were more frequently observed in malignant IPMNs (16/23, 69.6%) than benign IPMNs (6/21, 28.6%) (p < 0.01). The presence of pancreatitis and additional cystic lesion, maximal diameter of main pancreatic duct, size of the largest cystic lesion and solitary mural nodule parameters were compared between malignant and benign IPMNs using univariate and multivariate logistic regression analyses.

CONCLUSION
Mural nodules in main duct and multiple or diffuse distribution of mural nodules were independent predictors of malignancy in IPMNs with mural nodules.

CLINICAL RELEVANCE/APPLICATION
Mural nodules in main duct and multiple or diffuse distribution of mural nodules were independent predictors of malignancy in IPMNs with mural nodules.

VSGI31-10 • Acute Pancreatitis

Desiree E Morgan MD (Presenter) *

LEARNING OBJECTIVES
1) Discuss the imaging findings in patients with acute pancreatitis using the preferred nomenclature of the revised Atlanta Criteria. 2) Identify the various retroperitoneal collections associated with acute pancreatitis.

VSGI31-11 • Is CT Useful in Patients with Acute Pancreatitis Presenting to Emergency Department?

Atul B Shinagare MD (Presenter) ; Ivan Ip MD, MPH ; Ali Raja MD, MBA * ; Vikram A Sahni MBBS ; Peter A Banks ; Ramin Khorasani MD *

PURPOSE
To assess the use of CT in patients with acute pancreatitis (AP) presenting to the emergency department (ED).

METHOD AND MATERIALS
In this IRB-approved HIPAA-compliant retrospective study, we identified all patients with AP presenting from March 2012 through February 2013 to ED of an academic teaching hospital with approximately 60,000 annual visits. Patients were initially identified using ICD-9 code for AP (577.0) and diagnosis was then confirmed using clinical criteria from chart reviews. Based on existing literature, AP was confirmed when two of the following three were present: typical abdominal pain, elevated lipase/amylase >3 times normal and CT findings of pancreatitis. Abdominal CT scans obtained in ED or within 24 hours of admission were reviewed by a fellowship-trained abdominal radiologist.

RESULTS
Of 23 malignant IPMNs, 17 (73.9%) lesions had mural nodules in main duct or both main and branch duct on location, whereas 15 of 21 (71.4%) benign IPMNs had mural nodule in branch duct on location (p =0.008). Multiple or diffuse mural nodules were more frequently observed in malignant IPMNs (16/23, 69.6%) than benign IPMNs (6/21, 28.6%) (p < 0.01). The presence of pancreatitis and additional cystic lesion, maximal diameter of main pancreatic duct, size of the largest cystic lesion and solitary mural nodule parameters were compared between malignant and benign IPMNs using univariate and multivariate logistic regression analyses.

CONCLUSION
Mural nodules in main duct and multiple or diffuse distribution of mural nodules were independent predictors of malignancy in IPMNs with mural nodules.

CLINICAL RELEVANCE/APPLICATION
Mural nodules in main duct and multiple or diffuse distribution of mural nodules were independent predictors of malignancy in IPMNs with mural nodules.

VSGI31-12 • Perfusion CT- Can It Predict the Development of Pancreatic Necrosis in Early Stage of Severe Acute Pancreatitis

Ajay K Yadav MBBS (Presenter) ; Raju Sharma MD ; Devasenathipathy Kandasamy ; Shivanand R Gamanagatti MBBS, MD ; Ashu Seth Bhalla MBBS, MD ; Deep N Srivastava MD, MBA ; Pramod Garg MBBS, MD ; Ankur Goyal MBBS, MD ; Sreenivas V ; Arun K Gupta MBBS, MD

PURPOSE
Pancreatic necrosis is among the most important factors which determine the outcome of patients with severe acute pancreatitis (SAP). This prospective study was conducted to evaluate if perfusion CT can detect pancreatic ischemia at an early stage of SAP and predict the development of necrosis.

METHOD AND MATERIALS
Perfusion CT (PCT) was performed in 42 consecutive patients of acute pancreatitis admitted within 72 hours from the onset of abdominal pain. Twenty-two patients were classified as having SAP on the basis of APACHE II (score >8) or SIRS criteria. All patients underwent a
RESULTS
Out of 22 patients of SAP, 12 patients showed severe pancreatic perfusion defects (blood flow
CONCLUSION
Perfusion CT is a reliable tool for the detection of pancreatic ischemia at an early stage of SAP and can be used to predict the development of necrosis.

CLINICAL RELEVANCE/APPLICATION
Perfusion CT can predict pancreatic necrosis in SAP which opens up the scope for early intervention to prevent this ominous complication.

VSGI31-13  •  Autoimmune Pancreatitis
Joel G Fletcher  MD (Presenter) *

LEARNING OBJECTIVES
1) To review the diagnostic criteria for autoimmune pancreatitis. 2) To discuss the differences between Type 1 and Type 2 autoimmune pancreatitis. 3) To emphasize the need to maximize visualization of pancreatic and intrahepatic ducts and understand temporal changes in contrast enhancement in autoimmune pancreatitis. 4) To describe the diagnostic and other frequently seen imaging findings of autoimmune pancreatitis. 5) To describe imaging findings demonstrating response to treatment and recurrence of autoimmune pancreatitis after remission. 6) To describe useful imaging features in the differential diagnosis of pancreatitis versus neoplasms and other inflammatory conditions.

VSGI31-14  •  Differentiation of Focal-type Autoimmune Pancreatitis from Pancreatic Carcinoma: Assessment by Multiphase Contrast-enhanced CT
Naohiro Furuhashi (Presenter) ; Kojiro Suzuki ; Yusuke Sakurai ; Mitsuru Ikeda MD ; Yuichi Kawai ; Shinji Naganawa MD

PURPOSE
To assess the utility of multiphase contrast-enhanced computed tomography (CT) for differentiating focal-type autoimmune pancreatitis (AIP) from pancreatic carcinoma (PC).

METHOD AND MATERIALS
Subjects in this retrospective study comprised 21 patients (20 men, 1 woman; mean age, 66.7 years; range, 55-79 years) with 22 focal-type AIP lesions who fulfilled International Consensus Diagnostic Criteria and/or Revised Japanese Pancreas Society criteria and 60 patients (36 men, 24 women; mean age, 65.8 years; range, 38-82 years) with 61 PC lesions who were pathologically diagnosed from surgically resected specimens. Two radiologists blinded to the final diagnosis and other examination findings independently evaluated findings from multiphase contrast-enhanced CT in each patient. Along with pancreatic findings, extrapancreatic findings for the bile duct, kidneys and lymph nodes were also evaluated. Frequencies of each finding were compared between AIP and PC. Interobserver agreement was evaluated by kappa statistic.

RESULTS
Homogeneous enhancement during the delayed phase (AIP, 86% vs. PC, 41%; p=0.001, ?=0.64) were more frequently observed in PC. Presence of four of seven CT findings, that is, i) homogeneous enhancement during the delayed phase, ii) dot enhancement during the pancreatic phase, iii) duct penetrating sign, iv) main pancreatic duct wall enhancement, v) capsule-like rim, vi) absence of ring-like enhancement during the delayed phase and vii) absence of peripancreatic strand, offered 82% sensitivity and 95% specificity for identifying focal-type AIP.

CONCLUSION
The combination of CT findings can be helpful for differentiating focal-type AIP from PC.

CLINICAL RELEVANCE/APPLICATION
Focal-type AIP can mimic PC and responds to steroid therapy. Differentiation of these two entities might contribute to improvements in patient management.

VSGI31-15  •  Autoimmunpancreatitis: Therapy Monitoring Using IVIM-diffusion MRI
Miriam Klauss MD (Presenter) ; Klaus Maier-Hein ; Jens Werner MD, PhD * ; Hans-Ulrich Kauczor MD * ; Lars Grenacher MD ; Bram Stieltjes MD

PURPOSE
To evaluate diffusion imaging in autoimmune pancreatitis (AIP) before and after steroid treatment using IVIM-derived parameters.

METHOD AND MATERIALS
To date, 17 patients suspected of having an AIP underwent diffusion-MRI (1.5 T). Diffusion-weighted images were acquired using a single-shot echo-planar imaging sequence in breath-hold with the following imaging parameters: TR = 1300 ms, TE = 60 ms, FOV = 350 x 273 mm2, 14 slices, b-values = 0, 50, 100, 150, 200, 300, 400, 600 and 800 s/mm2. DW-data were post-processed using an in-house developed software. Eight patients had an AIP (n=2 resection, n=6 clinical consensus). Six patients had follow-up examinations during steroid treatment. IVIM-parameters (perfusion fraction f and perfusion free diffusion coefficient D) were extracted from manually drawn ROIs for patients with and without AIP for initial and follow-up examinations. ROIs were anatomically matched between initial and follow-up examinations in AIP patients using an unpaired and paired t-test respectively.

RESULTS
Homogeneous enhancement during the delayed phase (AIP, 86% vs. PC, 41%; p=0.001, ?=0.64) were more frequently observed in PC. Presence of four of seven CT findings, that is, i) homogeneous enhancement during the delayed phase, ii) dot enhancement during the pancreatic phase, iii) duct penetrating sign, iv) main pancreatic duct wall enhancement, v) capsule-like rim, vi) absence of ring-like enhancement during the delayed phase and vii) absence of peripancreatic strand, offered 82% sensitivity and 95% specificity for identifying focal-type AIP.

CONCLUSION
The combination of CT findings can be helpful for differentiating focal-type AIP from PC.

CLINICAL RELEVANCE/APPLICATION
Focal-type AIP can mimic PC and responds to steroid therapy. Differentiation of these two entities might contribute to improvements in patient management.

Genitourinary Series: Prostate Cancer 2013-Review of the Disease and the Role of MR in Staging and Surveillance

Tuesday, 08:30 AM - 12:00 PM  •  N228

VSGU31  •  AMA PRA Category 1 Credit ™:3.25  •  ARRT Category A+ Credit:3.5
Co-Moderator
Peter L Choyke , MD *
Co-Moderator
Anwar R Padhani , MD *

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VSGU31-01 • Introduction: Prostate Cancer: Why We Need Imaging

Peter L. Choyke MD (Presenter) *

ABSTRACT
There have been exciting recent developments in new PET/SPECT tracers for oncology. It is now possible to examine all of the major hallmarks of cancer using PET tracers including proliferation (18F-FLT), angiogenesis (18F-Fluciclitide), apoptosis (18F-CP18) and hypoxia (18F-VM4). These agents, among others, will be introduced in the context of targeted molecular therapy of cancer.

VSGU31-02 • Basics of Prostate MRI: Detection

Masoom A Haider MD (Presenter) *

LEARNING OBJECTIVES
1) Have a systematic approach to the interpretation of multiparametric MRI for prostate cancer localization prostate. 2) Appreciate the strengths and limitations of multiparametric MRI in cancer localization. 3) Understand the requirements for performing a state of the art prostate MRI protocol for cancer localization.

VSGU31-03 • Role of Repeat 3T Multiparametric MR Imaging and MR-guided Biopsy versus Repeat TRUS-guided Biopsies after 1 Year Follow-up in Low-risk Prostate Cancer Patients in an Active Surveillance Protocol

E. H. J. Hamoen MD (Presenter); Caroline M Hoeks MD; Rik Somford MD; Henk Vergunst; J. Oudens; Christina A Hulsbergen-Van De Kaa MD, PhD; Inge Van Oort MD, PhD; Fred Witjes MD, PhD; Chris Bangma; Jelle O Barentsz MD, PhD

PURPOSE
To evaluate reclassification rates after 1 year follow-up of repeat 3T multiparametric MR imaging (mp-MRI) and MR guided biopsy (MRGB) versus repeat TRUS-guided biopsy (TRUSGB) for men with prostate cancer within the Prostate Cancer Research International Active Surveillance (PRIAS) study.

METHOD AND MATERIALS
From September 2009 to February 2013, 93 prostate cancer patients from 4 referral centers were included in the MR-PRIAS protocol. Inclusion criteria: PSA > 10 ng/ml, PSA density < 0.2 ng/ml/ml, clinical stage = cT2, Gleason score = 6, and = 2 positive biopsy cores. Patients underwent mp-MRI and MRGB within 3 months after diagnosis, and mp-MRI, MRGB and TRUSGB after 1 year follow-up. Reclassification was defined as more than two positive cores at repeat TRUSGB, Gleason > 6 at repeat TRUSGB or MRGB, presence of prostate cancer in ≥3 separate cancer foci upon both MRGB and TRUSGB, or suspicion on T3 tumor on mp-MRI. Results of combined repeat mp-MRI and MRGB were compared with standard repeat TRUSGB at 1 year follow-up.

RESULTS
With mp-MRI + MRGB, 24/93 (26%) patients were initially reclassified. In the first year, 9/93 (10%) patients were excluded on patient request or because of other reasons. Repeat examinations at 1 year follow-up were thus far performed in 41 patients, of whom 17/41 (41%) showed reclassification and were advised to undergo radical treatment. The other 24/41 (59%) patients remained on active surveillance. Reclassification at 1 year was due to both TRUSGB and MRGB results in 6/17 patients (35%), due to TRUSGB results only in 7/17 patients (41%), and due to mp-MRI or MRGB results only in 4/17 patients (24%). Combined with standard repeat TRUSGB, performing repeat mp-MRI and MRGB after 1 year led to an additional reclassification of 10% (4/41) of the patients.

CONCLUSION
Repeat mp-MRI and MRGB after 1 year follow-up are of additional value in prostate cancer patients in an active surveillance protocol, as combining mp-MRI and MRGB with repeat TRUSGB leads to an additional reclassification of 10% of the patients.

CLINICAL RELEVANCE/APPLICATION
mp-MRI and MRGB are of added value in low-risk prostate cancer patients on active surveillance, especially shortly after the initial diagnosis. However, TRUSGB cannot be omitted at 1 year follow-up.

VSGU31-04 • Multi-parametric MR Imaging Characteristics of Missed Prostate Cancer: Correlation with Histopathology

Nelly Tan MD (Presenter); Daniel J Margolis MD *; David Y Lu MD; Kevin G King MD; Steven S Raman MD; Robert E Reiter MD; Jiaoti Huang

PURPOSE
To determine the characteristics of prostate cancer foci missed by multiparametric MRI.

METHOD AND MATERIALS
A HIPPA-compliant, IRB-approved retrospective study of 122 patients with multi-parametric prostate MRI were compared to whole mount prostate obtained after a radical prostatectomy was performed between October 2010 and January 2013 was performed. Clinical (age, PSA, biopsy), MR imaging (T2, DWI, DCE and MRSI), and pathologic features (Gleason Score, size of tumor, pathological stage, extracapsular extension) were obtained. A GU radiologist and pathologist collectively reviewed each case and matched the MR lesion to whole-mount pathology lesion. A standardized classification system (Pi-RADS) was used to characterize the multi-parametric MR features based on Linkert scale (1-5). Chi-square analysis was performed for categorical variable and t-test for continuous variable. A p-value of 0.05 was considered significant.

RESULTS
122 patients had 284 unique prostate tumor foci. 149 (52.5%) prostate cancer foci in 74 patients were missed by MRI. 111 (74%) were missed on mp-MRI + MRGB versus repeat TRUSGB. Results of combined repeat mp-MRI and MRGB were compared with standard repeat TRUSGB at 1 year follow-up.

CONCLUSION
Repeat mp-MRI and MRGB after 1 year follow-up are of additional value in prostate cancer patients in an active surveillance protocol, as combining mp-MRI and MRGB with repeat TRUSGB leads to an additional reclassification of 10% of the patients.

VSGU31-05 • Staging Prostate Cancer with MRI

Neil M Rofsky MD (Presenter)

VSGU31-06 • Identification of Apparent-diffusion-coefficient (ADC) Cut-off Values for the Detection of Lymph Node Metastasis During DWI-MRI in High-risk Prostate Cancer Patients: Implication for Daily Clinical Practice

Marc Regler (Presenter); Christian Seiwerts; Frank Oliver G Henes MD; Hendrik Kooijman *; Hendrik Isbarn; Markus Graefen; Guido Sauter; Gerhard B Adam MD; Lars Budaus
Recent investigations have outlined a remarkable potential of diffusion-weighted MRI (DWI) to detect lymph node metastases in various tumour entities. Therefore, the purpose of this study was to determine apparent-diffusion-coefficient (ADC) cut-off values for the differentiation of benign and malignant lymph nodes in patients suffering from prostate cancer in a high-risk constellation.

METHOD AND MATERIALS
In 59 consecutive patients classified as high-risk following the D’Amico criteria, pelvic MRI was performed one day prior to radical prostatectomy. A standardized T2-STIR and DWI sequence were applied to all patients (b-values: 0, 25, 75, 100, 200, 500 and 900). Monoexponential ADC calculation and mapping was performed for all lymph nodes within the small pelvis which had been identified reading the T2-STIR and DWI data. Overall, 1393 lymph nodes were removed during radical prostatectomy and level based drawings were used to record their location. Histopathologic analysis was performed for all dissected nodes using standard techniques. Finally, lymph nodes were dichotomized into benign and malignant and ADC cut-off values were determined using ROC, Wilcoxon and chi-square test.

RESULTS
Histopathologic analysis revealed nodal metastases in 35.6% (21/59) of all patients. The mean number of lymph nodes removed was 26 in node negative and 24 in node positive patients (p=0.35). In all patients, lymph nodes >4mm were successfully identified at MRI. In malignant lymph nodes the mean ADC was 0.76 x 10-3mm2/s, whereas in benign nodes the mean ADC was 1.43 x 10-3mm2/s (p=0.99) for the differentiation of benign and malignant lymph nodes.

CONCLUSION
In a high-risk collective, DWI with ADC mapping can be used to assess lymph node metastases prior to prostatectomy. Mean and minimum ADC cut-off values of 0.98 x 10-3mm2/s and 0.74 x 10-3mm2/s allow for the discrimination of benign and malignant lymph nodes with high accuracy.

CLINICAL RELEVANCE/APPLICATION
The application of DWI with ADC cut-off values determined can help to assess nodal metastases in prostate cancer prior to surgery and should therefore be implemented into preoperative routine imaging.

VSGU31-07 • The Role of PI-RADS Scoring System in Increasing Radiologist’s Performance in Detecting Prostate Cancer with a Multiparametric-MRI Examination
Flavio Barchetti ; Valeria Panebianco MD ; Valerio Forte ; Damiano Caruso MD ; Maria Giulia Bernieri ; Chiara Zini MD
(Presenter) ; Carlo Catalano MD

PURPOSE
To evaluate the gain of radiologist’s performance in assessing suspected areas of prostate cancer (PC) by assessing the increase of sensitivity and specificity employing PI-RADS scoring system in a Multiparametric-MRI (Mp-MRI).

METHOD AND MATERIALS
400 patients who underwent from June 2010 to January 2013 a Mp-MRI examination of the prostate gland for raising PSA serum levels and who were positive for PC at histology, were independently retrospectively evaluated by the same 2 readers who together previously observed the exams. Reader A (R.A) was an experienced radiologist in uro-genital field with 10 years of experience, and reader B (R.B) was a radiology resident with 3 years of experience. In the previous reading session the suspected lesions were assessed without using PI-RADS scoring system, while in the second reading session PI-RADS was employed.

RESULTS
58 patients out of 400 were originally assessed negative for the presence of morpho-functional changings both in peripheral zone (PZ) and central zone (CZ). In the second reading session R.A identified 25 PI-RADS 1, 21 PI-RADS 2 and 12 PI-RADS 3, while R.B 34 PI-RADS 1, 14 PI-RADS 2 and 10 PI-RADS 3 (K = 0.765, P = 0.134). 145 patients out of 400 were originally assessed doubtful for the presence of PC. R.A in 94 out of 145 patients subsequently considered the lesions PI-RADS 4, in 8 men PI-RADS 5 and in 43 PI-RADS 3, while R.B in 84 patients assumed the altered areas PI-RADS 4, in 5 men PI-RADS 5 and in 56 PI-RADS 3 (K = 0.754, P = 0.254). In the remaining 197 patients the lesions were esteemed simply as suspicious PC in the previous reading session. In the second reading session R.A deemed 156 altered zones as PI-RADS 5 and the other 41 as PI-RADS 4, on the other hand R.B accounted 141 lesions as PI-RADS 5 and 56 as PI-RADS 4 (K = 0.862, P = 0.383). All in all the sensitivity and specificity of R.A in evaluating the foci of morpho-functional changings increased respectively from 59% to 94% and from 52% to 94% (P = 0.025) and for R.B respectively from 47% to 86% and from 41% to 92% (P = 0.038).

CONCLUSION
The sensitivity and specificity of radiologist’s performance in assessing suspected areas of PC by employing PI-RADS scoring system in a Mp-MRI examination seems to increase substantially reaching statistically significative results (P < 0.05).

CLINICAL RELEVANCE/APPLICATION
We highlight the importance of PI-RADS in evaluation of prostate cancer.

VSGU31-08 • The Role of Imaging in Active Surveillance
Anwar R Padhani MD (Presenter) *

LEARNING OBJECTIVES
1) To provide an overview of the concepts underpinning active surveillance (AS) strategies for low risk prostate cancer patients. 2) To illustrate the ability of multiparametric (mp) MRI (diffusion weighted, dynamic contrast enhanced and spectroscopy) to assess tumor location, volume and grade. 3) To discuss the role of mpMRI for confirming clinical patient selection criteria for AS. 4) Highlight the benefits of mpMRI for detecting cases at higher risk and thus unsuited for AS. 5) Demonstrate changing imaging phenotype during AS period.

ABSTRACT
Active surveillance is a widely accepted treatment strategy for men diagnosed with low-risk prostate cancer. However, follow up studies show that up to one third of suitable patients eventually undergo radical therapy. Early conversion to radical therapy is likely to be due to imperfect initial selection methods resulting in inclusion of higher-risk cases. Large anterior-apical lesions of higher grades constitute these cases. This MRI overview will provide radiologists with the necessary knowledge on how to best inform clinicians of the suitability of cases for AS and to identify those at higher risk requiring earlier intervention. Multiparametric MRI assessments enable the location, grading and volumetry of index prostatic lesions to be undertaken. Reviews of mpMRI of index lesions suspicious of high grade and high-risk, unsuitable for AS and requiring earlier intervention will be shown. Challenges facing mpMRI in this area of clinical application will be discussed.

VSGU31-09 • Prospective Comparative Study of Targeted Prostate Biopsy Directed to MRI-suspicious Regions vs. Artemis™ Computerized 12 Core Template Biopsy
James Wysock (Presenter) ; Andrew B Rosenkrantz MD ; Fang-Ming Deng MD, PhD ; Samir S Taneja MD *

PURPOSE
Artemis™ computerized 12 core template biopsy (ARTEMIS 12 core) standardizes prostate sampling through template construction from 3D ultrasound (US) model of 2D transrectal ultrasound. MRI-targeted biopsy aims to optimize diagnostic yield via targeted sampling of MRI-suspicious regions (mSR). This study describes results of an IRB-approved prospective study of men undergoing MRI-targeted biopsy of mSR followed by ARTEMIS 12 core in order to prospectively compare mSR targeted biopsy to 12 core biopsy.
METHOD AND MATERIALS
125 men enrolled in a prospective clinical trial underwent biopsy that included 4 cores to each mSR (2 cores via MRI-US fusion guidance and 2 cores via visual guidance) followed by ARTEMIS 12 Core. All mSR were localized by a single radiologist and reviewed by two urologists prior to biopsy. Biopsy yield was compared between the two techniques.

RESULTS
Mean age of the study cohort was 64.0 ± 8.15 yrs with a mean PSA 5.91 ± 4.37 ng/mL. The cohort was composed of 67 (53.6%) men undergoing initial biopsy and 34 (27.2%) undergoing repeat biopsy without a prior diagnosis of cancer and 24 (19.2%) men on active surveillance. Overall, cancer was detected in 71 (56.8%) men on targeted biopsy and 61 (48.8%) by ARTEMIS 12 core biopsy (p 0.254). MRI-targeted biopsy detected Gleason 7 or higher in 34 (27.2%) men, equal to the detection rate with ARTEMIS 12 core 34 (27.2%), (p 0.789). MRI-targeted biopsy detected Gleason 6 cancer in 37 (29.6%) as compared to 47 (37.6%) detected on ARTEMIS 12 core (p 0.185). Mean cancer core length per positive core and percent positive cores were significantly greater in MRI-targeted than ARTEMIS 12 core among all cancers detected, (p 0.014, p 0.0001, respectively).

CONCLUSION
MRI-targeted biopsy with 4 cores per mSR provided equivalent detection of Gleason 7 or greater cancer as ARTEMIS 12 core biopsy while significantly reducing the number of cores to obtain this information and providing significantly greater cancer core length per core.

CLINICAL RELEVANCE/APPLICATION
Targeted biopsy of mSR improves diagnostic efficiency over 12 core biopsy. Future work may prove targeted biopsy alone sufficient for prostate cancer evaluation.

VSGU31-10 ● Initial Prospective Evaluation of the Prostate Imaging Reporting and Data Standard (PI-RADS)
Geert Litjens MSc (Presenter) ; Nico Karssemeijer PhD * ; Jelle O Barentsz MD, PhD ; Henkjan Huisman PhD *

PURPOSE
To evaluate the performance of the prostate imaging reporting and data standard (PI-RADS) proposed by the European Society of Urogenital Radiology and the effect of reader experience on this performance.

METHOD AND MATERIALS
A consecutive cohort of 254 patients who underwent a detection MRI in 2012 and a subsequent MR guided biopsy were included. All patients were prospectively reported by 1 out of the 10 reporting radiologists according to the PI-RADS guidelines. Two radiologists are experts (20 and 15 years of experience) and 8 are inexperienced (3 years of experience or less). The inexperienced and experienced readers reported 146 and 108 cases respectively. The radiologists reported 436 lesions in these patients of which 339 were biopsied. 190 of these 339 were prostate cancer. 127 tumors had a Gleason 4 or higher component and were considered high-grade cancer, all others were considered low grade. Each lesion received an overall PI-RADS score between 1 and 5. The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated by thresholding at each of the PI-RADS scores with the biopsy results as ground truth. High-grade cancers with a PI-RADS score above or equal to the threshold are true positives. Non-cancers below the threshold were considered true negatives.

RESULTS
In total 19, 67, 112 and 141 lesions were biopsied for PI-RADS 2, 3, 4 and 5. The inexperienced reader sensitivities for PI-RADS 2, 3, 4 and 5 are: 1, 1, 0.96 and 0.69 respectively. The experienced readers obtained 1, 1, 0.98 and 0.71. The specificities were 0, 0.16, 0.48 and 0.76 for the inexperienced and 0, 0.07, 0.36 and 0.89 for the experienced readers. The PPV and NPV were 0.46, 0.50, 0.61, 0.71 and 1, 1, 0.93, 0.74 for the inexperienced readers. For the experienced readers we obtained 0.46, 0.48, 0.57, 0.84 and 1, 1, 0.96, 0.78 respectively.

CONCLUSION
Only PI-RADS 4 and 5 lesions require biopsy; inexperienced and experienced readers have sensitivities of 0.96 and 0.98 at this threshold. Experience matters: the number of unnecessary biopsies in PI-RADS 5 lesions is reduced by almost half, according to the PPV change from 0.71 to 0.84 between inexperienced and experienced readers.

CLINICAL RELEVANCE/APPLICATION
PI-RADS reported lesions may help reduce the number of unnecessary biopsies. The strong effect of experience emphasizes the need for adequately trained radiologists for reporting prostate MR.

VSGU31-11 ● Negative Predictive Value of Multimparametric MRI for Prostate Cancer Detection: Outcomes of 5-year Follow Up For Men with Negative Findings on Initial MRI
Ryo Itatani (Presenter) ; Tomohiro Namimoto MD ; Shutaro Atsujii ; Kazuhiro Katahira ; Shojo Morishita MD ; Kousuke Kitani ; Yasuyuki Hamada ; Mitsuhiko Kitaoka ; Takeshi Nakaura MD ; Yasuyuki Yamashita MD *

PURPOSE
Prostate cancer is currently screened by PSA and digital rectal examinations (DRE), and diagnosed by random biopsy resulting in the discovery of multiple insignificant cancers that often lead to overtreatment. MRI may be used to triage patients who require invasive treatment if its negative predictive value (NPV) is sufficiently high. The purpose of our study was to assess NPV of multiparametric MRI and evaluate its clinical utility as an optimal tool to rule out significant prostate cancer to investigate outcomes of 5-year follow up for men with negative findings on initial MRI.

METHOD AND MATERIALS
Between November 2004 and August 2007, there were 622 men who were suspected of harboring prostate cancer and underwent MRI followed by transrectal ultrasound (TRUS)-guided biopsy in our institution. Among them, 255 men with negative findings on MRI were included in our study and their 5-year outcomes were retrospectively assessed. A positive finding by TRUS-guided biopsy was considered as false negative. Patients with neither increase in PSA value nor positive finding on DRE, MRI and TRUS-guided biopsy for 5-year follow up were considered to be true negative. NPV of multiparametric MRI was calculated. For patients undergone radical prostatectomy who had positive finding in biopsy, mean signal intensity (SI) on T2 weighted imaging and mean apparent diffusion coefficient (ADC) value on ADC map of initial MRI were compared between peripheral-zone cancer and normal peripheral zone based on pathologic maps.

RESULTS
For 5-year follow up, 49/255 patients had positive findings of TRUS-guided biopsy. Among them, 27/49 cases proved to be clinical insignificant cancer. The other 206/255 patients had no clinical evidence of prostate cancer. NPV was 80.8% for total prostate cancer detection. It was 91.4% for significant prostate cancer detection. With respect to SI and ADC value, there was no significant difference between peripheral-zone cancer and normal peripheral zone.

CONCLUSION
Our study showed that negative findings on multiparametric MRI were associated with either negative TRUS-guided biopsy or insignificant prostate cancer. The risk of harboring significant prostate cancer is considered to be relative low in such patients.

CLINICAL RELEVANCE/APPLICATION
Multiparametric MRI shows great NPV for prostate cancer detection and is a useful tool to rule out clinical significant prostate cancer before biopsy.

VSGU31-12 ● A Global Standard for Prostate MRI Reporting
LEARNING OBJECTIVES
1) After this course the participants will have guidelines for magnetic resonance imaging (MRI) in prostate cancer. 2) They will know clinical indications, and minimal and optimal imaging acquisition protocols. 3) The participants will have an introduction in a structured reporting system (PI-RADS).

ABSTRACT
The aim is to show clinical guidelines, developed for multi-parametric MRI of the prostate by a group of prostate MRI experts from the European Society of Urogenital Radiology (ESUR), based on literature evidence and consensus expert opinion. True evidence-based guidelines cannot be formulated, but a compromise, reflected by "minimal" and "optimal" requirements will be made. The scope of these ESUR guidelines is to promulgate high quality MRI in acquisition and evaluation with the correct indications for prostate cancer across the full range of Europe and eventually outside Europe. The guidelines for the optimal technique and three protocols for "detection", "staging" and "node and bone" will be presented. The use of endorectal coil vs. pelvic phased array coil and 1.5 vs. 3 T discussed. Clinical indications and a PI-RADS classification for structured reporting are shown. This presentation provides guidelines for magnetic resonance imaging (MRI) in prostate cancer. Clinical indications, and minimal and optimal imaging acquisition protocols shown. A structured reporting system (PI-RADS) will be introduced and described.

VISU31-13 • Discussion and Concluding Comments

Radiology Informatics Series: Natural Language Processing: Extracting Information from Text Radiology Reports to Improve Quality

Tuesday, 08:30 AM - 12:00 PM • SS02AB

LEARNING OBJECTIVES
1) Learn how natural language processing (NLP) can be used to extract information from radiology reports. 2) Understand the basic NLP methods and their strengths and weaknesses. 3) Examine examples of how NLP can be used to automate quality improvement processes in radiology practices. 4) Assess the synergy between NLP and standardized reporting practices.

ABSTRACT
Natural Language Processing (NLP) refers to the automated extraction of meaningful information from narrative text. Some NLP systems use simple rules to categorize text according to whether a particular concept may be present. More sophisticated systems use part-of-speech tagging and grammatical parsing to extract concepts and relationships from text. Some NLP systems use statistical approaches that can learn to categorize text automatically based on a test set of positive and negative examples. When applied to radiology reports, NLP systems are most frequently used to identify and retrieve reports of interest, such as reports containing a critical result, an incidental finding, or a recommendation for follow up. NLP systems are simpler to construct and more accurate when the structure of the analyzed text is constrained in some manner. Several real-world examples of both simple and sophisticated NLP systems in radiology will illustrate the spectrum of applicable techniques and the potential benefit to radiology practice.

VISU31-01 • Natural Language Processing: Motivations and Overview

Curtis P Langlotz MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Learn how natural language processing (NLP) can be used to extract information from radiology reports. 2) Understand the basic NLP methods and their strengths and weaknesses. 3) Examine examples of how NLP can be used to automate quality improvement processes in radiology practices. 4) Assess the synergy between NLP and standardized reporting practices.

ABSTRACT
Natural Language Processing (NLP) refers to the automated extraction of meaningful information from narrative text. Some NLP systems use simple rules to categorize text according to whether a particular concept may be present. More sophisticated systems use part-of-speech tagging and grammatical parsing to extract concepts and relationships from text. Some NLP systems use statistical approaches that can learn to categorize text automatically based on a test set of positive and negative examples. When applied to radiology reports, NLP systems are most frequently used to identify and retrieve reports of interest, such as reports containing a critical result, an incidental finding, or a recommendation for follow up. NLP systems are simpler to construct and more accurate when the structure of the analyzed text is constrained in some manner. Several real-world examples of both simple and sophisticated NLP systems in radiology will illustrate the spectrum of applicable techniques and the potential benefit to radiology practice.

VISU31-02 • Enhancing Provided Patient Clinical Information by Automated Review of Prior Radiology Reports Using the Clinical Context Indicator (CCI): A NLP Based Data Extraction and Presentation PACS-integrated Tool

Adam R Travis MD (Presenter); Paul J Chang MD *; Yuechen Qian; Merlijn Sevenster PhD *; Gabriel Mankovich BSC; Johannes Buurman PhD *

PURPOSE
Physicians do not always provide adequate histories when ordering imaging studies; this may be due to Computerized Physician Order Entry (CPOE) systems that allow limited modified indications ("drop down menus") as input parameters. Lack of history may result in suboptimal or even incorrect interpretation by radiologists. We test the hypothesis that a PACS-integrated view of patient history automatically synthesized from prior radiology reports improves the quality of clinical history sections in radiology reports.

METHOD AND MATERIALS
CCI functions as a PACS plugin that extracts pertinent information from prior radiology reports and displays it along three “axes” for each exam: history, acute indication, and follow-up recommendations. CCI uses natural language processing (NLP) to populate the history and follow-up axes by extracting and filtering unique sentences from relevant sections in prior reports. The acute indication axis is populated with the Reason For Exam (RFE) from the CPOE system. Prospective evaluation was conducted by a team of senior residents in normal workflow. First, the reader reviewed the CCI summary and dictated the history based only on this information. Then, the reader reviewed all pertinent patient data (e.g., pathology, labs) from the EHR and modified the dictated history, if necessary. Later, for each dictated study an attending radiologist compared the quality of the initial CCI-only history to the final dictated history and to the RFE, which were each used as baselines.

RESULTS
Preliminary data on 32 neuro CT cases shows that 34.4% of CCI-only histories were rated significantly more complete than RFE histories. However, CCI-only histories were significantly augmented with pathology (18.8%) and/or other data (9.4%) derived from the EHR.

CONCLUSION
Patient clinical context derived from CPOE exam indications alone were enhanced by the automated extraction and PACS-integrated presentation of information derived from prior radiology reports. However, additional important patient information was derived from the EHR. Therefore, automated PACS-integrated tools designed to present patient context should extract data from both prior radiology reports and the EHR.
**VSIN31-03 • Facilitate Mammography Quality Standards Act (MQSA) with Automatically Correlating Radiology Reports of Breast Cancer Patients Containing Biopsy Recommendations with Subsequent Pathology Reports**

**Ye Xu** PhD (Presenter) ; **Thusitha Mabotuwana** ; **Yuechen Qian** ; **Merlin Sevenster** PhD *

**PURPOSE**
MQSA mandates for quality control of breast radiology reports suggesting a biopsy follow-up (BIRADS scores 3, 4 and 5) are correlated with pathology outcome. This is typically done manually, which is time consuming and error prone. Our purpose is to develop and evaluate a natural language processing system (NLP) that 1) automatically recognizes if a breast radiology report contains a biopsy recommendation and, if so, 2) finds the pathology reports that discusses biopsy outcome from a stack of pathology reports.

**METHOD AND MATERIALS**
Our NLP system includes two components: 1) recommendation detector; 2) pathology report finder. Annotation guidelines were created in an iterative fashion for creating recommendation detection ground truth by four researchers, including one radiologist. Ground truth was created based on 5,200 radiology reports, from a deidentified corpus of breast radiology report obtained from a hospital in the Midwest. From a test set of 300 reports, we selected all reports that contain a recommendation of any type (not necessarily biopsy recommendations), yielding a final test set of 110 reports.

The pathology report finder utilizes laterality, interval and reason for exam information to determine if a pathology report is the follow-up of a give radiology report. We conducted a preliminary evaluation on the full radiology-pathology histories of 21 breast cancer patients with at least one radiology report with a biopsy recommendation.

**RESULTS**
Evaluated on the 110 reports, the recommendation detector achieves precision, recall and F-measure scores of 0.97, 0.99, and 0.98 respectively. Among 18 of 21 patients (86%), the pathology report finder successfully finds matches between pathology reports and radiology reports containing biopsy recommendation. Among those 18 patients (20 reports), there are 4 breast image studies with BIRADS 4, but their pathology diagnosis identified as benign.

**CONCLUSION**
This study demonstrates the potential of using NLP technologies to facilitate the quality assurance of MQSA. Our algorithms reliably identify studies that contain biopsy recommendation and can support automatic correlation with biopsy reports. Adequately integrated in a workflow support tool, healthcare providers can use it to get instant feedback on false positive rates of imaging diagnosis based on biopsies.

**CLINICAL RELEVANCE/APPLICATION**
Facilitate the quality assurance of MQSA

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**VSIN31-04 • Using an Enterprise Cloud-based NLP Platform to Convert Unstructured Reports into Structured Clinical Data for Analytics**

**James Maisel** (Presenter) *

**CONCLUSION**
Natural language processing was demonstrated to extract structured codes from unstructured data sources such as transcription. The structured codes could be queried with a basic analytic tool to provide subsets of patients based upon structured data with typical stratifications required for clinical studies and practice management issues.

**Background**
Analytics is a tool to extract and use meaning from data and facilitates screening, outcomes analysis, evidence-based decision support, audit protection, research, cross-system communication, and reporting. In our study, an enterprise cloud-based platform was designed to accept unstructured clinical documentation from diverse sources. With Natural Language Processing (NLP), data can be structured and coded for analytics. The study evaluated the potential of the platform to structure data and make it available for secondary use with analytic reporting. Study results and implications will be discussed.

**Evaluation**
Assorted types of data including over 500,000 records from dictation, scanned records and semi-structured EHR text were evaluated as potential sources for analytics. Dictation was converted to text with back-end speech recognition and edited. Transcribed, scanned OCR documents and semi-structured EHR messages were preprocessed and passed through natural language processing (NLP). The output was post-processed and coded into standardized terminologies including SNOMED CT, ICD-9, ICD-10, RxNorm, LOINC and CPT-4 codes derived from postprocessing and stored within a MS SQL database to serve as a clinical data repository. A front end application was designed to allow physicians to query the database for analytic output based on these codes and terms.

**Discussion**
The NLP platform successfully processed all forms of unstructured text and semi-structured data and output structured codes. The analytic form worked well at extracting subsets of records based on their codes. The analytics reporting application successfully extracted records that contained one or more structured terminologies or exact text searches. Combinations of terms and exclusions and nested searches could be performed in live-time. Record names could be de-identified.

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**VSIN31-05 • An NLP-based, Data-driven Paradigm for Clinical Documentation Improvement and Analytics**

**James Maisel** (Presenter) *

**CONCLUSION**
Not only does natural language processing increase the effectiveness and efficiency of clinical documentation (by reducing physician time required and increasing documentation quality), but it makes possible a variety of secondary data uses.

**Background**
A clinical documentation workflow utilizing dictation and natural language processing can make the documentation process faster and produce structured data required for software-based clinical documentation improvement, analytics, and reporting. The workflow involves a physician dictating a note, the dictation’s conversion to text by speech recognition, natural language processing generating structured data from the text, entry of the structured data and text into the EHR, processing of the structured data by clinical documentation improvement application, manual documentation improvement using the documentation improvement application’s output, and making available the note’s structured data in a data repository for analytics and reporting.

**Evaluation**
Integrating Natural Language Processing (“NLP”) into the clinical workflow can enable increased documentation efficiency, clinical documentation improvement, and various analytics that take advantage of the structured data generated by NLP.

**Discussion**
Because free (unstructured) dictation is a faster method of documentation than standard EHR data entry, free text will continue to be an important part of electronic health records. Natural Language Processing (NLP) can be used to structure free text contained in the physician’s documentation. The following is an example of a clinical documentation improvement application that would use structured, codes generated by NLP. An “ICD-10 specificity” application could prompt the physician to enter more details about a medical
problem in order to generate a more specific ICD-10 code, which might be beneficial for billing. The structured data stored in the data repository can be used for a variety of analytical and reporting purposes, including for outcomes analysis, value-based medicine, surveillance of high-risk populations, PQRS measure reporting, research, case management, quality informatics, and public health analytics.

**VSIN31-06 • Natural Language Processing to Solve Problems in Clinical Practice**

**Michael E Zalis MD (Presenter) * **

**LEARNING OBJECTIVES**

1) Describe salient features of electronic health record data and Radiology workflow that create obstacles for efficient, high quality care delivery. 2) Describe and demonstrate essential aspects of natural language processing and related aspects of computer science and show how these tools can begin to improve Radiology work-flow and care delivery. 3) Describe future directions for natural language processing tools in Imaging.

**ABSTRACT**

Electronic health record data, whether in discretized (structured field) or unstructured forms presents a potentially overwhelming amount of information for a Radiologist to consume at the time of clinical encounter. This applies for both in- and out-patient settings, and spans a broad range of sub-specialty and acuity scenarios. Consuming and understanding this data in an efficient way is essential for efficient, high quality care delivery, especially since Most Radiologists have little prior familiarity with their patients. Several natural language processing techniques are available to filter the EHR data to permit a Radiologist or affiliated support staff the ability to ascertain essential information for their care. In addition, related techniques of knowledge management and machine learning can combine to form powerful tools that can assist the Radiologist in rapidly gleaning essential contextual and safety information contained in the EHR. We will show several examples of these techniques at work in clinical settings. Coupled to industry market trends as well as mandates related to Meaningful Use 2, these tools are becoming increasingly powerful and pervasive. Improved automation and accuracy of filtration will make these tools all the more useful, widespread and value-adding to the practice of Radiology.

**VSIN31-07 • Follow-up Imaging of Pulmonary Nodules**

**Cara L Morin MD (Presenter) ; Scott Shimp BS ; William W Olmsted MD ; Amy Kunce ARRT ; Eliot L Siegel MD * **

**PURPOSE**

Initial imaging studies often include findings that cannot be completely evaluated, and radiologists often make recommendations for additional imaging. For pulmonary nodules, well-known guidelines address such recommendations. In routine practice, however, the rates of radiologists’ recommendations for follow-up and of referring physicians’ compliance are not well documented. Data are limited on whether clinicians follow the advice of radiologists.

**METHOD AND MATERIALS**

A retrospective analysis on a sample of 10,000 radiology records from 2006 to 2010 from our institution that included pulmonary nodule findings was performed using statistical and pattern matching methods. Analysis was performed for follow-up recommendations and adherence. If the term ‘follow up’ was detected in a record, all records were analyzed to determine if there was a subsequent record with a later date and the same patient ID. If such a record was found, it was assumed that a follow up did occur. Analysis was also performed on a subsample of patients with at least 2 reports (5,954 records). Results for the full sample and subsample provided a range of values to be refined in subsequent analysis.

**RESULTS**

Within the sample of patients obtaining an initial XR (radiograph), CT, or PET study (9,863), ~48% of reports contained a recommendation for follow-up. The recommendation rate varied between 41% and 57% across all sample years. Of reports recommending follow-up, 53%–71% resulted in a subsequent study within 2 yr. CT and XR accounted for ~73% and ~23% of all studies, respectively. CT and PT accounted for ~73% and ~23% of all studies, respectively, whereas CT and XR accounted for ~73% and ~23% of all studies, respectively, of follow-up recommendations in ~55% of cases, whereas only ~28% of XR studies resulted in follow-up recommendations. With respect to timing, 38% of follow-up reports occurred within 3 mo, 22% within 3–6 mo, and 22% within 6–12 mo.

**CONCLUSION**

Our data on a large sample set of imaging records indicate that follow-up imaging for pulmonary nodule is recommended for ~48% of XR, CT, or PET studies. In those cases where follow-up imaging is recommended, approximately 53%–71% are actually obtained.

**CLINICAL RELEVANCE/APPLICATION**

Recommendations for additional imaging are common in radiology reports. Our initial analysis demonstrates suboptimal adherence and these cases should be tracked.

**VSIN31-08 • Measuring Expressions of Uncertainty in Radiology Texts for Natural Language Processing Applications**

**Brian E Chapman PhD (Presenter) ; Amilcare Gentili MD ; James Y Chen MD * ; Asako Miyakoshi MD ; Wendy Chapman PhD **

**CONCLUSION**

Our results showed that radiologist had high overall consistency in where they centered probabilities but that their probability mappings had high variability. We observed inconsistency in our NLP cue categorization, particularly the overlap between the definitely and probably negated categories. Further, the results indicate our model of uncertainty could be improved by adding a fifth category of “ambivalent” to capture the highly uncertain existence cues with probabilities near 0.5.

**Background**

Natural language processing (NLP) is an important tool for extracting structured information from radiology texts. pyConTextNLP uses linguistic cues to determine whether a finding is negated, asserted, or uncertain. We compared probabilities assigned by radiologists against categories defined in pyConTextNLP.

**Evaluation**

A set of linguistic cues describing negated and asserted existence with and without uncertainty was created by combining (a) 133 pyConTextNLP cues categorized as “definitely negated,” “probably negated,” “probably existent,” and “definitely existent” and (b) 108 cues translated from Swedish clinical texts. Three radiologists separately reviewed the cues in random order and assigned single-point probabilities to each cue followed by probability ranges (blinded to single-point responses).

**Discussion**

Pairwise comparisons of single-point probabilities showed very small differences in the mean values (mean difference of 0.012) but large variability (mean standard deviation of 0.21). Similarly range mappings showed small but somewhat differences in the mean locations (-0.0035) and widths (0.0008) of the assigned probability ranges but large variability in these measures (mean standard deviation of 0.21 and 0.30). Examining mean range width versus the mean point mapping showed that cues with point mappings near the extremes (0.0 and 1.0) had much smaller range widths than cues with point mappings near 0.5. Radiologist discordance showed a similar pattern. For the categorized cues, the mean (standard deviation) of the assigned point probabilities were as follows: definitely negated 0.078 (0.11), probably negated 0.17 (0.16), probably existent 0.71 (0.11), definitely existent 0.91 (0.083).

**VSIN31-09 • Unlocking Information from Text: Pulmonary Embolism, Pneumonia, and Report Clarity**

**Wendy Chapman PhD (Presenter)**

**LEARNING OBJECTIVES**

1) Be able to define natural language processing (NLP) and describe some of the tasks accomplished through this technique. 2) Understand how NLP could be used to help identify patient cohorts for imaging/radiology studies. 3) Know how well NLP performs at
To develop and test a Natural Language Processing (NLP) algorithm that analyzes clinical reports of CT Pulmonary Angiography (CTPA) for the diagnoses of pulmonary embolism (PE), the chronicity of PE when present, and the location of the most proximal filling defect considered positive for PE.

METHOD AND MATERIALS
The final CTPA reports for 10,330 CTPA examinations performed at our academic institution from 8/1/03 and 3/31/10 were manually, independently reviewed by at least two physicians for the diagnosis of PE. For patients with PE, chronicity subtype information (acute, subacute, chronic, acute on chronic, and other) and the most proximal embolus location (central, lobar, segmental, or subsegmental pulmonary artery) were also recorded. A NLP program was developed to analyze the content of the reports and to convert the semantics to numeric features as the counts on the occurrences of relevant concepts related to PE status and subtypes. Statistical models were built to classify the diagnoses of PE, the chronicity, and the most proximal locations by aggregating information from all informative features.

RESULTS
The prevalence of PE was 19.3% (1996/10330), determined from manual review of the reports and considered “true.” The classification algorithm based on the NLP extracted features was highly accurate in the detection of PE with a cross-validated AUC of 0.995. Among patients with PE, the “true” fraction of acute, subacute, chronic, acute on chronic, and other PE were 82.7%, 2.1%, 8.3%, 3.9%, and 3.0%, respectively. Proximal extension of the embolus was classified as central in 24.3%, lobar in 23.2%, segmental in 39.4%, and subsegmental in 13.1% of patients. The current classification models for acute versus non-acute and central versus non-central PE based on the NLP extraction achieved an AUC of 0.897 and 0.956 respectively.

CONCLUSION
Natural language processing is a promising automated tool to identify patients with a positive CTPA report, and provides data regarding chronicity and the proximal embolus location.

CLINICAL RELEVANCE/APPLICATION
Given the relatively standard terminology, range of findings, and low positivity rate, NLP for automated extraction of PE-related information has the potential to creation of large research cohorts.

VJ Jagannathan PhD; Claudine Martin BS; Juergen Fritsch PhD (Presenter) *

CONCLUSION
The proposed BI-RADS information identification approach allows for more efficient mammography reporting workflows (see diagram). Furthermore, it can be used to notify the radiologist in real-time about any missing, relevant information needed for reporting purposes. The recommendation captured in structured form can drive reminders and follow-ups and the assessment captured can be used for patient communication.

Background
Breast Imaging Reporting and Database System (BI-RADS®) is a quality assurance guide developed by the American College of Radiology (ACR) to standardize breast imaging reporting. In this work, we review an approach to capture the standard BI-RADS data elements directly from narrative mammography reports. The data elements include:

1) Breast Density
2) BI-RADS Assessment
3) Recommendation for Follow-Up
4) Laterality

The proposed workflow supports processing of unstructured (typed or dictated) Radiology reports via a Natural Language Understanding (NLU) engine to automatically identify and then validate the correctness of the above data elements. Radiology reports are converted into standard HL7 Clinical Document Architecture (CDA) format, which also allows for encoding the discovered BI-RADS data elements in structured form. 1 http://www.acr.org/~/media/ACR/Documents/PDF/QualitySafety/Resources/BIRADS/BIRADSFAQs.pdf

Evaluation
Users review and validate the correctness and completeness of the data and thereby provide implicit feedback that is being used to continuously improve system performance, which is being measured via precision and recall on a manually annotated gold standard data set.

Discussion
We present an approach that allows identifying and validating structured BI-RADS data from unstructured, narrative reports. Diagnostic mammograms, MRIs and Ultrasound reports will contain explicit BI-RADS assessments but not typically explicit breast density values as found in screening mammograms. Also, laterality identification in the presence of multiple tumors is non-trivial. Yet, Radiologists prefer narrative reporting systems over structured reporting tools for efficiency and expressiveness reasons.

VJ Jagannathan PhD; Claudine Martin BS; Juergen Fritsch PhD (Presenter) *

CONCLUSION
Radiology report errors inevitably occur and may impact patient management. Our project not only documents error rates, but shows that automated intervention can positively impact patient management by both prospectively decreasing error rates and correcting substantial numbers of errors that do occur.

Background
Radiology report errors occur due to inaccurate speech recognition, report macros, and other human error. We created a system that detects report errors in real-time and sends immediate notifications to the reporting radiologists by page and email. Our goal is to improve report quality by two main mechanisms: correct errors that do occur quickly and provide continuous feedback in hopes of decreasing future error rates.

Evaluation
We receive a real-time Health Level 7 (HL7) feed from our Radiology Information System (RIS) (Siemens). Our Mirth Connect HL7 engine (Mirth Corporation) filters report messages and checks for errors using custom JavaScript algorithms. If a potential error is detected, a call is made to custom Bash (GNU) scripts that page and email the associated radiologists. All related information is tracked in a MySQL (Mirth Corporation) filters report messages and checks for errors using custom JavaScript algorithms. If a potential error is detected, a call is made to custom Bash (GNU) scripts that page and email the associated radiologists. All related information is tracked in a MySQL (Mirth Corporation) database.

We focused on two error types. Laterality errors were flagged on discrepancy between laterality in the procedure name and the report conclusion. Gender errors were flagged on discrepancy between patient sex and descriptors in the report. Error rates were determined for 4 months before (Pre) and 7 months after (Post) the notification system was implemented. Flagged reports were curated to determine true positive detections. These were then followed to see if they were ultimately corrected.

Discussion
We found significant improvement in potential errors detected (Pre: 198/149,537; 0.13%, Post: 290/277,531; 0.10%, p-value 0.01) and true positive rates (Pre: 116/149,537; 0.08%, Post: 147/277,531; 0.05%, p-value 0.002) after the detection and notification system was implemented. Most importantly, the number of true positive reports ultimately corrected improved dramatically after our notification system started (Pre: 17/116; 15%, Post: 133/147; 90%, p-value 0.01).

**VSIN31-13 • Automated Structuring of Radiology Reports using Natural Language Processing**

Paras Lakhan MD (Presenter)

**LEARNING OBJECTIVES**
1) Learn about the differences between and structured, standardized, and free-text reporting. 2) Learn about basic natural language processing (NLP) techniques, and how they can be applied to transform free-text narrative radiology reports into standardized reports. 3) Learn about the pros and cons of such automated systems. 4) Provide real-life examples of the natural language processing system with various reporting styles. 5) Discuss future directions of NLP and its applicability to structured reporting.

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**Interventional Radiology Series: Venous Disease**

Tuesday, 08:30 AM - 12:00 PM • E351

**VSIR31 • AMA PRA Category 1 Credit ™: 3.25 • ARRT Category A+ Credit: 3.75**

**Moderator**
Scott O Trerotola, MD *

**LEARNING OBJECTIVES**
1) Describe the use of radiofrequency wire in central venous occlusion. 2) Explain the current role of inferior vena caval filtration in venous disease. 3) Describe the steps involved in creating a quality improvement project related to inferior vena cava filter follow-up.
4) Outline the current approach to diagnosis and treatment of central venous stenosis. 5) Describe the rationale for adrenal vein sampling. 6) List 3 differences between the US and Europe in fistula use and how Fistula First has narrowed that gap.

**VSIR31-01 • Central Venous Stenosis - Why Does It Occur? How Can We Prevent It? Treatment With Conventional Tools**

Dheeraj K Rajan MD (Presenter) *

**LEARNING OBJECTIVES**
1) Describe common causes of central venous stenosis (CVS). 2) Describe preventative measures that may be undertaken to avoid CVS.
3) Describe common tools and techniques for treatment of CVS available to radiologists.

**VSIR31-02 • Central Venous Occlusion Treatment with RF Wire**

Marcelo Guimaraes (Presenter) *

**LEARNING OBJECTIVES**
1) Describe the radio-frequency wire technique in the recanalization of chronic and benign central venous occlusions.

**ABSTRACT**

Purpose: Central venous occlusion is not an infrequent problem in patients who had long-term venous catheters. The recanalization of CVO's using conventional techniques may fail in up to 24% of cases. The radiofrequency wire puncture technique was utilized in symptomatic patients. MandM: Between 2008-2013, 58 patients, ages 26-78 years, presented with swollen arm and/or face secondary to benign CVO's related to tunneled catheters. Coronal chest CTA was used to evaluate the central venous anatomy. First, a pericardium window is selected for potential cardiac tamponade drainage. Simultaneous upper extremity (brachial) and central venograms (femoral approach) are performed to define the CVO. Typically, the RF wire was advanced within a 5-Fr KMP catheter from the cranial venous stump towards a 10 mm snare placed in the caudal stump. The RF wire tip and the snare alignment was checked PA, RAO, LAO. If the RF wire puncture was inadequate, a new location was pursued. Pre-stent 4mm balloon PTA was followed by 9-12mm stent placement. Self-expandable stents were used in the subclavian-brachiocephalic transition and balloon-expandable stents were used in brachiocephalic or SVC lesions. Clinical and venogram F/U's were scheduled at 3, 6, 9 and 12 months. Results: 56 patients were successfully treated with RF wire technique. One hemothorax and one cardiac tamponade were successfully treated with drain catheter placement without clinical repercussions. Resolution of symptoms was obtained in 51/56 patients treated in mean follow-up of 16 months. 5/56 patients had stent occluded at 3 months that required balloon angioplasty for successful recanalization and all had improvement of symptoms following the second intervention. Conclusion: RF wire technique is a good alternative in benign CVO's when conventional techniques have failed. It is an alternative in the management of symptomatic patients. Thorough technique must be used in the order to minimize potential complications.

**VSIR31-04 • Prophylactic Placement of an Inferior Vena Cava Filter during Endovenous Intervention for Acute Deep Venous Thrombosis of the Lower Extremity**

So Hyun Park (Presenter); Se Hwan Kwon MD; Joo Hyeong Oh MD; Tae-Seok Seo; Myung Gyu Song MD

**PURPOSE**

To evaluate the usefulness of an inferior vena cava (IVC) filter during endovenous intervention for acute deep vein thrombosis (DVT) in the lower extremity.

**METHOD AND MATERIALS**

We performed endovenous intervention in 106 patients (M:F =30:76; mean age, 59.8 years) with acute DVT in the lower extremity after placement of an IVC filter between July 2004 and December 2012. In all patients, aspiration thrombectomy was performed, and percutaneous transluminal angioplasty (PTA) or additional stent placement was carried out in six and 88 patients, respectively. We evaluated presence of a trapped thrombus in the IVC filter on final venograms obtained during the procedure (n=106) or on follow-up CT (n=55), respectively. The transverse length of the trapped thrombus was defined as four grades (1–4) divided by the IVC filter diameter evaluated presence of a trapped thrombus in the IVC filter on final venograms obtained during the procedure (n=106) or on follow-up CT (n=106). A trapped thrombus in the IVC filter was observed on venograms in 35/106 patients (33%) and on follow-up CT in 25/55 patients (45%). A trapped thrombus in the IVC filter was detected in 46/106 patients (43%) on final venograms or on follow-up CT. A trapped thrombus in the IVC filter was detected in 8/12 patients (75%) after aspiration thrombectomy only, in 4/6 patients after additional PTA (67%), and 34/88 patients after additional stent placement (39%). A trapped thrombus in the IVC filter was observed on venograms in 35/106 patients (33%) and on follow-up CT in 25/55 patients (45%). In 25 trapped thrombi observed on CT images, 11 were not shown on final venograms and were newly detected on CT images. Thrombus sizes were grade 1 in four patients (8.7%), grade 2 in eight patients (17.4%), grade 3 in 22 patients (47.0%), and grade 4 in 12 patients (26.1%). Among 67 patients in whom DVT was detected on CT before the procedure, the incidences of a trapped thrombus in cases with or without an extended thrombus into the IVC on CT images were 13/17 (76.5%) and 18/50 (36.0%), respectively.

**CONCLUSION**

Thrombus migration developed frequently during endovenous intervention in patients with DVT in the lower extremity, and IVC filter placement may be useful for prevention of pulmonary thromboembolism.
Excellent Success Rate of Adrenal Venous Sampling after Simple Modification of Routine Protocol

Sadahiro Yamamura (Presenter); Yoshinori Shigematsu; Koichi Yokoyama; Osamu Ikeda MD; Toshinori Hirai MD; Yasuuyuki Yamashita MD *

PURPOSE
To evaluate efficacy of the modification of adrenal venous sampling (AVS) protocol in comparison with our previous results.

METHOD AND MATERIALS
Since 2009, 114 patients with primary aldosteronism were subjected to AVS conducted by a single radiologist. From the retrospective reviews of the first 72 patients, AVS protocol was modified and applied prospectively for the latter 42 patients. The criterion for biochemical successful catheterization was cortisol value of more than 200?g/dl and/or an adrenal vein/inferior vena cava cortisol ratio of greater than 5. The blood was drawn at the central adrenal veins with use of ACTH.
RESULTS
The biochemical success rate (BSR) for the first 72 patients was 91.7% (66/72), and the causes of the failure in these 6 patients were analyzed. In all six patients, the procedures were unsuccessful on the right side. For 3 patients, the catheter tip slippage was seen during the sampling. Adrenal hemorrhage occurred in 8 patients and AVS was biochemically unsuccessful in 2.
For the latter patients, our routine AVS protocol was modified in two points. First, to avoid catheter tip slippage, the way of catheter tip settlement was changed. Before the modification, in case that the catheter tip was too deep into the adrenal vein, we had moved the tip of the 4F catheter by pulling the catheter. After modification, we moved the 4F catheter tip by pushing the adrenal venous wall with microguidewire through the 4F catheter. The blood was drawn through the space between the microguidewire and 4F catheter by using a Y-shape connector. Second, to avoid adrenal hemorrhage, we used a 5mm cylinder instead of a 10 ml cylinder when fumbling and injecting to the right adrenal vein.
In the latter 42 patients, the BSR was perfect. The incidence of the right adrenal hemorrhage decreased to 2.4%.

CONCLUSION
Use of microguidewire, Y-shape connector and smaller cylinder of 5ml improved BSR of AVS with a low risk of right adrenal hemorrhage.

CLINICAL RELEVANCE/APPLICATION
AVS collecting whole adrenal venous blood with our method will improve the cure rate of the operated patients because it can also guarantee the normal adrenal function of the non-operated side.

Non-contrast-Enhanced MR Imaging of Right Adrenal Vein for Adrenal Venous Sampling: Comparison with Multidetector CT Angiography

Hideki Ota MD, PhD (Presenter); Kei Takase; Kazumasa Seiji MD, PhD; Ryo Morimoto; Fumitoshi Satoh MD, PhD; Shoki Takahashi MD

PURPOSE
Primary aldosteronism is the main cause of secondary hypertension in younger population and induces renal dysfunction. Adrenal venous sampling (AVS) is essential to localize unilateral or bilateral lesions causing primary aldosteronism. However, catheterization to the right adrenal vein is technically challenging due to its small size and anatomical variations. Identification of the right adrenal vein prior to AVS is important to achieve successful procedure. This study aims to compare detectability of the right adrenal vein by non-contrast-enhanced MR imaging at 3T and multidetector CT angiography.

METHOD AND MATERIALS
Consecutive 65 patients (mean age, 54.5, range 33-77) scheduled for AVS were included. Sixty-three patients underwent both MR and CT imaging. The remaining two underwent only MR imaging due to high risk of contrast-induced nephropathy. Three-dimensional respiratory-triggered true fast imaging with steady-state precession imaging was acquired in transverse section for MR imaging. Contrast-enhanced four-phase scanning was performed for CT imaging. On both modalities, image quality of the right adrenal vein was evaluated on a five-point scale (1=invisible, 5=excellent). Detectability and image quality were compared using McNemar’s test or Wilcoxon signed ranks test.

RESULTS
Non-contrast enhanced MR imaging demonstrated right adrenal veins in 59 of the 65 patients (91%). In the 63 patients who underwent both examinations, the detectability of the right adrenal vein was significantly higher for CT than MR imaging (100% vs. 90%, p=0.04). When all patients scheduled for AVS were included, the detectability was not significantly different between both modalities (p=0.28). CT demonstrated significantly higher image quality than MR imaging (p<0.04). CT angiography is a reliable tool for detection of the right adrenal vein. When risks of radiation and contrast-induced complication were taken into account, non-invasive MR imaging becomes a first choice for planning of AVS.

CLINICAL RELEVANCE/APPLICATION
Non-contrast-enhanced MR as well as CT can demonstrate the right adrenal vein. MR exam is recommended for planning of AVS when risks of radiation and contrast-induced complication was taken into account.

Adrenal Vein Sampling: You Can Do This (Maybe)

Scott O Trerotola MD (Presenter) *

LEARNING OBJECTIVES
1) Describe the laboratory profile of candidates for adrenal vein sampling in aldosteronism. 2) List characteristic features and tip-offs for identifying the right adrenal veins. 3) Describe the catheter shapes that work most commonly for AVS. 4) Interpret a straightforward set of AVS results. 5) Explain the roles of lateralization index, selectivity index, and contralateral suppression in AVS.

ABSTRACT
Adrenal vein sampling, by far most commonly performed for aldosteronism, is experiencing a resurgence with recognition that the poor results of the past, particularly with right sided sampling, can be markedly improved with new techniques and materials. This presentation will focus on the technical aspects of AVS, with a strong focus on correct identification of the right and left adrenal veins as well as mimics which can undermine success. Recent advances aimed at improving results even for inexperienced operators will be discussed, including the roles of cone beam CT, preoperative CT, anatomic clues, rapid cortisol assays, and catheter optimization. Typical patient selection, patient preparation and results interpretation will be covered using a case presentation format. Strategies for developing an AVS program will be reviewed. The presentation will focus exclusively on aldosteronism, since other indications for AVS are rare.

Wrap Up and Discussion

LEARNING OBJECTIVES
View learning objectives under main course title.

Musculoskeletal Radiology Series: Ultrasound

Tuesday, 08:30 AM - 12:00 PM • E451B

VSMK31 • AMA PRA Category 1 Credit™:3.25 • ARRT Category A+ Credit:3.5
Moderator
Marnix T Van Holsbeek, MD *
Moderator
Kenneth S Lee, MD *

VSMK301-01 • Shoulder Ultrasound (Demonstration)

Jon A Jacobson MD (Presenter) *
PURPOSE
To investigate the relationship between visualization of the rotator cable (RC) on ultrasound (US) and functional outcome, tear size and muscle fatty atrophy in subjects with full-thickness rotator cuff tears (RCT) and asymptomatic volunteers (AV).

METHOD AND MATERIALS
In this cross-sectional study, 52 subjects with full-thickness RCT (32 men; age range 39-67 years; mean 57 years) and 20 (AV) (11 men; age range 35-64 years; mean 54 years) were examined prospectively with US by a musculoskeletal radiologist with 17 years of experience. A RC was defined as an articular-sided bundle of fibers perpendicular to the rotator cuff tendons. The length and width of the full-thickness RCT were measured in the frontal and sagittal planes and tear area was calculated. Supraspinatus (SS) muscle atrophy was assessed by calculating the occupation ratio of the SS fossa (Thomazeau 1997). SS and infraspinatus (IS) fatty atrophy was graded by comparing the echogenicity and panniculus pattern with that of the trapezius muscle (Khoury 2008). A physiotherapist used the Constant score to measure functional outcome. Statistical analysis was performed using the Student t test and the Fisher exact test.

RESULTS
The RC was visualized in 75% of AV and in 25% of RCT subjects. Non-visualization of the RC in RCT subjects correlated significantly with a larger tear area (612.12 mm² vs. 247.24 mm²), p < 0.0001, 95% CI (31.6; 40.7) but it did not correlate with RC visualization in the RCT group (p = 0.3) nor in the AV group (p = 0.11). There was a significant difference in the severity of muscle fatty replacement of the SS (p = 0.03) and the IS (p = 0.014), as well as in the severity of SS muscle atrophy (p = 0.04) in RCT subjects without a visible RC as compared to those with a visible RC.

CONCLUSION
Non-visualization of the RC on US correlates with larger RCT, higher grades of SS and IS muscle fatty replacement and with SS muscle atrophy. Visualization of the RC in subjects with RCT does not appear to correlate with better functional outcomes.

CLINICAL RELEVANCE/APPLICATION
RC visualization on US in subjects with full-thickness RCT may assist orthopedic surgeons in choosing the optimal treatment for their patients (conservative vs surgery).

VSMK31-03 • Dynamic Ultrasonography of the Shoulder: Availability to Diagnose Combined Adhesive Capsulitis with Full-thickness Tear of the Supraspinatus Tendon

Hoseok Lee (Presenter); Jae Hyuck Yi MD

PURPOSE
To determine the availability of dynamic ultrasonography of the shoulder to diagnose combined adhesive capsulitis with full-thickness tear of the supraspinatus tendon.

METHOD AND MATERIALS
Since 2010, total 80 patients (M:F = 37:43, mean age: 61.56, age range: 36-82) with full-thickness tear of supraspinatus tendon (SSPT) who performed both dynamic ultrasonography (dUS) and MRI of the shoulder (32 cases of conventional MRI and 48 cases of indirect MR arthroscopy) were included in this retrospective study. 35 patients who showed subacromial gliding limitation (SGL) of the SSPT during dUS were classified into group I, 45 patients who did not show SGL of the SSPT were classified into group II. The dUS score was estimated by severity of SGL (0: none, 1: mild, 2: moderate, 3: severe). MRI was assessed for following 3 findings suggesting adhesive capsulitis: 1) maximal capsular thickness in axillary recess (AR) =4mm, 2) maximal capsular thickness in rotator cuff interval (RC) =7mm, 3) presence of bright signal change of capsule in AR and RI on fat-suppressed T2-weighted image of conventional MRI or capsular enhancement in AR on indirect MR arthroscopy. Each of these findings was given 1 score, and total MRI score of each patients was calculated. Statistical analysis was performed by using Pearson correlation coefficient and Fischer exact test.

RESULTS
The mean value of dUS score and MRI score of total patients were 0.59 ± 0.77 and 1.42 ± 1.13. The mean thickness in AR and RI were 5.45 ± 1.37 mm and 6.81 ± 1.37 mm in group I, and 3.20 ± 0.86 mm and 6.08 ±1.39 mm in group II. dUS score was significantly correlated with capsular thickness in AR (r=0.742, p<0.001).

CONCLUSION
Subacromial gliding limitation of the supraspinatus tendon during dynamic ultrasonography was significantly correlated with MR findings suggesting adhesive capsulitis. Therefore, dynamic ultrasonography of the shoulder may be useful to diagnose combined adhesive capsulitis with full-thickness tear of the supraspinatus tendon.

CLINICAL RELEVANCE/APPLICATION
Dynamic ultrasonography can demonstrate subacromial gliding limitation of the supraspinatus tendon and this exam is recommended in the evaluation of suspected adhesive capsulitis.

VSMK31-04 • Diagnostic Performance of Conventional Ultrasonography Combined with US Strain Elastography for Differentiation between Benign and Malignant Subcutaneous Soft Tissue Mass Lesions

Tharakeswara Kumar Bathala MD (Presenter); Gaiane M Rauch MD, PhD; Melanie Bass; Deborah Borst; Brian Hobbs PhD; Deepak G Bedi MBCh *

PURPOSE
To evaluate diagnostic performance of conventional ultrasonography (US) combined with US Strain Elastography (USE) for differentiation between benign and malignant subcutaneous soft tissue mass lesions, with the pathology as reference standard.

METHOD AND MATERIALS
After Institutional IRB approval, we identified 74 patients with a subcutaneous soft tissue mass who had US and USE from January 2009 to May 2012. Three radiologists retrospectively reviewed US and USE images in consensus. Gray scale US imaging features were classified as benign, malignant and indeterminate. USE images were assessed according to tissue elasticity based on color scale and classified as soft, intermediate and hard. Pathological diagnosis obtained either by percutaneous biopsy or surgical excision was used as reference standard. The statistical analysis included evaluation of sensitivity and specificity for US and USE separately, as well as a composite evaluation of US + USE; Bowker's test was used for evaluation of matched US and USE outcomes for symmetry.

RESULTS
Out of 74 lesions, US 37 were classified as benign, 8 indeterminate, 29 malignant. USE found 35 benign, 14 indeterminate, 25 malignant lesions. USE + USE was classified 40 as benign, 4 indeterminate and 30 malignant. The estimated sensitivity and 95% CI for US, USE and US+USE was 100% (82-100%), 95% (75-100%), and 100% (82-100%) respectively. The specificity for US, USE and USE+USE was 71% (57-82%), 67% (53-79%), and 77% (63-87%) respectively. Significant evidence for the lack of agreement among the matched US and Elastography results was not found (p=0.51). The data suggest US alone is highly sensitive for detecting and characterization of subcutaneous soft tissue lesions. Only 8 patients resulted in an indeterminate US, all of which had benign lesions on pathology. Among these 8, USE was determined for only 4, of which 3 were correctly classified as benign and 1 was incorrectly classified as malignant.
CONCLUSION
In the presence of an indeterminate result on conventional US, USE may improve specificity for diagnosing subcutaneous soft tissue lesions. Combination of US and USE could provide a better diagnostic performance than conventional US alone.

CLINICAL RELEVANCE/APPLICATION
Addition of USE evaluation to conventional gray scale US imaging improves imaging-based diagnostic information for soft tissue nodule work up.

VSMK31-05 • Value of Real-time Sharewave Elastography in Achilles Tendinopathy: Is the Abnormal Tendon Softer?
Jean-Philippe Nueffer MD (Presenter) ; Fabio Becce MD ; Fabrice Michel MD, PhD ; Benoit Barbier-Brion MD ; Adrian I Kastler MD, MSc ; Sebastien L Aubry MD, PhD

PURPOSE
To determine if the viscoelastic properties of Achilles tendon assessed by real-time sharewave elastography (SWE) are modified in tendinopathy

METHOD AND MATERIALS
Twenty-six abnormal tendons (16 unilateral and 5 bilateral tendinopathies) from 21 patients with Achilles tendinopathy and 176 normal tendons (from 16 patients and 80 healthy volunteers) were prospectively included and compared. Mean sharewave velocity (Vmean) was measured on axial and sagittal SWE images at two degrees of passive ankle flexion (position 1: complete plantar flexion; and position 2: 0 degree flexion). Tendon maximum anteroposterior and lateral diameters, cross sectional area and the presence of tears were also noted

RESULTS
In position 1, the abnormal tendons Vmean was significantly lower than for contralateral normal tendons on sagittal (r=-1.23m/s, p=0.004) and axial elastograms (r=-0.68m/s, p=0.03); and significantly lower than for normal tendons only on axial images (r=-0.69m/s, p=0.01). In position 2 and on axial elastograms, the abnormal tendons Vmean was 1.14m/s lower than for contralateral normal tendons however without reaching statistical significance (p=0.07). In position 2, the abnormal tendons Vmean was significantly lower than for normal tendons on sagittal (r=-1.26 m/s, p

CONCLUSION
Abnormal Achilles tendons have lower Vmean and are therefore softer than normal tendons. There is no SWE signal into tendon tears

CLINICAL RELEVANCE/APPLICATION
Tendon softening, assessed by real-time SWE, is a new helpful tool in the evaluation of Achilles tendinopathy. SWE may also provide quantitative parameters to assess the severity of tendinopathy

VSMK31-06 • Ultrasound-guided Shoulder Injection
Etienne Cardinal MD (Presenter)

LEARNING OBJECTIVES
1) Be familiar with ultrasound examination and anatomy of the hip and common pathology.

VSMK31-07 • Ultrasound-guided (US) Percutaneous Treatment of Rotator Cuff Calcific Tendinitis (RCCT): Randomized Comparison between One- and Two-needle Procedure
Davide Orlandi MD (Presenter) ; Giulio Ferrero ; Francesca Lacelli MD ; Enzo Silvestri MD ; Giovanni Serafini MD ; Luca Maria Sconfienza MD, PhD

PURPOSE
US-Guided percutaneous treatment of RCCT has been widely demonstrated to be effective using one or two needles, but direct comparison between the two methods has never been performed. Our aim was to compare the technical and one-year clinical outcome of these two different approaches.

METHOD AND MATERIALS
IRB approval and patients informed consent were obtained. One hundred patients to be treated for RCCT diagnosed with ultrasound (77 females, mean age 46y, range 32-70 years) were randomized into two groups. Group A (50 patients; mean visual analogue scale [VAS]=7.8) was treated using an US-guided 16G double-needle technique (local anesthesia, washing with warm saline, intrabursal steroid), while group B (50 patients; mean VAS=7.4) was treated using a 16G single-needle technique. Calcification appearance at US (fluid, soft, hard), procedure time and ease of calcium dissolution (subjectively scored as easy=1, intermediate=2, difficult=3) were recorded. VAS follow-up was performed at 1,3,6 and 12 months. Complication rate was noted. Mann-Whitney U and Chi-square statistics were used.

RESULTS
CONCLUSION
One- and two-needle procedures are equally effective in treating RCCT with no major complications. Two-needle procedure allows for significantly reducing treatment time and appears to be much easier when dealing with soft and hard calcium deposits.

CLINICAL RELEVANCE/APPLICATION
Two needle US-guided percutaneous treatment of RCCT seems to be the treatment of choice in patients affected by soft and hard calcifications, compared to one needle technique.

VSMK31-08 • Postoperative Monitoring of Local and Free Flaps with Contrast Enhances Ultrasound (CEUS)- Analysis
Ernst Michael Jung MD (Presenter) ; Janine Rennert MD ; Lukas Prantl MD

PURPOSE
Tissue defects are a common problem in trauma surgery or oncology. Flap transplantation is often the only therapy to cover these extensive wound defects. To date several monitoring systems exist but none has made it to clinical day work.

METHOD AND MATERIALS
112 patients were examined after local or free flap transplantation during the first 72 hours after operation. CEUS was performed by one experienced examiner with a linear transducer (6-9 MHz, LOGIQ E9/GE) after a bolus injection of 2.4 ml sufohexa-fluoride microbubbles (SonoVue®, Bracco, Italy). Retrospective vascular perfusion was quantified by evaluating the stored DICOM cine loops using the perfusion software QONTRAST® (Bracco, Italy). Over a total penetration depth of 3 cm every centimetre was analysed separately. 27 complications were observed. Complete flap loss was only seen in 4 cases whereas 23 flaps had to undergo minor revisions and survived.

RESULTS
Regarding the complete flap size quantitative analysis showed significant higher perfusion values in patients without complications compared to patients with complications: PEAK 16.5 vs. 10.0 (p=0.001), TTP 32.6 vs. 22.2 (p=0.001), RBV: 738.8 vs. 246.2 (p

CONCLUSION
CEUS was capable of detecting vascular disturbances after flap transplantation. TTP, RBV and MTT seem to be the most accurately parameters and are very susceptible to malfunction during measurement.
**VSMK31-09 • The Effects of US-guided Injection of Platelet-rich-Plasma (PRP) on the Degenerative Disease of the Achilles and Patellar Tendon in Athletes**

Alice La Marra MD (Presenter) ; Lorenzo Maria Gregori ; Silvia Mariani MD ; Luigi Zugaro ; Antonio Barile ; Carlo Masciocchi

**PURPOSE**
To evaluate and show the result of injection with Platelet Rich Plasma (PRP) of tendinosis of Achilles and Patellar tendon in athletes.

**METHOD AND MATERIALS**
In the last three years we evaluated 50 athletes with degenerative tendinosis of Achilles tendon and 30 athletes with degenerative tendinosis of patellar tendon. All the patients were first evaluated through diagnostic testing (MRI and US guided) and then through clinical observations (VAS for pain and VISA-A and VISA-P for functionality). The patients underwent a cycle of platelet rich plasma US-guided infiltrations every 21 days for a total of three treatments. Another MRI was performed 30 days and one year after the last infiltration.

**RESULTS**
In the patients with tendinosis of Achilles tendon we have found an improved overall by 80% (VAS) and 53% (VISA-A). Relatively to the patellar tendon, the VAS value is increased by 75% (VAS) and 50% (VISA-P). We observed partial or complete morphological recovery and normalization of MRI signal in 90%. We observed a reduction of sectional area in the Achilles tendon in 39/50 cases and in the patellar tendon in 18/30 cases. Eight patients with Achilles tendinosis of cadaver presented an area increased by 10% and five patients with tendinosis of patellar tendon presented an area increased by 15%. The mean VAS at one year of treatment improved in all cases overall by 70%.

**CONCLUSION**
Our study showed that in patients who underwent PRP treatments there was an improvement of the functionality, a decrease in pain and a normalization of the signal intensity seen on MRI. Therefore, our experience proves that PRP infiltration may be a good therapeutic alternative for the treatment of Achilles and patellar tendinopathy in athletes.

**CLINICAL RELEVANCE/APPLICATION**
The US-guided PRP treatment in case of degenerative tendon disease may increase Achilles’s and Patellar tendons functionality and reduce recovery times in athletes.

**VSMK31-10 • Wrist and Hand Ultrasound (Demonstration)**

Marinix T Van Holsbeeck MD (Presenter) *

**LEARNING OBJECTIVES**
1) Be familiar with ultrasound examination and anatomy of upper extremity nerves and common pathology.

**VSMK31-11 • High-resolution Ultrasonography of the Dorsal and Palmar Extrinsic Wrist Ligaments in Correlation with 3T Magnetic Resonance Imaging in 40 Normal Volunteers and 10 Cadaveric Specimens with Surgical Correlation**

Mirha S Taljanovic MD (Presenter) ; Dean Holden MD, FRCPC ; Elizabeth A Krupinski PhD ; Joseph E Sheppard MD

**PURPOSE**
To confirm that high-resolution ultrasonography (HRUS) has comparable results with 3T Magnetic Resonance Imaging (MRI) in visualization of the extrinsic wrist ligaments.

**METHOD AND MATERIALS**
HRUS and 3T MRI of the extrinsic wrist ligaments were performed on 10 fresh frozen cadaveric wrist specimens and on 40 wrists in normal volunteers. Dorsal radiocarpal-DRCCL, dorsal intercarpal-DICL and dorsal ulnolotriquetral-DUTL, radioscaphocapitate-RSCL, long radiolunate-LRLL, short radiolunate-SRLL, radioscapholunate-RSLL, palmar ulnolunate-PULL, palmar ulnotriquetral-PUTL, ulnolunate-UCL, and palmar scaphotriquetral-PSTL ligaments were evaluated. The ligaments were graded by two examiners in consensus, using the following grading system: A- ligament equally well seen on US and MRI, B- ligament better seen on MRI, and C- ligament better seen on US. All cadaveric wrists were dissected by an orthopaedic hand surgeon. The results for each of the ligaments were compared using the following grading system: Grade 1- ligament completely seen, Grade 2- ligament partially seen (< 100% but > 50% of the ligament clearly seen) and Grade 3- ligament not seen (< 50% of the ligament clearly seen). Visualization on US and 3T MRI was compared using the following grading system: more scores of "A" than the other ligaments and the other 8 ligaments receiving more "C" scores. For US, there was a significant difference in visualization of the ligaments (X2 = 143.83, p < 0.0001) with DUTL, PUTL, and PSTL receiving significantly more scores of "Grade 2" than the other ligaments. There was a significant difference (X2 = 335.72, p < 0.0001) with DUTL, PUTL, and PSTL receiving significantly more "B" scores than the other ligaments and the other 8 ligaments receiving more "C" scores. On surgical dissections in 10 cadavers all dorsal and palmar extrinsic wrist ligaments were intact.

**RESULTS**
None of the examined 550 ligaments received grade "3". For MRI there was a significant difference in visualization of the ligaments (X2 = 143.04, p < 0.0001) with DUTL, RSCL and UCL receiving significantly more scores of "Grade 2" than the other ligaments. For US, there was a significant difference in visualization of the ligaments (X2 = 143.83, p < 0.0001) with DUTL, PUTL, and PSTL receiving significantly more scores of "Grade 2" than the other ligaments. There was a significant difference (X2 = 335.72, p < 0.0001) with DUTL, PUTL, and PSTL receiving significantly more "B" scores than the other ligaments and the other 8 ligaments receiving more "C" scores. On surgical dissections in 10 cadavers all dorsal and palmar extrinsic wrist ligaments were intact.

**CONCLUSION**
HRUS enables satisfactory visualization of the extrinsic wrist ligaments with results that are at least comparable to 3T MRI.

**CLINICAL RELEVANCE/APPLICATION**
High-resolution ultrasonography enables good visualization of the extrinsic wrist ligaments and can be utilized in evaluation of these structures in routine clinical practice and sports medicine.

**VSMK31-12 • Ultrasound-guided Percutaneous Injection for De Quervain’s Disease Using Three Different Techniques: Preliminary Results of a Randomized Controlled Trial**

Luca Maria Sconfienza MD, PhD (Presenter) ; Davide Orlandi MD ; Emanuele Fabbro MD ; Giovanni Mauri MD ; Giovanni Serafini MD ; Francesco Sardanelli MD *

**PURPOSE**
De Quervain’s disease is a painful stenosing tenosynovitis of the first dorsal compartment of the wrist, caused by a thickening of the retinaculum. Ultrasound-guided intracompartamental steroid injections reported pain relief in up to 97% of patients at 6 months follow-up with a rate of symptoms recurrence up to 20%. We compared the efficacy and the outcome at 6 months follow-up of three different ultrasound-guided treatment options for De Quervain’s disease.

**METHOD AND MATERIALS**

**RESULTS**
None of the examined 550 ligaments received grade "3". For MRI there was a significant difference in visualization of the ligaments (X2 = 143.04, p < 0.0001) with DUTL, RSCL and UCL receiving significantly more scores of "Grade 2" than the other ligaments. For US, there was a significant difference in visualization of the ligaments (X2 = 143.83, p < 0.0001) with DUTL, PUTL, and PSTL receiving significantly more scores of "Grade 2" than the other ligaments. There was a significant difference (X2 = 335.72, p < 0.0001) with DUTL, PUTL, and PSTL receiving significantly more "B" scores than the other ligaments and the other 8 ligaments receiving more "C" scores. On surgical dissections in 10 cadavers all dorsal and palmar extrinsic wrist ligaments were intact.

**CONCLUSION**
HRUS enables satisfactory visualization of the extrinsic wrist ligaments with results that are at least comparable to 3T MRI.

**CLINICAL RELEVANCE/APPLICATION**
High-resolution ultrasonography enables good visualization of the extrinsic wrist ligaments and can be utilized in evaluation of these structures in routine clinical practice and sports medicine.
Ultrasound-guided intracompartiment injection of triamcinolone acetonide + sodium hyaluronate seems to represent a promising approach to treat De Quervain’s disease, reducing symptoms recurrence up to six months.

**CLINICAL RELEVANCE/APPLICATION**
Combined injection of steroid and hyaluronic acid is effective to treat De Quervain’s disease and prevents symptoms recurrence up to six months.

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**VSMK31-13 • Ultrasonography of the Radial and Ulnar Collateral Ligaments of the Wrist with Surgical Correlation**

**Miha S Taljanovic** MD (Presenter) ; **Stephen Johnston** ; **Wynter N Phoenix** MD ; **Joseph E Sheppard** MD

**PURPOSE**
To re-evaluate the utility of high-resolution sonography (HRUS) in the assessment of collateral ligaments of the wrist.

**METHOD AND MATERIALS**
HRUS of the radial (RCL) and ulnar (UCL) collateral ligaments of the wrist was performed on 56 cadaveric wrists on the General Electric Logiq 9 ultrasound machine, with a 9-12 MHz linear hockey stick transducer. Both ligaments were primarily scanned in the longitudinal axis using the anatomic landmarks. The visibility of these ligaments was assessed during the sonographic examination by the examiner and additional 3 observers (surgery resident, medical student and ultrasound technologist). The ligaments were classified as well seen, adequately seen or not seen on sonography. Surgical dissections of 12 RCLs and 12 UCLs in 6 cadavers with their surrounding relationships to the extensor tendons and dorsal compartments of the wrist were subsequently performed. The ligaments were classified as present or absent and graded I or II depending on the surgeon’s subjective assessment of ligamentous thickness (I- thick, II-thin).

**RESULTS**
The RCLs were seen on sonography in all cadaveric wrists in their anatomic locations between the radial styloid and radial aspect of the scaphoid, dorsal to the radial artery and deep and somewhat dorsal to the 1st extensor compartment. They had an echogenic fibrilar appearance. All UCLs had an appearance of a thick echogenic band and were seen between the ulnar styloid and triquetrum abutting the deep aspect of the 6th extensor compartment. In 9 cadavers, 16 right and left UCLs were well seen and in the remaining 19 cadavers they were adequately seen. In 8 cadavers, 16 right and left UCLs were well seen and in the remaining 20 cadavers they were adequately seen. On sonography, the investigators were uncertain if what they called UCLs represent true ligaments or thickening of the joint capsule. On surgical dissections all RCLs and UCLs were proven to be true ligaments. On dissections, 9 of 12 RCLs were graded I and 3 were graded II. All UCLs were graded I on dissections. All of the dissected ligaments were well seen on sonography.

**CONCLUSION**
The RCL and UCL of the wrist are true ligaments that can be well seen on HRUS.

**CLINICAL RELEVANCE/APPLICATION**
The collateral ligaments of the wrist are true ligaments and can be well seen on HRUS which can be utilized in clinical practice in evaluation of these structures.

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**VSMK31-14 • Prognosis Value of Ultrasonographic Assessment in Muscle Strain Injuries: Longitudinal Study of a 70 Elite Athletes Cohort**

**Jerome Renoux** MD (Presenter) ; **Jean-Louis Brasseur** ; **Philippe Thelen** ; **Christian Dibie**

**PURPOSE**
To evaluate prognosis value of ultrasonography performed in the first days of muscle strain injuries.

**METHOD AND MATERIALS**
A prospective cohort study was lead between 2010 and 2012 in the French National Sport Institute. Ultrasonographic assessment of muscle strain lesions was performed between the 2nd and the 8th day. Return to play (total or best clinical recovery) was evaluated with a benefit of a six months hindsight. Correlation between ultrasonographic signs and clinical prognosis was statistically evaluated. Echographic signs included the local semiology (Rodineau and Durey’s 5 grades classification system was used), lesion size, lesion type (myofascial vs. pure fascial), and location of the lesion (muscular group, centromuscular vs. perimuscular, proximal vs. distal). Echographic and clinical follow-up were performed until return to play.

**RESULTS**
70 patients were recruited. 67% of the lesions were located at the lower limbs, 20% at the upper limbs and 13% at the abdominal or thoracic walls. Mean delay between trauma and ultrasonography was 4.5 days. 3 percents were grade 0 injuries, 33% grade 1, 42% of grade 2, 20% of grade 3 and 2% of grade 4. Return to play time differed between the 5 grades of injuries (respectively 1.2±0.8 ; 3.1±1.2 ; 4.8±1.8 ; 8.5±3.8 ; 18 ± 10 weeks ; p = 0.03). Myofascial lesions were correlated with a better lay-off time compared to pure fascial lesions (4.7 vs. 5.8 weeks ; p = 0.02). Proximal lesions had a poorer prognosis compared to distal lesions (5.2 vs. 3.9 weeks ; p = 0.009). Recurrence occured in 16%.

**CONCLUSION**
Ultrasoundography has a good prognosis value for muscle strain lesions. For this purpose, ultrasonography has to describe precisely the grade, the lesion type and its precise location.

**CLINICAL RELEVANCE/APPLICATION**
Ultrasoundography can help clinicians to determine prognosis of muscle strain lesions. It helps to distinguish two types of lesions (pure fascial and myofascial) with different treatments.

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**VSMK31-15 • Interesting Musculoskeletal Ultrasound Cases**

**Jon A Jacobson** MD (Presenter) *

**LEARNING OBJECTIVES**
1) Be familiar with important topics in musculoskeletal ultrasound.

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**Nuclear Medicine Series: Non-FDG PET Radiotracers in Oncology**

**Tuesday, 08:30 AM - 12:00 PM • SS05AB**

**VSNM31 • AMA PRA Category 1 Credit ™:3.25 • ARRT Category A+ Credit:4**

**Moderator**
**Jonathan E McConathy** , MD, PhD *

**Moderator**
**Hossein Jadvar** , MD, PhD
LEARNING OBJECTIVES

1) Describe the kinetics of thymidine relevant to FLT PET imaging. 2) Discuss approaches to FLT image interpretation. 3) Describe studies that have tested FLT PET as a marker cancer response to treatment.

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1) Describe the kinetics of thymidine relevant to FLT PET imaging. 2) Discuss approaches to FLT image interpretation. 3) Describe studies that have tested FLT PET as a marker cancer response to treatment.

ABSTRACT

4'-[methyl-11C]-thiothymidine (4DST) is a novel PET tracer available for evaluating proliferation of malignancy. We prospectively compared the diagnostic ability of 4DST PET/CT and FDG PET/CT for detection of regional lymph node metastasis of non-small cell lung cancer (NSCLC). In addition, we surveyed the relation between these PET results and prognosis of NSCLC patients.

METHOD AND MATERIALS

A total of 31 patients with NSCLC underwent 4DST PET/CT and FDG-PET/CT. PET imaging was obtained from 40 min for 4DST and 60 min for FDG after injection. The PET/CT images were evaluated qualitatively and quantitatively for focal uptake of each PET tracers, according to American Joint Committee on Cancer staging system. Surgical and histologic results were regarded as reference standards. Patients were followed up 2 years after surgery for survey of recurrence. A multivariate analysis was performed to assess the prognostic significance of T stage, N stage and maximum SUV of 4DST and FDG for primary lung tumor.

RESULTS

Four patients were inoperable by being proved dissemination during surgery. In 27 patients with 156 resected lymph nodes, metastasis was pathologically proved in 9 patients with 17 lesions. On a per-lesion basis, sensitivity, specificity, positive predictive value, negative predictive value and accuracy for lymph node staging were 82, 73, 33, 96 and 74 % respectively for 4DST, 29, 86, 25, 88 and 78 % respectively for FDG. Statistical significant difference was confirmed in the sensitivity between 4DST and FDG. The cases with positive nodal findings by 4DST showed higher rate (91%) of lesion extent or recurrence within 2 years, compared to FDG (45%). Multivariiate analysis showed that N stage by 4DST was most influential prognostic factor for recurrence or lesion extent.

CONCLUSION

4DST PET/CT showed high sensitivity for the detection of lymph node metastasis, and it was independent prognostic value for recurrence or lesion extent in NSCLC.

CLINICAL RELEVANCE/APPLICATION

4DST PET/CT can contribute to detect lymph node metastasis, and 4DST PET/CT can predict prognosis for recurrence or lesion extent in NSCLC.

LEARNING OBJECTIVES

1) To identify the advantages of F-18 NaF PET/CT imaging in oncology. 2) To understand the importance of a standardized imaging protocol. 3) To become comfortable differentiating benign from malignant lesions on F-18 NaF PET/CT.

ABSTRACT

F-18 NaF PET/CT has been shown to have higher sensitivity and specificity than planar 99m-Tc MDP bone scanning in several small studies. The concomitant acquisition of anatomic images permits immediate correlation of any abnormal findings. Additionally, F-18 NaF PET/CT bone imaging can be quantitated, allowing bone disease to be “measureable”, increasing its utility therapy monitoring. When a proper threshold can both provide accuracy estimation of pathologic tumor length. Those different indices extracted from PET scans can be potentially employed to differentiate AJCC and TNM in ESCC stage.

RESULTS

The 18F-FDG and 18F-FLT PET scans have their own advantages in ESCC staging and tumors were well identified as the nonphysiologic distribution of radiotracers intensity typically higher than normal tissues on either PET scans. Delineation on the two types of PET with proper threshold can both provide accuracy estimation of pathologic tumor length. Those different indices extracted from PET scans can be potentially employed to differentiate AJCC and TNM in ESCC stage.

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CLINICAL RELEVANCE/APPLICATION

4DST PET/CT can contribute to detect lymph node metastasis, and 4DST PET/CT can predict prognosis for recurrence or lesion extent in NSCLC.
Using [F-18]-FDG and [C-11]-Methionine quantitatively assessed. Distribution of trace uptake was qualitatively evaluated in comparison with MR images. To confirm tissue hypoxia, surgery. The maximum standardized uptake value (SUV max), tumor/background ratio (TBR), and volumetric analysis were evaluated using Spearman rank correlation (r). Two patients underwent biopsy of metastatic lesions.

RESULTS
15 metastatic bone lesions were evaluated. The average value for SUVmax was 28.6 (5.9-61.7, SD 27). The average value (10^-3 mm^2/sec) for ADCmean was 0.93 (0.47-1.8, SD 0.38), for Dfast was 18.2 (11-28, SD 4.5), and for Dslow was 0.98 (0.4-1.7, SD 0.39). The average PF (%) was 10.3 (3.2-18.5, SD 5.1). There was a significant negative correlation between SUVmax and ADCmean (r= -0.75; p=0.001). There were weak to moderate negative correlations between SUVmax and IVIM parameters (p>0.14). Dfast: r=-0.11; Dslow: r=-0.38; PF: r=-0.17. In both patients who had biopsies of metastatic lesions, the biopsy site was determined after reviewing the PET-MRI images. One patient had a biopsy of a bone lesion with a high SUVmax of 48.9 in the L5 vertebral body. Another patient had a biopsy of a metastatic supraclavicular lymph node rather than a bone lesion due to a low SUVmax value of 5.9 of the dominant bone lesion. Both patients with biopsies of metastatic lesions, were positive for metastatic PC.

CONCLUSION
ADCmean and SUVmax show a significant negative correlation in 18F-NaF PET-MRI. IVIM parameters showed weak to moderate negative correlations with SUVmax and may provide complementary information to ADC and SUV, thus warranting further attention in future larger studies.

CLINICAL RELEVANCE/APPLICATION
Our pilot data shows feasibility of 18F-NaF PET-MRI in providing quantitative metrics (SUV,ADC,IVIM) of PC bone metastases, which warrant study as biomarkers for biopsy planning and treatment response.

VSNM31-07 • Prostate Cancer Choline PET Imaging and Other PET Tracers
Hossein Jadvar MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Review the major biological targets that may be useful for imaging in prostate cancer, 2) Understand the need for tailoring the imaging technique to the particular clinical phase of disease.

ABSTRACT
Recent advances in the fundamental understanding of the complex biology of prostate cancer have provided increasing number of potential targets for imaging and treatment. In this presentation, I review the experience with a number of major PET radiotracers for potential use in the imaging evaluation of men with prostate cancer.

VSNM31-08 • [Cu-62]-ATSM PET-CT Study as Hypoxic Imaging in Patients with Gliomas: Comparison with Multitracer Approach Using [F-18]-FDG and [C-11]-Methionine
Ukihide Tateishi MD, PhD (Presenter) ; Kensuke Tateishi ; Ayako Shishikura ; Tomohiro Yoneyama ; Ikuo Torii ; Tomio Inoue MD, PhD ; Nobutaka Kawahara

PURPOSE
The purpose of study was to investigate multitracer approach by [Cu-62]-diacetylpyridine (4N4-methylthiosemicarbazone) ([Cu-62]-ATSM) PET-CT as hypoxic imaging comparing with [F-18]-FDG PET-CT and [C-11]-Methionine PET-CT for differentiation of tumor grade in patients with glioma.

METHOD AND MATERIALS
Multitracer PET-CT studies using [Cu-62]-ATSM, [F-18]-FDG and [C-11]-Methionine were performed in 32 patients with glioma prior to surgery. The maximum standardized uptake value (SUV max), tumor/background ratio (TBR), and volumetric analysis were quantitatively assessed. Distribution of trace uptake was qualitatively evaluated in comparison with MR images. To confirm tissue hypoxia, the transcription factor hypoxia inducible factor-1alpha (HIF-1alpha) utilized as a hypoxic marker was also assessed.
Comparison with F-18 FDG PET

VSNM31-10 • Diagnostic Performance of Synthetic Amino Acid Anti-3-[18F] FACBC PET in Recurrent Prostate Carcinoma Detection

Oluwaseun Odewole MBBS, MPH (Presenter); Pooneh Taleghani MD; Ashesh B Jani MD; Bital Savir-Baruch MD; Leah M Bellamy; Adeboye Osunkoya MD; Weiping Yu PhD; Raghoveer K Haklar MD*; Peter Nieh MD; Viraj Master MD; Mark M Goodman PhD *; David M Schuster MD

RESULTS

109 out of 115 patients and 96 out of 115 patients had a reference standard sufficient to determine the presence of prostatic or extraprostatic disease respectively. Mean PSA (±SD) was 7.1 (±7.7) ng/ml. Average follow-up after imaging was 41.5 (±13.4) months. 94 of 115 (81.7%) examinations were positive. In the prostate bed, anti-3-[18F] FACBC had a sensitivity of 89.0%, specificity of 35.1%, accuracy of 70.6%, positive predictive value of 72.7% and a negative predictive value of 61.9% while for extra-prostate disease detection, anti-3-[18F] FACBC had a sensitivity of 58.3%, specificity of 94.7%, accuracy of 74.4%, positive predictive value of 93.3%, and a negative predictive value of 64.3%. All prostatic true positive lesions (100%) on FACBC and 89.3% of extra-prostatic lesions had histological confirmation of disease. On a whole body basis, true positive lesion detection rate was 16.7, 72.7, 85.2 and 84.3 at PSA (ng/ml) of 0-1, 1.1-2, 2.1-5 and >5.1 respectively.

CONCLUSION

anti-3-[18F] FACBC has diagnostic favorable performance in the detection of recurrent prostate cancer and can delineate prostatic from extra-prostatic recurrence.

VSNM31-11 • Correlation of F-18 Fluoromisonidazole PET Findings with HIF-1α and p53 Expressions in Head and Neck Cancer: Comparison with F-18 FDG PET

Takashi Norikane (Presenter); Yuka Yamamoto MD, PhD; Yukito Maeda; Nobuyuki Kudomi; Yoshihiro Nishiyama MD

RESULTS

There was a significant correlation between hypoxic volume and T/Bmax (r = 0.53, P = 0.003) using FMISO PET and between hypermetabolic volume and SUVmax (r = 0.38, P = 0.046) using FDG PET. The hypoxic volume using FMISO PET and hypermetabolic volume using FDG PET also showed a significant correlation (r = 0.44, P = 0.020). The values of FMISO hypoxic volume was significantly correlated with HIF-1α (r = 0.40, P = 0.037) and p53 (r = 0.47, P = 0.012) obtained on immunohistochemical examination.

CONCLUSION

These preliminary results suggest that hypoxic volume measured by FMISO PET may be a potential noninvasive biomarker for predicting
Language lateralization. We hypothesized that language lateralization indices (LIs) would be threshold- and task-dependent.

Methods:

Functional magnetic resonance imaging (fMRI) is a non-invasive pre-surgical tool that may be used to measure lateralization of language function in brain tumor and vascular lesion patients, and guide neurosurgeons to devise a surgical approach to treat lesions. We investigated the effect of varying the statistical thresholds as well as the type of language task on functional activation patterns and function in brain tumor and vascular lesion patients, and guide neurosurgeons to devise a surgical approach to treat lesions. We

Purpose:

To evaluate the accuracy of 3Tesla functional MRI (fMRI) for preoperative language mapping, compared to direct electric cortical stimulations (DCS) during awake surgery in adult patients with diffuse gliomas. To identify clinical and tumor factors associated with fMRI accuracy.

Results:

In all the patients the ratio between 18F-Cho lesion and normal brain tissue were significantly elevated and were shown to be independent predictors of the presence of gliomas. The areas of 18F-Cho uptake matched to areas of contrast enhancement and of restricted diffusion.

Conclusion:

PET MR allows simultaneous acquisition of morphological and molecular images. ADC maps may provide additional information in staging and follow up brain tumors.

Clinical Relevance/Application:

PET MR allows simultaneous acquisition of morphological and molecular images. ADC maps may provide additional information in staging and follow up brain tumors.
VSNR31-04 • Diffusion Applications in Brain Tumors

Aaron S Field MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Review the fundamental mechanisms by which diffusion imaging can address problems of tissue characterization in brain tumor patients. 2) Examine the role of diffusion imaging in differential diagnosis of the most common brain tumors including meningioma, glioma, lymphoma, and pediatric tumors of the posterior fossa. 3) Understand the potential but also the limitations of diffusion tensor imaging in defining tumor margins and planning tumor resections. 4) Understand the role of diffusion imaging in evaluating brain tumor treatment-related effects, including cytoreductive therapeutic response, radiation necrosis, and treatment-related white matter injury.

CONCLUSION
Examining lateralization index (LI) using a variable statistical threshold and different tasks may maximize retention of language activity in tumor and vascular lesion patients, post-surgically.

VSNR31-05 • Diffusion Repeatability Evaluation And Measurement (DREAM)-MRI: A New Technique for Quantifying the Voxel-wise ADC Probability Density Function for Brain Tumor Characterization and Response Measurement

Benjamin M Ellingson MS, PhD (Presenter) *; Timothy F Cloughesy MD *; Whitney B Pope MD, PhD *

PURPOSE
Diffusion MRI has been shown to be valuable for characterizing brain tumor cellularity and response to therapy; however, measurements of ADC can often be prone to noise contamination and other artifacts that lead to inaccurate measurement. We have developed a new method termed “diffusion repeatability evaluation and measurement” (DREAM-MRI) for repeatedly acquiring ADC measurements in a short period of time in order to construct the voxel-wise ADC probability density function (ADC PDF) and provide a measure of uncertainty in ADC estimation. In the current study we have examined this technique in phantoms, normal volunteers, and patients with glioblastoma.

METHOD AND MATERIALS
All scans were performed on a 3T MR system (Siemens Trio; Erlangen, Germany). The ACR and ADNI phantoms were used to test ADC PDF dependence on pulse sequence parameters. A total of 10 healthy volunteers and 5 patients with glioblastoma were enrolled in the current study. DREAM-MRI consisted of a total of 100 diffusion measurements in the x, y, and z direction were obtained within 8 minutes for 10 slices using optimized partial Fourier encoding, parallel imaging, and echoplanar acquisition. ADC PDFs were constructed from the different samples and compared across sequence parameters and tissue types.

RESULTS
ADC PDF variability was lowest using a b-value of 500s/mm², but did not change appreciably across TR, TE, number of acquisitions, shimming technique, or T1 characteristics of the material (from ADNI phantom). Mean ADC and variability in ADC appeared correlated. As expected, normal matter had a lower mean ADC and lower ADC variability compared with gray matter. Serial ADC PDFs showed no appreciable difference when volunteers were rescanned at a later time point. Glioblastoma patients showed low ADC PDF characteristics in tumor regions, which changed serially as a result of radiation therapy.

CONCLUSION
DREAM-MRI is a novel technique for quantifying the voxel-wise ADC PDF and may be useful for evaluation of brain tumor response to therapy.

CLINICAL RELEVANCE/APPLICATION
Diffusion MRI is useful for brain tumor treatment evaluation, but ADC measurement uncertainty is a concern. The DREAM-MRI sequence overcomes this limitation.

VSNR31-06 • Potential Use of Mean Apparent Diffusion Coefficient Values in Defining the Portal for Radiotherapy

Daniel Jeong MD (Presenter); Sharon E Byrd MD; Shalini Garg MD; Mehmet Kocak MD

PURPOSE
A major challenge in treating Glioblastoma Multiforme (GBM) is distinguishing the extent of tumor from surrounding inflammation and edema on conventional MRI sequences. The T1 post contrast and T2/FLAIR sequences are widely utilized to assess tumor extent and define the radiation portal for radiotherapy, but Apparent Diffusion Coefficient (ADC) maps are not as widely used. Multiple authors have shown significant difference in ADC values for tumor, edema, and normal white matter. However, few studies have evaluated ADC values at sites of future tumor recurrence using pre and post treatment MRI exams. The aim of this study is to evaluate pre treatment mean ADC values at sites that gave rise to future tumor recurrence compared to similar background tissue that did not progress to tumor.

METHOD AND MATERIALS
Out of 110 consecutive patients with pathology proven GBM at our institution from 1/1/2009 to 5/31/2012, 20 had definitive post radiotherapy recurrence after 3 months and had received treatment and follow-up imaging at our institution. These 20 patients were included in this single-center retrospective cohort study. Pre and post radiotherapy MRI exams were evaluated, and the sites of tumor recurrence on post treatment exams were correlated with corresponding tissue on pretreatment exams and the type of background surrounding tissue was noted (edema, normal white or gray matter). Mean ADC values were compared for sites of future tumor recurrence and background tissue that did not progress to tumor recurrence.

RESULTS
The mean ADC value of brain tissue on pre-radiotherapy MRI exams in regions of future tumor recurrence was significantly lower than the mean ADC values in regions of surrounding tissue not progressing to tumor (p = 0.002), without noticeable abnormalities seen on conventional T1 post contrast and T2/FLAIR MR sequences.

CONCLUSION
Mean ADC values may help predict sites of future tumor recurrence in GBM, and could be helpful in pre-radiation planning and identifying microscopic tumor prior to gross tumor recurrence on conventional MR imaging.
**VSNR31-07 • Perfusion Methods in CNS Tumors**

**Daniel P Barbiorak MD (Presenter) * **

**LEARNING OBJECTIVES**

1) To gain familiarity with the basic principles used to derive imaging measurements of blood volume, blood flow and capillary permeability in brain tumors. 2) To learn the potential utility of perfusion imaging for providing insight into the processes of neoangiogenesis and into the methods of action of brain tumor therapies. 3) To understand how the challenges of lack of standardization in both image acquisition and analysis are being addressed by national research and cooperative groups.

**ABSTRACT**

In the context of brain tumors, perfusion imaging is a broad term referring to a variety of techniques measuring delivery of blood to tumors, the intrinsic vascularity of tumors, and the permeability of the blood brain barrier. The most commonly used techniques are dynamic susceptibility contrast-enhanced MRI (DSC-MRI), dynamic contrast-enhanced MRI (DCE-MRI) and arterial spin labeling (ASL). The most commonly used figures of merit corresponding to these techniques are relative cerebral blood volume and blood flow (rCBV, rCBF) for DSC-MRI, volume transfer coefficient and initial area under the gadolinium concentration curve (Ktrans, IAUGC) for DCE-MRI and cerebral blood flow (CBF) for ASL. There is considerable interest in using these techniques to grade tumors by predicting either tumor pathology or patient survival, to distinguish between true progression and pseudoprogression / radiation necrosis in patients with recurrent enhancement after treatment, and to provide an earlier or more reliable indicator of patient response to treatment. Without question, perfusion imaging has provided insight into the brain tumor vascular microenvironment, which could be considered a phenotypic characteristic of tumors with important implications for tumor genomics, tumor pathophysiology and drug development. Although these techniques have been shown to influence therapy decisions for individual patients, multicenter clinical trials demonstrating the added value of perfusion imaging have yet to be successfully concluded. In this talk, four questions will be addressed. First, how are figures of merit derived from perfusion imaging related to underlying tumor pathophysiology? Second, how can these figures of merit be derived? Third, why have these techniques not yet been being integrated into routine clinical practice? Finally, what is the future outlook for these techniques?

**VSNR31-08 • Baseline Spin-Echo Echo-Planar Perfusion nCBV > 2.0 prior to Chemoradiation Is a Strong Independent Predictor of Poor Progression-free and Overall Survival in Patients with Newly Diagnosed Glioblastoma**

**Ayca Akgoz MD (Presenter) ; Rifaquat Rahman ; Hui You ; Alhafidz Hamdan ; Ravi T Seethamraju PhD * ; Patrick Y Wen MD * ; Geoffrey S Young MD * **

**PURPOSE**

Prior studies have indicated that gradient-echo echo-planar (GE-EPI) perfusion weighted imaging (PWI) may be helpful in prognostication and treatment assessment in newly diagnosed glioblastoma (GBM) patients. While both animal and limited human data suggest that SE-EPI PWI data is more closely correlated with the presence of neovascularity and survival in GBM than GE-EPI PWI, no large series has assessed this. We assessed whether SE-PWI before and after initiating chemoradiation can stratify patients with respect to progression free survival (PFS) and overall survival (OS).

**METHOD AND MATERIALS**

Sixty-eight glioblastoma patients with interpretable pre and post-treatment SE-PWI were identified. In each study, normalized cerebral blood volume (SE-nCBV) was calculated by hot-spot method from 3 regions of interest (ROI) selected within the areas of maximal cerebral blood volume (CBV) in enhancing and/or non-enhancing tumor and 1 ROI selected within the contralateral normal appearing white matter. Univariate and multivariate Cox proportional hazards model was utilized to identify perfusion parameters predictive for PFS and OS. Receiver operator curve characteristic analysis was used to identify thresholds optimized for 15-month survival, and Kaplan-Meier estimates of PFS and OS were calculated.

**RESULTS**

In multivariate analysis, baseline mean SE-nCBV was predictive of PFS (p=0.038) and OS (p=0.004). Patients with a baseline mean SE-nCBV < 2.0 had a PFS (median 47.0 weeks, p=2.0 (median PFS 25.3, median OS 56.0 weeks). Exploratory multi-group stratification demonstrated that survival was inversely proportional to baseline mean SE-nCBV over a range from 2.0 - 4.0 (p=0.025) suggesting a dose dependency for SE-nCBV as a survival marker.

**CONCLUSION**

Baseline mean SE-nCBV prior to chemoradiation promises to be strongly predictive of poor chemoradiation response and poor survival in the subgroup of GBM patients with SE-nCBV >2.0. Prospective evaluation of SE-nCBV as a marker to select patients for more frequent monitoring and possibly early initiation of adjunctive therapy is indicated.

**CLINICAL RELEVANCE/APPLICATION**

Glioblastoma patients with high SE nCBV prior to adjuvant radiochemotherapy should be monitored particularly carefully and strongly considered for adjuvant therapy when indicated.

**VSNR31-09 • Intravoxel Incoherent Motion of Malignant Brain Tumors: A Validation Study with Pathologic Correlation and Normalized Cerebral Blood Volume**

**Chong Hyun Suh MD (Presenter) ; Ho Sung Kim ; Ji-Won Kang MD ; Seung Soo Lee MD ; Namkug Kim PhD ; Choon Gon Choi MD ; Sang Joon Kim MD **

**PURPOSE**

To validate the perfusion (f) and true diffusion (D) parameters derived from intravoxel incoherent motion (IVIM) MR imaging with pathologic correlation of hypervascular tumor (glioblastoma) and hypovascular tumor (primary CNS lymphoma, PCNSL) and normalized cerebral blood volume (nCBV) derived from dynamic susceptibility contrast MR perfusion imaging.

**METHOD AND MATERIALS**

Our institutional review board approved this study. Fifty-nine consecutive patients (33 men, 26 women, mean age 54.5 years) who had pathologically confirmed glioblastoma (n=38) or PCNSL (n=21) prior to any treatment were assessed using maximum f (fmax) and minimum D (Dmin) derived from IVIM MR imaging. We acquired 16, different b-values. The best predictor for differentiating glioblastoma from PCNSL was determined by receiver operating characteristic (ROC) curve analyses. A corresponding nCBV was used for validation of the fmax using partial correlation analysis.

**RESULTS**

The mean fmax was significantly higher in the glioblastoma group (0.101 ± 0.016) than in the PCNSL group (0.021 ± 0.010) (p < 0.0001). The mean fmin did not significantly differ between the two groups (P = 0.190). fmax was an excellent predictor for differentiating glioblastoma from PCNSL (area under the curve, 0.987; 95% confidence interval (CI): 0.916, 0.996; cut-off value, 0.025, with a sensitivity of 97.4% and a specificity of 90.5%. There was a significant positive correlation between fmax and corresponding nCBV for all cases (r = 0.651; P < 0.0001).

**CONCLUSION**

IVIM MR imaging can be used as a non-contrast, noninvasive imaging method to assess the diffusion and perfusion characteristics of malignant brain tumors.

**CLINICAL RELEVANCE/APPLICATION**
Intravoxel incoherent motion (IVIM) MR imaging allows noninvasive, reliable distinction as part of the diagnostic workup for patients who are suspected of having malignant brain tumors.

**VSNR31-10 • Imaging the Post Therapy Brain**

**Eu-Meng Law** MBBS (Presenter) *

**LEARNING OBJECTIVES**
1) To understand the challenges with current and novel therapeutics for brain tumors, particularly with regard to conventional imaging of the post therapeutic brain. 2) To understand the challenges with defining and characterizing pseudoprogression and the application of advanced MRI methods. 3) To understand pseudo response with anti-angiogenic agents therapy and the application of advanced MRI methods in characterizing pseudo response.

**REFERENCES:**

**VSNR31-11 • Proliferation Rate Estimates Derived from Serial Diffusion MR Scans Correlate with [18F]-FLT PET SUV Values in Recurrent Glioblastoma Treated with Bevacizumab**

**Benjamin M Ellingson** MS, PhD (Presenter) *; **Timothy F Cloughesy** MD *; **Johannes Czernin** MD *; **Whitney B Pope** MD, PhD *

**PURPOSE**
Proliferation rate estimates from cell invasion, motility, and proliferation level estimate (CIMPLE) maps derived from fitting a novel spatiotemporal mathematical model to serial diffusion MR data have been shown to correlate with choline-to-NAA ratio using NMR spectroscopy, glioma grade, and PFS/OS during bevacizumab. These maps predict future contrast enhancement in approximately 30% of patients on bevacizumab, as suggested in a recent pilot study. Proliferation rates based on the time-rate-of-change in ADC values within a voxel may reflect proliferative potential. The current study examined the relationship between CIMPLE map estimates of proliferation rate and 18F-FLT PET SUV, a molecular marker of DNA synthesis, in order to test whether CIMPLE maps could spatially localize regions of proliferative tumor.

**METHOD AND MATERIALS**
Fourteen patients were enrolled in the current pilot study. All patients had at least three MRI scans and one 18F-FLT PET scan during bevacizumab therapy. MR scans consisted of at least a T2w, post-contrast T1w, and diffusion MR scan with b=0 and 1000s/mm². Diffusion MR scans were distortion corrected, then all follow-up MR scans were registered to the first post-treatment MR scans. CIMPLE maps were generated by fitting a voxel-wise spatiotemporal model of cell invasion and proliferation, assuming ADC a surrogate for cell density. A new matrix solution to the CIMPLE map algorithm was implemented for patients with >3 scans. 18F-FLT PET scans were acquired during the period of MR evaluation. PET SUV scans were co-registered to MR space for subsequent analyses.

**RESULTS**
Regions with high proliferation rate on CIMPLE maps appeared generally colocalized to regions of 18F-FLT PET. Average proliferation rate within contrast-enhancing regions was highly correlated with average 18F-FLT PET SUV (Pearson’s correlation coefficient, R² = 0.79, P<0.05). CIMPLE maps provided a non-invasive method for estimating tumor growth dynamics, which may be useful for treatment monitoring and predicting tumor progression.

**CLINICAL RELEVANCE/APPLICATION**
CIMPLE maps provide a non-invasive method for estimating tumor growth dynamics, which may be useful for treatment monitoring and predicting tumor progression.

**VSNR31-12 • Change in ADC of High Grade Glioma Infiltrative Component during Radiotherapy Predicts Treatment Response and Time-to-Progression**

**Jin Rong Qu** MD, PhD; **Jian-Ping Dai** MD; **Tao Jiang**; **Ayca Akgoz** MD (Presenter); **Ravi T Seethamraju** PhD *; **Qifeng Wang**; **Shao-Wu Li**; **Lin Ai**; **Tianzi Jiang** PhD; **Geoffrey S Young** MD *

**PURPOSE**
Apparent diffusion coefficient (ADC) derived from diffusion-weighted imaging (DWI) is a promising marker for cellularity in a wide range of tumors. While change in ADC during chemoradiation is a rational marker for prediction of high grade glioma (HGG) patient response and prognosis, mixed success has been reported to date. This may be because temozolamide chemotherapy and angiogenesis inhibition induce changes in vascular permeability and edema that confound the correlation of ADC with cellularity. As such, we hypothesized that ADC should perform well as a marker of survival in a cohort of patients treated with radiotherapy (RT) alone.

**METHOD AND MATERIALS**
In 25 patients who had undergone resection of HGG, ADC was measured in ROI placed in residual solid and infiltrative tumor before and after 30Gy RT. RT response during radiation was classified as complete resolution (CR), partial response (PR), stable disease (SD), or progressive disease (PD) based on conventional anatomic MRI images. Change in ADC during RT was correlated with treatment response, TTP and OS.

**RESULTS**
As predicted, RT response correlated significantly with TTP (0.59; p=0.002). Median TTP was 49.9 days for patients with PD compared with 202.7 days for SD, 208.0 days for PR, 234.5 days for CR. The ADC of the residual solid tumor increased during RT in the CR group but did not significantly change in the PD group. ADC of infiltrative tumor increased during RT in PD. Increase in infiltrative tumor ADC correlated significantly with shorter TTP (0.455; p=0.005). Correlation between increase in solid tumor ADC and longer TTP (0.286; p=0.249) did not reach statistical significance but showed a trend consistent with the prior literature.

**CONCLUSION**
Decrease in non-enhancing infiltrative tumor ADC correlates with better RT response and longer progression free survival of HGG patients treated with radiation alone. This supports our hypothesis that temozolamide chemotherapy and angiogenesis inhibition effects on vascular permeability may significantly confound the use of ADC for detection of HGG response.

**CLINICAL RELEVANCE/APPLICATION**
Increase in ADC of infiltrative tumor during RT of HGG correlates with worse treatment response, shorter time to progression and decreased overall survival.

**PEDIATRIC RADIOLOGY SERIES: CHEST/CARDIOVASCULAR IMAGING I**

**Tuesday, 08:30 AM - 12:00 PM • S102A**

**VSNR31 • AMA PRA Category 1 Credit ™: 3.25 • ARRT Category A+ Credit: 3.5**
VSPD31-01 • State of the Art MRI and MRI of Congenital Heart Disease

Francis Chan MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) To review the MRI environment and anesthesia requirements for pediatric patients with congenital heart disease. 2) To understand what MRI can do that echocardiography or catheter angiography cannot, and how this is used to advantage in congenital heart disease. 3) To explore advanced techniques, such as four-dimensional phase contrast imaging, real-time imaging, and non-contrast coronary angiography, that can expedite and increase the capability of cardiac MRI studies.

ABSTRACT
Cardiac MRI is an established imaging tool for the assessment of congenital heart disease in children and adults. The lack of oncongenic radiation makes MRI the preferred tool over CT. However, in young patients who require general anesthesia, the imaging should be familiar with the risks involved. While usually safe, general anesthesia has heightened risk in patients with aortic obstruction, pulmonary hypertension, arrhythmia, and ventricular failure. In current clinical practice, the three-dimensional capability of cardiac MRI is used to accurately assess ventricular volume and function. Flow measurement by two-dimensional phase contrast is used to assess shunt ratio, cardiac output, and valvular regurgitation. Comprehensive cardiac MRI examination for a patient with complex congenital heart disease can be time-consuming, and it requires an MRI operator with considerable skill and knowledge of cardiac anatomy. Four-dimensional phase contrast imaging capture a volume of the cardiac anatomy and flow physiology, which can be analyzed by post-processing, thereby simplifying the scan protocol and shortening the study time. Other advanced MRI techniques include real-time and pseudo-gated imaging for fetal studies, delayed-enhancement of myocardium for endocardial fibroelastosis, and MR coronary angiography for coronary anomalies.

VSPD31-02 • Clinical Validation of Free Breathing Navigator Triggered Retrospectively Cardiac Gated Cine Steady-state Free Precession (NAV-SSFP) Imaging in Sedated Children

Lamya A Atweh MD (Presenter) ; Amol Pednekar PhD * ; Siddharth P Jadhav MD ; Esben S Vogelius MD ; Raja Muthupillai MD * ; Rajesh Krishnamurthy MD *

PURPOSE
The cine steady-state free precession (SSFP) is the preferred sequence for venicular function evaluation, however it requires suspended respiration which is difficult in sedated children. Many groups perform multi-NSA acquisitions (MN) during free breathing. In this work, we validate a navigator triggered SSFP (NAV-SSFP) sequence that drives the magnetization to steady-state before cardiac gated cine acquisition in the sedated free-breathing pediatric population.

METHOD AND MATERIALS
This prospective study was performed with IRB approval on 20 sedated children with congenital heart disease (age: 7±6 yrs, HR: 97±22 bpm, Respr: 22±9 bpm). The cine SSFP sequence was modified to include respiratory triggering with Navigator [1]. Imaging was performed on a 1.5T MR scanner. Identical imaging parameters were used for MN (4 NSA) and NAV sequences, covering both ventricles in short-axis orientation (TR/TE/flip angle: 3/1.6/60°; acquired voxel size: 1.3-1.6 x 1.3-1.8 x 4-9.5 mm3; SENSE acceleration factor: 2; temporal resolution: 30-45 ms). Image quality assessment (Figure 1) and quantitative volumetric analysis was performed by a single blinded user. One-sided Wilcoxon signed rank test and Box plot analysis were performed to compare the clinical scores. Bland-Altman (BA) analysis was performed on LV and RV volumes.

RESULTS
The clinical scores for NAV-SSFP were consistently better than MN-SSFP (Table 1). Total score with equal weights to each clinical score category was significantly better for NAV compared to MN. EDef scores were significantly better for NAV-SSFP than MN-SSFP. ISA scores were identical. The BMC scores were not significantly different. BA analysis for LV volumes indicates that variability between NAV and MN acquisitions is comparable to inter and intra-observer variability reported in the literature (Table 2) [2]. Total scan duration for NAV-SSFP (4.1±1.6 min) was shorter than MN-SSFP (5.2±0.8 min).

CONCLUSION
Modifying the cardiac gated cine SSFP sequence for free-breathing and navigator triggering allows clinically diagnostic images in sedated patients without penalty for contrast, spatio-temporal resolution, or total scan time while significantly decreasing RF duty cycle and improving spatial detail. 1 ISMRM 3938, 2012 2 JMRI 28(39-50), 2008

CLINICAL RELEVANCE/APPLICATION
Free-breathing navigator triggered cine SSFP allows diagnostic images in sedated patients with improved spacial resolution and shorter scan times.

VSPD31-03 • Noninvasive 4D Pressure Difference Mapping Derived from 4D Flow MRI in Patients with Repaired Aortic Coarctation: Comparison with Young Healthy Volunteers

Fabian Rengler MD (Presenter) ; Michael Delles DiplEng ; Joachim Eichhorn MD ; Hendrik Von Tengg-Kobligk MD * ; Hans-Ulrich Kauczor MD * ; Roland Unterhinninghofen PhD ; Sebastian Ley MD

PURPOSE
In patients with aortic coarctation, pressure measurements before and after repair currently are obtained by invasive catheterization or by echocardiography using the Bernoulli equation. Purpose of this study was to assess spatial and temporal pressure changes in patients with repaired aortic coarctation compared to young healthy volunteers using 4D flow MRI and derived 4D pressure difference maps.

METHOD AND MATERIALS
4D flow MRI of the thoracic aorta was performed at 1.5T in 13 patients after aortic coarctation repair without recoarctation (mean age 18.8 years, 5 female, 8 male) and 13 healthy volunteers (mean age 22.9 years, 4 female, 9 male). Spatial/temporal resolution was 1.6x1.6x2.1mm³/28ms. Using published algorithms and in-house developed image processing software, 4D pressure difference maps relative to the proximal ascending aorta were computed based on the Navier-Stokes equation. The thoracic aorta was divided into four segments: ascending aorta, aortic arch, proximal descending aorta, and distal descending aorta. For each segment, spatial pressure range at mid systole and maximum slope of local pressure amplitudes were calculated.

RESULTS
Mean spatial pressure range at mid systole for patients/volunteers was (in mmHg): ascending aorta 1.8/1.6 (p=ns), arch 4.8/1.7 (p=0.02), proximal descending 8.9/1.6 (p

CONCLUSION
Noninvasive 4D pressure difference mapping derived from 4D flow MRI showed significant spatial and temporal changes in patients with repaired aortic coarctation compared to young healthy volunteers, particularly affecting aortic arch and proximal descending aorta, but also distal descending aorta. The technique can characterize such changes not only noninvasively but also in greater detail than echocardiographic pressure gradient measurements.

CLINICAL RELEVANCE/APPLICATION
4D pressure difference mapping can characterize spatial and temporal changes of intraluminal aortic pressure and may evolve into a
Underwent Bidirectional Glenn Shunting

VSPD31-04 • Assessment of Conduit Size prior to Percutaneous Pulmonary Valve Replacement: Which MR Sequence Is Best?

LaDonna J Malone MD (Presenter) ; Jane Gralla ; Uyen Truong ; Brian Fonseca ; Thomas Fagan MD ; Lorna Browne MD, FRCR

PURPOSE

The advent of percutaneous pulmonary valve replacement (PVR), providing a nonsurgical approach to the management of severe pulmonary regurgitation in patients with right ventricle to pulmonary artery (RV-PA) conduits, has transformed treatment of patients with repaired congenital heart disease. Cardiac MRI (CMR) is increasingly relied upon to determine candidacy for percutaneous PVR using angiographic size criteria. In order to optimize the CMR assessment, our goal was to determine which pulse sequence had the best agreement with conventional angiographic measurement of the right ventricle to pulmonary artery (RV-PA) conduit obtained during percutaneous PVR.

METHOD AND MATERIALS

15 patients had CMR performed prior to percutaneous PVR procedure. Measurements of the narrowest diameter of the RV-PA conduit were obtained on the following sequences: cine gradient echo (GE) at end-systole and at end-diastole, T1 TSE obtained in systole, 3D gadolinium enhanced MRA, and 3D SSFP. Multplanar reformats using 3D reconstruction software were used to measure both AP and transverse dimensions on 3D sequences, but only AP diameters if an RVOT plane was obtained (cine GE and T1 TSE). These were compared to angiographic measurements using Bland Altman plots and Intraclass Correlation Coefficient (ICC).

RESULTS

Cine GE measurements at end-systole had the best agreement with angiogram with a mean difference of 0.8 mm (95% limits of agreement -3.8 to 5.46 and ICC 0.75). The AP dimension on 3D MRA also had a high ICC (0.85) and a relatively narrow 95% limits of agreement (-0.89-5.67), but demonstrated a consistent over-measurement bias with a mean difference from angiogram of 2.39 mm. The 3D SSFP measurements demonstrated the worst agreement, likely due to inherent artifacts in stenosed conduits. Slow flow artifact on T1 TSE impaired accurate measurement in irregularly calcified conduits.

CONCLUSION

RV-PA conduit measurements obtained from cine GE at end-systole and 3D MRA demonstrate strongest agreement with conventional angiographic measurements in evaluating percutaneous PVR candidacy.

CLINICAL RELEVANCE/APPLICATION

Standardization of RV-PA conduit measurements with improved angiographic agreement should decrease incidence of unsuccessful percutaneous PVR procedures related to failure to meet size criteria.

VSPD31-05 • Noninvasive Quantification of Aortopulmonary Collateral Flow and Intracardiac Shunt Flow for the Patients who Underwent Bidirectional Glenn Shunting

Rongpin Wang MD (Presenter) ; Qiping Deng MD ; Meiping Huang MD

PURPOSE

To explore the feasibility of calculating aortopulmonary collateral flow (APCF) and intracardiac shunt flow (ICSF) in patients underwent bidirectional Glenn shunt (BGS) by using phase-contrast MRI (PC-MRI) sequence.

METHOD AND MATERIALS

Twenty-two BGS patients (patient group) and 15 healthy volunteers (control group) were performed at 3.0 tesla MR system by using PC-MRI sequence to measure the flow of great vessels of right pulmonary artery (RPA), left pulmonary artery (LPA), ascending aorta (AA), superior vena cava (SVC) and inferior vena cava (IVC). The quantity of AA (Qa), pulmonary (Qp) and venous return (Qv) per minute were calculated by using Report Card software. APCF and ICSF was calculated as the formula: APCF= Qp-QV, ICSF= 2QV - (Qa+Qp). The end-diastolic volume index (EDVI) of major ventricle were measured with cine-MRI sequence, and the regurgitation area of atrioventricular valve were measured with ultrasound cardiology. The difference of Qp, Qs and Qv and blood flow of great vessels were assessed by using paired samples t-test. The relationship of ICSF with EDVI of major ventricle and with the regurgitation area of atrioventricular valve was found with correlation and regression analysis.

RESULTS

In control group, Qp: Qs: Qv were found to be 1: 1.009: 0.974. In patient group, Qs was found significantly higher than Qv, and Qv was significantly higher than Qp. The blood flow of great vessels in patient group were found to be significantly lower than that of in control group except the flow of AA, while the regurgitation fraction of great vessels in patient group were found to be significantly higher than that of in control group. The APCF ranged from 0.22 to 1.29 l/min/m² (mean 0.88 l/min/m²), and the ICSF ranged from 0.22 to 1.29 l/min/m² (mean 0.61 l/min/m²). A positive relationship between ICSF and EDVI and the regurgitation area of atrioventricular valve were found (r=0.685, and r=0.806).

CONCLUSION

The parameters of blood flow of great vessels can be reliably measured with PC-MRI sequence on 3.0 tesla MR system. And then, the APCF and ICSF can be calculated.

CLINICAL RELEVANCE/APPLICATION

The APCF and ICSF can be calculated simultaneously in BGS patients by using phase-contrast MRI sequence, which may play an important role for therapeutic decision-making and evaluating prognosis.

VSPD31-06 • Evaluation of the Pulmonary Vasculature in Mouse Models of Congenital Diaphragmatic Hernias

Michael Phillips ; Daku Siewe BS (Presenter) ; Joshua C Tan ; Scott Moore ; Sean McLean ; Yueh Z Lee MD, PhD *

PURPOSE

Congenital diaphragmatic hernia (CDH) is a common birth defect that leads to pulmonary hypertension. Decreased arterial development in the lung contributes to the pulmonary hypertension observed in CDH. The Slit3 knockout mouse is a viable mouse model for CDH that develops pulmonary hypertension (Phtn). We sought to quantitatively assess pulmonary artery blood vessel development using specimen CT scanning of the perfused pulmonary vasculature of mouse models of CDH.

METHOD AND MATERIALS

We perfused the pulmonary vasculature of 3 month old Slit3 wild type mice (no hernia) to Slit 3 knock mice (CDH/Phtn) using a radio-opaque material (microfil) with density tailored to minimize venous contamination. Vessel overfill was determined through examination by microscope. The mouse lungs with the filled vasculature were excised and scanned on a specimen scanner (Scanco microCT 40) at 8 micron resolution. The data was transferred for offline analysis using InTuition (Terarecon). Vessel branching, length and diameter were measured.

RESULTS

5 wildtype (Slit3) and 5 CDH (Slit3 KO) were scanned. Severe hypoplasia was evident in the lungs from the CDH mice. Total lung volume was decreased in the knockout mice, consistent with the presence of a CDH. Vessel overfill The pulmonary vasculature was also altered, reflecting the abnormal development. Branch by branch vessel quantitation analysis is ongoing.

CONCLUSION

Quantitative analysis of pulmonary vasculature specimens from mice is readily feasible, providing a powerful new tool for the evaluation of mouse models of disease that effect the lung and lung development. We hope to combine our novel methods of in-vivo and ex-vivo
Translational Experience in the Treatment of Duchenne Muscular Dystrophy (DMD) by Intra-arterial Transplantation of Mesoangioblasts (MABs): From a Toxicity Study in 10 Beagle Dogs to the First, Phase-1 Study in 3 Dystrophic Children

Maik Weidner (Presenter); Frank G Zoellner; Claudia Hagelstein MD; Stefan O Schoenberg MD, PhD *; Katrin Zahn; Thomas Schable; Lothar R Schad PhD; Wolfgang Neff MD, PhD

PURPOSE
Congenital diaphragmatic hernia (CDH) leads to lung hypoplasia. Using dynamic contrast enhanced (DCE) MR imaging, lung perfusion can be quantified. As according to simulations absolute MR perfusion values depend on temporal resolution, we compared two different MR protocols to investigate firstly if impaired ipsilateral lung perfusion is present with both protocols in 2-year old children after CDH repair, secondly if simulation results can be confirmed and thirdly which protocol should be preferred.

METHOD AND MATERIALS
DCE-MRI was performed in 36 children after CDH repair using a 3D TWIST sequence. Two MR protocols were applied: protocol A (n=18) based on a high spatial (3.0sec/voxel size:1.25x1.25x1.25mm3) and protocol B (n=18) on a high temporal resolution (1.5sec/voxel size:2x2x2mm3). 0.05mmol/kg body weight of contrast agent (Dotarem, Guerbet, France) was administered. Pulmonary blood flow (PBF) was calculated for both lung sides by placing 6 cylindrical regions of interest (ROI), apical, middle and basal, in the ventral and the dorsal lung, respectively. Peak signal to noise ratio (PSNR) was calculated.

RESULTS
In 2-year old children after CDH repair ipsilateral lung perfusion is significantly reduced. Higher temporal resolution and increased voxel size show a gain of PSNR and significantly decrease the underestimation of PBF. Protocol B should therefore be preferred, as a 2 mm3 isotropic voxel resolution is sufficient to detect side-differences of lung perfusion.

CLINICAL RELEVANCE/APPLICATION
In the long-term follow up of children after CDH, MR-perfusion imaging can help to quantify lung impairment without ionizing radiation. A temporal resolution of 1.5 sec is advisable.

Coronary Artery Imaging in Children

Massimo Venturini MD (Presenter); Giulio Cossu; Letterio S Politi MD; Michele Colombo; Giulia Agostini; Alessandro Del Maschio MD

PURPOSE
Literature lacks of complete, single-center translational studies. DMD, a genetic syndrome characterized by progressive absence of dystrophin protein, causes progressive muscle degeneration, paralysis and death. Corticosteroids are not effective, while novel therapies (gene/stem cells) are on work. Our aim was to assess MABs intra-arterial infusion in Beagle dogs and, subsequently, in 3 dystrophic children, at escalating dose, to preliminarily assess the safety.

METHOD AND MATERIALS
Every 3 weeks, 10 dogs, under immunosuppressive treatment (cyclosporine-A), were submitted to 4 intra-arterial infusions each (2 in one lower limb, 2 multidistrict) using a 4-Fr introducer/catheter. Efficacy was assessed every 2 months by quantitative measurements (Kin-Com-test) and thighs/legs fibro-fatty degeneration/quantification (MRI), and after 8 months by gastrocnemius biopsies.

RESULTS
No mortality related to MABs in Beagle dogs was recorded. The 12 intra-arterial MABs infusions were regularly performed with no peri-procedural complications, except for one successfully treated vasospasm. The only relevant complication was 1 focal thalamic ischemia of 1-cm (MRI) that occurred 5 hours after the fourth infusion, after sporadic atrial fibrillation (EKG) (Atrial-fibrillation-related-thrombosis? Late vasospasm?), without consequences. Relative stabilization/decrease in disease progression was observed. At MRI, a stabilization of fibro-fatty degeneration was more evident in the child treated at an earlier disease stage.

CONCLUSION
Our translational experience about MABs intra-arterial infusion in DMD, showed no signs of toxicity in beagle dogs and a relative safe and partial effective in dystrophic children, with encouraging future perspectives.

CLINICAL RELEVANCE/APPLICATION
In DMD, a major MABs intra-arterial concentration, transplanted exclusively in the lower limbs, at an early disease stage, could determine an improvement of dystrophin restoration and clinical impact.

Coronary Artery Imaging in Children

Cynthia K Rigsby MD (Presenter)

LEARNING OBJECTIVES
1) To provide an overview of the imaging modalities used to image coronary arteries in children. 2) To show examples of anomalies of coronary artery origin, course, and termination. 3) To illustrate coronary artery anomalies associated with congenital heart disease. 4) To demonstrate coronary artery findings in Kawasaki disease.

ABSTRACT
Coronary artery anomalies can be classified as anomalies of origin and course, anomalies of coronary termination, coronary anatomy with congenital heart disease and acquired coronary abnormalities. Normal coronary artery anatomy and an imaging focused discussion of each of the different type of coronary abnormalities will be presented.

Correlation of CT and MR findings with Surgery for Anomalous Aortic Origin of Coronary Arteries (AAOCA)

Lamya A Atweh MD (Presenter); Carlos M Mery MD; Prakash M Masand MD; Silvana M Lawrence MD, PhD; Dean E McKenzie; Rajesh Krishnamurthy MD *

PURPOSE
Anomalous aortic origin of the coronary artery (AAOCA) is commonly evaluated with magnetic resonance imaging (MRI) or computed tomography (CT) prior to surgery. Imaging targets include ostial location and morphology, intramuralrity, and presence of proximal stenosis. Precise description of the AAOCA morphology is important for surgical planning. Our objective is to correlate CT and or MRI with
METHOD AND MATERIALS

IRB approval was obtained for our retrospective study. We identified all patients with AAOCA who were operated at our institution from 2003-2013. Patients who had no imaging available for review were excluded. Imaging was reviewed by a pediatric radiologist with 13 years of experience in cardiac imaging who was blinded to the results of the surgeries. Studies were assessed for the type of AAOCA, location and morphology of the anomalous ostium, right-left ostial relationship, and presence and length of intramural course. Surgical findings in this high-risk population.

RESULTS

The patient population consisted of 16 patients (M:F = 10:6; age: 10 years ± 5), with 8 CT and 10 MR exams. 2 patients had both MRI and CT. CT was more accurate than MRI for all imaging targets (Table). MRI accurately predicted the type of coronary artery anomaly (90%) and ostial location (80%), but fared poorly in predicting type of R-L ostial relationship (60%), ostial morphology (10%) and intramurality (30%). Apart from its high accuracy for imaging targets, CT also provided virtual angioscopic views of the ostia that simulated surgical exposure.

CONCLUSION

CT is more accurate than MRI for characterization of critical imaging targets of AAOCA.

CLINICAL RELEVANCE/APPLICATION

CT is more accurate than MRI in defining ostial morphology, ostial relationship and intramural course and should be the imaging method of choice for AAOCA.

VSPD31-11 • Compression of the Left Anterior Descending Artery during Percutaneous Pulmonary Valve Replacement: The Protective Role of Epicardial Fat?

Ladonna J Malone MD (Presenter) ; Uyen Truong ; Brian Fonseca ; Thomas Fagan MD ; Lorna Browne MD, FRCR

PURPOSE

The advent of percutaneous pulmonary valve replacement (PVR), providing a nonsurgical approach to the management of severe pulmonary regurgitation in patients with right ventricle to pulmonary artery (RV-PA) conduits, has transformed treatment of patients with repaired congenital heart disease. Extrinsic compression of the left anterior descending artery (LAD) during percutaneous PVR is a rare but potentially catastrophic complication, necessitating preoperative selective coronary angiogram with test balloon inflation to assess risk. If LAD occlusion is demonstrated, the percutaneous PVR is aborted. Cardiac MRI (CMR) is the gold standard in measuring RV size and optimal timing of PVR. Although LAD anatomy is well delineated on CMR, the minimum separation between the RV-PA conduit and LAD that would prevent LAD compression is unknown.

METHOD AND MATERIALS

16 patients underwent CMR prior to percutaneous PVR. Prior to PVR, 2 patients demonstrated extrinsic compression of the LAD during test balloon inflation while the other 14 did not. CMRs in both groups were retrospectively reviewed and the following data recorded in each: i) shortest distance between LAD and RV-PA conduit, ii) presence of circumferential epicardial fat surrounding the LAD, iii) thickness of conduit calcification, iv) proximal LAD course and v) relative position of the great vessels. Mean distance and minimum distance between LAD and RV-PA conduit were calculated in all patients and parameters in both patient groups compared.

RESULTS

In patients without extrinsic LAD compression, the mean distance from LAD to RV-PA conduit was 6.8 mm. The minimum distance was 1.6 mm. All these patients demonstrated a circumferential cuff of epicardial fat between the LAD and RV-PA conduit. Both patients with LAD compression had no measureable distance (0 mm) between the conduit wall and LAD, and a circumferential cuff of epicardial fat was absent. There was no significant difference in conduit calcification thickness between the two groups.

CONCLUSION

A circumferential cuff of epicardial fat between the LAD and RV-PA conduit decreases risk of extrinsic LAD compression during percutaneous PVR.

CLINICAL RELEVANCE/APPLICATION

The absence of a circumferential cuff of epicardial fat between the LAD and RV-PA conduit on a pre PVR CMR should raise concern for potential LAD compression during percutaneous PVR.

VSPD31-12 • Cardiovascular CT in Neonates and Infants: Comparison of Effective Radiation Dose between Target-mode Prospective EKG-gated Volumetric CT Using 320 Detector Scanner and Ungated CT Using 64-slice Scanner

Siddharth P Jadhav MD (Presenter) ; Prakash M Masand MD ; Rajesh Krishnamurthy MD *

PURPOSE

The target mode of prospective EKG gating with the volumetric 320 detector scanner provides cardiac pulsation-related motion compensation for cardiovascular imaging without increasing radiation exposure when compared to ungated volumetric studies. The objective of this study is to compare target mode volumetric imaging (320) to ungated 64 slice imaging (64) for cardiovascular studies in neonates and infants for image quality, diagnostic efficacy and radiation exposure.

METHOD AND MATERIALS

Following IRB approval, a retrospective evaluation of our experience with CTA for cardiovascular indications in neonates and infants aged 0-6 months was performed. 29 patients who underwent ungated imaging with 64 slice scanner from 2010-2012, and 22 patients who underwent volumetric imaging with the target protocol on the 320 detector scanner in 2012-2013 were included. Parameters collected included clinical history, indication for CT, qualitative assessment of image noise and pulsation related blurring, diagnostic efficacy, and radiation dose parameters (CTDI and DLP). Comparison was made to catheterization data and surgical reports for diagnostic accuracy.

RESULTS

The distribution of clinical indications was comparable between the 64 and 320 groups, and included status of branch pulmonary arteries in Tetralogy of Fallot, evaluation of aortopulmonary collaterals or ductal dependent pulmonary flow in pulmonary atresia, anomalous pulmonary venous return, pulmonary vein stenosis in patent ductus, hepatic or saphenous, and vascular mediated airway compromise. All studies were diagnostic for the main clinical indication. Average DLP for target 320 studies was 11.6, with average effective dose of 0.75 mSv using conversion tables from ICRP publication 103. Average DLP for 64 slice studies was 63.88, with average effective dose of 4.31 mSv. The 320 studies resulted in higher image quality related to less pulsation artifact, with visualization of coronary origins in all but one case.

CONCLUSION

Volumetric imaging with the target mode offers several advantages over previous generation scanners for cardiovascular indications in infants, including a 82% reduction in effective dose, ability to perform free-breathing studies, and improved image quality.

CLINICAL RELEVANCE/APPLICATION

Volumetric imaging with target-mode of EKG gating offers improved image quality and reduced radiation dose when compared to 64 slice CT for cardiovascular imaging in neonates and infants.

VSPD31-13 • Radiation Dose and Image Quality Comparison of Three Scan Schemes in Retrospective ECG-gated Coronary CT Angiography for Pediatric Patients

Zhiming Liu MD (Presenter) ; Yong Li Cao ; Yun Peng MD

PURPOSE

The target mode of prospective EKG gating with the volumetric 320 detector scanner provides cardiac pulsation-related motion compensation for cardiovascular imaging without increasing radiation exposure when compared to ungated volumetric studies. The objective of this study is to compare target mode volumetric imaging (320) to ungated 64 slice imaging (64) for cardiovascular studies in neonates and infants for image quality, diagnostic efficacy and radiation exposure.
Purpose
Retrospective ECG-gated coronary CT angiography (CCTA) is often used in children because of their higher heart rates. In this study, we assessed the image quality and radiation dose of three scan schemes in order to select an optimal retrospective CCTA technique for maximum dose reduction.

Method and Materials
60 consecutive patients (ages: 2 months - 13 years) were randomly assigned to three groups (20 in each group) for retrospectively ECG-gated CCTA with different tube current (mA) selection schemes. The tube voltage was 80kV, gantry rotation speed was 0.35s and helical pitches were between 0.16 and 0.20 based on patient heart rates for all groups. Group A used a fixed 350mA, group B used ECG modulated mA (350mA for 40-80% cardiac phases and 70mA for other phases), and group C also applied patient-dependent mA selection scheme for ECG modulation. The patient-dependent mA selection method was based on the CT value measurement in the scout view for individual patients. Image quality was assessed and image noise and CTDI value were measured for the three groups, and statistically compared with SPSS13.0.

Results
Image noises and their standard deviations were 25.5±4.3HU, 25.0±4.8HU and 24.8±1.2HU, respectively, with no difference among the three groups (p>0.05). Group C had much less deviation in image noise than groups A and B. There was no statistical difference between image quality scores among the three groups (4.3±0.4, 4.4±0.3 and 4.5±0.4, all p>0.05). The effective doses were 4.39mSv, 3.23mSv and 2.34mSv for groups A, B and C, respectively. Dose reductions of 26% and 47% were achieved for groups B and C, respectively, compared with group A with the use of a fixed mA. Group C with the patient-dependent mA for ECG modulation had the lowest effective dose.

Conclusion
Patient-dependent tube current scheme in retrospective CCTA for pediatric patients allows us to achieve a desired and consistent image quality across patient population, with the lowest radiation dose to patients.

Clinical Relevance/Application
Low kVp and patient-dependent mA in retrospective CCTA for pediatric patients allows us to achieve a consistent image quality across patient population, with the lowest radiation dose to patients.
LEARNING OBJECTIVES
1) Describe the relevant complex cardiac anatomy encountered in CHD adolescents and young adults, many of whom have undergone prior surgical repairs. 2) Describe the most likely lesions encountered in CHD adolescents and young adults. 3) Discuss some common surgical repairs and encountered complications. 4) Determine appropriate MR protocols for evaluating congenital heart disease according to the anatomic, pathologic, and hemodynamic characteristics of the defect and type of previous surgical repair. 5) Discuss the main clinical questions that are specifically posed in individual cases of pre and post operative CHD in adolescents and young adults.
MSAS32A • PET/MR-Should You Add One To Your Practice

David A Bluemke MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Describe the components of an integrated MRI-PET scanner. 2) Describe the potential applications of an MRI-PET scanner.

ABSTRACT
There are many conditions for which both MRI and PET data are required for patient triage and diagnosis. There are several strategies for integrating this information in a single examination. Most recently, an integrated MRI-PET unit has been developed and is commercially implemented. Potential advantages of MRI-PET include time savings for the patient, reduced radiation dose and improved registration of the MRI-PET data. In addition, simultaneous acquisition of MRI and PET data could potentially be used to assess molecular receptors in combination with functional stimuli. This lecture will discuss the current state of the art for MRI-PET scanning, potential applications as well as current limitations of the technique.

MSAS32B • MR Elastography

Richard L Ehman MD (Presenter) *

LEARNING OBJECTIVES
1) Describe in simple terms the technology underlying MR Elastography. 2) Discuss the indications for MR Elastography of the liver.
3) Describe the findings of hepatic fibrosis as observed with MR Elastography.

ABSTRACT
Many diseases markedly affect the mechanical properties of tissues. This accounts for the efficacy of palpation, a centuries-old technique of clinical medicine. MR Elastography (MRE) is an MRI-based technique for quantitatively assessing the mechanical properties of tissue. The most important current application of MRE is for diagnosing hepatic fibrosis. Chronic liver disease is a serious worldwide problem, and hepatic fibrosis is the most important consequence, which if not detected and treated, eventually leads to cirrhosis which is irreversible and associated with high mortality. MRE can be readily implemented on a standard MRI system. The technology is available as an FDA-approved option from several manufacturers of MRI systems. A drum-like “passive” acoustic driver is used to generate vibrations in the abdomen. The resulting mechanical waves are imaged with a special MRI pulse sequence. Imaging time is approximately 15 seconds, using parallel acquisition techniques and is done during suspended respiration. The MRE data are automatically processed by the MRI scanner to generate quantitative images showing the stiffness of the liver and other tissues in the upper abdomen. Multiple published studies have established that MRE is an accurate method for diagnosing hepatic fibrosis. MRE-measured hepatic stiffness increases systematically with fibrosis stage. Importantly, hepatic stiffness is not systematically influenced by the presence of steatosis. For many patients, MRE offers a more comfortable, safer, and less expensive alternative to biopsy for assessment of hepatic fibrosis.

MSAS32C • Silent MR

Frank R Korosec PhD (Presenter) *

LEARNING OBJECTIVES
1) Understand why MRI scanners make sound while scanning. 2) Describe some of the potential benefits of scanning without sound.
3) Identify differences in images acquired with sound-producing versus early-stage silent MR scans.

ABSTRACT
Since MRI was developed, the scanners have made sound while scanning due to activation and de-activation of the magnetic field gradients. As the gradients have become stronger and faster, the sound has become louder. There are a number of implications of the loud scans, including reports of transient hearing loss by patients (which can be ameliorated by providing hearing protection to the patients), patient anxiety, difficulty communicating with the patients, difficulty keeping infants asleep during scans, interference with measurements of brain activity when performing fMRI scans, as well as a host of other inconveniences. Recently, methods have been developed that allow MR scans to be performed without producing sound. Silent MR scanning will be described during this session. A variety of sequences (designed for different applications) will be summarized, and images obtained with these sequences will be compared with images obtained using standard sequences.

Case-based Review of Nuclear Medicine: PET/CT Workshop-Cancers of the Abdomen and Pelvis (In Conjunction with SNM/MII) (An Interactive Session)

Tuesday, 10:30 AM - 12:00 PM • S406A

MSCC32 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

Director
John A Parker, MD, PhD
Jacqueline C Brunetti, MD

LEARNING OBJECTIVES
1) Demonstrate an understanding of normal distribution of FDG PET in the abdomen and pelvis and possible pitfalls in interpretation of PET/CT scans of the abdomen and pelvis. 2) Understand the variability of FDG PET metabolic activity in specific abdominal and pelvic malignancies and apply this knowledge to optimally utilize this modality for the most efficient and accurate patient care. 3) Understand the current accepted indications of FDG PET/CT in diagnosis, staging and restaging in neoplasms of the abdomen and pelvis.

ABSTRACT
FDG PET/CT has evolved into a routine tool in the diagnosis, staging and restaging of cancer patients. The accuracy and clinical benefit of the technique, however, are dependent on the glycolytic activity of the specific neoplasm, the background activity and the pattern of spread of metastatic disease. As the healthcare system is increasingly stressed by decreasing reimbursements and increasing regulations, it is critical for the Radiologist to have a clear concept of the value of FDG PET/CT for each tumor type. Acting in the role as consultant, the Radiologist can steer the referring physician to the most cost efficient approach that will yield the most beneficial and appropriate treatment choice. This course will present a case-based review of abdominal and pelvic malignancies, highlighting the benefits, pitfalls and best indications for FDG PET/CT in tumors of the hepatic, gastrointestinal, gynecologic and urologic neoplasms.

Essentials of Ultrasound

Tuesday, 10:30 AM - 12:00 PM • S100AB

UES32 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

UES32A • US Evaluation of the Aorta

Leslie M Scount MD ( Presenter) *

LEARNING OBJECTIVES
1) Describe the role of ultrasound in screening for abdominal aortic aneurysms. 2) Discuss the role of ultrasound in the follow up of patients s/p endovascular aortic repair (EVAR). 3) Demonstrate examples of other common and uncommon aortic pathology on ultrasound.

ABSTRACT
This lecture is part of the essentials of radiology series and will focus on reviewing the role of ultrasound in screening for abdominal aortic aneurysms and in the follow up of patients who have undergone endovascular aortic repair (EVAR). The ultrasound appearance of endoleaks will be presented and the ultrasound findings in a range of aortic pathology will be discussed including aortic dissection and rupture.

MSES32C • US of Multiple Gestations

Peter M Doubilet MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Understand the limitations of determining pregnancy number (singleton, twin, triplet, etc.) in the early first trimester. 2) Understand how to determine chorionicity and amnionicity of twins. 3) Diagnose twin-twin transfusion syndrome and other complications of multiple gestations.

ABSTRACT
1. Assessment of Fetal Number (Singleton, Twin, ...)
   Pregnancy number before 6 weeks gestational age is determined by counting gestational sacs and yolk sacs. After 6 weeks, pregnancy number is determined by counting embryos/fetuses in the uterus. Pregnancy number diagnosed on the initial ultrasound in the early first trimester may change on subsequent scans, due to two phenomena: ‘vanishing twin’ and ‘appearing twin’. II. Measurements:
   1. Gestational age (GA) assignment
      (i) Initial sonogram: If the two GA’s (determined from measurements as per singleton GA determination) are discordant, assign GA as the average of these two values. If the two GA’s are discordant, assign GA as the greater of the two values, and consider the possibility that the smaller twin is abnormal.
      (ii) On all subsequent sonograms, GA is assigned as the sum of the GA by first sonogram plus the number of intervening weeks
   2. Fetal weight estimation and comparison (=24 weeks): Compute an estimated weight and weight percentile for each fetus, and compare the fetal weights by computing the relative weight difference (difference in estimated weights divided by larger twin’s estimated weight). Findings suggesting abnormal growth include: either twin’s weight is 1. Chorionicity is determined by membrane thickness, number of placenta and fetal sex concordance/discordance.
   2. Amnionicity: diamniotic if intertwin membrane seen; monoamniotic if no membrane visible and cords are intermingled IV. Complications
      1. preterm delivery
      2. low birth weight
      3. twin-twin transfusion syndrome (if monochorionic)
      4. acardiac twin (if monochorionic)
      5. conjoinment

MSES32C • US of the Gallbladder and Biliary Tract

Helen Bungay MBBCh (Presenter)

LEARNING OBJECTIVES
1) To be familiar with the normal ultrasound appearances of the gall bladder and biliary tract, including normal variants. 2) To know the wide differential of causes of abnormalities of the gall bladder wall. 3) To recognize the variety of appearances of common benign and malignant processes involving the gall bladder and biliary tract, especially adenomyomatosis, polyps and carcinoma. 4) To be able to use specific features to aid in the differential diagnosis of abnormalities of the gall bladder. 5) To have a management strategy for gall bladder polyps. 6) To know the ultrasound appearances of acute cholecystitis and the important signs and complications to look for, including perforation, abscess formation, emphysematous cholecystitis, and Mirizzi's syndrome.

ABSTRACT
Ultrasound remains the first line modality for imaging the gall bladder and biliary tract. It is of utmost importance in guiding the clinician in the investigation of jaundice and obstructive liver function tests. Whilst having limitations in demonstrating some causes of biliary obstruction, the presence or absence, and level of obstruction, of dilated ducts dictates further imaging and management choices. With its high spatial resolution, and real time multiplanar capabilities, ultrasound is ideal for examining the gall bladder. This session will review the multiple causes of abnormalities of the gall bladder wall, and clinical and imaging features useful in the differential diagnosis. The imaging appearances of acute cholecystitis, and especially features of particular clinical import, such as emphysematous change, perforation, abscess and Mirizzi's syndrome, will be reviewed. Patients presenting less acutely with abnormalities of the gall bladder wall can be a diagnostic challenge. The typical features of adenomyomatosis and carcinoma will be examined, together with features aiding the differential diagnosis. Gall bladder polyps are common and a management dilemma. Their significance and a strategy for management will be discussed. Apart from the presence or absence of biliary dilatation, the use of ultrasound in evaluation of the bile ducts is limited, with other modalities, such as magnetic resonance cholangiography and endoscopic retrograde cholangiography, predominate. However, the ducts can actually be well seen in patients of appropriate physique. Changes seen in primary sclerosing cholangitis, cholangiocarcinoma, intrahepatic duct calculi, and some unusual and rarer conditions will be demonstrated.
Patients with stenosis level 2 and higher or the presence of passage disturbance were deemed to have esophageal stenosis.

The median follow-up period for surviving patients was 12.3 months (range: 1.7-76.4 months). Twenty patients obtained complete response, while 4 had stable disease and another resulted in disease progression. Esophageal stenosis occurred in 8 patients (32%), causing passage disturbance in 3 patients. The number and percentage of patients at each stenosis level were as follows: level 1: n = 17 (68%); level 2: n = 5 (20%); level 3: n = 3 (12%); level 4: n = 0 (0%). The occurrence of grade 3-4 acute esophagitis during treatment was significantly associated with the frequency of esophageal stenosis (p=0.024). Tumor location, stage, preceding endoscopic surgery, use of chemotherapy, radiotherapy dose, and treatment response were not associated with the frequency of stenosis.

Conclusions:
Significant proportion of patients experience esophageal stenosis after radiotherapy for superficial esophageal carcinoma. The occurrence of grade 3-4 acute esophagitis during treatment may predict post-treatment esophageal stenosis.

MSRO32-05 • Impact of Medications to Control Inflammation, Cholesterol and Blood Sugar on Survival in Esophageal Cancer Patients
Nicholas Figura BS (Presenter)

MSRO32-06 • The Role of Proton Therapy in Postoperative Radiotherapy for Gastric Cancer: A Dosimetric Analysis
Nicholas Lukens (Presenter)

MSRO32-07 • Assessing Effectiveness of Proton Stereotactic Radiotherapy (PSRT) for Liver Metastasis with MRI
Surabhi Bajpai MBBS, DMRD (Presenter) ; Sheela Agarwal MD, MS ; Theodore S Hong MD ; Andrew X Zhu MD, PhD ; Dushyant V Sahani MD

PURPOSE
We investigated the imaging manifestations and treatment effect in liver metastasis following Proton Stereotactic Radiotherapy (PSRT).

METHOD AND MATERIALS
In this ongoing study, 17 patients (10M: 7F, mean=66 yrs) with liver limited metastasis (CRC-9, gastric-1, pancreatic-4, neuroendocrine-2) treated with PSRT were included. The patients underwent CE-MRI (Magnevist, n=12; Eovist, n=22) at baseline and 4-8 weeks after treatment. MR images (n=34) at baseline and after PSRT were evaluated for size on post contrast T1 images, signal on T2, and enhancement characteristics on post contrast images. Treatment response was classified as local response according to RECIST criteria and long term outcome based on development of new hepatic metastases and extrahepatic disease.

RESULTS
Seventeen patients with 31 metastatic lesions (solitary, n=12, multiple, n=5 and size=2.6±1.8cm) were included in the final analysis. Out of 17 patients, 12 (70.5%) demonstrated local treatment response (Pre: 2.83 ±2.1cm, post: 1.8±1.7cm, p<0.05). The calculated occurrence of grade 3 acute esophagitis during treatment was significantly associated with the frequency of esophageal stenosis (p<0.05). Tumor location, stage, preceding endoscopic surgery, use of chemotherapy, radiotherapy dose, and treatment response were not associated with the frequency of stenosis.

CONCLUSION
MR is an accurate method for monitoring treatment response to proton beam radiation in patients with metastatic liver disease.

CLINICAL RELEVANCE/APPLICATION
CE-MRI is often a preferred modality for pre and post treatment evaluation and therefore it is essential to familiarize with the expected and unexpected MR features following PSRT.

MSRO32-08 • Retreatment of Hepatic Malignancies with Yttrium-90 Resin Microspheres
Gentaro Togasaki, MD (Presenter)

ABSTRACT

Purpose/Objective(s):
To evaluate the frequency of esophageal stenosis after radiotherapy for superficial esophageal carcinoma and its association with patient or treatment related factors.

Materials/Methods:
We retrospectively reviewed 25 patients with superficial esophageal carcinoma treated by radiotherapy with curative intent at Chiba University Hospital between January 2002 and December 2012. The age of the patients ranged from 55 to 85 years old (median age 72 years). There were 23 men and 2 women. All tumors were classified according to the UICC AJCC TNM staging system: 5 patients had T1a tumor and 20 patients had T1b tumor. All tumors had squamous cell carcinoma histology. Location of the lesion were as follows: cervical esophagus in 2 patients, upper thoracic in 3, mid thoracic in 7, lower thoracic in 11, abdominal esophagus in 2. Total dose of radiotherapy ranged from 60 to 66 Gy at daily 2 Gy per fraction. Prior to radiotherapy, 8 patients had received endoscopic submucosal dissection or endoscopic mucosal resection. Six patients were treated with radiotherapy alone, while other 19 patients were treated with concurrent chemotherapy. Upper gastrointestinal endoscopy or esophagography was performed for all patients before treatment and within 3 months after completion of the radiotherapy. Post-treatment esophagographs were reviewed to calculate the stenotic ratio. The calculated stenotic ratio was then classified into the four levels: stenosis level 1, stenotic ratio of 0-25%; 2, 25-50%; 3, 50-75%; 4, 75-100%. Patients with stenosis level 2 and higher or the presence of passage disturbance were deemed to have esophageal stenosis.

Results:
The median follow-up period for surviving patients was 12.3 months (range: 1.7-76.4 months). Twenty patients obtained complete response, while 4 had stable disease and another resulted in disease progression. Esophageal stenosis occurred in 8 patients (32%), causing passage disturbance in 3 patients. The number and percentage of patients at each stenosis level were as follows: level 1: n = 17 (68%); level 2: n = 5 (20%); level 3: n = 3 (12%); level 4: n = 0 (0%). The occurrence of grade 3-4 acute esophagitis during treatment was significantly associated with the frequency of esophageal stenosis (p=0.024). Tumor location, stage, preceding endoscopic surgery, use of chemotherapy, radiotherapy dose, and treatment response were not associated with the frequency of stenosis.

Conclusions:
Significant proportion of patients experience esophageal stenosis after radiotherapy for superficial esophageal carcinoma. The occurrence of grade 3-4 acute esophagitis during treatment may predict post-treatment esophageal stenosis.
ABSTRACT

Purpose/Objectives: The use of yttrium-90 resin microspheres in hepatic radioembolization (RE) is well established in the management of primary and metastatic malignancies of the liver. However, few data have been reported on the safety and efficacy of retreatment with yttrium-90 RE. We present data on patients treated with multiple courses of RE.

Materials/Methods: Using an institutional review board approved protocol, all patients treated with multiple courses of yttrium-90 RE from 2009-2012 for primary or metastatic malignancies of the liver were reviewed retrospectively. Baseline demographic, laboratory and pathologic information were recorded, as well as dosimetric factors related to all courses of RE. Acute treatment toxicity was recorded using common terminology criteria for adverse events (CTCAE), version 4.0. Response to treatment was measured using RECIST criteria.

Overall and progression-free survival were calculated using the method of Kaplan and Meier. Statistical analyses were conducted with SPSS, version 20.

Results: 70 patients were treated with RE and were evaluated for inclusion. With a median follow up of 17 months (range 3-22 months), 8 patients, all male, were treated with multiple courses of yttrium-90 RE. 6 patients (75%) were treated with 2 courses of RE, and 2 patients (25%) were treated with 3 courses of RE, a total of 18 courses of RE and 10 retreatments. Median patient age was 62 years (range 33-78). 4 patients (50%) had hepatocellular carcinoma, and 4 patients (50%) had metastatic liver tumors. 7 patients (87.5%) had disease that was limited to the liver. 6 patients (75%) had tumors associated with portal vein thrombosis. Mean time between first and second RE was 3.5 months (range 1-17 months). Cumulative median total liver dose was 58.37 Gy (range 28.93-80.71 Gy), and cumulative median total lung dose was 5.22 Gy (range 1.82-17.2 Gy). One patient had grade 3 gastrointestinal toxicity after a second course of RE; no grade 4 or greater toxicity was seen. For all repeat treatments with RE, analysis with RECIST criteria showed partial responses in seven retreatments (70%). For patients receiving first retreatment, analysis with RECIST criteria showed five patients (62.5%) with partial responses, one patient (12.5%) with stable disease and two patients (25%) with progressive disease. Two patients had a third RE course and both showed partial responses (100%). Median overall survival from date of first RE was 17 months (95% CI = 11.87-22.13). From time of second RE, median progression free survival was 10.5 months (95% CI = 0.96-19.97) and median overall survival was 10.7 months (95% CI not calculable).

Conclusion: For selected patients, retreatment with yttrium-90 RE for primary and metastatic liver malignancies can be performed with acceptable acute toxicity, with high rates of radiographic response.

MSRO32-09 • CT Guided Fiducial Placement for Targeted Image Guided Radiation Therapy in Hepatic Malignancies

Avinash R Kambadakone MD, FRCR (Presenter); Selim R Butros MD; Theodore S Hong MD; Debra A Gervais MD *; Ronald S Arellano MD

PURPOSE

The purpose of our study was to evaluate the safety and efficacy of CT guided fiducial placement for targeted image guided stereotactic radiation therapy in hepatic malignancies.

METHOD AND MATERIALS

In this retrospective study, we included 108 patients (73M: 35 F, mean age 70 yrs, age range-30-94 yrs) who underwent image guided fiducial placement prior to image guided stereotoxic radiation therapy. The fiducial placement was performed under CT guidance with the 'push' technique and with conscious sedation. The fiducial location was determined based on anatomic location of the tumor. The electronic medical records and the imaging studies in these patients were retrospectively evaluated to record the indications for fiducial placement, CT technique, procedure details and complications. The technical success rate and impact of the fiducial placement on treatment planning was evaluated.

RESULTS

A total of 215 fiducials were placed around 124 hepatic tumors in 108 patients under CT guidance. The technical success rate was 98% for placement of liver fiducials. The co-axial push CT technique performed with 19 gauge Chiba needle provided optimal results. The procedure related complications were seen in 6/108 patients (5.5%) which included hematoma, pseudoaneurysm and fiducial migration. The fiducial location around the tumor combined with surrounding anatomic landmarks in the liver were successfully used for stereotactic radiation treatment planning.

CONCLUSION

CT guided fiducial placement is a safe and effective technique with low complication rate for tumor bracketing of hepatic malignancies for performance of image guided stereotactic radiation therapy.

CLINICAL RELEVANCE/APPLICATION

With the increasing use of targeted radiation therapies for treatment of hepatic malignancies, CT guided fiducial placement is a safe and effective for treatment localization.

BOOST: Breast-Integrated Science and Practice (ISP) Session

Tuesday, 10:30 AM - 12:00 PM • S103CD
(SUVRmax), metabolic tumor volume (MTV) and total lesion glycolysis (TLG) and clinical outcomes.

RESULTS

CONCLUSION
Volume-based parameters on pretreatment FDG-PET/CT improve recurrence prediction in postmastectomy breast cancer patients with 1-3 positive nodes. The addition of MTV to ER status or TN could identify a subgroup of patients at higher risk for recurrence.

CLINICAL RELEVANCE/APPLICATION
Patients with high pretreatment MTV or TLG values should be monitored closely or considered for more aggressive treatments including adjuvant radiotherapy or systemic therapy.

MSR035-03 • Axillary Lymph Node Dose with Whole Breast Radiation Using 3D Conformal and Intensity-modulated Radiation Therapy

Matthew Janko BS (Presenter) ; Shirin Sioshansi MD ; Patrick J Bonavitacola ; Paul S Rava MD, PhD ; Thomas J Fitzgerald MD

PURPOSE
Intensity-modulated radiotherapy (IMRT) for whole breast irradiation has been shown to decrease acute radiodermatitis in the axilla. Although beneficial from a toxicity perspective this raises the concern of less incidental radiation to the axilla. As the extent of axillary surgery decreases, the radiation dose and distribution within the axilla become increasingly important. Here, we report a dosimetric comparison of incidental dose delivered to axillary level I-III lymph node volumes using CT-based three-dimensional conformal radiation therapy (3DCRT) and hybrid intensity-modulated radiation therapy (IMRT) techniques.

METHOD AND MATERIALS
58 women treated with whole breast irradiation (WBI) at our institution in 2011-2012 were identified. Patients with bilateral disease, regional nodal disease, or deliberate targeting of the axilla were excluded. All patients underwent CT-based planning. Breast tissue and tumor bed contouring was performed on all patients at the discretion of the treating radiation oncologist and treatment planning was performed to encompass the entire breast parenchyma. Axillary lymph node (ALN) level I, II and III volumes were retrospectively contoured according to the RTOG contouring atlas. The mean dose as well as the volume of each level receiving 50% (V50%), 90% (V90%) and 95% (V95%) of the prescription dose were calculated from treatment plans. Independent samples t-tests and univariate analyses were used to compare baseline characteristics and observed incidental doses.

RESULTS
Mean volumes of breasts, tumor beds and axillary levels did not differ significantly between WBI techniques. Mean doses to the ipsilateral breast, tumor bed and ALN levels I, II and III were similar between WBI techniques. No significant difference was seen in V50%, V90% and V95% for the same levels.

CONCLUSION
We report essentially identical incidental dose to axillary levels I, II and III using IMRT and 3DCRT for standard tangential whole breast irradiation.

CLINICAL RELEVANCE/APPLICATION
WBI with IMRT results in less acute desquamation and better quality of life. In the era of less axillary surgery, our results are reassuring that IMRT does not give less incidental dose than 3DCRT.

MSR035-04 • Patterns of Care in Ductal Carcinoma in Situ of the Breast: An Institutional Practice Quality Improvement Initiative

Parima Daroui MD, PhD (Presenter) ; Jeffrey V Kuo MD ; Nilam S Ramsinghani MD

ABSTRACT

Purpose/Objective(s):
Mastectomy has historically been the standard treatment for Ductal carcinoma in situ (DCIS) of the breast with excellent local control. However to spare patients from possible overtreatment and the morbidity of radical surgery, the treatment paradigm has shifted to an increased use of breast conserving surgery (BCS). In addition, several large randomized trials have demonstrated that the addition of adjuvant radiation treatment (RT) after BCS reduces breast recurrences by 50% to 60%, comparable to results with mastectomy. Although the role of RT in DCIS is strongly supported by randomized data, there are also data that support the possible omission of adjuvant RT in certain low risk subgroups, in attempts to further optimize the risk-benefit ratio in patients with DCIS. The purpose of our study is to determine the pattern of care and utilization of BCS+RT in patients with DCIS treated at our institution, as a quality of care improvement initiative.

Materials/Methods:
A retrospective analysis of data from patients with a first diagnosis of DCIS of the breast from 2008-2010 was performed. Predictors for the use of RT, in addition to the relative frequencies of mastectomy, BCS, and BCS+RT were evaluated to determine the pattern of care for DCIS at our institution in the specified interval.

RESULTS
A total of 37 patients with DCIS were treated for their disease. Of these patients 78% (n=29) received BCS, and 22% (n=8) received mastectomy as initial treatment. Of the remaining 21 patients receiving BCS, nearly all patients (n=20) were given adjuvant RT after BCS, with the exception of one patient who refused RT. Among the patients who received mastectomy as an initial treatment (n=8), the choice of mastectomy as primary surgery was based on the presence of extensive or multifocal disease in 50% (n=4), patient choice in 25% (n=2) and was unknown in 25% (n=2). In addition, of the 8 patients undergoing mastectomy, 2 patients had residual close margins and one of the two was offered RT after mastectomy.

Conclusions:
In contrast to published data that report an under-utilization of RT after BCS in patients with DCIS, utilization of BCS+RT in patients treated at our institution was within the expectation of current standard of care. The majority of patients with DCIS had BCS as their initial surgical treatment (75%, n=29), and mastectomy was only used as a primary modality in patients with extensive disease, or based on patient preference. Of patients eligible for RT after BCS (n=21), nearly all (n=20) completed RT as per current standard of care guidelines. The implementation of practice quality improvement initiatives such as this can be helpful to gauge practice patterns and identify areas of variance from evidence-based guidelines.

MSR035-05 • Assessment of Lung Dose during Breast-respiratory-Gated Irradiation Using a 4-dimensional Breast Phantom Moving to Simulate Respiratory Motion

Shirin Sioshansi MD ; Toshiie Horibe ; Yukihiko Oshima ; Toshiki Kawamura ; Masaru Nakamura ; Tsuneo Ishiguchi MD

ABSTRACT

Purpose/Objective(s):
In standard radiotherapy after breast-conserving therapy, a portion of the lung is included in the irradiation field due to shifting of the thorax from respiratory motion, and may be a cause of radiation pneumonitis post-therapy. To reduce the lung dose, using a 4-dimensional breast phantom simulating respiratory motion the lung dose was compared between the presence and absence of irradiation during respiratory gating.

Materials/Methods:
Phantoms resembling breast and lung tissues were
Purpose/Objective(s): To explore the feasibility, efficacy and cosmetic effect of three-dimensional conformal external(3D-CRT) beam partial breast irradiation after breast-conserving surgery for the selected Chinese patients with early-stage breast cancer.

Materials/Methods: From June 2003 to December 2010, Forty four Chinese patients with early-stage breast cancer underwent three-dimensional conformal external beam partial breast irradiation (EB-PBI) after breast-conserving surgery in Shandong Cancer Hospital. The patients were divided into two groups according to the state of moderate deep inspiration breathing hold (mDIBH) or 20 mm from the breast lower margin (FB). The surgical cavity marked by silver clips was defined and delineated as gross tumor volume (GTV), and planning target volume (PTV) was defined as the area encompassed GTV with extended margin of 15 mm for the patients treated in the state of mDIBH or 20 mm (FB). The surgical cavity marked by silver clips was defined and delineated as gross tumor volume (GTV), and planning target volume (PTV) was defined as the area encompassed GTV with extended margin of 15 mm for the patients treated in the state of mDIBH or 20 mm (FB). The surgical cavity marked by silver clips was defined and delineated as gross tumor volume (GTV), and planning target volume (PTV) was defined as the area encompassed GTV with extended margin of 15 mm for the patients treated in the state of mDIBH or 20 mm (FB). The surgical cavity marked by silver clips was defined and delineated as gross tumor volume (GTV), and planning target volume (PTV) was defined as the area encompassed GTV with extended margin of 15 mm for the patients treated in the state of mDIBH or 20 mm (FB).

Results: All patients were followed up for nine to nineteen months with a median follow-up of fifty-four months. Grade 1 of acute dermatitis was observed, and no any grade of acute radiation-induced pneumonitis was observed. Cosmesis scored basing on Harris criteria was good or excellent in all cases at the time of six months after radiotherapy and in 94.9% cases at the time of two years after radiotherapy. 3- and 5-year local control rates were 100% (39/39), 98.8% (30/31) and 93.8% (15/16), respectively. The 2-, 3-, and 5-year survival rates were all 100% and no metastases occurred.

Conclusions: EB-PBI delivered by 3D-CRT is feasible for the selected Chinese patients with early stage breast cancer after breast-conserving surgery, satisfactory cosmetic effect, local control rate and long-term survival rate are obtained, meanwhile, acute radiation response rate is lower.
CONCLUSION

grade, p53, bcl-2, EGFR, and CK5/6. In a multivariate logistic regression analysis, tumor size (P positive correlation between 18F-FDG uptake and tumor size (Spearman's correlation coefficient = 0.38) as well as Ki-67 (Spearman's correlation coefficient = 0.49). Triple-negative breast cancer showed higher FDG uptake than tumors with low nuclear grade (mean SUVmax 3.96±2.31, n=6). There was a

RESULTS

The mean SUVmax value of the 112 tumors was 10.05 ± 5.8 (range: 1.4–32.8). Tumors with high nuclear grade (mean SUVmax 10.39±5.75, n=106) showed higher FDG uptake than tumors with low nuclear grade (mean SUVmax 3.94±2.31, n=6). There was a

PURPOSE

To compare the diagnostic potential of FDG-PET/MRI mammography and FDG-PET/CT for local staging in breast cancer patients.

METHOD AND MATERIALS

43 Patients with biopsy-proven invasive breast cancer were included in our study. In addition to a clinically indicated FDG-PET/CT all patients subsequently underwent contrast enhanced FDG-PET/MR mammography (Biograph mMR, Siemens) using a 16-channel breast coil. Two readers evaluated separately both imaging methods concerning lesion detection and size measurement of the primary tumor as well as detection of multifocality / multicentricity and bilateral lesions. All patients underwent surgery; histopathology examination served as a reference of standard.

RESULTS

A total of 52 lesions, including 49 primary tumor lesions and three contralateral lesions were detected. While PET/CT allowed for identification of 46/52 cases (88.5%), PET/MRI offered correct identification of 50/52 (96.2%) breast cancer lesions. PET/MRI enabled a correct assessment of the T stage in 44/52 cases (84.6%); compared to PET/CT (31/52; 59.6%). In five cases the same lesion at T2 stage was falsly diagnosed as T1 stage by both diagnostic modalities.

CONCLUSION

The results demonstrate the superioruty of PET/MRI in detecting malignant lesions and in its size estimation compared to PET/CT while both diagnostic methods reveal the tendency to underestimate the tumor size.

CLINICAL RELEVANCE/APPLICATION

PET/MRI seems to be a powerful tool in detecting and rating primary breast cancer lesions as well as accessory lesions and should be diagnostic modality of choice for staging primary breast cancer.

SGG01-04 • Meta-analysis of Molecular Breast Imaging (MBI) Studies

James W Hugg PhD (Presenter) *

PURPOSE

Molecular Breast Imaging (MBI) uses planar imaging of single gamma photon emission from intravenous injection of Tc99m-sestamibi or tetrofosmin to visualize breast cancers that are often occult on mammography in the 40-50% of women with radiographically dense breasts. Clinical results published since 2002 support a meta-analysis of the MBI studies in three clinical applications: diagnostic workup, extent of disease, and high-risk screening.

METHOD AND MATERIALS

MBI consists of a pair of opposed semiconductor (CZT) gamma photon cameras. Breast-Specific Gamma Imaging (BSGI) consists of a single scintillator (NaI or CsI with PS-PMT or photodiode) gamma camera and a compression paddle. In both MBI and BSGI the breast is mildly compressed in standard planar mammographic views. We culled the literature until we had 19 studies and 4948 patients for diagnostic workup, 8 studies and 1507 patients for extent of disease, and 5 studies and 3013 patients for dense-breast screening. The analysis pools studies performed by BSGI (Dilon) and MBI (Gamma Medica or GE Healthcare).

RESULTS

Patient injected doses were 8-20 mCi for MBI and 20-44 mCi for BSGI, with a general reduction in dose over time. The diagnostic workup studies, including primarily women with suspicious lesions on screening mammography, had a sensitivity of 94% for the detection of 1652 cancers and a specificity of 85%. The extent of disease studies in women with biopsy-proven cancer yielded additional cancers in 8% of women, changing clinical treatment in many cases. The high dense-breast screening studies detected a prevalence of 12.9 cancers per 1000 asymptomatic women screened by MBI or BSGI, compared to an incidence of 3.0 per 1000 for annual screening mammography.

CONCLUSION

MBI and BSGI are more sensitive and specific than mammography, especially in dense breasts, and should be considered as an adjunct diagnostic and screening tool in breast cancer. Efforts to improve the technology and reduce the patient dose will further encourage the adoption of this new breast imaging modality.

CLINICAL RELEVANCE/APPLICATION

MBI and BSGI are more sensitive and specific than mammography, especially in dense breasts, and should be considered as an adjunct diagnostic and screening tool in breast cancer.
SSG01-06  Molecular Breast Imaging: The Sensitivity of Breast-specific Gamma Imaging (BSGI) as a Diagnostic Adjunct to Mammography and Ultrasound in a Triple Assessment Protocol

Jean M Weigert MD (Presenter) *; Douglas A Kieper BS *; Marcela Bohm-Velez MD

PURPOSE
BSGI is a diagnostic breast imaging procedure becoming more common in clinical breast practice. The goal of this work is to quantify its performance as an addition to mammography and ultrasound in detection of breast carcinoma when used in the community breast center setting.

METHOD AND MATERIALS
A multi-center patient registry was maintained for all patients routinely sent to BSGI as part of their diagnostic work up. From the registry data, patients who had a mammogram followed by ultrasound and BSGI were selected for evaluation. The BI-RADS rating scheme was used for mammography and sonography and a similar category system was used for the BSGI images. For each modality, the reports were classified as positive (categories 4 - 6) or Negative (categories 0 – 3). Needle and/or surgical biopsy were conducted as deemed clinically necessary and all patients who had a malignant diagnosis by pathology were entered into this analysis.

RESULTS
731 patients had all three imaging modalities as part of their diagnostic work up resulting in 180 malignancies confirmed by pathology: 29 ductal carcinoma in-situ, 110 infiltrating ductal carcinoma, 11 infiltrating lobular carcinoma, 9 papillary carcinoma and 21 mixed component malignancies. Mammography was positive in 130 (sensitivity = 72%) while ultrasound was positive in 114 (sensitivity = 63%) and BSGI was positive in 147 (sensitivity = 82%). Mammography and ultrasound were positive in 163 cases (sensitivity = 90%). BSGI provided positive findings for 177 malignancies resulting in a sensitivity of 98%. A breast MRI detected one lesion missed by the three modalities while two lesions were found by pathology alone.

CONCLUSION
Of the three imaging modalities, BSGI provided the highest independent sensitivity and when added to the diagnostic workup, BSGI detected an additional 14 malignancies, increasing the sensitivity from 90% to 98%. Although it is beyond the scope of this work, it is interesting to note that the cost of the BSGI procedure is relatively low, about $320, and that in this population the BSGI specificity was 74%. In summary, when added to the diagnostic work up of patients in the community breast cancer, BSGI can improve the detection of breast malignancy when compared to mammography and ultrasound alone.

CLINICAL RELEVANCE/APPLICATION
BSGI can improve the detection of breast malignancy when compared to mammography and ultrasound alone.

SSG01-07  False Positive Findings on Adjunct Screening Molecular Breast Imaging with Tc-99m Sestamibi

Carrie B Hruska PhD (Presenter) *; Amy L Conners MD; Katie N Jones MD; Michael K O’Connor PhD *; Deborah J Rhodes MD

PURPOSE
To determine the rates and histopathologic subtypes of false positive imaging findings and benign biopsies generated from adjunct screening with molecular breast imaging (MBI).

METHOD AND MATERIALS
Screening MBI was performed in asymptomatic women presenting for screening mammography who had dense breasts (>50% fibroglandular) on past prior mammogram. Intravenous injection of 8 mCi Tc-99m sestamibi was administered; bilateral 2-view MBI was performed using a dual-head CZT-based gamma camera. MBI studies were interpreted with access to the current screening mammogram and assigned an assessment of 1-5 that parallels BI-RADS. Assessment of 3 or higher was considered test positive. Participants with negative reference standard (benign biopsy result or negative/benign imaging at one year) were analyzed.

RESULTS
Of 1638 eligible participants, 1578 (96%) had complete reference standard, of which 1557 had no diagnosis of cancer. In 1557 participants with negative reference standard, 105 (6.7%) had test positive screening MBI and were recalled for diagnostic workup. Of these 105, 70 (67%) were resolved with benign findings on immediate diagnostic mammogram/ultrasound and follow-up MBI at 6 months. Final impressions included: stable background uptake (24) or resolved focal uptake (16); appearance of fibrocystic change (14), fibroadenoma (3), lymph node (3), post-operative change (4), or stable mass (2); and previously biopsied papilloma (2). The remaining 35 of 105 (33%) underwent biopsy: ultrasound-guided in 26, magnetic resonance imaging-guided in 7, and stereotactic in 2. Pathologic findings included fibroadenoma (11), benign breast parenchyma (6), fibrocystic change (5), papilloma (4), radial scar (3), stromal fibrosis (2), pseudoangiomatous stromal hyperplasia (2), atypical ductal hyperplasia (2).

CONCLUSION
For non-cancer cases, adjunct MBI had a recall rate of 6.7% and benign biopsy rate of 2.3%. The most common false positive imaging finding was benign background uptake of Tc-99m sestamibi in fibroglandular tissue; the most common biopsied benign lesion was fibroadenoma.

CLINICAL RELEVANCE/APPLICATION
MBI demonstrated a relatively low additional false positive rate compared to that reported for other modalities under consideration for supplemental screening in the dense breast.

SSG01-08  Improved Diagnostic Yield in Dense Breasts with Supplemental Screening Molecular Breast Imaging

Deborah J Rhodes MD (Presenter); Carrie B Hruska PhD *; Amy L Conners MD; Katie N Jones MD; Michael K O’Connor PhD *

PURPOSE
We previously demonstrated that addition of Molecular Breast Imaging (MBI) using 20 mCi Tc-99m sestamibi to screening mammography (SM) increased diagnostic yield for breast cancer in dense breasts (supplemental yield of 7.5/1000 screened). After implementing radiation dose reduction techniques, we are comparing performance of incident SM and prevalent screen MBI in women with dense breasts.

METHOD AND MATERIALS
Women presenting for SM with heterogeneous or extremely dense breasts on past prior SM were enrolled and underwent digital SM and MBI. MBI was performed with 8 mCi Tc-99m sestamibi and dual-head cadmium zinc telluride detectors. SMs were read independently; MBIIs were read in comparison with SM. MBIIs were assigned an assessment score of 1-5 which parallels BI-RADS; scores of 3-5 on MBI were considered positive.

RESULTS
In 1651 women enrolled, 1578 (96%) completed imaging and had reference standard of pathology findings within 365 days or negative imaging at >300 days. In 1578 analyzable participants, 21 had breast cancer diagnosed. Sensitivity was 5/21 (24%) for SM alone and 19/21 (91%) for the combination of SM and MBI. Diagnostic yield was 3.2 for SM and 12.0 for the combination (p = 0.0001). Diagnostic evaluation was prompted by SM alone in 174 (11%) patients and by the combination in 280 (18%). Biopsy was prompted by SM in 21 (1.3%) patients and by the combination in 67 (4.3%). The number of breast cancers diagnosed per number of biopsies (PPV) was 24%.
for SM and 28% for combination. Specificity was 88% for SM alone and 82% for the combination (p = 0.0001). Fourteen patients had cancer detected only on IMR: ductal carcinoma in situ (DCIS); 8 invasive ductal carcinoma (IDC); and 2 invasive lobular carcinoma (ILC); median pathologic tumor size was 12 mm; range 4-62 mm. Three of 14 were node positive. The 4 MBI occult cancers were node negative and included 1 DCIS, 1 IDC, and 2 ILC; median pathologic tumor size was 6 mm, range 3-7 mm. Two patients had cancers detected on neither modality, including a 6 mm ILC detected on MRI and a 7 mm ILC detected on prophylactic mastectomy.

CONCLUSION
Low dose MBI as an adjunct to SM in women with dense breasts provided a supplemental yield of 8.8 per 1000 with a modest decline in specificity.

CLINICAL RELEVANCE/APPLICATION
The supplemental yield of adding screening MBI to SM in women with dense breasts is preserved at a lower administered dose of 8 mCi Tc-99m sestamibi.

SSG01-09 • Background Parenchymal Uptake of Tc-99m Sestamibi on Molecular Breast Imaging in Mammographically Dense Breasts

Carrie B Hruska PhD (Presenter) *; Amy L Conners MD; Katie N Jones MD; Deborah J Rhodes MD; Michael K O’Connor PhD *; Celine M Vachon *

PURPOSE
Background parenchymal uptake (BPU), or uptake of Tc-99m sestamibi in normal fibroglandular tissue (FT), has been observed on molecular breast imaging (MBI). We describe categories of BPU and examine associated factors, including mammographic density.

METHOD AND MATERIALS
Screening MBI exams between April 2010-March 2012 from women with BI-RADS D3/D4 density on last mammogram were reviewed. Participants with breast implants or cancer diagnosed at screening were excluded. BPU intensity was subjectively categorized by two radiologists as photopenic (uptake in FT < subcutaneous fat), mild (uptake in FT = fat), moderate (uptake in FT up to 2x fat), or marked (uptake in FT > 2x fat). Association of BPU with age, current BI-RADS mammographic density, menopausal status, and use of hormonal medications was examined.

RESULTS
In 1274 screening MBI exams, BPU was photopenic in 273 (21%), mild in 826 (65%), moderate in 136 (11%), and marked in 39 (3%). Moderate/marked BPU occurred in 31% (99/315) of women age 40-49 compared to 8% (76/959) of women age 50 and older (p < 0.01). Moderate/marked BPU occurred more often in denser breasts and in women who were younger, pre- or perimenopausal, or on exogenous hormones. In each density category, substantial proportions of both moderate/marked and photopenic BPU were observed, establishing that similar-appearing FT on mammography can demonstrate considerable differences in BPU on MBI.

CLINICAL RELEVANCE/APPLICATION
BPU may reflect underlying functional activity of mammographically dense tissue. Additional studies are needed to determine if BPU can help predict an individual’s density-related breast cancer risk.

Cardiac (Coronary CT/MR III)

Tuesday, 10:30 AM - 12:00 PM • SS04AB

SSG03 • Submillisievert Radiation Dose Coronary CT Angiography: Clinical Impact of the Iterative Model Reconstruction (IMR) with Low kVp Scan

Takeshi Nakaura MD (Presenter); Shinichiro Tokuyasu RT *; Masafumi Kidoh; Shinichi Nakamura MD; Kazunori Harada; Yasuyuki Yamashita MD *; Ryo Iitani

PURPOSE
Recently, the submillisievert radiation dose coronary CT angiography becomes clinically available by the techniques such as the iterative reconstruction technique, prospective ECG gating and low kVp setting. However, increased image noise is a problem except the extremely small body size patients. The purpose of this study was to evaluate the usefulness of the recent introduced iterative model reconstruction (IMR, Philips Healthcare) in ultra-low dose cardiac CT.

METHOD AND MATERIALS
This prospective study received institutional review board approval; prior informed consent to participate was obtained from all patients. We performed submillisievert radiation dose coronary CT angiography (CTA) to 25 patients who had suspicious or past history of the ischemic heart disease. We also performed phantom study to evaluate the influence of object size with AEC phantom (CT-AEC Cone Phantom, Kyoto Kagaku). We reconstructed clinical and phantom studies with filtered back projection (FBP), hybrid-iterative reconstruction (iDose®) and IMR. We compared CT number, image noise and contrast noise ratio (CNR) in ascending aorta of each reconstruction technique. We compared relationship between image noise and body mass index (BMI) for clinical study, and object size for phantom study.

RESULTS
Calculated effective dose of patients was 0.98 mSv. The image noise of IMR reconstructed images is significantly lower than that of FBP and iDose® reconstructed images (IMR: 16.7±2.8; FBP: 67.5±14.5; iDose®: 28.3±5.8, respectively) (p<0.0001); however, this correlation was not significant in IMR reconstruction technique (r = 0.31, p = 0.14). The phantom study suggested that there are the exponential regressions between image noise and object size in each reconstruction technique, and image noise of IMR reconstructed images were about 36% less influenced by the object size than that of FBP and iDose® reconstructed images.

CONCLUSION
The IMR reconstruction offers stable and dramatic noise reduction in ultra low dose cardiac CT in various patient size as compared with FBP and iDose® reconstruction.

CLINICAL RELEVANCE/APPLICATION
The IMR reconstruction offers stable and dramatic noise reduction, and it might offer submillisievert radiation dose coronary CTA for most patients with diagnostic image quality.

SSG03-02 • Impact of 100-kV on Image Quality, Noise and Radiation Dose of Coronary Angiography with 320-row CT in Patients with Different Body Mass Index
Correlation of Left Bifurcation Angulation with Plaque Formation

This method of 320-row CTCA has been used in daily clinic works.

**SSG03-03 • Is Coronary Artery Imaging Feasible with Non-ECG-Triggered CT? Comparison of Image Quality and Radiation Dose of Non-ECG-Triggered High-Pitch Dual-source CT Angiography Versus Non-ECG-Triggered Standard-Pitch CT Angiography of Thoracoabdominal Aorta**

**Sung Mok Kim MD (Presenter) ; Hee Young Lee MD ; Eun Young Kim MD ; Sohee Song ; Yeon Hyeon Choe MD, PhD**

**METHOD AND MATERIALS**

We retrospectively assessed data from 137 patients (77 men, 60 women; mean age, 59±15 [SD] years) undergoing CTA of thoracoabdominal aorta on 128-slice dual-source scanner using either non-ECG-triggered high-pitch helical mode (group1, n=92) or non-ECG-triggered standard-pitch helical mode (group2, n=45). Group1 was divided into two subgroups according to HR. Group1A was defined as patients with HR lower than 60bpm and group1B was defined as patients with HR higher than 60bpm.

**RESULTS**

Interobserver agreement on grade of image quality for 1,507 coronary segments evaluated by both observers was good (κ=0.68). In group1, diagnostic image quality was found for 963 of 1,012 segments (96.1%) in 92 patients (95.2%). Whereas, in group2, diagnostic image quality was found in 3 of 45 patients (6.6%). Average HR was 53.4±4.8 in group1A and 73.2±11.7 beats/min in group1B. However, within group1, average HR was not significantly higher in patients with at least one nondiagnostic coronary segment compared with those without. All patients with average HR less than 60 beats/min had diagnostic image quality in all coronary segments. Group 2 scans displayed higher image noise at the root of aortic valve. Effective radiation dose was lower in group1 (mean±SD, 4.3±0.7 mSv) than group2 (5.4±1.2 mSv).

**CONCLUSION**

Coronary artery imaging is feasible with non-ECG-triggered high-pitch CTA, especially in patients with lower HR. Thoracoabdominal aorta CTA with non-ECG-triggered high-pitch mode provides higher quality images of aortic valves and coronary arteries with lower effective radiation doses compared with non-ECG-triggered standard-pitch helical CT.

**CLINICAL RELEVANCE/APPLICATION**

Coronary artery imaging is feasible with non-ECG-triggered high-pitch CTA, especially in patients with lower HR.

**SSG03-04 • Application of a Novel Motion Correction Algorithm in Prospective ECG-gated Coronary CTA of Patients with Relative High Heart Rates: Preliminary Study**

**Peng-Yu Li (Presenter) ; Qianwen Li ; Zhuangzhi Su ; Xinyu Yao ; Xiangying Du MD ; Kuncheng Li MD**

**PURPOSE**

Prospective ECG-gated CT coronary CTA was usually carried out under low heart rates because of limited temporal resolution. Our study is to evaluate the effect of a novel motion correction algorithm (SnapShot Freeze, SSF) in improving the image quality of patients with relatively high regular heart rates using the prospective ECG-gated scan mode.

**METHOD AND MATERIALS**

Patients with heart rates ranging from 65 to 75 bpm underwent prospective ECG-gated CTA using a 64-slice high definition CT system (GE, Discovery HD750). The X-ray exposure covered both the end-systole and middle-diastole of cardiac cycle. All image datasets were reconstructed at the optimal phase for each coronary artery with (group B) or without SSF (group A). Two experienced readers independently analyzed the image datasets according to a standard 15-segment model and a 5-score method (based on the interpretability of vessels in axial images): very poor (1), poor (2), adequate (3), good (4), and excellent (5). The coronary vessels with diameter no less than 1.5 mm were accessed. Scoring discordance was assigned by the third reader for consensus. X2 test of paired comparison of enumeration data was used to test the difference in image quality between group A and B on per-segment level. Values of P < 0.05 were considered to reveal statistically significant differences.

**RESULTS**

Interobserver agreement on grade of image quality for 1,507 coronary segments evaluated by both observers was good (κ=0.68). In group1, diagnostic image quality was found for 963 of 1,012 segments (96.1%) in 92 patients (95.2%). Whereas, in group2, diagnostic image quality was found in 3 of 45 patients (6.6%). Average HR was 53.4±4.8 in group1A and 73.2±11.7 beats/min in group1B. However, within group1, average HR was not significantly higher in patients with at least one nondiagnostic coronary segment compared with those without. All patients with average HR less than 60 beats/min had diagnostic image quality in all coronary segments. Group 2 scans displayed higher image noise at the root of aortic valve. Effective radiation dose was lower in group1 (mean±SD, 4.3±0.7 mSv) than group2 (5.4±1.2 mSv).

**CONCLUSION**

Motion correction algorithm is useful in improving the image quality of patients with relatively high heart rates in prospective ECG-gated coronary imaging.

**CLINICAL RELEVANCE/APPLICATION**

As a new method to reduce the motion artifact of coronary artery, SSF will expand the use of prospective ECG-gated coronary CTA to higher heart rates and subsequently reduce patients radiation dose.

**SSG03-05 • Coronary CT Angiography Visualization of Coronary Plaques: An Investigation of Intraluminal Appearances and Correlation of Left Bifurcation Angulation with Plaque Formation**

**Zhonghua Sun PhD (Presenter)**

**PURPOSE**

The aim of this study was to characterize the intraluminal appearances of coronary plaques and identify the relationship between left coronary bifurcation angle and plaque formation using coronary CT virtual intravascular endoscopy (VIE).

**METHOD AND MATERIALS**

Fifty patients suspected of coronary artery disease undergoing coronary CT angiography were included in the study. 3D VIE images were generated to visualize the intraluminal appearances of coronary wall due to presence of coronary plaques. Left coronary bifurcation angle formed by left anterior descending (LAD) and left circumflex (LCx) was measured on 3D volume rendering and multiplanar reformatted images to determine the relationship between plaque formation and corresponding coronary dimensional changes.

**RESULTS**

VIE provides unique information about intraluminal appearances of coronary wall due to presence of plaques. There is a direct correlation...
and Z-axis Location on Image Quality

SSG03-06 • Effect of a Novel Motion-correction Algorithm in the Improvement of Image Quality of Coronary CTA with Higher Heart Rates

Xiangying Du MD (Presenter); Kuncheng Li MD

PURPOSE
To verify the motion correction effect of a novel algorithm in coronary CTA of patients with higher heart rates

METHOD AND MATERIALS
15 patients with high heart rate (67bpm-85bpm, 73.7±5.5bpm) underwent retrospective ECG-gated coronary CTA using a GE CT scanner (GE Discovery CT750HD) with a speed of 0.35s/rotation. Images at 30%-80% R-R interval were reconstructed with single sector reconstruction at 5% intervals to select the best phase at end-systole and middle-diastole. Based on the best phasing, a motion correction algorithm (Snap shot freezing, SSF) was carried out to reconstruct the SSF images at the corresponding phases. In accordance with AHA staging, the right coronary artery was divided into three sections for evaluation. All images were independently assessed by 2 experienced radiologists who were blinded to each other. Image quality was graded with a 5-point scale and the images from the two reconstruction methods were compared accordingly.

RESULTS
A higher score of image quality was achieved at the SSF group. In end-systole, through the application of SSF algorithm, the rate of qualified images increased from 86.7% to 94.4%, with 58.3% of the images of 2 points increased to 3 points or more. While in middle-diastole, the rate of qualified images increased from 48.9% to 67.8%, with 50% of the images of 2 points increased to 3 points or more.

CONCLUSION
SSF can be used to improve the image quality of coronary CTA in higher heart rates

CLINICAL RELEVANCE/APPLICATION
The SSF algorithm is an effective way to improve image quality of coronary CTA in higher heart rates.

SSG03-07 • What Is the Clinical Utility of Computed Tomography Angiography in Patients with a Previous Functional Test?

Maria C Ziado MD (Presenter); Juan Manuel Montero; Juliana Fiorenza; Roberto L Villavicencio MD

PURPOSE
Computed tomography angiography (CTA) represents an excellent imaging modality to exclude obstructive coronary artery disease (CAD) noninvasively. We sought to assess the utility of CTA in patients (pts) without overt CAD and a previous functional test.

METHOD AND MATERIALS
Among 133 consecutive adult pts who underwent CTA, 78 pts (58.6%) had a previous functional study (99mTc SPECT, an exercise treadmill test (ETT) or a stress Echo) = 6 months. Test conclusions were categorized as follows: normal; abnormal due to ischemic ECG response; equivocal o inconclusive; myocardial ischemia; and/or necrosis. Coronary artery lumen on CTA was considered: normal=0%, mild= 1-49%, moderate= 50-69% and severe =70% stenosis. Obstructive CAD was defined as a ≥50% stenosis in any major vessel. Pre-test likelihood of CAD was considered : low, intermediate or high according to Diamond and Forrester classification.

RESULTS
Mean age was 56 ±14 years old, 42 pts were males. Most pts had a low (n=42) and intermediate (n=31) pre-test likelihood of CAD. A total of 58 pts (74%) had a previous SPECT, 17 pts (22%) an ETT and 3 pts (4%) a stress Echo. The prevalence of obstructive CAD was 19% (n=15). In 4 out of 15 pts (27%) with a normal test, CTA uncovered obstructive CAD. In 10 out of 14 pts (72%) with an ischemic ECG response, CTA showed 0% coronary stenosis, in 3 pts (21%) mild CAD and in 1 pt (7%) moderate CAD. Most pts with an equivocal or inconclusive test (n=26/29, 90%) presented not hemodynamically significant CAD. Among pts with myocardial ischemia (n=17), 6 pts (35%) had 0% stenosis, 5 pts mild CAD (29%) and 6 pts (36%) obstructive CAD. One out of 3 pts (34%) with a previous SPECT suggestive of necrosis had non-obstructive CAD on CTA.

CONCLUSION
CTA is clinically useful in pts with a previous false negative functional test. An ischemic ECG response may be associated with non-obstructive CAD, subject to secondary prevention. CTA is valuable to rule out significant CAD in pts with attenuation artifacts on SPECT, often mislabelled as necrosis or ischemia, and particularly in pts with a previous equivocal test.

CLINICAL RELEVANCE/APPLICATION
CTA yields high negative predictive value to exclude obstructive CAD, specially in intermediate risk pts and in those with previous equivocal tests. CTA provides additional data to functional imaging.

SSG03-08 • 256-slice CT Angiographic Evaluation of Coronary Artery Bypass Grafts: Effect of Heart Rate, Heart Rate Variability and Z-axis Location on Image Quality

Bettina M Gramer MD (Presenter); Patricia Diez Martinez MD; Anne S Chin MD; Nicolas Noiseux MD, MSc; Ernst J Rummenny MD; Carl Chartrand-Lefebvre MD *

PURPOSE
To assess the effect of heart rate (HR), heart rate variability (HRV) and z-axis location on coronary artery bypass graft (CABG) image quality using 256-slice CT.

METHOD AND MATERIALS
Approval was obtained by the institutional review board and written informed consent provided by all subjects. This prospective study includes 78 consecutive patients (71 men; age 68.6 ± 7.5 years) for a total of 254 CABG (762 graft segments) (postoperative time 23.5 ± 16.4 mo) which underwent 256-slice CT, with 270-msec gantry speed rotation and prospective ECG-gating. The standard deviation of patient HR was used for HRV measurement. Two observers rated graft segments for image quality (5-point scale). Predictors of image quality were assessed with logistic and cumulative link mixed models.

RESULTS
Mean HR during scan was 59.7 ± 9.8 bpm (range 38-98 bpm), and mean HRV 7.2 ± 1.6 bpm. Prescan beta-blockers were used in 37 patients (47.4%). Mean CT coverage was 251.9 ± 28.7 mm. Graft image quality was judged as diagnostic (scores 5 (excellent), 4 (good) and 3 (moderate)) in 96.6% of the 762 segments, with excellent interobserver agreement (kappa values = 0.90). Low quality scores were significantly associated with HRV = 1 bpm, with an odds ratio (OR) of 4.31 (95% confidence interval (CI) 1.10 - 16.84; p = 0.036). Association between low scores and body-mass index was near significance level (p = 0.053), with an OR of 1.15 (95% CI 1.00 - 1.32). There was no significant association between quality scores and HR, age, prescan nitroglycerine, NYHA class and LV ejection fraction. Quality scores were in the diagnostic range (scores 3-5) in 99.4% of proximal graft segments, as well as in 97.2% and 93.2% of middle and distal graft segments, respectively. Scores were significantly lower in distal segments, more susceptible to cardiac motion (p values = 0.02).

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CONCLUSION
CABG imaging with 270-msec rotation 256-slice MDCT and prospective ECG-gating showed an adequate image quality in 96.6% of graft segments, and an excellent interobserver agreement. Graft image quality was not influenced by HR level. Image quality scores were however significantly decreased in patients with high HR, as well as in distal graft segments.

CLINICAL RELEVANCE/APPLICATION
With 270-msec rotation 256-slice CT, CABG image quality is significantly decreased with high HRV and in distal segments near to the heart. Beta-blockers should still be considered for CABG imaging.

SSG03-09 • Prospective ECG-gated Coronary CT Angiography: Clinical Value of Noise-based Tube Current Reduction Method with Iterative Reconstruction

Junlin Shen (Presenter); Kuncheng Li MD; Xiaying Du MD; Daode Guo; Yan Gao MD; Lizhen Cao; Jiabin Liu

PURPOSE
We developed the noise-based tube current reduction method, which was used to calculate the required tube current to obtain the desired noise according to the test bolus image noise measurement. The aim of this study was to evaluate the clinical value of noise-based tube current reduction method with iterative reconstruction for obtaining consistent image quality with dose optimization in prospective electrocardiogram (ECG)-gated coronary CT angiography (CCTA).

METHOD AND MATERIALS
We performed a prospective randomized study evaluating 338 patients undergoing CCTA with prospective ECG-gating. Patients were randomly assigned to fixed tube current with filtered back projection (Group 1, n=113), noise-based tube current with filtered back projection (Group 2, n=109) or with iterative reconstruction (Group 3, n=116). Tube voltage was fixed at 120 kV. Qualitative image quality was rated on a 5-point scale (1= impaired, to 5= excellent, with 3-5 defined as diagnostic). Image noise and signal intensity were measured; signal-to-noise ratio was calculated; radiation dose parameters were recorded. Statistical analysis included one-way analysis of variance, chi-square test, Kruskal-Wallis test and multivariable linear regression.

RESULTS
Image noise was maintained at the target value of 35 HU with small interquartile range for Group 2 (35.00-35.03 HU) and Group 3 (34.99-35.02 HU), while from 28.73 to 37.87 HU for Group 1. All images in the three groups were acceptable for diagnosis. A relative 20% and 51% reduction in effective dose for Group 2 (2.9 mSv) and Group 3 (1.8 mSv) were achieved compared with Group 1 (3.7 mSv). After adjustment for scan characteristics, iterative reconstruction was associated with 26% reduction in effective dose.

CONCLUSION
Noise-based tube current reduction method with iterative reconstruction maintains image noise precisely at the desired level and achieves consistent image quality. Meanwhile, effective dose can be reduced by more than 50%.

CLINICAL RELEVANCE/APPLICATION
Noise-based tube current reduction method with iterative reconstruction can further reduce radiation dose while maintaining consistent image quality in coronary CT angiography.

Chest (Functional Lung/Perfusion)

Tuesday, 10:30 AM - 12:00 PM • S404CD

SSG04-01 • CT-PRM: A Novel Imaging Biomarker of Small Airways Disease in Asthma

Ruth Hartley MBCh, MRCS (Presenter); Sherif Gonem; Jennifer Boes; Maria Bule; Sumit Gupta MRCP; PhD; Christopher Brighting MRCP; PhD; Brian D Ross PhD *; Craig J Galban PhD *; Salman Siddiqui MRCP

PURPOSE
Asthma is a chronic inflammatory airway disease that is characterised by variable airflow obstruction. The parametric response map (PRM) image analysis technique has recently been utilised to differentiate functional small airway disease (fSAD) from emphysema (using image registration techniques) in patients with chronic obstructive pulmonary disease (COPD) [Galban et al, Nature Med 2012]. It is not known whether fSAD or emphysema are features of asthma, or whether they correlate with the degree of airflow obstruction.

METHOD AND MATERIALS
Fifty-two patients with asthma were recruited and underwent inspiratory and expiratory computed tomography (CT). Images were analysed using the PRM algorithm, and the relative lung volumes exhibiting fSAD and emphysema were determined, as well as the centre of mass of the voxel distribution. Lung function was measured using spirometry, and multiple breath inert gas washout (MBW), a technique for measuring ventilation heterogeneity (VH) in the conductive (Scond) and intra acinar (Sacin) small airways. Data is presented as the mean [standard deviation]

RESULTS
The relative volume of fSAD in patients with asthma was 14.3 [10.7], whereas significant emphysema was not observed in patients with asthma (2.9[3.0]). The ratio of forced expiratory volume in one second to forced vital capacity correlated negatively with fSAD (R = -0.295, p

CONCLUSION
Functional small airway disease, but not emphysema, occurs commonly in patients with asthma, and correlates significantly with spirometric airflow obstruction. Further studies are required to determine if fSAD as measured by PRM on CT may be used to predict prognosis or response to treatment in patients with asthma.

CLINICAL RELEVANCE/APPLICATION
PRM provides an objective quantitative assessment and visualisation of lung disease extent and discriminates between emphysema and functionally important small airway disease.

SSG04-02 • Respiratory Muscle Movement in Pompe Disease Using Cine Magnetic Resonance Imaging

Pierluigi Ciet MD (Presenter); Stephan C Wens MD; Adria Perez-Rovira PhD; Karla M Logie BSc; Piotr A Wielopolski PhD; Marleen De Bruijne PhD *; Ans T Van Der Ploeg MD; Pieter A Van Doorn PhD; Harm A Tiddens MD

PURPOSE
Late-onset Pompe’s disease is a slowly progressive proximal myopathy. Respiratory problems are the major cause of death. Up-to-date respiratory muscles in Pompe patients have never been investigated using cine-Magnetic Resonance Imaging (cine-MRI). Cine-MRI allows us to assess the contribution of each respiratory muscle during the breathing cycle. We aimed to assess the performance of respiratory muscles in a group of Pompe patients and healthy volunteers. We compared diaphragmatic displacement between the groups and
RESULTS
To date 10 Pompe patients (mean age 48.6 years, range 39–66 years, 5 males) and 6 volunteers (mean age 43.3 years, range 27–60 years, 3 males) performed spirometer-controlled cine-MRI. Pompe patients showed abnormal expiratory pattern with main contribution by the anterior chest wall during expiration. Vertical diaphragmatic displacement was significant different between patients and volunteers: mean displacement for volunteers 15.30 ± 7.88 mm and 58.9 ± 12.36 for patients; mean difference 43.58 ± 7.02 mm; p = 0.001; C.I. 26.40–60.77. FEV1% recorded during scans highly correlated with diaphragmatic displacement r = 0.9; p = 0.037.

CONCLUSION
Diaphragmatic function is significantly impaired in Pompe patients. In fact, in these patients movement of the anterior chest-wall is the main contributor to breathing. Cine-MRI can be a useful tool for patient’s characterization and to monitor treatment response in Pompe’s disease.

CLINICAL RELEVANCE/APPLICATION
Cine-MRI is a safe and feasible technique that can provide a new insight in Pompe disease.
similar in quality to hyperpolarized (HP) noble gas MRI. Inert fluorinated gases are nontoxic, abundant, inexpensive, and they have short longitudinal relaxation times. As a result, there is sufficient thermally polarized signal for imaging, and the gases do not need to be hyperpolarized prior to their use in MRI. The purpose of this study was to optimize image acquisition strategies and breathing protocols for imaging of human lungs with inert fluorinated gas MRI.

METHOD AND MATERIALS
Imaging was performed using a 3.0T Philips Achieva scanner and a flexible wrap-around quadrature transmit/receive coil (Clinical MR Solutions). Eleven healthy volunteers were enrolled in this study with no history of lung diseases. Breathing protocols were optimized for imaging with an inhaled gas mixture of 79% perfluoropropane (PPF) and 21% O₂. 3D 19F images were acquired using ultra-short echo time (UTE) and gradient echo techniques.

RESULTS
In one representative subject, the signal-to-noise ratio (SNR) in the center slices was 37 ± 4 for UTE, and 29 ± 6 for gradient echo images. In both cases, the SNR was more than a factor of 2 larger than the SNR reported by Soher et al. (Proc. ISMRM, 2010). Overall, the SNR from UTE images was significantly different from gradient echo images (p = 0.02). UTE images had a superior SNR; however, they suffered from poor edge detail due to the nature of the data acquisition.

CONCLUSION
Overall, 19F MRI using inert fluorinated gases is a new pulmonary imaging modality that can provide valuable spatially localized and functional information without the need for scarce noble gas isotopes, an expensive polarizer, or ionizing radiation. This preliminary study demonstrates the potential of 19F MRI for visualizing the distribution of ventilation in human lungs, and this may be a viable clinical imaging modality that can provide useful information for the diagnosis of chronic respiratory diseases.

CLINICAL RELEVANCE/APPLICATION
Inert fluorinated gas MRI can cheaply and efficiently obtain high quality images of the lungs, and it can potentially be performed on patients with chronic respiratory diseases.

SSG04-06 • Crus Atrophy: Accuracy of CT in Diagnosis of Diaphragmatic Paralysis

Warawut Sukkasem MD (Presenter) ; Sherine G Moftah MD ; Joshua O Benditt MD ; Sudhakar N Pipavath MD * ; J. D Godwin MD ; Eric J Stern MD

PURPOSE
To evaluate ability of CT measurement of diaphragmatic crus thickness to distinguish a paralyzed from a non-paralyzed hemidiaphragm in patients with suspected diaphragmatic dysfunction.

METHOD AND MATERIALS
We performed a retrospective review of patients with suspected diaphragmatic dysfunction between January, 1997, and February, 2013. We identified 5,402 patients, 90 (1.7%) of whom underwent chest fluoroscopy; 72 patients (1.3%) had concurrent CT scans available for measurement of diaphragmatic crus thickness at the level of celiac and superior mesenteric arteries and the L1 vertebra. ROC analysis was performed to determine an optimal threshold for discriminating between paralyzed hemidiaphragm and non-paralyzed hemidiaphragm.

RESULTS
Of 72 patients, 11 (15.3%) had diaphragmatic paralysis by chest fluoroscopy. There was a significant difference in thickness of the crus for patients with and without diaphragmatic paralysis at the level of the celiac artery (mean±SD 1.7±0.6 mm vs. 3.6±1.3 mm, p = 0.017 on right; 1.1±0.4 mm vs. 3.0±1.4 mm, p = 0.001 on left) and the level of the L1 vertebra (mean±SD 1.5±0.7 mm vs. 4.4±1.6 mm, p = 0.018 on right; 1.5±0.6 mm vs. 3.6±1.7 mm, p = 0.017 on left). A threshold crus thickness of 2.5 mm at the celiac artery level on axial CT permitted optimal distinction and provided a sensitivity of 100% and a specificity of 86% in identifying diaphragmatic paralysis for the right hemidiaphragm, and a sensitivity of 100% and a specificity of 64% for the left. A threshold crus thickness of 2.5 mm at the L1 vertebra level on coronal CT permitted optimal distinction and provided a sensitivity of 100% and a specificity of 88% in identifying diaphragmatic paralysis for the right hemidiaphragm, and a sensitivity of 100% and a specificity of 77% for the left. There was no statistical difference between axial and coronal measurements (AUC 0.93 vs. 0.94, p = 1.000 on the right; 0.82 vs. 0.89, p = 0.570 on the left).

CONCLUSION
Diaphragmatic crus atrophy assessed by CT is a good discriminator of paralyzed vs. non-paralyzed hemidiaphragm in patients with clinically suspected diaphragmatic dysfunction

CLINICAL RELEVANCE/APPLICATION
In patients with suspected hemidiaphragm paralysis, CT measurement of diaphragmatic crus thickness of

SSG04-07 • Reproducibility of Breath-hold and Free-breathing Quantitative Pulmonary Perfusion MRI

Daniel Maxien MD (Presenter) ; Michael Ingrisch ; Felix G Meinel MD ; Maximilian F Reiser MD ; Olaf Dietrich PhD ; Konstantin Nikolaou MD *

PURPOSE
Examinations in breath hold (BH) are often difficult for patients suffering from lung diseases. Recently the quantitative assessment of pulmonary perfusion using dynamic contrast-enhanced (DCE)-MRI with a measurement during free breathing (FB) was demonstrated. In this study, we compared the reproducibility of the quantitative assessment of pulmonary perfusion during FB with the reproducibility of the gold standard BH measurements.

METHOD AND MATERIALS
10 healthy, male volunteers underwent DCE-MRI on a 1.5T scanner for the assessment of pulmonary perfusion, using an accelerated 3D view sharing gradient-echo sequence. Each volunteer was examined twice at intervals of one week +/− one day. Each of these two examinations included a BH and a FB DCE-MRI acquisition, at intervals of at least 20 min. Hence, 40 DCE MRI datasets were acquired in total. Pulmonary plasma flow (PPF) and pulmonary plasma volume (PPV) were determined pixel-wise, using a one-compartment model. For FP and BH measurements, the intra-class correlation coefficient (ICC) and the coefficients of variation (CV) between first and second measurement were calculated to assess test-retest reproducibility. Differences of CV between FB and BH measurements were assessed with a non-parametric, paired two-sided Wilcoxon signed rank test. Reproducibility R of PPF and PPV was calculated as root-mean-square average of CV.

RESULTS
The ICC for both measured quantitative parameters was lower during BH than in FB technique (PPF: 0.37 vs. 0.69; PPV: 0.69 vs. 0.84). Additionally, the R values of the BH measurements were higher than the corresponding R values of the FB measurements (PPF 0.32 vs. 0.16; PPV: 0.18 vs. 0.10). Overall, CV is significantly lower for the FB measurements both for PPF (p=0.008) and PPV (p=0.03). ICC values of PPF and PPV are higher for FB than for BH measurements and test-retest reproducibility is significantly better (p

CONCLUSION
A free-breathing measurement of pulmonary perfusion is suitable for the quantification of pulmonary perfusion and leads to parameter estimates with a better reproducibility than the conventionally used measurements during breath hold.

CLINICAL RELEVANCE/APPLICATION
Regarding the reproducibility, this study demonstrates that the desirable quantitative assessment of pulmonary perfusion during free breathing might be superior to the common breath hold technique.

SSG04-08 • Hyperpolarized 3He Magnetic Resonance Imaging Temporal-spatial Maps of Asthma to Guide Endobronchial
Thermo-ablation

Sarah Svenningsen BSc (Presenter) ; Miranda Kirby PhD ; Stephen Choy MD ; Andrew Wheatley ; David McCormack MD ; Grace Parraga PhD

PURPOSE
Pulmonary functional imaging using hyperpolarized $^3$He magnetic resonance imaging (MRI) provides a way to map heterogeneous ventilation abnormalities that are regionally and temporally persistent in asthma. Bronchial thermoplasty is a novel asthma treatment that aims to reduce smooth muscle mass in the lobar and segmental bronchi, with the goal being improved symptoms and asthma control. Currently, treatment is not guided by imaging to specific airway abnormalities. The purpose of this study was to exploit the image-guidance potential of $^3$He MRI by developing lung function maps that spatially identify airway abnormalities in asthma.

METHOD AND MATERIALS
For a severe asthmatic, temporally persistent ventilation defects were observed on two visits 8 months apart after thermo-ablation therapy was completed. To improve the efficacy of thermoablation and decrease treatment time and cost, we investigated the potential for temporal-spatial lung function maps to guide therapy in asthmatics (n=7, 28±9 yr) who were evaluated using hyperpolarized $^3$He MRI three times, 7±2 days apart. Temporal maps were generated from ventilation images acquired on three occasions by co-registering $^3$He MRI after segmenting $^3$He voxel intensities using a modified k-means cluster algorithm. Corresponding, co-registered voxels were classified as 1) persistent defect, 2) intermittent defect, 3) partial ventilation, and, 4) persistent ventilation. The temporal map was registered to thoracic CT to enable structure-function comparisons and help guide therapy to specific ventilation defects.

RESULTS
We present a $^3$He MRI temporal-spatial lung function map co-registered to a CT-derived airway tree for a single asthmatic. Regions-of-interest (ROI) were identified with persistent and intermittent defects as appropriate targets for treatment, whereas ROI with partial or full ventilation were also identified as regions that should be avoided.

CONCLUSION
Personalized temporal-spatial lung function maps of asthma can be generated to display functional abnormalities observed over time and to guide localized therapy.

CLINICAL RELEVANCE/APPLICATION
Temporal-spatial lung function maps identified spatially and temporally persistent ventilation defects and the airways that lead to them as potential targets for thermo-ablation.

SSG04-09 • Impact of Scanning Conditions in the Evaluation of Pulmonary Blood Volume with Dual-energy CT: Results in 42 Subjects

Francesco Molinari MD (Presenter) ; Paul Felloni MD ; Francois Pontana MD ; Nunzia Tacelli MD ; Teresa Santangelo ; Martine J Remy-Jardin MD, PhD *

PURPOSE
To evaluate the characteristics of pulmonary blood volume (PBV) on dual-source, dual-energy chest CT examinations.

METHOD AND MATERIALS
Eligibility to this study required (a) the absence of respiratory disease after a diagnostic work-up including a dual-source, dual-energy chest CT angiographic examination; (b) rated with an excellent image quality (i.e., excellent quality of vascular opacification; no respiratory motion artifacts); and (c) obtained on the same CT unit (Definition Flash, Siemens Healthcare). Over a 2 year-period, 42 patients (mean age: 43.05 yr) fulfilled these criteria, enabling analysis of PBV in the following conditions: (a) collimation: 32x2x0.6 mm; rotation time: 0.28 s; pitch: 0.5; caudo-cranial acquisition without modulation of milliamperage; (b) administration of 80 mL of a 40% contrast agent followed by 40 mL of a diluted contrast agent (70% NaCl; 30% iodine) at a flow rate of 4mL/s,. Qualitative analysis was based on visual assessment. Quantitative analysis measured the (a) iodine concentration per lung (IPIPE software; Siemens) and (b) regional distribution of iodine after semi-automatic division of each lung into 18 areas (OSIRIX).

RESULTS
Distribution of PBV is influenced by physiological gradients and scanning conditions.

CLINICAL RELEVANCE/APPLICATION
This study provides quantitative information on lung perfusion in the conditions of standard evaluation of normal subjects.
All solid subcentimeter nodules having initial two-year stability at screening LDCT can be considered benign, because none shows growth at further follow-up CT. On the other hand, subcentimeter GGNs have a more chance of growth than solid nodules and need further follow-up CT for more than two years.

CLINICAL RELEVANCE/APPLICATION
This study demonstrates the two-year stability rule for subcentimeter solid nodules in LDCT using volumetry and CT follow up for more than two years seems to be mandatory for subcentimeter GGNs.

SSG05-02 • Inter-reader Variability in the Application of the 2013 Fleischner Society Recommendations on the Management of Solitary Subsolid Pulmonary Nodules

Alex C Penn MD (Presenter) ; Mingming Ma MD ; Benjamin B Chou MD ; Jeffrey Tseng MD ; Peter Phan MD

PURPOSE
To evaluate inter-reader variability in applying the 2013 Fleischner Society recommendations when presented with a potential solitary sub-solid nodule identified on CT.

METHOD AND MATERIALS
Potential sub-solid lung nodules were identified through a systematic retrospective review of CT studies that reported a “ground glass” lesion over a one-year period. Three radiologists decided whether the potential sub-solid nodules merited application of the Fleischner Society guidelines. They then determined if a solid component was present, measured each component in two dimensions, and issued management. Inter-reader variability for management was determined based on comparing all possible reader pairs and Fleiss’ kappa was used to determine significance. Fisher’s exact determined whether management was contingent on each decision. A Bland-Altman plot determined the limits of agreement for measurement within a 95% confidence interval.

RESULTS
Forty-four nodules with mean diameter 9.4 mm were evaluated by three radiologists with a measurement variability of -2.5 to +2.7 mm (95% C.I.). Management recommendations between two readers were in agreement for 85 out of 132 cases (64.4%, kappa = 0.43) (Figure 1). The remaining 47 cases of inter-reader variability in management recommendation were contingent on disagreement over whether a potential sub-solid nodule met Fleischner criteria for 24 cases (51.1%, p 0.05), and greater than one of these factors for four cases (8.5%).

CONCLUSION
Our data shows moderate inter-reader variability in applying the 2013 Fleischner Society recommendations. Significant contributors of variability include determining whether the potential sub-solid nodules fit criteria and whether there was a solid component. Although measurement variability was present, it did not significantly affect the final management decisions.

CLINICAL RELEVANCE/APPLICATION
Moderate interreader variability when applying the 2013 Fleischner recommendations for sub-solid nodules was largely due to differences in categorization rather than in measurement.

SSG05-03 • Solitary Pure Ground-glass Nodules â‰£5 mm: Incidence of Growth

Ryutaro Kakinuma MD, PhD (Presenter) ; Yukio Muramatsu MD ; Masahiko Kusumoto MD ; Akiko Maeshima ; Hisao Asamura ; Noriyuki Moriyma MD, PhD

PURPOSE
A statement from the Fleischner Society suggests that solitary pure ground-glass nodules (SGGNs) in categorization rather than in measurement.

METHOD AND MATERIALS
RESULTS
A total of 354 SGGNs

CONCLUSION
Overall, 8.7% (31/355) of SGGNs

CLINICAL RELEVANCE/APPLICATION
SGGNs

SSG05-04 • Subsolid Pulmonary Nodules Detected during Lung Cancer Screening: Results of a Close Follow-up Approach

Hester Gietema MD (Presenter) ; Ernst T Scholten MD ; Rozemarijn Vliegenthart MD, PhD ; Harry De Koning * ; Willem P Malli MD, PhD ; Mathys Oudkerk MD, PhD ; Rob Van Klaveren ; Mathias Prokop MD, PhD * ; Pim A De Jong MD, PhD

PURPOSE
Pulmonary Subsolid nODULES (SSNs) have a high likelihood of malignancy, but they are often indolent with slow growth and a low propensity for distant spread. Aim of the current analysis was to show that close follow-up of SSNs is safe and that only growing SSNs and SSNs with a new or growing solid component need further evaluation and treatment.

METHOD AND MATERIALS
The study population consisted of participants of the Dutch-Belgian lung cancer screening trial (NELSON). All detected SSNs were included in this analysis. Retrospectively, all persistent SSNs (visible on at least two computed tomography (CT) exams) and SSNs that were resected after first detection were segmented with dedicated software and maximum diameter, volume and mass were assessed. Volume doubling time (VDT) and mass doubling time (MDT) was calculated. SSNs that showed significant change were referred to a pulmonologist.

RESULTS
In total 7156 volunteers received up to four rounds of CT-screening. Two hundred sixty-four SSNs in 234 (3.3%) participants were detected during the trial. Hundred forty-seven (63%) SSNs in 126 participants disappeared at follow-up, leaving 117 persistent SSNs found in 108 (1.5%) participants available for analysis. Median follow-up duration was 1094 days (range 38 – 2380). Thirty-three (28%) SSNs were resected, and 28 SSNs were (minimally) invasive. None of the 84 (72%) non-resected SSNs developed into a clinical relevant malignancy.

CONCLUSION
Persistent SSNs have a high malignancy rate according to pathological analysis, but they rarely develop into clinical manifest malignancies unexpectedly. Our data suggest that long-term follow-up with CT may be a safe option to monitor changes in persistent SSNs. Resection should be considered only in SSNs that show rapid growth or appearance or growth of a solid component.

CLINICAL RELEVANCE/APPLICATION
Follow-up with CT may be a safe option to monitor changes in persistent SSNs, while resection should be considered only in SSNs that show rapid growth or appearance or growth of a solid component.

SSG05-05 • Pulmonary Pure Ground-glass Opacity Nodules: Added Value of Quantitative Dual Energy CT Analysis for Distinguishing Invasive Adenocarcinoma from Non- or Minimally Invasive Adenocarcinoma

Ji Ye Son (Presenter) ; Ho Yun Lee MD ; Jae-Hun Kim PhD ; Joungho Han ; Ji Yun Jeong ; Kyung S Lee MD, PhD ; O. Jung Kwon ; Young Mog Shim MD

PURPOSE
To determine whether quantitative analysis of iodine-enhanced images generated from Dual-energy CT (DECT) have added value in distinguishing invasive adenocarcinoma from non- or minimally invasive adenocarcinoma (MIA), showing pure ground-glass nodule (GGN).

METHOD AND MATERIALS

RESULTS

CONCLUSION

Volumetric quantification using iodine-enhanced imaging metrics was more accurate for distinguishing IA from AIS or MIA than that of nonenhanced imaging metrics.

CLINICAL RELEVANCE/APPLICATION

Quantitative analysis of DECT imaging can help predict pathologic classification of pure GGN, which can better assist in surgical planning to select the candidate for limited resection.

SSG05-06 • Impact of Section Thickness on Classification of Pulmonary Nodules into Solid, Part-solid, and Non-solid: An Observer Study

Sarah J Van Riel MD (Presenter); Cornelia M Schaefer-Prokop MD *; Eva M Van Rikxoort PhD; Bram Van Ginneken PhD; Mathias Prokop MD, PhD *; Steven Schalekamp MD *; Colin Jacobs MSc *; Pim A De Jong MD, PhD; Hester Gietema MD; Ernst T Scholten MD

PURPOSE

Recently published recommendations by the Fleischner Society differentiate between solid, part-solid, and non-solid nodules. A section thickness of 1mm is recommended for evaluation. It is, however, common practice to reconstruct thicker (3mm or 5mm) sections to reduce the number of sections to evaluate. Purpose of this study was to evaluate the impact of section thickness on nodule classification agreement.

METHOD AND MATERIALS

20 part-solid, 10 non-solid and 10 solid nodular lesions were randomly selected from the NELSON screening trial. A reference standard was established using the consensus reading of two experienced chest radiologists. Data had been acquired using a low dose (16x0.75mm, 120-140 KvP, 30 mAs) protocol. Complete CTs were shown with axial and coronal projections with either 1mm, 3mm or 5mm section thickness, the latter two with 1mm overlap. Readers could interactively scroll through the scans, use magnification, windowing and manual calibre measurements as warranted. Four readers of varying experience were asked to classify the lesions as solid (1), part-solid (2), or non-solid (3). All readings were done twice in six sessions, in which all permutations of nodules and section thicknesses were presented in different random orders. We report percentage agreement between observers and the consensus reference. All results stated are averaged over all reading sessions.

RESULTS

Mean agreement rate with the reference standard decreased from 85% (range 78-95%) to 77% (range 68-84%) and 75% (range 68-84%), for 1mm, 3mm, and 5mm section thickness, respectively. Readers were affected differently by increasing section thickness. The most experienced reader was influenced the least (agreement = 84-82-80%). Two readers demonstrated a major decrease in performance already for 3mm (81-72-70%) and 91-78-81%). One reader showed a stepwise performance decline (86-77-69%).

CONCLUSION

Nodule classification is affected by section thickness. The degree of loss of accuracy appears to be reader dependent.

CLINICAL RELEVANCE/APPLICATION

Nodule classification is impaired by increasing section thickness which may have consequences for patient management. Visual classification therefore requires acquisition and storage of 1mm sections.

SSG05-07 • Newly Developed Early Lung Cancer during Follow-up of Idiopathic Interstitial Pneumonia: Serial HRCT Observations

Mi Young Kim (Presenter); Ji-Eun Kim MD; Sang Young Oh MD; Chang-Min Choi; Tae Sun Shim; Dong Soon Kim MD

PURPOSE

To describe HRCT findings of newly developed peripheral T1 lung cancer in idiopathic interstitial pneumonia (IIP) during IIP follow-up

METHOD AND MATERIALS

Between November 2001 and October 2012, 66 consecutive patients (62 men, 4 women; median age 64, range 40–85 years) who were diagnosed as IIP, fulfilled the American Thoracic Society diagnostic criteria and new cancer (including fourteen small cell) simultaneously, were included. Two radiologists independently reviewed 132 serial CT scans of 66 patients, determined the earliest scan showing lung cancer, and evaluated tumor size (mm), lobar location, axial location on transverse image, shape, and density of tumor. The median interval between null-IIP to new cancer-IIP was measured. Delay in diagnosis was measured from the time of the earliest scan showing lung cancer and the subsequent clinical diagnosis. Formal radiologic reports as 'first choice' before diagnosis of cancer were reviewed.

RESULTS

The inter-observer agreement was good (Kappa value > 0.77). The median smallest tumor size on axial scan at presentation was 17mm (± 6.57, range, 5-30mm) with T1a/T1b (48/18). Tumor was most commonly located in right lower lobe (29/66, 43.9%), followed by left lower lobe (13, 19.7%). Thirty five tumors (53.0%) were in the interface between normal and fibrotic lung cysts such as honeycomb cysts, twenty two (33.3%) were in the midst of fibrotic lung cysts, and nine (13.6%) were in the normal lung. Fifty nine (83.3%) tumors were diagnosed as IIP, fulfilled the American Thoracic Society diagnostic criteria and new cancer (including fourteen small cell) simultaneously, Between November 2001 and October 2012, 66 consecutive patients (62men, 4 women; median age 64, range 40~85 years) who were

CONCLUSION

About one third of the tumors were misdiagnosed including missed in ten percents. Over fifty percent of the cancers are located at the interface between normal lung and fibrotic cysts. New lung cancers usually show as tumor with a round or oval shape and solid density.

CLINICAL RELEVANCE/APPLICATION

It is important to acknowledge CT characteristics of new early cancer in IIP patients’, because it is easily missed or confused with pneumonia or fungal infection.

SSG05-08 • Quantitative Measurement of Part-solid Nodule Size on CT in a Chest Phantom: Effect of Dose on Accuracy

Ann L Scherzinger PhD (Presenter) *; Kavita Garg MD; Grace Kim MD; Nayana U Patel MD; Samuel Chang MD; Paul R Garrett MD; Luduan Zhang PhD; Nicholas Petrick PhD; Michael F McNitt-Gray PhD *

PURPOSE

To assess the effect of dose on the accuracy of part-solid compared to solid nodule size measurements obtained from CT images of the chest.

METHOD AND MATERIALS

Twelve synthetic nodules, four solid (spherical) and eight part solid (spherical and lobular) (CIRS, Norfolk, VA) were imbedded in the lungs of an anthropomorphic torso phantom (LUNGMAN, Kyoto Kagaku Co., Ltd., Kyoto, Japan). The thorax phantom was imaged on a
RESULTS
The relative bias estimates for part-solid nodules were 13.8% (16.1) for the longest diameter (1D) measure and 15.5% (20.4) for the volume (3D) measure with the 200mAs acquisition, and 13.6% (16.9) for 1D and 14.6% (23.7) for 3D at 40mAs. For solid nodules the relative bias estimates were 1.4% (5.4) for 1D and 31.6% (17.2) for 3D at 200mAs and 3.6% (6.5) for 1D and 36.6% (33.7) for 3D at 40mAs. Although the relative bias of solid nodule 3D volume measurements were significantly higher (p < 0.05) interaction between solidity and dose.

CONCLUSION
Although the segmentation utilizing this semi-automatic technique consistently over estimated the size of both solid and part-solid nodules, this study showed that the bias in any of the morphometric measures, regardless of lesion soliocity, was not influenced by changes in CT dose.

CLINICAL RELEVANCE/APPLICATION
The accurate measurement of part-solid lung nodule size change while minimizing cumulative radiation dose is important for the management of patients with suspected or proven lung cancer.

SSG05-09 • Stratification of Early Stage Lung Adenocarcinoma by Using Quantitative Analysis of Dual Energy CT Imaging
Jungmin Bae (Presenter); Ho Yun Lee MD; Ji Yun Jeong; Jae-Hun Kim PhD; Kyung S Lee MD, PhD; Joungho Han; Ji Ye Son; O. Jung Kwon; Byung-Tae Kim MD; Young Mog Shim MD
PURPOSE
To evaluate the usefulness of quantitative analysis of dual energy CT (DECT) imaging metrics as predictors of histopathologic tumor grade and invasiveness in early stage lung adenocarcinoma in an attempt for treatment stratification.

METHOD AND MATERIALS
Patients in stage 1 or 2 with lung adenocarcinoma were prospectively included. All patients underwent DECT and PET/CT followed by complete tumor resection. Quantitative imaging parameters were assessed both from iodine map and non-contrast image of DECT datasets. Histologic tumor grades and subtypes of adenocarcinoma in situ (AIS), minimally invasive adenocarcinoma (MIA), and invasive adenocarcinoma (IA) were also evaluated. Clinico-demographic, DECT, and PET data were investigated by univariate and multivariate analyses to identify features that helped distinguish high-grade adenocarcinoma or invasive tumor.

RESULTS
Enrolled 60 patients included 48 in 1A stage (80%), 10 in 1B (17%), and 2 in 2A (3%). Of 71 tumors of 60 patients, 6 were AIS (8%), 11 were MIA (16%), and 54 (76%) were IA. In terms of tumor grade, 20 were low-grade (28%), 43 were intermediate grade (61%), and 8 were high-grade (11%). Multivariate analysis showed that presence of solid component, uniformity on iodine map (a = 0.01), and tumor density (>0.55 g) and the 75th percentile CT attenuation value (=-400 HU) on non-contrast image were statistically significant independent predictors of pathologic invasiveness. Independent predictors of high-grade adenocarcinoma consisted of tumor density on iodine map (a = 0.73 g), and the 75th percentile CT attenuation values on non-contrast image (=-400 HU). Using these characteristic features, the performance of the logistic regression model showed excellent differentiating accuracy (AUC, 0.973 for invasiveness, 0.972 for high-grade).

CONCLUSION
Quantification using preoperative DECT imaging metrics can help to predict pathologic aggressiveness and invasiveness, which may help select the candidate for limited resection or adjuvant therapy.

CLINICAL RELEVANCE/APPLICATION
Quantitative analysis of DECT imaging metrics can help predict pathologic classification of lung adenocarcinoma and help establish treatment strategy.

Gastrointestinal (Hepatic Steatosis Imaging)
Tuesday, 10:30 AM - 12:00 PM • E350

SSG06 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Shahid M Hussain, MD *
Moderator
Alvin C Silva, MD
Moderator
Bachir Taouil, MD *

SSG06-01 • Slower Hepatic Metabolic Rates in NASH Patients Revealed by the Fast and Localized 31P Saturation Transfer at 7T
Siegfried Trattning MD (Presenter); Ladislav Valkovic PhD; Martin Gajdosik MSc; Stefan A Traussnigg; Marek Chmelik MS; Ivan Frollo; Michael Trauner; Martin Krssak PhD
PURPOSE
Invasive liver biopsy is the only method currently used to distinguish between relatively benign non-alcoholic fatty liver (NAFL) and potentially progressive steatohepatitis (NASH). Phosphorus magnetic resonance spectroscopy (31P-MRS) combined with saturation transfer (ST) enables non-invasive measurement of metabolic activity at rest in vivo, which is indicative for inflammatory liver diseases. Therefore the aim of this study was to test the feasibility of ST at 7T for non-invasive distinction of NAFL and NASH.

METHOD AND MATERIALS
In addition to routine MR examination of the liver with dynamic contrast enhancement (Gadoterate meglumine; Dotarem, Guerbet, France) 31P-MRS ST measurements of ten suspected NAFL/NASH patients (6m/4f, a=49.5±13.2y) were performed one day prior the liver biopsy. Additionally four healthy males (a=25.3±2.9y) were measured as controls. Examinations were performed in morning sessions after overnight fasting on a 7T MR system (Siemens Healthcare, Erlangen, Germany) using 1H/31P surface coil. The reaction rate between inorganic phosphate (Pi) and adenosine-tri-phosphate (ATP) was calculated from liver spectra acquired w/o saturation of G-ATP. The reaction rate constant (k) and metabolic flux (F) were correlated with histology, regarding disease status and steatosis degree.

RESULTS
The patient group was resolved by the histological diagnosis into fatty liver (NAFL; n=4) and steatohepatitis (NASH; n=6) subgroups. The NAFL patients had significantly lower k and F values when compared to NASH (p=0.001) and also to healthy volunteers (p=0.002), with no overlap between the NAFL and NASH subgroups. Furthermore, the forward rate constant of the chemical exchange between Pi and ATP as determined by the ST experiment correlated well with the histologically assessed steatosis degree.
CONCLUSION
Liver Pi-ATP exchange, measured in vivo by the ST technique at 7T, is decreased in NASH in comparison to NAFL patients and controls. This is connected to the lower exchange rate constant and might provide a clinical tool for future investigations of the NASH and NAFL disease progression.

CLINICAL RELEVANCE/APPLICATION
This technique may replace invasive liver biopsy.

SSG06-02 • Quantification of Liver Iron Overload and Steatosis at 3T

Anne Boulic (Presenter); Anita Kiani; Edouard Bardou-Jacquet; Bruno Turlin MD; Herve Saint-Jalmes PhD; Yves Gandon MD

PURPOSE
To evaluate quantification of both liver iron overload and steatosis with a multi-echo gradient echo MR sequence at 3T, compared to liver biopsy as a gold standard.

METHOD AND MATERIALS
Following consent, 105 patients (68 men and 37 women, mean age 52 years; range 18-75) needing a liver biopsy mainly for metabolic liver disease were investigated at 3T. A single breath-hold gradient-recalled echo (GRE) sequence (body coil, TR=120 ms, FA=20°) was acquired for each patient with 11 TE multiples of 1.15 ms or 1.23 ms depending on whether an Achieva (Philips) or Verio (Siemens) system was used. Liver to muscle (L/M) signal intensity ratio and several T2* maps (overall, in-phase, out-of-phase) were calculated. An L/M algorithm based on 5 echoes was defined similarly to the one described at 1.5T. MR Fat fraction (FF) was estimated by the Dixon methods without and with the T2* correction methods. MR results were correlated with biochemical liver iron concentration (LIC) and steatosis METAVIR grade.

RESULTS
66 patients had liver iron overload ranging from 36.1 to 629 µmol/g and 37 had a steatosis grade above 20%. There was a strong linear correlation (R²=0.94) between the L/M algorithm and LIC, including in heavily overloaded livers. An exponential correlation was also observed between LIC and T2* (R²=.84) up to a maximum of 150 µmol/g. Subsequently, under 2 ms, T2* became difficult to assess. FF was better correlated with steatosis grade (R²=.6) when using T2* correction methods which partially reduced the calculation errors observed in the case of combined overload. The correlation was further improved (R²=.77) by selecting patients with LIC below 150 µmol/g.

CONCLUSION
A single breath-hold GRE multi-echo sequence allows simultaneous quantification of LIC and FF. A combined evaluation is essential to avoid calculation errors. Similarly to 1.5T, an algorithm for calculating liver iron concentration at 3T has been developed.

SSG06-03 • A Multiparametric Approach Combining T2-corrected IVIM, MR-DCE Imaging and Fat Volume Fraction Quantification to Evaluate Chronic Liver Diseases at 3.0T

Benjamin Leporq MS (Presenter); Frank Pilieux MD; Jerome Dumortier; Pierre-Jean Valette MD; Olivier Guillaud; Thibaud Lefort; Olivier Beuf PhD

PURPOSE
To evaluate a multi-parametric approach combining T2-corrected IVIM, MR-DCE imaging and a fat content quantification method for chronic liver diseases assessment at 3.0T.

METHOD AND MATERIALS
3 algorithms were developed: (i) a Fat Volume Fraction (FVF) quantification algorithm correcting for relaxation time effects using a disjointed estimation of T1 and T2* of fat and water and accounting for the NMR spectrum of fat; (ii) an algorithm to quantify perfusion parameters including a rigid image registration procedure, an auto-calibrated tracer concentration quantification method based on a T1 precontrast mapping and a modeling step using a non-linear least square fit on a dual-input one compartment model; (iii) an algorithm to quantify IVIM parameters using a non-linear least square fit on a modified IVIM model including liver and blood T2 decays. Validations were performed on a prospective study including 14 patients with chronic liver diseases.

RESULTS
Based on Wilcoxon's test: FVF allowed to distinguish between all histological grade of steatosis. DSLOW significantly decrease in patients with steatosis without fibrosis. Hepatic perfusion index allowed to distinguish between non fibrosis, non-advanced fibrosis and advanced fibrosis. Portal and total perfusion, DFast, and mean transit time allowed to distinguish between non-advanced and advanced fibrosis. A significative correlation was found between DFast and portal perfusion or total perfusion (? = 0.86 and 0.81 respectively; p<0.05).

CONCLUSION
Perfusion parameters given by MR-DCE imaging alone are relevant to evaluate fibrosis severity whereas fat overload constitute a confounding factor for fibrosis evaluation using IVIM when NAFLD and chronic hepatitis are mixed. The combination of IVIM and MR-DCE imaging do not bring additional information for fibrosis assessment in a wide spectra of etiologies. Since IVIM can give information about both hemodynamic changes and molecular diffusion restriction associated to liver fibrosis, IVIM could be a useful injection-free method to distinguish between pure steatosis and NASPH in patients with NAFLD, if combined with a suitable MR fat quantification method.

CLINICAL RELEVANCE/APPLICATION
A single breath-hold GRE multi-echo sequence allows simultaneous and accurate quantification of liver iron overload and liver steatosis at 3T.
RESULTS

CONCLUSION
These early results are encouraging for QUS BSC potentially being able to detect early NAFLD and to monitor its progression using a simple, inexpensive ultrasound technique. Additional recruitment of subjects is anticipated to increase sample size and explore further this interesting preliminary result.

CLINICAL RELEVANCE/APPLICATION
Non-invasive ultrasound that is sensitive to early stage NAFLD and capable of staging progression would be an invaluable tool for clinical care, clinical trials and drug development.

SSG06-05 • Accuracy of Spectrally-corrected MRI 2-echo and 6-echo Proton Density Fat Fraction (PDFF) in Measuring Longitudinal Hepatic PDFF Change Using MRS PDFF as Reference
Abdullah T Alturki MD, MBBS (Presenter) ; Tanya Wolfson MS ; Jessica Lam BS ; Gavin Hamilton PhD ; Claude B Sirlin MD * ; Michael S Middleton MD, PhD *

PURPOSE
To measure accuracy of longitudinal differences in 2-TE and 6-TE spectrally corrected MRI hepatic PDFF using MRS differences as reference.

METHOD AND MATERIALS

RESULTS

CONCLUSION
Cross-sectional and longitudinal accuracy were high for both MRI methods with MRS as reference, and PDFF differences between time points for 2-TE, 6-TE, and MRS were comparable.

CLINICAL RELEVANCE/APPLICATION
Since longitudinal 2-TE and 6-TE PDFF differences were comparable, spectrally corrected 2-TE MRI may suffice in some clinical and research settings to assess hepatic steatosis.

SSG06-06 • Quantification of Liver Fat at 3 Tesla: Intraindividual Comparison of Two Modified Dixon Techniques with MR Spectroscopic T2 Relaxometry and Histopathology
Guido M Kukuk MD (Presenter) * ; Frank Traeber ; Alois Martin Sprinkart MSc ; Wolfgang Block ; Holger Eggers PhD * ; Winfried A Willinek MD * ; Verena Sailer MD ; Hans H Schild MD

PURPOSE
To assess the accuracy of dual-echo and multi-echo modified Dixon techniques for the in-vivo quantification of liver fat in comparison with MR spectroscopic and histopathologic determination of the fat fraction.

METHOD AND MATERIALS

RESULTS
21/43 patients had a hepatic fat fraction of more than 5% as determined by MRS, with a maximum of 47% and a mean value of 18%. Bland-Altman analysis revealed good agreement between 6-point mDixon and MRS, with a mean difference of only 1.6% and a Pearson correlation of r=0.982 (p

CONCLUSION
2-point mDixon slightly underestimates hepatic fat fraction in comparison to 6-point mDixon, which excellently matches the results from MR spectroscopy and histopathology.

CLINICAL RELEVANCE/APPLICATION
The 6-point mDixon method allows accurate in-vivo determination of liver fat contents at 3 Tesla.

SSG06-07 • Comparison of Single Slice Low-dose and Full-dose Nonenhanced CT Protocols for Evaluation of Pathology Proven Hepatic Steatosis
Michael Y Park MD (Presenter) ; Joon-Il Choi ; Seung Hwan Lee ; Young Joon Lee MD ; Seung Eun Jung MD ; Jae Young Byun MD

PURPOSE
To determine the effects and adequacy of using a single slice low-dose nonenhanced CT protocol for evaluation of hepatic steatosis.

METHOD AND MATERIALS
The hepatic attenuation (HAT) and hepatic attenuation minus splenic attenuation difference (CTL-S) values were measured in 283 liver donor patients with liver biopsy performed during surgery. Full-dose nonenhanced CT was performed in 139 patients. Low-dose CT protocol with only a single slice including the superior segments of the liver and spleen was performed in 144 patients. Patients were divided in normal and fatty liver groups according to whether there was greater than or equal to 30% (moderate to severe) hepatic steatosis on pathological examination. The HAT and CTL-S were compared between the two protocols. Cutoff values with high sensitivity for screening the fatty liver patients were determined.

RESULTS
The median (IQR; interquartile range) of HAT was 59 (57.00~62.50) HU in the low-dose normal group and 51.33 (48.33~54.84) HU in the full-dose normal group, showing a statistically increased value (P < 0.0001) in the low-dose group. The median (IQR) of CTL-S was 7.75 (3.00~11.25) HU in the low-dose normal group and 7.63 (4.50~11.02) HU in the full-dose normal group, and did not show a statistical difference. Using a CTL-S cutoff value of less than or equal to 1 HU resulted in a 100% sensitivity, 86.03% specificity, 24% PVV, and 100% NPV for screening fatty liver patients using low-dose protocols. Using a CTL-S cutoff value of less than or equal to 1.83 HU resulted in a 100% sensitivity, 86.67% specificity, 18.2% PVV, and 100% NPV for screening fatty liver patients using full-dose protocols.

CONCLUSION
CTL-S is a more stable value than HAT for evaluation of hepatic steatosis when using differing CT dose protocols. The threshold value and efficiency for CTL-S to evaluate moderate to severe hepatic steatosis is similar to that of full-dose protocols.

CLINICAL RELEVANCE/APPLICATION
This study shows that using single slice low-dose nonenhanced CT protocols for screening of moderate to severe hepatic steatosis is feasible and can drastically reduce patient dose exposure.

SSG06-08 • Non Invasive Quantification of Hepatic Steatosis in Living, Related Liver Donors Using Dual Echo Dixon Imaging and Single Voxel Proton Spectroscopy
Sonal Krishan MD (Presenter) ; Yogesh Bathina

PURPOSE
To evaluate the diagnostic implications of hepatic fat fraction calculated using dual echo Dixon imaging and 1-H MR spectroscopy technique to detect hepatic steatosis in potential liver donors using histopathology as the reference standard.

METHOD AND MATERIALS
106 potential liver donors were included. MRI was performed on a 1.5-T scanner using a three-dimensional dual echo MRI sequence with automated reconstruction of in-phase (IP), out-of-phase (OP), fat-signal-only and water-signal-only images. Hepatic fat fraction was calculated by drawing 15 regions of interest on the IP, OP, fat only and water only images. Single voxel MR spectroscopy was performed at TEs of 30 and 20 in right as well as the left lobe of liver. Liver fat fraction was calculated from water and fat peaks. 106 biopsies were prospectively evaluated for steatosis by a pathologist using traditional determination of the cell-count fraction. MRI and pathology values of steatosis were correlated using the Pearson correlation coefficient. Sensitivity and specificity of each of these methods was calculated using histopathology as gold standard.

RESULTS
CONCLUSION
Combination of dual echo Dixon imaging and proton spectroscopy is a useful tool for the preoperative diagnosis of hepatic steatosis in potential living liver donors. This can help avoid unnecessary biopsies in these patients.

CLINICAL RELEVANCE/APPLICATION
This study provides evidence for the use of noninvasive MRI based methods to assess hepatic steatosis in evaluation of potential liver donors and further avoiding unnecessary liver biopsies.

SSG06-09 • Combined Use of Magnetic Resonance Fat Quantification and Magnetic Resonance Elastography in Liver Living Donors: Can It Reduce Need for Preoperative Liver Biopsy?

Jeong Hee Yoon MD (Presenter) ; Jeong-Min Lee MD * ; Inpyeong Hwang MD ; Joon Koo Han MD ; Byung Ihn Choi MD, PhD *

PURPOSE
To determine whether combination of magnetic resonance (MR) fat quantification tools and MR elastography (MRE) can reduce the necessity of preoperative liver biopsy (LB) in living liver donor candidates.

METHOD AND MATERIALS
This retrospective study was approved by institutional review board and informed consent was waived. From January to December 2012, 124 living liver donor candidates (M:F=80:44, age range 16-61 years) underwent MRE at 1.5T and MR fat quantification tools such as 3 point Dixon method and spectroscopy (MRS) at 3T. Among them, 115 patients underwent operations and the others did not for following reasons: deceased donor (n=3); revocation of donation (n= 2); death of potential recipient (n=1); detection of other diseases during work-up (n=3). Sensitivity, specificity, positive predicted value (PPV) and negative predicted value (NPV) were obtained for detecting significant fibrosis (=F2) or significant hepatic steatosis (>10%). On MRE, cut-off values were set as 2.5kPa, according to the previous study of nonalcoholic steatohepatitis. On liver fat quantification map or MRS, cut-off values were 5%= due to known underestimation of fat quantification on MR.

RESULTS
CONCLUSION
Combination of MR fat quantification and MRE is a good surveillance tool for determining necessity of LB in living donor candidates.

CLINICAL RELEVANCE/APPLICATION
Combined use of MR fat quantification and MRE could select liver biopsy cases among liver donor candidates, and therefore, can reduce the necessity of biopsy which has potential of morbidity and mortality.
SSG07-03 • Medicare Spending on Medical Imaging Varies Greatly between States

David A Rosman MD (Presenter) *; Eugene Nsiah; Danny Hughes PhD; Richard Duszak MD

PURPOSE
To study regional variation in per beneficiary Medicare Physician Fee Schedule (MPFS) spending on diagnostic imaging services in relation to that for all healthcare services.

METHOD AND MATERIALS
Using a 5% random sample of all approximately 32 million Medicare Part B beneficiaries in 2011, total spending was calculated on a state-by-state and US Census Bureau regional basis for all MPFS-covered diagnostic imaging services. Regional variation was analyzed.

RESULTS
Mean diagnostic imaging per beneficiary spending was $197.08 (+62.96, range $98.79 in Hawaii to $368.83 in New Jersey), with 13 states $250. Mean total MPFS per beneficiary spending was $2,102.29 (+486.76, range $1,175.76 in Hawaii to $3,536 in New Jersey) with 4 states $2,500. Mean total and diagnostic imaging spending were both higher in the South and Northeast ($236.21 and $2,412.84 and $201.37 and $2,191.11, respectively) than the Midwest and West ($168.75 and $1,979.44 and $169.10 and $1,748.10). Overall, diagnostic imaging comprised 9.8% of total MPFS spending (+1.2%, range 6.8% in Vermont to 12.3% in Nevada), with 7 states 11.0%.

CONCLUSION
MPFS spending on diagnostic imaging services per beneficiary varies 3.7-fold between states. Spending on all healthcare services varies 3.0-fold. The percentage of spending on diagnostic imaging to total spend varies 1.8-fold. Regional variation in total healthcare and diagnostic imaging utilization is large, creating opportunities for improved utilization management, particularly in the context of emerging shared risk and savings payment models.

CLINICAL RELEVANCE/APPLICATION
Marked variation in MPFS spending on diagnostic imaging and total health services creates opportunities for utilization management and empowers shared risk and savings payment models.

SSG07-04 • Nationwide Medicare Data Show the End of Growth in Utilization Rates of Advanced Imaging

David C Levin MD (Presenter) *; Vijay M Rao MD; Laurence Parker PhD; Andrea J Frangos MPH

PURPOSE
Anecdotal reports from various sources have suggested that advanced imaging is no longer growing. Our purpose was to determine the correctness of this perception by studying recent trends in utilization rates of CT, MRI, and nuclear medicine, using a nationwide database.

METHOD AND MATERIALS
The Medicare Physician/Supplier Procedure Summary Master Files for 2000-2011 were used. These files cover all Medicare beneficiaries in traditional fee-for-service Medicare (36.3 million in 2011). All CPT codes for CT, MRI, and nuclear medicine (including PET) were selected except those for guidance for invasive procedures and for radiation therapy planning. Procedure volumes in the 3 modalities were determined by tabulating global and professional component claims. Utilization rates per 1000 beneficiaries were calculated and tracked from 2000 through 2011.

RESULTS
The CT utilization rate per 1000 rose from 325 in 2000 to a peak of 637 in 2009 (+96%). In 2010, for the first time, a small drop in the rate was seen, to 626. In 2011 a large drop to 500 occurred. This was mostly attributable to bundling of the codes for CT of the abdomen and pelvis. The nuclear medicine rate per 1000 rose from 193 in 2000 to a peak of 320 in 2006 (+66%). There was a gradual and slight decline over the next 3 years, to 303 in 2009. In 2010, there was a sharp decline to 135, which was primarily due to bundling of the codes for primary myocardial perfusion imaging and its 2 add-on codes for left ventricular wall motion and ejection fraction. A further decline to 128 occurred in 2011. The MRI rate rose from 95 in 2000 to 185 in 2006 (+95%). The rate thereafter remained essentially flat, and was 184 in 2011. No code bundling occurred in MRI.

CONCLUSION
The rapid growth that was seen in use of advanced imaging in the early part of the last decade has stopped. Sharp declines were seen in CT in 2011 and nuclear medicine in 2010, due primarily to code bundling. However, even before then, growth in those 2 modalities had halted. In MRI, where no bundling occurred, growth stopped after 2006. The cause of the cessation of growth is multifactorial.

CLINICAL RELEVANCE/APPLICATION
Not applicable.

SSG07-05 • Cost Implications for Following Nationally Recommended Best-practice Follow-up Guidelines for Adrenal Lesion Characterization Detected by CT

David A Rosman MD (Presenter) *; Tarik K Alkasab MD; Anand M Prabhakar MD; Daniel I Rosenthal MD; Keith J Dreyer DO, PhD *; Debra A Gervais MD *; Giles W Boland MD

PURPOSE
In an attempt to reduce variation and improve outcomes, the ACR developed consensus best-practice guidelines for evaluating adrenal lesions detected at CT. However the cost implications of implementing these guidelines has not been evaluated. We have also separately presented poor compliance with these guidelines, which can substantially improve using a point-of-care clinical decision support tool (CDS) built upon the ACR recommendations. We evaluated the financial cost implications when radiologists adhered to these guidelines using a CDS tool when compared to recommendations without use of the tool.

METHOD AND MATERIALS
33,352 consecutive abdominal CT examinations were performed January 1 through October 23, 2012. Those 510 adrenal lesions (209 adenomas, 230 Indeterminate lesions and 71 other) were identified. Without the CDS tool, overall imaging recommendation rates for further workup were 29% (147/510) compared to 66% (339/510) when using the CDS tool. Our clinical recommendation rate was 7.6% without the tool compared to 72% with the CDS tool. Excessive recommendations for f/u were made in Cost implications included: Cost of non contrast abdomen CT (74150 code - $232.48). Cost of abdomen CT W/WO (74170 code - $419.34) Total cost in 147 patients of radiologist imaging recommended f/u without CDS: $57,440.82. Total cost with CDS imaging f/u: $121,786.52 Cost of recommended endocrine consultation (99204 code - $158) and two follow-up exams (99214 - $99): $11,748 without CDS and cost with CDS for endocrine consult: $130,652.

CONCLUSION
Compliance with nationally accepted best practice algorithms for adrenal lesion workup leads to an increase in cost of 264% due to the greater number of imaging and biochemical recommendations.

CLINICAL RELEVANCE/APPLICATION
Consistently following departmental guidelines for adrenal lesion characterization would increase the imaging cost of evaluating patients with adrenal lesions. The effect on outcomes is not known.
SSG07-06 • The Value of Imaging: The Primary Care Physician Perspective

Christine Hughes (Presenter) *

PURPOSE
Measure the extent to which PCPs value advanced imaging (AI) modalities (MRI, CT, PET/CT) and to identify what the PCPs believe to be the benefits and drawbacks of AI.

METHOD AND MATERIALS
We worked with Harris Interactive, an independent polling firm to conduct 42 qualitative interviews with PCPs in April and May of 2011, to begin the process of defining the value of imaging and assigning metrics. A quantitative Internet survey of 500 PCPs was administered in July and August of 2012. To qualify as respondents PCPs were required to meet the following criteria: practice in the US, duly licensed in the state where practicing, General Practice, Family Practice or Internal Medicine as specialty, practice in mostly office or clinic-based setting, spend at least 75% of time in direct patient care, and see at least 1 patient for whom an advanced imaging study is appropriate in a typical month. Final results were weighted to be representative of the AMA universe based on gender, years in practice, region and specialty.

RESULTS
Primary Care Physicians believe imaging provides value. Ninety percent (90%) of the survey respondents agreed that AI allows them to be more confident in their diagnoses, and AI provides unique data that is otherwise not available, 89% believe AI allows them to make better clinical decisions and increases their confidence in treatment choices. Statistically significant differences occurred between age groups. More experienced physicians who were likely to have practiced without ready access to AI placed a higher value on AI than younger physicians. Whereas, younger physicians were more likely to view AI in as a tool in practice efficiency than older physicians.

CONCLUSION
There is no question of perceived value of advanced imaging: PCPs agree AI allows them to be more confident in diagnoses, provides unique data, and assists with clinical decision making and treatment choices.

CLINICAL RELEVANCE/APPLICATION
The partnership between PCPs and Radiologists will be bolstered with a deeper understanding of the perceived benefits and drawbacks of advanced imaging.

SSG07-07 • Emergency Radiology Utilization at a Level 1 Trauma Center from 1996-2012

Vignesh A Arasu MD (Presenter) ; Garry Choy MD, MS ; Hani H Abujudeh MD, MBA * ; Elkan F Halpern PhD * ; James H Thrall MD * ; Robert A Novelline MD ; Paul D Biddinger MD

PURPOSE
To retrospectively review growth rate in emergency radiology volume at an academic level 1 trauma center in a major urban city from 1996-2012.

METHOD AND MATERIALS
We reviewed our institution's computer database on aggregated diagnostic radiology examination volume ordered for patients visiting our emergency department (ED) from January 1, 1996 to December 31, 2012. Changes in exam coding were manually reviewed and corrected to ensure accuracy. The growth rate in volume was calculated as the average annual percent change in imaging examinations per 1000 ED visits. We statistically compared the growth rate to zero annual growth during 1996-2003 and 2003-2012 using z-test.

RESULTS
Both ED visits and imaging volume grew continuously throughout 1996-2012. When adjusting for ED visits, statistically significant growth of total imaging was observed from 1996-2003 at 8% per year (SD 6%, p < 0.01), while no significant growth was seen from 2003-2012 at 2% per year (SD 3%, p = 0.96). By modality, statistically significant growth was observed in CT and MRI from 1996-2003, and no significant growth from 2003-2012. Ultrasound showed no growth throughout 1996-2012. Ultrasound grew significantly during 1996-2003 at 12% per year (SD 10%, p < 0.01), and during 2003-2012 at 4% per year (SD 7%, p < 0.05). By anatomic region, no significant growth was observed from 2003-2012 for head and neck, abdomen and pelvis, chest, and extremity.

CONCLUSION
We observed a stable period of practice patterns for utilization of overall ED imaging, and specifically of CT and MRI, during the last 9 years at our institution. This is likely due to slowing of new imaging protocols during this time period, introduction of decision support systems, and increased awareness of practice guidelines and radiation risk among ED physicians. While the national health care discussion focuses on continual imaging growth, we demonstrate long-term stability in utilization of ED imaging is achievable.

CLINICAL RELEVANCE/APPLICATION
During the last 9 years at our institution, we have observed no significant growth in the overall utilization of imaging in the ED when adjusting for increasing ED visits.

SSG07-08 • Developing and Maintaining Imaging Volumes in Outpatient Radiology: The Impact of Direct Radiologist Interaction

Joseph Vavricek MD (Presenter) ; Laurent Grignon MD * ; William W Horsley MD ; Raymond A Murphy MD, PhD ; Mark D Keiper MD

PURPOSE
Direct sales and marketing efforts to referring clinicians may have a profound effect on referral patterns. This study was performed to assess the relative effect of direct radiologist participation in marketing and sales efforts on the development and maintenance of referral volumes in outpatient imaging.

METHOD AND MATERIALS
Monthly referral volumes of CT and MRI scans ordered by 19 referring clinicians to an outpatient imaging practice were collected over a 6 month period (January-June) in three sequential years. Data was collected in these months to control for seasonal variation. During the first 6 month period, a radiology sales representative visited the referring clinicians twice a month to provide basic support, substantive educational material and personal interaction with the clinicians. During the second 6 month period, the same sales representative visited referring clinicians’ offices every two weeks but accompanied by a radiologist as a team once a month. The radiologist and sales representative provided educational lectures, technical expertise and substantive personal interactions. During the final 6 month period, the sales representative visited the referring clinicians twice a month without a radiologist. No significant changes in radiology practice service parameters occurred during the time periods studied.

RESULTS
The presence of a radiologist during the marketing and sales visits to referring clinicians had a positive statistically significant effect on overall scan volumes. During the time period in which the radiologist and sales representative visited clinicians, the number of CT and MRI volumes increased as much as 2.5 times when compared with baseline. However, the referral volumes began to decrease for all providers approximately 1.5 months after the radiologist stopped visiting the clinicians. Additionally, the referral volumes returned to baseline levels approximately 5 months after the radiologist terminated visits.

CONCLUSION
Direct radiologist participation in marketing and sales efforts to referring clinicians is a robust tool for creating and maintaining scan volumes in outpatient radiology.
**SSG07-09 • Relationship of Ordering Physician MRI Equipment Ownership to the Frequency of Negative Cervical Spine MRI**

Timothy J Amrhein MD (Presenter) ; Ben E Paxton MD ; Matthew P Lungren MD ; Heather R Collins PhD ; Ramsey K Kilani MD *

**PURPOSE**
To determine if ownership of MRI equipment by ordering physicians influences the frequency of negative cervical spine MRIs, and to evaluate cervical spine MRI pathology rates as a metric for comparison of utilization.

**METHOD AND MATERIALS**
A retrospective review was performed of 500 consecutive cervical spine MRIs ordered by two separate referring physician groups serving the same geographic community. The first group (FI) owned the scanners used and received technical fees for their use. The second group (NFI) did not have financial interest in the scanners used. All exams were performed with identical protocols and interpreted by a single musculoskeletal radiology group without financial interest in the imaging equipment. Final reports were reviewed and exams with moderate or severe spinal canal stenosis, neuroforaminal narrowing, facet degeneration, or disk bulges were considered positive. The percentage of negative studies in each group was calculated and the number of concomitant shoulder MRIs was recorded. Among positive scans, the frequency of severe lesions per scan was calculated for each group. Chi-square tests were used for categorical data and t-tests (2-tailed) and ANCOVAs (covarying for age) were used on continuous data.

**RESULTS**
A total of 500 consecutive cervical spine MRIs that met inclusion criteria were reviewed (250 FI, 250 NFI). 164 were negative (109 FI, 55 NFI); there were 98% more negative scans in the FI group (p

**CONCLUSION**
Cervical spine MRIs referred by physicians with a financial interest in the imaging equipment used were significantly more likely to be negative than those referred by physicians with no financial incentive. Among the positive studies, there was no statistically significant difference in the number of severe lesions per scan suggesting a highly similar distribution and severity of disease between the two patient samples. Further, patients in the FI group were more likely to undergo concomitant shoulder MRI.

**CLINICAL RELEVANCE/APPLICATION**
MRI referral patterns may be affected by the presence of an ordering physician’s financial interest in the imaging equipment used.

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**SSG08 • Grey-matter Volumetry Predicts Decline of Intelligence Quotient in Children with Sickle Cell Disease**

Rong Chen PhD (Presenter) ; Michal Arkuszewski ; Jaroslaw Krejza MD ; Edward H Herskovits MD, PhD ; Elias R Melhem MD, PhD

**PURPOSE**
For children with sickle cell disease (SCD), we aim to differentiate those with decline of intelligence-quotient (IQ) from counterparts without decline, based on structural magnetic-resonance (MR) imaging volumetry

**METHOD AND MATERIALS**
This prospective cohort study included 25 children with SCD, homozygous for hemoglobin S, with no history of stroke. We administered the Kaufman Brief Intelligence Test (K-BIT) to each child at yearly intervals for 2-4 years. Each child underwent MR examination within 30 days of the baseline K-BIT evaluation date. We calculated K-BIT change rates, and used rate of change in K-BIT to classify children into two groups: a decline group and a non-decline group. We then generated predictive models to predict the group-membership variable (K-BIT decline / non-decline) based on regional gray-matter volumes computed from structural MR images.

**RESULTS**
We identified six gray-matter structures (the left median cingulate gyrus, the right middle occipital gyrus, the left inferior occipital gyrus, the right fusiform gyrus, the right middle temporal gyrus, the right inferior temporal gyrus) that, when assessed for volume at baseline, are jointly predictive of whether or not a child would suffer subsequent K-BIT decline. Based on these six regional GM volumes, maternal education, and the baseline K-BIT, we built a prognostic model using the K* algorithm. The accuracy, sensitivity and specificity were 0.84, 0.75 and 1.0, respectively.

**CONCLUSION**
Structural MR imaging predicts subsequent IQ decline for children with SCD.

**CLINICAL RELEVANCE/APPLICATION**
Structural MR derived features can be used as a biomarker to predict subsequent IQ decline for children with SCD.

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**SSG08-02 • Heterogeneity as Biomarker in Tumour Imaging**

Lejla Alic ; Jifke F Veenland PhD (Presenter)

**PURPOSE**
Tumour heterogeneity could be a valuable biomarker for differentiation, grading, response monitoring and outcome prediction. Many quantification techniques have been described, however in clinical practice these methods are scarcely used. The aim of this study is to evaluate the performance of the described methods and to identify the bottlenecks for the implementation in clinical practice.

**METHOD AND MATERIALS**
We searched OVID, EMBASE, and Cochrane CENTRAL up to 24 March 2013. Heterogeneity analysis methods were classified into four categories, i.e., non-spatial methods (NSM), spatial grey level methods (SGLM), fractal analysis (FA) methods, and filters and transforms (FandT).

**RESULTS**
From 6908 potentially relevant publications, 183 studies were included. The number of studies has been increasing steadily since 2009. Generally, 60 % studies use NSM,49% use SGLM, 11 % use FA, and 28% use FandT. Differential diagnosis, grading or outcome prediction was the goal in 86% studies, 36% studies were based on MRI, and 88% studies were conducted retrospectively. Tumours in the breast and brain together cover 49% of the studies.

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No relation was found between the discriminative power and the quantification methods used, or between the discriminative power and the imaging modality. The reported AUC ranged from 0.5 to 1 with a median of 0.89. A negative correlation was found between the AUC and the number of features estimated per tumor, which is presumably caused by overfitting in small datasets. In only 53.4% of the classification studies, the use of cross-validation was reported. None of the publications report the use of an external validation set to test their findings. Retrospective analyses were conducted in 60% of the studies without a clear description of the inclusion criteria. Only 12% of the studies had a prospective study design. Almost none of the papers evaluated the incremental value of the heterogeneity biomarker on top of clinical established markers.

CONCLUSION

To enable the translation of imaging biomarkers from the research stage to clinical practice, research should focus more on prospective studies, use external datasets for validation, and focus on the added value of the proposed heterogeneity biomarker on top of the clinical established markers.

CLINICAL RELEVANCE/APPLICATION

Heterogeneity has the potential of a valuable biomarker.

SSG08-03 • Effective Staging of Fibrosis by the Selected Texture Features of Liver: Which One Is Better, CT or MR Imaging?

Xuejun Zhang PhD (Presenter) ; Yufan Zeng ; Hiroshi Fujita PhD ; Yan Wen ; Liling Long MD ; Yu Huang MMmed

PURPOSE

Different types of datasets acquired from CT and MR images are investigated to select the optimal parameters for the classification of texture patterns of hepatic fibrosis using in Computer-aided Diagnosis.

METHOD AND MATERIALS

149 patients were scanned by MDCT and 218 patients were performed abdominal examination using 1.5T and 3T superconducting MR scanners. For each case, at least four sequenced phase images are acquired: pre-contrast, arterial, portal venous and delayed phase. 15 texture features calculated from gray level co-occurrence matrix (GLCM) are extracted within an ROI in liver as one set of input vectors. Each combination of these input subsets is checked by using support vector machine (SVM) with leave-one-case-out method to differentiate fibrosis into two groups: normal or abnormal. 10 ROIs in liver are manually picked up dispersedly by experienced radiologist from each sequenced image and each item in 15 features is averaged by 10 ROIs in each case to reduce the validation time. The number of input items n is selected from the combinations of 15 features exhaustively. \((2^{15}-1\) different combinations obtained, where \(n\in\{1,15\}\))

RESULTS

According to the accuracy rate (AR) calculated from each combination, the optimal number of texture features to classify liver fibrosis degree is from 4 to 7, no matter what modalities are used. The overall performance calculated by the average sum of maximum AR value of all 15 types number of features is 66.83% in CT images, while 68.14%, and 71.98% in MR images (Fig.1a), respectively; among 15 texture features, mean gray value and entropy are in most common used in 3 datasets. Correlation has the lowest AR value and is abandoned to be used in all datasets. AR value tends to increase with the injection of contrast agency, and both CT and MR images reach highest performance in equilibrium phase as shown in Fig.1b.

CONCLUSION

Comparing the accuracy of classification on two modalities, we should reveal that MR images have an advantage over CT images, while 3T MRI is better than 1.5T MRI to detect liver fibrosis. The texture analysis is effective in equilibrium phase than in other phased images.

CLINICAL RELEVANCE/APPLICATION

MR can demonstrate fibrotic texture efficiently and equilibrium phase image is recommended as a main tool for interpretation of cirrhosis.

SSG08-04 • The Development of a Methodology to Simulate 3D Models of Benign and Malignant Breast Masses

Eman Shaheen (Presenter) ; Chantal Van Ongeval MD ; Frederik De Keyzer ; Kenneth C Young PhD ; David Dance PhD ; Hilde Bomsans PhD *

PURPOSE

Breast cancer remains a major health concern and a leading cause of cancer mortality among women. The commonly used screening mammography has limited sensitivity for small lesions detection due to anatomical noise. Therefore, new breast imaging modalities with proven superiority for lesion detection may remedy this shortcoming in breast cancer screening and diagnosis. Clinical trials are very expensive, giving rise to alternative dedicated simulation studies for the investigation of new modalities in terms of lesion detectability. Here, we present a new method to create more clinically-relevant 3D models of benign and malignant breast masses for use in simulation studies.

METHOD AND MATERIALS

Breast MRI cases with histologically-proven malignant masses, imaged with a 3D contrast enhanced acquisition, were collected. Each mass was manually segmented in three reconstructed orthogonal planes (sagittal, transversal, coronal), and then combined with logical OR, resampled to have isotropic voxel sizes in 3D space, then meshed. Due to the low resolution of MRI images, most of these masses had well defined borders. In order to create spiculated masses, suspicious for malignancy, the segmented model was used as nucleus with branches grown on the surface. The branches had different lengths, bifurcations, orientations and thicknesses. The clinical had well defined borders. In order to create spiculated masses, suspicious for malignancy, the segmented model was used as nucleus with branches grown on the surface. The branches had different lengths, bifurcations, orientations and thicknesses. The clinical

RESULTS

Preliminary results for the benign category (well defined borders) with 7 simulated masses showed a BIRADS score between 2 and 3, and the average realism score was 8.3 (8-9) in 2D and 7.6 (7-9) in BT. Preliminary results for the benign category (well defined borders) with 7 simulated masses showed a BIRADS score between 2 and 3, and the average realism score was 8.3 (8-9) in 2D and 7.6 (7-9) in BT.

CONCLUSION

A new method to simulate 3D models, based on an atlas of real lesions, with variety of shapes and degree of malignancies was presented with promising results.

CLINICAL RELEVANCE/APPLICATION

The proposed 3D mass models are promising candidates to create enriched databases for virtual clinical trials and observer detectability studies to optimize the performance of mammographic systems.

SSG08-05 • Tumor Heterogeneity Assessed with First Order Histogram Features in Dependence from Image Resolution: A Point to Be Considered in Clinical Routine?

Matthias Benndorf MD (Presenter) ; Martin Soschynski ; Sabine Bucher ; Marisa Windfuhr-Blum PhD ; Matthias F Langer MD, PhD ; Elmar C Kotter MD, MSc *

PURPOSE

Measurement of tumor heterogeneity in contrast enhanced MRI is a promising method to obtain additional information about prognosis, tumor type and therapy response. One way to describe heterogeneity is by histogram analysis of the tumor signal intensities. Our aim was to analyze to what extent image resolution affects first order histogram features, using breast MRI examinations.

METHOD AND MATERIALS

The proposed 3D mass models are promising candidates to create enriched databases for virtual clinical trials and observer detectability studies to optimize the performance of mammographic systems.
We designed a fast and robust automated image analysis platform with a quantification tool that facilitates accurate quantification of pulmonary infections using three small animal models—rabbit, ferret, and mouse.

PURPOSE
Brent Foster

To develop a complete image analysis and quantification framework that accurately determines disease severity and its progression in pulmonary diseases such as pulmonary hypertension, interstitial lung disease and COPD using volumetric chest CT.

RESULTS
The Shannon entropy within tumors decreases with decreasing image resolution, whereas basic distribution information like mean and standard deviation remain relatively stable. Uniformity behaves inversely to entropy.

CLINICAL RELEVANCE/APPLICATION
When interpreting studies about diagnostic performance of histogram analysis, one should consider the imaging protocol used in the respective study. Image resolution affects entropy estimates.

SSG08-06 • Differential Diagnosis of Benign and Malignant Brain Tumors by Use of Texture Analysis on FDG-PET Images

Shoiji Kido MD, PhD (Presenter) ; Akiko Katamoto BS ; Rui Xu ; Yasushi Hirano

PURPOSE
To develop the computer-aided diagnosis (CAD) method by use of texture analysis and pattern classification technique to analyze F-18-fluorodeoxyglucose (FDG) uptake distribution of brain tumors for differential diagnosis of malignancy and benignancy on FDG-PET images.

METHOD AND MATERIALS
We used consecutive 24 patients with brain tumors (10 benign and 14 malignant cases). Each patient underwent MRI and PET scans continuously. In the PET images, it is difficult to determine the contours of tumors in many cases. So, MR images were used for determination for tumor regions on PET images. In the first step, each patient of MR image data was superimposed to PET image data by use of a three-dimensional registration algorithm. After manual segmentation of tumor regions on MR images, tumor regions on PET images were segmented based on those on MR images. Texture features representing FDG uptake distributions were obtained from these tumor regions on PET images. From these texture features, four optimal parameters to distinguish malignancy from benignancy were selected. For pattern classification technique, we used a support vector machine (SVM) as a classifier. We classified 24 tumors into benign and malignant cases with the SVM by a leave-one-out method. The performance of our CAD method was compared with a maximum standard uptake value (SUVmax) based method that was generally used in clinical diagnosis.

RESULTS
The accuracy rate of our CAD method for all cases was 91.7% (22/24 cases). The accuracy rate for benign cases was 80.0% (8/10 cases), and that for malignant cases was 100.0% (14/14 cases). On the other hand, the accuracy rate of SUVmax based method for all cases was 62.5% (15/24 cases). The accuracy rate for benign cases was 20.0% (2/10 cases), and that for malignant cases was 92.9% (13/14 cases). The performance of our CAD method was superior to that of the SUVmax based method (P < 0.05).

CONCLUSION
The CAD method for differential diagnosis of brain tumors on FDG-PET images by use of texture analysis and the SVM classifier indicated high performance compared with the SUVmax based method. This method is feasible for assisting radiologists in the differential diagnosis of brain tumors on FDG-PET images.

SSG08-07 • Quantification of the Distribution and Extent of Automatically Classified Small Pulmonary Arteries and Veins on Volumetric Chest CT

Seyoun Park ; Sang Min Lee MD ; Namkug Kim PhD (Presenter) ; Joon Beom Seo MD, PhD ; Joon Ho Choi MD

CONCLUSION
Our automatic vessel classification-based quantification approach may be useful for assessing the status of many pulmonary disease, considering the spatial distribution and extents of automatically classified, small pulmonary arteries and veins.

Background
As one of meaningful indicators for assessing the status of pulmonary circulation in various pulmonary diseases, analysis of the distribution and extent of small pulmonary vessels is necessary. We developed a quantitative analysis method for determining the total vascular structure in 3D from volumetric chest CT.

Evaluation
Non-contrast volumetric chest CT scans with sub-millimeter thickness of 29 patients with chronic obstructive pulmonary disease (COPD) were used for this study. We extracted vessels as 3D points from volumetric CT images. A minimum spanning tree of pulmonary arteries and veins were then generated by construction energy minimization from extracted points. This tree was divided into smaller branches by cutting the mediastinal region. The arteries and veins were then separately collected to observe distributions. From the distal to proximal surfaces, we extracted 6 offset surfaces at 5mm intervals, respectively. Among those, the diameters of only arteries of 29 patients' lungs are 1.513±0.159, 1.840±0.105, 1.929±0.076, 1.823±0.093, 1.934±0.079, 1.968±0.073, 1.977±0.082, and 1.994±0.092mm (mean±SD) from distal to proximal surfaces with 5 mm intervals, respectively. The diameters of vessels are 1.544±0.158, 1.823±0.093, 1.934±0.079, 1.968±0.073, 1.977±0.082, and 1.994±0.092mm (mean±SD) from distal to proximal surfaces with 5 mm intervals, respectively. Among those, the diameters of only arteries of 29 patients' lungs are 1.513±0.159, 1.840±0.105, 1.929±0.076, 1.823±0.093, 1.934±0.079, 1.968±0.073, 1.977±0.082, and 1.994±0.092mm (mean±SD) from distal to proximal surfaces with 5 mm intervals, respectively.

DISCUSSION
This method is especially useful in artery and vein classification and could be possible to evaluate etiology and progress of many pulmonary diseases such as pulmonary hypertension, interstitial lung disease and COPD using volumetric chest CT.

SSG08-08 • Quantitative Analysis of Infectious Lung Disease from Serial PET-CT Scans in Small Animal Models

Brent Foster (Presenter) ; Ulas Bagci PhD, MSc ; Ziyue Xu PhD ; Awais Mansoor PhD ; Brian Luna ; Bappaditya Dey ; Colleen Jonsson ; William Bishai ; Sanjay K Jain MD ; Daniel J Mollura MD

PURPOSE
To develop a complete image analysis and quantification framework that accurately determines disease severity and its progression in pulmonary infections using three small animal models—rabbit, ferret, and mouse.

METHOD AND MATERIALS
We designed a fast and robust automated image analysis platform with a quantification tool that facilitates accurate quantification of
Recent studies have shown efficient and local drug delivery with nanoparticles, though the targeting method in atherosclerosis has not been fully established. Atherosclerotic disease is a major cause of global morbidity and mortality that might benefit from targeted therapy to the vessel wall. The proposed method was tested using sequentially acquired CT and PET images. The rabbits were infected with Mycobacterium tuberculosis (TB) (92 PET-CT scans). The ferrets were injected with the H1N1 influenza virus (44 PET-CT scans), and the mice were infected with an aerosolized respiratory pathogen (24 PET-CT scans). Segmentations were evaluated by expert radiologists and compared with ground truth segmentations.

RESULTS
Each small animal model was evaluated within the same animal type and the Dice Similarity Coefficient (DSC), and the Hausdorff distance (HD) were used for evaluation of the proposed method. The estimated lesion volume sizes from CT and PET images, estimated from the proposed method and the ground truth ($R^2=0.8922$, $p$-value). The proposed computational framework can increase the efficiency and quality of pre-clinical findings relative to clinical standards and decrease the inter-observer variation from manual quantification methods that can obscure findings.

CLINICAL RELEVANCE/APPLICATION
This framework can be applied clinically for accurate, efficient, and robust quantification of infectious diseases using longitudinal PET-CT images.

SSG08-09 • Computerized Differentiation of Regional Patterns of Diffuse Infiltrative Lung Disease for Iodine Quantification in Dual-energy CT Using SVM Classifier and a Hybrid Segmentation Method

Jangpyo Bae MS (Presenter) ; Yongjun Chang ; Jung Won Moon ; Ho Yun Lee MD ; Namkug Kim PhD

PURPOSE
To construct the computerized differentiation framework to quantify the iodine concentration according to the regional patterns of diffuse infiltrative lung disease (DILD) in dual-energy CT.

METHOD AND MATERIALS
Volumetric CT scans of thirty patients with diffuse interstitial lung disease (DILD) were performed by a 64-multiprojector row dual energy CT scanner (Siemens Definition Flash) with in 0.75mm collimation at dept. of radiology, Samsung Medical Center. Two hundred seventy one rectangular regions of interest (ROIs) with 20x20 pixels, consisting of each 57 ROIs representing three regional disease patterns (ground-glass opacity; GGO; reticular opacity; RO; and consolidation; CONS) and 100 ROIs for normal region were marked at dual-energy CT images of various DILD by two experienced radiologists with consensus. Twenty eight density, textural and shape features (histogram, gradient, run-length, co-occurrence matrix, cluster, and top-hat) were calculated and employed to characterize the ROIs by a SVM classifier with sequential forward selection method which differentiate the ROI into each class. The lung segmentation was performed with a hybrid method using rib information and an inverse level set of which parameters were adjusted with the density histogram of lung region. In addition, five folding cross validation with twenty repetitions were performed for average ROI based accuracy. To validate the region based accuracy, 40 slices were randomly selected from 20 patients and drawn by two radiologists with consensus, which was compared with the computerized method.

RESULTS
The accuracies of the classification of ROIs and whole lung region were 87.61±0.76 and 74.20±4.62, respectively. The region based accuracies of normal, RO, GGO and CONS were 77.04±4.50, 37.69±12.20, 62.38±9.53 and 45.03±13.18.

CONCLUSION
The proposed classification methods showed clinically applicable accuracy. In addition, the proposed segmentation method was effective in the lung with DILD in dual energy CT.

CLINICAL RELEVANCE/APPLICATION
This method is useful in computer aided differentiation and quantification of regional disease patterns of diffuse infiltrative lung disease in dual energy CT images.
Recent studies have shown efficient and local drug delivery with nanoparticles, though the targeting method in atherosclerosis has not been clarified. In the current study we used in and ex vivo imaging methods to investigate nanoparticle targeting and the role of permeability in a rabbit model of atherosclerosis. 1Tabas I, Glass CK, Science 2013 2Lobatto ME et al. Nat Rev Drug Discovery 2011

METHOD AND MATERIALS
To achieve this we developed a novel black-blood 3D Dynamic Contrast Enhanced (DCE)-MRI technique that allows the assessment of endothelial permeability over a large vascular region, e.g. the infra-renal aorta of an atherosclerotic rabbit. Atherosclerotic rabbits (n=8) were subjected to a DCE-MRI scan on a 3T clinical scanner and injected with nanoparticles labeled with the fluorescent dye Cy7 (Cy7-LN) that we allowed to circulate different time points (½-hour, 6 hours and 24 hours). Next, we injected a fluorescent dye (Evans Blue (EB)) that extravasates at sites with enhanced permeability, after which rabbits were sacrificed. Near infrared fluorescence imaging was then used to quantify both Cy7-LN and EB in excised aortas.

RESULTS
Excellent correlation was observed between the accumulation of Cy7-LN at a ½-hour and permeability determined with EB (r²=0.8, p=0.65, p=0.47, p=0.007; DCE: r²=0.53, p=0.003), but became insignificant after 24 hours (EB: r²=0.08, p=0.33; DCE: r²=0.08, p=0.33). With fluorescence microscopy we found Cy7-LN confined to the vasculature when circulated for a ½-hour, while gradual extravasation from the lumen and neovessels was seen at 6 hours. At 24 hours LN was found diffusely throughout the plaque, clarifying the aforementioned decrease in correlation between LN accumulation and endothelial permeability.

CONCLUSION
CyD-MRI allowed the visualization of permeability within atherosclerotic plaques, which similarly correlated with nanoparticle uptake.

CLINICAL RELEVANCE/APPLICATION
As nanoparticles may be employed for local drug delivery to atherosclerotic plaques, 3D DCE-MRI might be a valuable in vivo tool to predict if a subject is amenable to nanoparticle therapy.

SSG909-03 • Cardiac PET/MRI with 18F-FDG: Feasibility and Initial Results in Patients with Acute Myocardial Infarction

Felix Nensa MD (Presenter); Thorsten D Poeppel; Karsten J Beiderwellen MD; Juliane Schelhorn MD; Amir A Mahabadi MD; Philipp Heusch MD; Kai Nassenstein; Michael Forsting MD; Thomas W Schlosser MD

PURPOSE
To assess the feasibility of hybrid imaging of the heart with 18F-fluorodeoxyglucose (18F-FDG) on an integrated 3 Tesla PET/MRI system and to discuss its potential clinical impact.

METHOD AND MATERIALS
Twenty patients with confirmed acute myocardial infarction underwent 18F-FDG PET/MRI with oral glucose loading within 2-7 days after interventional revascularization. Tracer accumulation in each myocardial segment was compared to regional wall motion abnormalities and to signal intensity in late gadolinium-enhanced (LGE) images with Cohen’s ? statistics. The size of the infarction zone was measured on LGE and PET images.

RESULTS
Absolute parallelized scan time was 71±3 min. Categorical inter-method agreement between PET and LGE over all patients and segments was =0.83, and =0.81 between PET and cine imaging. On average 20±17% of the entire left ventricular myocardium was classified as infarcted in PET images and 19±19% in LGE images (p=0.65). Bland-Altman analysis of tracer uptake in PET/MR and PET/CT yielded limits of agreement of -3.04 to 3.65 (SUVmax) compared between PET/CT and PET/MR.

CONCLUSION
Cardiac PET/MRI in patients with acute myocardial infarction is feasible on an integrated PET/MR scanner. Comparison of PET images from PET/CT and PET/MRI showed good concordance. A close match between PET and MRI regarding myocardial viability and infarct quantification was demonstrated. Further study will show if hybrid PET/MRI with 18F-FDG yields added value in patients with ischemic cardiac disease.

CLINICAL RELEVANCE/APPLICATION
Cardiac PET/MRI provides quantitative information on metabolic processes that might be incorporated into cardiac MRI protocols to improve risk stratification in acute myocardial infarction.

SSG909-04 • Non-Invasive Assessment of Inflammation in a Murine Model of Chronic Inflammatory Bowel Disease Using Ultrasound Molecular Imaging

Ferdinand Knieling (Presenter); Steven B Machtaler PhD; Thierry Bettinger *; Richard Luong; Huaijun Wang MD, PhD; Juergen K Willmann MD *

PURPOSE
Ultrasound (US) molecular imaging has shown promising results in imaging inflammation in murine models of acute inflammatory bowel disease (IBD). The purpose of this study was to evaluate the feasibility of US molecular imaging using a clinically translatable microbubble (MB) targeted to the inflammation markers P- and E-selectin (MBselectin) for monitoring inflammation in a chronic and a chronic flare model of murine colitis.

METHOD AND MATERIALS
Acute colitis was established by rectal 2,4,6-trinitrobenzene sulfonic acid (TNBS) administration in 23 mice. Chronic colitis was established by 3 repetitive cycles of oral dextran sodium sulfate (DSS) administration in an additional 23 mice; an acute inflammatory flare in the chronic colitis mice was simulated by rectal TNBS injection. All mice were imaged in contrast mode following i.v. injection of 5x107 MBselectin and control microbubbles (MBcontrol) using a 21 MHz transducer (VisualSonics). In vivo imaging results were correlated with ex vivo immunofluorescence and histology.

RESULTS

CONCLUSION
Selectin-targeted US molecular imaging allows inflammation assessment in acute inflammation and chronic flare models of IBD in mice, which may simulate different disease states seen in patients with IBD.

CLINICAL RELEVANCE/APPLICATION
US molecular imaging is a clinically translatable approach to quantitatively assess inflammatory flares in both early and late stage IBD.

SSG909-05 • Inflammation Imaging Using Molecular Ultrasound in an Acute Terminal Ileitis Model in Swine

Huaijun Wang MD, PhD (Presenter); Stephen A Felt DVM, MPH; Ismayil Guracar *; Steven B Machtaler PhD; Thierry Bettinger *; Juergen K Willmann MD *

PURPOSE
To translate ultrasound (US) molecular imaging using a clinical grade contrast microbubble targeted at the inflammation markers P- and E-selectin (MBselectin) to a large animal model of acute terminal ileitis.

METHOD AND MATERIALS
An acute terminal ileitis porcine model was established in 9 female pigs using intraluminal 2,4,6-trinitrobenzene sulfonic acid (TNBS) installation. All pigs were imaged before (control), and 48 hours after induction of ileitis. US molecular imaging was performed after i.v. injection of either MBselectin or non-targeted MBcontrol at a dose of 5×10^8/kg b.w. each using a clinical US machine (Acuson Sequoia 512; Siemens) and a clinical transducer (15L8W; 7MHz). Four minutes after MB injection, images were acquired for 10 sec, followed by a 3-sec high power destruction pulse; this was followed by another 10-sec acquisition. Linearized imaging signal was expressed as intensity ratio, defined as average pre-destruction signal intensity divided by average post-destruction signal intensity. After imaging, pigs were sacrificed and the terminal ileum was analyzed for inflammation grade on HandE staining and for expression of P- and E-selectin using immunofluorescence.

RESULTS
US molecular imaging of the terminal ileum was feasible in all 9 pigs. Imaging signal intensity ratio using MBselectin was significantly higher (increased by 106%, P=0.005) in acute ileitis compared to normal control ileum. Also, imaging signal in acute ileitis using MBselectin was significantly different (P=0.06) when using MBcontrol in normal control ileum. Ex vivo analysis on HandE stained tissue samples confirmed strong inflammation in the terminal ileum. Immunofluorescence showed overexpression of selectins on the vasculature of inflamed bowel.

CONCLUSION
US molecular imaging with MBselectin can be translated to large animal imaging in an acute terminal ileitis porcine model and molecular US imaging signal correlates well with extent of inflammation on histology.

CLINICAL RELEVANCE/APPLICATION
The feasibility of US molecular imaging in large animals with ileitis paves the way towards clinical translation of US molecular imaging for the accurate quantification of inflammation in the abdomen.

SSG09-06 • Optical Imaging for Real-time Detection of Cartilage Matrix Degeneration in Experimental Osteoarthritis Models
Shadi A Esfahani MD, MPH (Presenter); Andrea Foote; Averi A Leahy; Li Zeng; Omar Mahmood MD, PhD

PURPOSE
Osteoarthritis (OA) is a degenerative disease due in part to permanent destruction of cartilage matrix, causing patients pain and immobility. This destruction occurs by highly activated proteases in the matrix, predominantly matrix metalloproteinase (MMP). We used an optical probe, cleaved and activated by MMP enzymes in the cartilage and assessed the ability of this probe for early detection and monitoring of OA progression in animal models.

METHOD AND MATERIALS

RESULTS
Our imaging and histopathology results showed that targeting MMP is a promising non-invasive method for early detection and monitoring of cartilage matrix degeneration in a wear-and-tear model of OA. The method is readily translatable to humans.

CLINICAL RELEVANCE/APPLICATION
Optical imaging of matrix metalloproteinase could aid in non-invasive detection of cartilage destruction in early stages of disease and in evaluation of treatment response in osteoarthritic patients.

SSG09-07 • Arterial Spin Labeling and T1-mapping for Evaluation of Renal Perfusion Impairment and Tissue Edema following Acute Kidney Injury in Mice-Comparison with Histopathology
Katja Huerer (Presenter); Marcel Gutberlet DiplPhys; Song Rong MD; Dagmar Hartung MD; Matti Peperhove MD; Amelie Barrmeyer; Michael Mengel; Hermann Haller MD; Frank K Wacker MD*; Martin Meier PhD; Falkah Gueler MD

PURPOSE
Acute kidney injury (AKI) leads to inflammation, decrease of renal perfusion, and loss of renal function. The purpose was to investigate whether arterial spin labeling (ASL) and T1-mapping allow monitoring renal perfusion impairment and acute tissue edema in a mouse model of ischemia induced AKI.

METHOD AND MATERIALS
AKI was induced in C57Bl/6 mice by transient unilateral clamping of the right renal pedicle for 35 min (n=10, moderate AKI) or 45 min (n=7, severe AKI). Animals underwent MRI prior to surgery and at different time points thereafter (d1, d7, d14, d21, d28) using a 7 Tesla magnet. Flow sensitive alternating inversion recovery (FAIR) EPI ASL sequences (13 inversion times) were acquired, and maps of renal perfusion and T1 relaxation time were calculated. Kidney volume was determined by segmentation of axial T2-weighted images.

RESULTS
Renal perfusion at d7 was significantly reduced to 56±8% after moderate (p = 0.001) and severe AKI. ASL and T1-mapping allow non-invasive monitoring of renal perfusion impairment and tissue edema after AKI in mice. Changes of renal perfusion and T1 relaxation time are associated with the severity of renal pathology and kidney volume loss.

CLINICAL RELEVANCE/APPLICATION
Renal perfusion and T1 relaxation time measured by arterial spin labeling and T1-mapping may serve as non-invasive biomarkers to characterize renal pathology after acute kidney injury.

SSG09-08 • Visceral Obesity Assessed by 1H-MRS Predicts Cardiovascular Events in Chronic Kidney Disease Patients
Francesca Bolacchi (Presenter); Ettore Squillaci MD; Fabrizio Chegai MD; Marco Nezzo MD; Giovanni Simonetti MD

PURPOSE
Cardiovascular disease is the leading cause of death among patients with chronic kidney disease (CKD). Although there is emerging evidence that excess visceral fat is associated with a cluster of cardiometabolic abnormalities in these patients, the impact of visceral obesity evaluated by a gold-standard method on future outcomes has not been studied. We aimed to investigate whether visceral obesity assessed by 1H-MRS was able to predict cardiovascular events in CKD patients.

METHOD AND MATERIALS
We studied 48 nondialyzed CKD patients [58% men; 29% diabetics; age 52.4 ± 9 years; body mass index (BMI) 26 ± 4.2 kg/m²; estimated glomerular filtration rate (GFR) 32.7 ± 11.5 ml/min/1.72 m²]. Visceral and subcutaneous abdominal fat were analysed by single voxel magnetic resonance spectroscopy (MRS). The MRS lipid spectrum was analysed and a lipid polysaturation index (PUI) was calculated. Fifteen healthy subjects were enrolled as controls. Cardiovascular events including acute myocardial infarction, angina, arrhythmia, uncontrolled blood pressure, stroke and cardiac failure were recorded during 24 months.

RESULTS
Cardiovascular events were 3-fold higher in patients with higher PUI index. The Kaplan-Meier analysis indicated that patients with a high PUI index had shorter cardiovascular event-free time than those with normal PUI values (P = 0.031). In the univariate Cox analysis, PUI
was associated with higher risk of cardiovascular events (hazard ratio = 3.4; 95% confidence interval = 1.1-10.5; P = 0.03). The prognostic power of PUI for cardiovascular events remained significant after adjustments for sex, age, diabetes, previous cardiovascular disease, smoking, sedentary lifestyle, BMI, GFR, hypertension, dyslipidemia and inflammation.

CONCLUSION
Visceral and subcutaneous fat as analysed by 1H-MRS is a valuable tool in predicting cardiovascular events in CKD patients.

CLINICAL RELEVANCE/APPLICATION
PUI index assed by 1-H MRS was a predictor of cardiovascular events in CKD patients.

SSG09-09 • C5b-9 Targeted Molecular MR Imaging in Rats with Heymann Nephritis: A New Approach in Evaluation of Nephrotic Syndrome

 Wenbo Xiao MD ; Qiang Huang (Presenter) ; Song Wen ; Chuanwen Guo ; Qidong Wang ; Rui Zhang

PURPOSE
To determine the feasibility of magnetic resonance imaging in rats with Heymann nephritis (HN) by using membrane attack complex C5b-9 targeted ultrasmall superparamagnetic iron oxide (USPIO)

METHOD AND MATERIALS

RESULTS

CONCLUSION
Anti-C5b-9-USPIO, as targeted molecular probe in MRI, could be used in specific imaging of rats with HN. Such a new molecular imaging method would be promising in the study of nephrotic syndrome diagnosis and treatment. [This study was supported by grants from the National Natural Science Foundation of P.R. China (81171388) to W.X. and partly from the Ministry of Health Research Foundation of P.R. China (WK2011-2-004) to W.X.]

CLINICAL RELEVANCE/APPLICATION
C5b-9 targeted molecular MR imaging can be a promising noninvasive approach in study of glomerulonephritis.

Musculoskeletal (Interventional II)

Tuesday, 10:30 AM - 12:00 PM • E450B

SSG10 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

Moderator
Daniel E Wessell , MD, PhD *

Moderator
Joseph S Yu , MD

SSG10-01 • Percutaneous CT-guided Biopsy of the Musculo-skeletal System: Results of 3146 Cases Carried Out in the Last 22 Years

Eugenio Rimondi MD (Presenter); Alberto Bazzocchi MD; Paolo Spinnato MD; Giancarlo Facchini; Teresa Calabro; Fabio Ferrari; Davide Donati; Pietro Ruggieri; Ugo Albisinni MD

PURPOSE
This is a retrospective review of a single institution experience with percutaneous CT-guided biopsy of musculo-skeletal lesions to evaluate results, to define indications and to emphasize the role of this procedure in the diagnosis and staging of inflammatory and neoplastic lesions of the musculo-skeletal system.

METHOD AND MATERIALS
From January 1990 until the end of January 2013, 3146 core needle CT-biopsy were performed. All histologic diagnoses and imaging studies were reviewed. Site of procedure included spine in 1103 (35.1%), thoracic cage in 141 (4.5%), upper limb in 255 (8.1%), pelvis in 703 (22.3%) and lower limb in 944 (30.0%) patients.

RESULTS
In 2495 (79.3%) CT-guided biopsies the procedure was diagnostic: at histology 664 (26.6%) lesions were malignant bone tumours, 587 (23.5%) benign tumours, 53 (2.1%) pseudo-tumours and 480 (19.2%) metastases. In 372 (14.9%) patients an acute or chronic inflammatory disease was found; 339 (13.6%) had other diagnoses (stress fractures, metabolic diseases, chronic degenerative arthropathies, Paget etc.). On the other hand, in 651 (20.7%) cases the CT-guided procedure was not successful: 63 patients underwent incisional biopsies and 588 a second CT-biopsy, diagnostic in 503 patients. This gives an overall rate of non-diagnostic exams of 148/3146 (4.7%). Major difficulties in obtaining a diagnostic sample were related with site, histotypes (small cells, myelomas and lymphomas are more difficult for adequate sampling), insufficient pre-biopsy evaluation or insufficient cooperation from the patient.

CONCLUSION
CT-guided biopsy is a useful and low-cost technique that should be recommended for most of the bony lesions, with or without soft tissues involvement, even deeply located and spinal lesions. Failures of this procedure can be reduced in experienced hands with a careful evaluation of the case before the procedure, and with a team approach from the radiologist, the orthopaedic surgeon and the pathologist.

CLINICAL RELEVANCE/APPLICATION
Percutaneous CT-guided biopsy is crucial in the management of musculo-skeletal lesions. This revisited presentation highlights potentials and limitations of the technique and a few clues for users.

SSG10-02 • Percutaneous Bone Biopsies: Comparison between CT-scan and Flat-Panel Cone Beam CT Guidance

Lambros C Tselikas MD (Presenter); Julien Joskin; Geoffroy Farouil; Florian Roquet; Serge Dreuil PhD; Anne Auperin MD; Thierry J De Baere MD *; Frederic Deschamps

PURPOSE
To compare the accuracy and the radiation dose of bone biopsies performed either under conventional computed tomography guidance (CT-guidance) or under fluoroscopic guidance using a flat-panel cone-beam CT with real-time 3D image fusion software (FP-CBCT-guidance).

METHOD AND MATERIALS
Institutional review board approval was obtained. Sixty-eight consecutive patients with bone tumor were prospectively included. The biopsies were scheduled under CT-guidance or under FP-CBCT-guidance according to operating room's availability without any preference. We prospectively compared the 2 guidance modalities for the feasibility, technical success, accuracy (distance between target and needle tip), puncture time (time from initial to final 3D acquisitions) and pathological success (biopsy contributive for pathological diagnostic). Patients and physicians radiations doses were also compared using dedicated dosimeters. Statistical significance was evaluated using two-tailed parametric and non-parametric t tests.
RESULTS
Thirty-four patients underwent bone biopsies under CT-guidance and 34 under FP-CBCT-guidance. All biopsies were feasible and technically successful, with both guidance modalities. There was no significant difference for puncture time (34.4 min and 34.3 min respectively; p = 0.49) and pathological results (88% and 88% of success respectively; p = 0.98). Precision was significantly better using FP-CBCT-guidance (3.5 mm and 4.8 mm respectively; p=0.002). Patients and operators radiations doses were significantly lower under FP-CBCT-guidance: patient's peak skin dose was 57 mSv +/- 44.6 versus 169 mSv +/- 146.3 (p

CONCLUSION
FP-CBCT-guidance for bone biopsy is accurate and reduces patient and operator’s radiations doses, compared to CT-guidance.

CLINICAL RELEVANCE/APPLICATION
Flat-panel-CBCT-guidance can be considered for bone biopsies, allowing a significant radiation dose reduction for the patient and the operator without decrease of accuracy or puncture time extension.

SSG10-03 • Vertebral Biopsy in Patients with Suspected Osteomyelitis: Does It Change Management?
Minzhi Xing MD (Presenter) ; Elizabeth I Parker MD ; Michael R Terk MD

PURPOSE
To determine if vertebral biopsy affects clinical decision-making in patients with suspected osteomyelitis and diskitis

METHOD AND MATERIALS
Forty-seven (n=47) consecutive patients (mean age 67.4 years, 41.7% male) with suspected vertebral osteomyelitis and diskitis who underwent CT-guided vertebral biopsy over a 5-year period (2008-2012) at a single institution were included. A retrospective chart review was performed to determine biopsy results, immune status, antibiotic status at time of biopsy, blood culture positivity (defined as =2 cultures positive) and results of other fluid cultures (abscess drainage, urine). A change in management was defined as commencement of an antibiotic regimen or a change from pre-biopsy antibiotic regimen following biopsy results.

RESULTS
The cohort comprised patients with suspected osteomyelitis and diskitis who underwent biopsy of the lumbar (33, 70.2%), thoracic (13, 27.7%) and cervical (1, 0.02%) vertebrae. 23 patients (48.9%) were receiving empiric treatment or antibiotics for co-morbid disease (HIV, TB) at the time of biopsy. Adequate pre-biopsy blood cultures were obtained for 37 patients (78.7%), of which 4 were culture positive. 12 patients would have required biopsy for diagnosis. Vertebral biopsy was positive in 13 (27.7%) and negative in 34 (72.3%) patients. A change in management based on overall biopsy results occurred in 7 patients (14.8%). Of the patients with positive biopsy results, there was no change in management in 7 patients, who were continued on pre-biopsy antibiotic regimens. Of the patients with negative biopsy results, there was no change in management in 33 patients: 16 continued on the same pre-biopsy antibiotic regimen with a clinical diagnosis of osteomyelitis, and in 17 patients the decision to stop antibiotics, or an alternative diagnosis, was made before biopsy results were obtained and thus not influenced by biopsy results.

CONCLUSION
In this study, only 14.8% of vertebral biopsies provided positive histological confirmation of osteomyelitis and changed management. In the majority of patients with suspected osteomyelitis undergoing vertebral biopsy, there was little evidence that clinical decision-making with respect to antibiotic regimen was influenced by biopsy results.

CLINICAL RELEVANCE/APPLICATION
Vertebral biopsy in the setting of suspected osteomyelitis does not lead to a change in antibiotic management in the majority of patients.

SSG10-04 • CT-based Finite Element Modeling and Microstructural Analysis Detect Reduced Bone Mineral Content and Bone Strength in the Spine after CT Fluoroscopy-guided Intervventional Procedures
Miyuki Takasu MD (Presenter) ; Yuko Nakamura MD ; Daisuke Komoto MD ; Masaki Ishikawa MD ; Masao Kiguchi RT ; Kazuo Awai MD * ; Shuji Date ; Chihiro Tani MD

PURPOSE
The long-term bone toxicity associated with CT fluoroscopy-guided interventional angiography has received little attention. The purpose of this study was to determine the prevalence of secondary osteoporosis (SO) and trabecular microstructural changes after CT fluoroscopy-guided transarterial chemoembolization (TACE) for hepatocellular carcinoma.

METHOD AND MATERIALS
Spinal microarchitecture was examined by 64-detector CT in 53 patients who underwent TACE and 85 sex- and age-matched controls. Each patient’s cumulative radiation exposure due to CT fluoroscopy was determined by summing the skin dose recorded by dosimeters placed on the examination table. Patients who had received medications that contribute to the risk of osteoporosis were excluded. Using a 3D image analysis system and finite element modeling (FEM), the bone mineral content per tissue volume (BMC/TV), trabecular parameters, and mechanical properties of the third lumbar vertebrae were calculated. Using BMC/TV with a reported cutoff value 58 mg/cm³, the prevalence of SO was analyzed with the chi square test. A multivariate regression model of patients’ characteristics including age, sex, cumulative radiation dose, and dose per procedure was constructed to identify predictors for SO. The trabecular parameters were compared among three groups, including controls, patients with SO, and patients without SO, by Scheffe’s post hoc test.

RESULTS
The prevalences of SO were 42.5% in males and 50.0% in females; it was higher in males than in the controls (P=0.04). By multivariate regression analysis, age was a significant contributor to SO (P=0.004). The microstructural and mechanical properties were significantly lower in patients with SO than in the controls and the elastic modulus obtained by CT/FEM was significantly lower in patients without SO than the controls (P=0.03).

CONCLUSION
The prevalence of SO was significantly higher in male patients than the controls. The bone quality and failure load were significantly reduced in patients with SO and the elastic modulus was significantly lower in patients without SO than in the controls.

CLINICAL RELEVANCE/APPLICATION
Multidetector CT detected an increased risk of SO after CT fluoroscopy-guided TACE. CT/FEM can alert to trabecular changes before the clinical manifestation of SO.

SSG10-05 • Anterior Endplate Cement Extravasation Following Vertebroplasty or Kyphoplasty Is Associated with Increased Odds of Adjacent Level Fracture in Osteoporotic Patients
Mary Kristen Jesse MD (Presenter) ; Brian D Petersen MD ; Deborah Glueck * ; Sarah M Kreidler MS

PURPOSE
To determine if the location and extent of endplate cement extravasation is associated with adjacent level fracture (ALF) in osteoporotic patients after vertebroplasty or kyphoplasty.

METHOD AND MATERIALS
156 fractureplasty levels in 80 patients were retrospectively reviewed. Data were obtained from a single center between 2008 and 2012. For each patient, demographics including age, gender, T-score, body mass index, and osteoporosis type (primary or secondary) were recorded. Outcomes included presence of adjacent level fracture (ALF), location of cement extravasation (anterior, middle, or posterior third of the vertebral body), and extent of extravasation (percentage of the intervertebral disc height occupied by the bolus). An ALF was defined as a fracture which was: 1) in an unrepaiured vertebra; 2) adjacent to a repaired level and 3) not due to trauma or pathology.
RESULTS
After exclusions, 98 levels in 52 patients remained. ALF occurred in 20 levels within 14 patients. For levels with adjacent level fracture (ALF), extravasation occurred in 9 levels, with 6 anterior, 3 middle, and no posterior leaks. For levels without ALF, extravasation was seen in 11 levels, with 2 anterior, 6 middle, and 3 posterior leaks. The odds of ALF in a given patient were 5.9 times higher (95% CI: 1.6 to 21.2) with extravasation when compared to no leakage. Leakage in the middle or posterior two thirds of the vertebra (p=0.30) and extent of extravasation (p=0.024) were not associated with ALF. No associations were observed between ALF and patient demographics.

CONCLUSION
Cement endplate extravasation in general and anterior extravasation in particular have high association with adjacent level fracture after vertebroplasty and kyphoplasty in patients with osteoporosis.

CLINICAL RELEVANCE/APPLICATION
Application of this data will allow a more sophisticated intra-procedural fracture risk assessment following cement leakage.

SSG10-06  CT-assisted Pedicle Screw Placement after CT-controlled, Presurgical Guide Wire Implantation in Pelvic Fractures

Purposes

CT-assisted pedicle screw placement is commonly used in pelvic fractures. However, the accuracy of guide wire placement may be compromised in unstable pelvic injuries. The aim of this study was to evaluate the feasibility and accuracy of CT-assisted percutaneous placement of iliosacral screws over guide wires in patients with unstable pelvic fractures.

Methods

CT-controlled fixation of unstable pelvic fractures is a safe and feasible method that is able to minimize the complications of surgical treatment.

SSG10-07  Cervical Interlaminar Epidural Steroid Injection for Cervical Radiculopathy: Median versus Paramedian Approach

Purposes

The aim of this study was to evaluate the feasibility and accuracy of CT-assisted percutaneous placement of iliosacral screws over guide wires in patients with unstable pelvic fractures.

Methods

Patients with unstable traumatic pelvic fractures were treated with percutaneous screw placement after CT-controlled presurgical guide wire implantation to prevent surgical complications regarding the presacral venous plexus and the sacral nerve root. The patients were placed in prone or supine position on the CT table and general anesthesia was induced. For planning a CT with a collimation of 4x2.5 mm or 6x4x0.625 mm (120 KV, 80 mAs) was performed. Based on this scan skin entry points were marked. Then thread Kirschner guide wires with a diameter of 2.5 mm were introduced percutaneously under CT control. After verification of the position of the Kirschner guidewires the distance for the correct placement of the 7 mm-screws was measured, which were then introduced over the guide wire in the operation unit or immediately in the CT intervention room through a small skin incision.

Results

In all cases the guide wires were successfully placed without complications. A total of 101 wires (47 on the right side and 54 on the left side) were introduced. All wires were correctly positioned in the first or second sacral vertebrae. In two patients with sacralized lumbal vertebrae one an additional wire was also positioned in L5. In all cases, the screws were placed over the wires without ventral or dorsal perforation of the sacrum and affection of the nerve roots. None of the patients showed radiologic or clinical evidence of instability of the sacroiliac joint or screw migration. The mean clinical and radiologic follow-up period was 16 months (range: 3-24).

Conclusion

CT-controlled fixation of unstable pelvic fractures is a safe and feasible method that is able to minimize the complications of surgical treatment.

SSG10-08  Long-term Results of Combined Intradiscal and Periganglionic Injection of Medical Ozone for the Treatment of Lumbar Disk Herniation: Effects on Disk Size and Lumbar Radiculopathy in 371 Patients

Purposes

To evaluate the therapeutic benefit and morphologic changes in herniated lumbar disk after CT-guided intradiscal and periganglionic oxygen-oxygen injection combined with a periganglionic administration of steroids and anesthetic.

Methods

371 patients with lumbar disk herniation received an intradiscal (3 mL) and periganglionic (7 mL) injection of an oxygen-oxygen mixture (ratio 3:97), followed by a periganglionic injection of corticosteroid (1 mL of Celestone®Depot, ESSEX PHARMA, Munich, Germany) and anesthetic (2 mL of Carboesten® 0.25%, AstraZeneca, Wedel, Germany) in the same session. Under CT guidance, intradiscal and...
RESULTS
Treatment was successful in 268 patients (72.2%). In the remaining 103 patients (27.8%), treatment was considered to have failed. Among the patients whose treatment was a success, outcome was excellent in 133 patients (49.6%) and good in 135 patients (50.4%). Among the patients whose treatment was a failure, this was poor in 76 patients (73.8%) and poor with recourse to surgery in 27 patients (26.2%). Complications occurred in 36 patients, who presented with episodes of impaired sensitivity in the lower limb ipsilateral to the treatment; the episode resolved spontaneously within 2 hours.

CONCLUSION
Our study shows that the combined intradiscal and periganglionic injection of medical ozone and periganglionic injection of steroids affects both the mechanical and the inflammatory components of pain caused by disk herniation. For this reason, this is a therapy option for treating lumbar disk herniation that has failed to respond to conservative management, before recourse to surgery or when surgery is not possible.

CLINICAL RELEVANCE/APPLICATION
The ease of execution and non-invasiveness of this therapy permit the successful outpatient treatment of lumbar sciatic pain.

SSG10-09 • A New Simplified CT Guided Peripheral Approach for Greater Occipital Nerve Infiltration in the Management of Arnoldâ€™s Neuralgia

Adrian I Kastler MD, MSc (Presenter); Yannick Onana; Sebastien L Aubry MD, PhD; Bruno A Kastler MD, PhD

PURPOSE
To evaluate the efficacy of a new simplified CT guided approach in the management of greater occipital nerve infiltration.

METHOD AND MATERIALS
Local Institution approval was obtained and written informed consent was waived. A total of 23 patients (6 men, 17 women, with a mean age of 46.3 y.o) who underwent 30 procedures were included in this retrospective study between March 2012 and December 2012. All included patients suffered from severe greater occipital nerve neuralgia refractory to conventional specific treatments. Procedures were performed under CT Guidance and local anesthesia. Initial non-enhanced planning CT was performed from C0 to C2. Infiltration of greater occipital nerve was exclusively performed at the most superficial site at the first bend of the GON between inferior obliquus capitis and semispinalis capitis muscles facing C1-C2 level, using a 22G needle. A mixture of fast- and slow-acting anesthetic (1.5 mL lidocaine hydrochloride 1% and 3 mL ropivacaine hydrochloride 0.25%) was then injected followed by the injection of 1.5mL of cortivazol at pre-defined target site. Pain was evaluated on VAS scores immediately before and after procedure and on a monthly basis following procedure. Technical success was defined by the ability to accurately position needle tip at target site. Clinical success was defined by pain relief greater than or equal to 50% lasting for at least 1 month.

RESULTS
Mean pain prior procedure was 7.72/10. Eighteen patients suffered from unilateral pain (right, n=10, left, n=8) and 4 from bilateral pain. Technical success of procedure was 100%. Procedure time ranged from 10-15 minutes. Clinical success rate was 81% (21/26 procedures). In case of clinical success, mean pain relief duration following procedure was 5.25 months (3-25 months).

CONCLUSION
This novel simplified CT guided infiltration approach appears to be effective in the management of refractory Arnold’s Neuralgia. With this new technique, infiltration of the GON is safer, faster and technically easier as it does not require the IV contrast injection, compared to other previously described techniques.

CLINICAL RELEVANCE/APPLICATION
This simplified GON infiltration under CT-guidance aiming at a new peripherals is well suited in the diagnosis and management of Arnold’s neuralgia, a benign but possibly very invalidating condition.

Neuroradiology (Advances in Intracranial CT and MR Angiography)

Tuesday, 10:30 AM - 12:00 PM • N226

SSG11 • AMA PRA Category 1 Credit™ • ARRT Category A: Credit:1.5

Moderator
Mark E Mullins , MD, PhD
Moderator
Pina C Sanelli , MD

SSG11-01 • The Clinical Applications of Iodixanol 270mgI/ml in Combination with Spectral CT Imaging in Intracranial CTA

Shan Hu (Presenter); Wenzhen Zhu MD, PhD

PURPOSE
To explore the clinical value of intracranial CTA using iodixanol 270mgI/ml in combination with spectral CT imaging mode.

METHOD AND MATERIALS
Forty patients (20 males and 20 females; average 48±12y; BMI=30) with suspected vascular diseases were randomly assigned into two groups and undergo intracranial CTA (Discovery CT750 HD, GE healthcare). Group A (n=20) was administered iodixanol 370 mgI/ml and 120kVp, 400mA. Group B (n=20) was administered iodixanol 270mgI/ml and spectral CT imaging (fast 80/140kVp switching, 550mA). Both groups were at the same injection volume of 0.8ml/kg, 4.8ml/s of injection rate, 0.5s of rotation time, and a pitch of 0.984. All the source images were transmitted to AW4.5 workstation. The keV images with the best CNR for group B were obtained by GSI viewer software and used for comparison. CT values and their standard deviations for the anterior cerebral artery, middle cerebral artery, posterior cerebral artery, and basal ganglia as background region were measured, and CNR and SNR values for the arteries were calculated. These values were statistically compared between the 2 groups. Three readers evaluated the image quality on VR images with scores 1-5.

RESULTS
The mean CT value, CNR and SNR for Group B were statistically higher than those for Group A (330±0.405HU, 4.7±0.75 and 5.1±0.75, respectively) (all P<0.05). But more terminal branches were displayed for Group B than Group A. Contrast dose was reduced by 27% in group B and CT dose index volume (CTDIvol) was statistically lower for group B than for group A (35.5±4.5mGy vs. 72.1±1.2mGy) (P<0.05). The use of iodixanol 270mgI/ml combined with spectral CT imaging in intracranial CTA provided acceptable or better image quality, with contrast dose reduction of 27% and radiation dose reduction up to 50%.

CONCLUSION
Using iodixanol 270mgI/ml in combination with spectral CT imaging mode in intracranial CTA can achieve acceptable or better image quality.
Efficacy of Automated Bone Removal Software for Head CT Angiography: Comparison Against Dual Scan Subtraction

Andres Kohan MD (Presenter) *; Christian Rubbert MD *; Leslie Ciancibello RT; Ekta D Dharaiya MS *; Gina M Anderson; Barbara A Bangert MD *

PURPOSE
Evaluate the efficacy of a single scan bone removal software solution in head CTA studies.

METHOD AND MATERIALS
30 head CTA performed through the dual scan technique (non-contrast scan followed by a contrast enhanced) on a 256 or a 64 slice CT scanner were retrospectively analyzed. The studies were processed in two ways: 1. Subtraction of the non-contrast scan from the contrast enhanced scan (Group A) and 2. Automated bone removal from a single contrast enhanced scan (Group B). The technologist recorded the time it took to perform each process. The images were also assessed by an experienced neuroradiologist (19y) with regard to success of bone removal, visualization of anterior and posterior vessels, readability, confidence in diagnosis and delineation of the pathology. For this purpose a 4 point likert-scale (1=Non diagnostic, 2=Poor, 3=Acceptable and 4= Good) was used. Reading of group A and B was performed with 2 weeks separation to reduce recall bias. Reading time needed per study was also recorded. Wilcoxon signed-rank test for paired samples was performed for differences in image quality and time between examinations.

RESULTS
The post-processing of images from group A took in average 222±68s while for group B it took 96±17s (p<0.001). The average grade between VIVID and IADSA were almost equal in Frontopolar artery, Anterior choroidal artery, Ophthalmic artery, Recurrent artery of Heubner, Cortical vein, Trolard vein, Labbe vein, and Internal cerebral vein(p>0.05). In Anterior communicating artery, Posterior communicating artery, Inferior sagittal sinus, Septal vein, Basal vein of Rosenthal, and Cavernous sinus, VIVID was higher average grade than IADSA(p<0.05). The post-processing of images from group A took in average 222±68s while for group B it took 96±17s (p<0.001). The post-processing of images from group A took in average 222±68s while for group B it took 96±17s (p<0.001).

CONCLUSION
Automatic bone removal from a single scan not only significantly improved the technological workflow by reducing post-processing times, but has also significantly improved the quality of the studies by removing bone more effectively than the double scan subtraction technique, while maintaining or even improving diagnostic confidence and image quality. The clinical impact of this software relies on its applicability to any scanner and the reduced radiation dose to the patient by avoiding the non-contrast enhanced scan.

Volume Intra-venous Injection DSA (VIVID) Compared with Intra-arterial Injection DSA (IADSA) for Evaluation of Cerebral Arteries and Veins

Akihiro Imamura MD (Presenter); Hideyuki Takano MD; Hiroyuki Funatsu MD; Naoyuki Ueno; Hidetoshi Taguchi MD

PURPOSE
We analyzed whether the intracranial arteries and veins could be detected using intravenous injection digital angiography (DSA) (VIVID) by using the flat-panel detector angiographic computed tomography CT system (FACT). We compared these results with IADSA.

METHOD AND MATERIALS
We retrospectively analyzed 17 consecutive patients (8 males and 9 females; 23 sides) who underwent both VIVID examinations and IADSA for neuronavigation. One hundred ml of nonionic iodine contrast (350 mg/ml) injection was injected via an 18-gauge plastic needle, at a rate of 10 ml/second, which was then flushed out using 25 ml of saline, followed by rotational DSAs. We analyzed data from the rotational DSAs processed by the DynaCT software on the workstation using the maximum intensity projection and volume rendering algorithms. The VIVID and IADSA images were analyzed and compared by 3 experienced radiologists independently. The quality of visualization was graded as non-visualized (0), noncontinuous(1), faint and continuous(2), continuous (3), and intense and continuous(4). The averages of grades of the veins were calculated. Comparison of VIVID and IADSA was made. The grades were assigned by reaching a consensus, following a discussion among the observers.

RESULTS
The average grade between VIVID and IADSA were almost equal in Frontopolar artery, Anterior choroidal artery, Ophthalmic artery, Recurrent artery of Heubner, Cortical vein, Trolard vein, Labbe vein, and Internal cerebral vein(p>0.05). In Anterior communicating artery, Posterior communicating artery, Inferior sagittal sinus, Septal vein, Basal vein of Rosenthal, and Cavernous sinus, VIVID was higher average grade than IADSA(p<0.05).

CONCLUSION
VIVID is comparable to IADSA in the detection of the intracranial arteries and veins. VIVID can perform easily and evaluate whole artery and veins and show 3 dimentional anatomy in single examination without severe complications.

Dural Arteriovenous Fistula: Diagnosis and Classification with 4D-CTA and DSA

Bing Tian MD (Presenter); Bing Xu; Qi Liu MD, PhD; Jianping Lu MD

PURPOSE
To compare the utility of 4D-CTA and DSA in assessing the presence, location, and classification of Dural Arteriovenous Fistula (DAVF).

METHOD AND MATERIALS
320-Multidetector row 4D-CTA and DSA were applied in 34 patients (mean age, 32 years; range, 18–57 years) with DAVF. 4D-CTA was performed within 2 days before DSA. All the images were independently reviewed by 2 readers for the presence, location, and classification of DAVF. The result of the DSA was used as the gold standard. The location of DAVF was divided into five areas: Cranial sinuses, sious cavernous, cyclorama, basilar venous plexus, and medistinum cerebri. The classification of DAVF was according to Borden, et al.

RESULTS
34 patients were all diagnosis as DAVF by 4D-CTA and DSA separately. The location of DAVF divided by DSA was cranial sinuses (12), sious cavernous (7), cyclorama (8), basilar venous plexus (6), and medistinum cerebri (1). There was full agreement for all the patients between 4D-CTA and DSA regarding the location. However, for the Borden classification of DSA, 18 were Borden I, 9 were Borden II, and 7 were Borden II. The classification of 4D-CTA in 32 patients were in accordance with DSA. In the remaining 2 patient, retrograde venous were missed by both readers on 4D-CTA which were classified as Borden I, while as Borden II by DSA.

CONCLUSION
4D-CTA seems be a reliable technique in the screening and surveillance of DAVF form the presence, location, and classification aspect in clinical.

CLINICAL RELEVANCE/APPLICATION
RESULTS

Patients

RESULTS

METHOD AND MATERIALS

We retrospectively enrolled 11 AVM patients (age; 40 ± 17 YO, 6 males) diagnosed by radiologists. Subjects were classified into two groups -- Small AVM (< 3cm) and Medium AVM: (3 ~ 6 cm) based on the Spetzler-Martin grading scale. We retrospectively performed serial 3D MRA on a 3T MRI system (MAGNETOM Verio, Siemens Healthcare), using a 32-channel phased-array head coil. For quantitative volumetric analysis, a program was developed using Mathcad (PTC, MA) in our image-processing laboratory. This image-processing tool generates 3D blood-only images through two segmentation steps: intracranial tissue segmentation followed by pixel value thresholding. From the segmented images with subtracted surrounding brain and meningeal tissues, we calculated the volume of an AVM lesion (the nidus, dilated feeding arteries and draining veins) by calculating the intracranial blood volume difference between both hemispheres. The AVM volume was then correlated with the maximal AVM lesion dimension.

RESULTS

Statistically significant differences were observed between the two subject groups. In the comparisons of the volume (cm³): 12.478 ± 5.743 and 53.963 ± 9.338 (mean ± stdev.) for Small AVMs (< 3cm) and Medium AVMs (3 ~ 6 cm) respectively; P < 0.005 for all. Additionally, we found an exponential correlation between the AVM volume and the maximum length of a nidus (trendline: y = 4.4183x0.536x with R² = 0.945).

CONCLUSION

CT angiograms can be processed to provide a more realistic three-dimensional measures of AVM size with potentially more clinical specificity and higher sensitivity to monitor treatment changes.

CLINICAL RELEVANCE/APPLICATION

Volumetric AVM measures have the potential of providing new standards for AVM size classification and could provide a useful tool for monitoring AVM evolution in time and in response to treatment.

SSG11-06 • Non-contrast-Enhanced High-temporal-Resolution 4D MRA with an Acquisition Window Covering Two Cardiac Cycles: Assessment of Brain Arteriovenous Malformations

Helene Raoult MD (Presenter) ; Elise Bannier; Peter Schmitt PhD * ; Benjamin Robert * ; Jean-Yves Gauvrit MD

PURPOSE

To assess the feasibility, quality and diagnosis performance of a bSSFP NCE 4D MRA ECG-gated sequence with a high temporal resolution to analyse brain arteriovenous malformations (AVM).

METHOD AND MATERIALS

After approval from the Institutional Review Board, ten patients presenting AVM and referred for digital subtraction angiography (DSA) were included in the study. Patients underwent NCE 4D MRA on a 3T system (MAGNETOM Verio, Siemens Healthcare), using a 32-ch head array coil. The NCE 4D MRA technique combined arterial spin labeling with an ECG-triggered 3D cine segmented multiphase bSSFP readout. Two sequences were performed, with temporal acquisition window over 1 (1-RR) or 2 (2-RR) cardiac cycles and acquisition times of 5-6 or 10-12 min respectively. Imaging parameters for 2-RR NCE 4D MRA were: Fov=220x192mm2, 44 slices, 1.5x1.5x1.5mmvoxel size, TR/TE=59.5ms/2.13ms, variable flip angle evolution, mSENSE 2. For 1-RR NCE 4D MRA, 64 slices achieved similar coverage with a 1x1x13mm3 voxel size. Other sequences performed were: TOF MRA (0.7x0.6x0.6mm3 voxel size) and 4D CE-MRA (0.9x0.8x1.5mm3 voxel size, 1.5s temporal resolution). All patients also underwent DSA with a filming rate of 3 images/s. Images were reviewed with respect to image quality and AVM diagnosis value.

RESULTS

Both NCE 4D MRA sequences were successfully performed in all patients achieving mean temporal resolution of 68,1 ms (±3,1; 20-32 phases) and 69,1ms (±5,6; 10-16 phases) and mean image quality score of 3,9/5 (±0,7) and 3,3/5 (±0,8), for 2-RR and 1-RR NCE 4D MRA respectively.

All AVM were depicted with their main feeding arteries and global nidus size in agreement with DSA data (fig.1). Venous drainage type was always correctly classified on 2-RR NCE 4D MRA images, but misidentified in five cases on 1-RR NCE 4D MRA. The 2-RR NCE 4D MRA was always correctly classified on 2-RR NCE 4D MRA images, but misidentified in five cases on 1-RR NCE 4D MRA. The 2-RR NCE 4D MRA allowed a more accurate delineation of the nidus than combined TOF and CE MRA data.

CONCLUSION

The bSSFP NCE 4D MRA sequence allows brain AVM analysis with a high temporal resolution, offering accurate nidus delineation, target of the treatment. A 2-RR sequence improves depiction of venous drainage, necessary to evaluate hemorrhagic risk.

CLINICAL RELEVANCE/APPLICATION

The bSSFP NCE 4D MRA sequence allows brain AVM analysis with a high temporal resolution, offering accurate nidus delineation, target of the treatment.

SSG11-07 • Evaluation of Brain Arteriovenous Malformations by Using 4D MR Angiography with Arterial Spin Labeling at 3T

Yasuhiro Iryo (Presenter) ; Toshinori Hirai MD ; Masanobu Nakamura ; Minako Azuma ; Yasuyuki Yamashita MD *

PURPOSE

To assess the usefulness of 4D magnetic resonance angiography (MRA) with an arterial spin-labeling (ASL) technique at 3T that yields high spatial resolution and time-resolved hemodynamics without exogenous contrast agents for the evaluation of brain arteriovenous malformations (AVMs).

METHOD AND MATERIALS

Our study included 8 patients (4 men, 4 women; age 7-65 years, mean 39.5 years) with brain AVMs. They underwent 4D ASL-MRA and digital subtraction angiography (DSA). The 4D ASL-MRA imaging was performed on a 3T MRI system; a sensitivity encoding (SENSE) phased-array 32-channel head coil was used. A pseudo-continuous arterial spin labeling (pCASL) preparation scheme with the Look-Locker sampling was employed for spin tagging. Seven phases of labeling and control images were acquired in an interleaved mode. Upon completion of two acquisitions, corresponding temporal phases with identical inversion delay were subtracted. Minimum-intensity-projection (MIP) images were then created for each subtracted data set in three orthogonal directions. The acquisition parameters were: FOV = 220x200 mm, matrix = 224x162, spatial resolution = 1x1x1 mm, flip angle = 12°, TR = 8.5 ms, TE = 4.2 ms, SENSE factor = 3.0, TI/TTI/final TI = 100 ms/250 ms/2.0 s. A transverse labeling plane was positioned 9 cm below the imaging center. Total acquisition time is approximately 5 min. Two independent readers reviewed the 4D MRA images for the nidus size, arterial feeders and venous drainage. Two other readers consensually reviewed the DSA images. Interobserver and intermodality agreement was assessed by statistics.

RESULTS

320-MDCT4D-CTA appears to be a valuable new adjunct in the noninvasive diagnostic work-up, treatment planning, and follow-up of patients with DAVF.
On all 4D ASL-MRA studies, the major intracranial arteries were successfully demonstrated at an inflow temporal resolution of 250 ms. Interobserver agreement was excellent for the nidus size (r = 1.0), very good for arterial feeders (r = 0.86) and good for venous drainage (r = 0.80). Intermodality agreement was excellent for the nidus size (r = 1.0), very good for arterial feeders (r = 0.88) and good for venous drainage (r = 0.80).

CONCLUSION
The agreement between 4D ASL-MRA and DSA findings was good to excellent with respect to the AVM nidus size, arterial feeders and venous drainage.

CLINICAL RELEVANCE/APPLICATION
With 4D ASL-MRA at 3T, hemodynamic information on the brain AVMs can be obtained without the use of exogenous contrast agents.

SSG11-08 • 7T versus 1.5T TOF MRA for Assessment of Intracranial Aneurysms: The More Tesla, the Better?
Lale Umutlu MD (Presenter) *; Karsten Wrede; Christoph Moenninghoff MD; Soren Johst; Philipp Dammann; Michael Forsting MD; Marc U Schlamann
PURPOSE
As rupture of intracranial aneurysms is considered the main cause of subarachnoidal haemorrhage, detection and high-quality assessment of aneurysm localization and related features (e.g. parent vessel) is of inevitable value for treatment planning. With 1.5 Tesla MRI being limited in the detection of small aneurysms, ultra-high-field MRI may enable superior examination of intracranial vasculature based on higher spatial resolution due to increased signal-to-noise ratio (SNR). Aim of this trial was to compare the diagnostic ability of 1.5 versus 7 Tesla TOF MRA for assessment of intracranial aneurysms.

METHOD AND MATERIALS
17 subjects were examined on a 1.5 Tesla (Magnetom Aera, Siemens Healthcare) and Time-of-flight MRA with a voxel size of 0.7x0.7x0.7mm3 was obtained. Subsequently all subjects underwent a 7 Tesla examination (7T whole-body MR system; Magnetom 7T, Siemens Healthcare) with a voxel size of 0.2 x 0.2 x 0.2mm3. Two radiologists in consensus assessed the delineation of the (1) aneurysm dome, (2) neck, (3) parent vessel, (4) vessel tissue contrast and (5) image impairment due to artifacts. For qualitative analysis a 5-point scale was used (5= excellent delineation; 1= non-diagnostic). Contrast ratios (CR) of all aneurysms and adjacent parenchyma were calculated. A Wilcoxon rank test was performed for analysis of statistical significance.

RESULTS
According to qualitative analysis 7 Tesla TOF MRA yielded significantly superior delineation of dome (mean 7T:4.5; mean 1.5T= 3.2; p

CONCLUSION
Despite slight impairments based on increased signal alterations, 7 Tesla TOF MRA provided superior assessment of the aneurysms and their related vessel-features based on high-quality vessel-tissue contrast and imaging at improved spatial resolution.

CLINICAL RELEVANCE/APPLICATION
Based on improved spatial resolution imaging, high-resolution 7T TOF MRA may bear the potential to overcome known limitations of 1.5 Tesla MRA in the assessment of intracranial aneurysms.

SSG11-09 • Ultra-high Temporal Resolution Vascular Pulsation of Aneurysms: A Novel Dynamic 4-dimensional Time of Flight MR Angiography Technique to Accurately Evaluate Dynamics of Cerebral Aneurysm
Till Illies MD (Presenter) ; Jan Sedlacik ; Jan-Hendrik Buhk MD * ; Daniel Kutzner ; Jens Fiehler ; Andre Kemmling MD
PURPOSE
Time resolved imaging of pulsatility of cerebral aneurysms has been performed using 4D CT angiography. Assessment of wall motion may be useful for stratification of rupture risk. Aim of the study was to implement a 4D TOF MRA technique to image aneurysmal wall motion with high temporal and spacial resolution.

METHOD AND MATERIALS
We performed time resolved MR-TOF angiography in an elastase induced rabbit model of cerebral aneurysm. Dynamic 4-dimensional TOF angiography was achieved with ultra high-temporal resolution of 30 3D-images per cardiac cycle (151 beat/min). Dynamic data sets were reconstructed from ekg-triggered 4D gradient echo TOF images (temporal resolution 75 frames per second, spacial resolution 0.5x0.5x1.0mm, TR 20ms, TE 5.76ms, 32 channel coil system at 3T). The 4D dataset was processed to calculate vessel motion: Voxels were classified as vessels using a semi-automated region-growing algorithm (Analyze 11.0). A relative vessel motility index was calculated using the voxel-wise frequency of a vessel vs. non-vessel classification from 30 time-points over the cardiac cycle.

RESULTS
The aneurysm (5mm diameter) and aortic arch were imaged with diagnostic image quality within 12 min. The temporal resolution of 75 frames/second allowed ready visualization of wall pulsation and vessel displacement in time. The relative vessel motility index showed highest wall motion at the aortic arch and tip of the aneurysm corresponding to qualitative assessment.

CONCLUSION
We successfully implemented a time resolved TOF-MRA-technique allowing 4-dimensional quantification of aneurysmal wall motion at high spacial and temporal resolution (75 frames per second).

CLINICAL RELEVANCE/APPLICATION
Quantification of aneurysmal pulsatility may be a valuable pathophysiological marker for assessing rupture risk.
METHOD AND MATERIALS
The phantom was constructed using arrays of glass capillaries oriented at 6 different directions: one set in the center and 5 at radial orientations. The capillary arrays at different orientations had different inner diameters (20, 40, 50, 100, 150, and 200um). DTI data of 212 healthy subjects were also analyzed. Phantom was scanned with the same scanners and acquisition parameters, as that of healthy individuals. The repetition time (84-105ms), b values (700-100s/mm²), field strength (1.5-3T), slice thickness (3-5mm), number of diffusion directions (11-64), relaxation time (5700-13000ms) and echo time (84-105ms) varied across different scans. The fractional anisotropy and principal eigenvectors of the diffusion tensors were calculated in different capillary sets in the phantom and 20 different white matter brain tracts. The correlation between DTI measurements of different white matter tracts and the phantom glass capillaries, scanned with the same acquisition parameters, was assessed.

RESULTS
There was a significant association between DTI measurements of various white matter tracts and different sets of phantom capillaries, scanned with the same acquisition parameters. A multivariate-regression model with age, gender, head motions and rotation angle, different acquisition parameters and diffusion tensor parameters of the phantom capillaries could explain 77-86% of variability in diffusion tensor measurements of the white matter tracts. The standardized residual values were calculated and the normal ranges for DTI parameters at different white matter tracts were estimated.

CONCLUSION
This study presents a practical and accurate model for standardization of diffusion tensor parameters.

CLINICAL RELEVANCE/APPLICATION
The capillary phantom introduced in this study can make DTI measures comparable between different acquisition settings.

SSG12-02 • Investigation of Influences of the Magnetic Field Inhomogeneity Due to the Subject Positioning on the Apparent Diffusion Coefficient in the Cerebral Cortex Using MRI Simulator
Daigo Ushijima (Presenter); Seiji Kumazawa PhD; Hidetake Yabuuchi MD; Masafumi Ohki

PURPOSE
In the study of neurodegenerative diseases, apparent diffusion coefficient (ADC) values in the cerebral cortex are investigated using diffusion-weighted images (DWIs). However, DWIs suffer from geometric distortion due to magnetic field inhomogeneity (MFI) caused by susceptibility effect. It is known that the cortical ADC values increase due to contamination of signal intensity in cerebrospinal fluid by distortion. It is reported that distribution of MFI depends on the subject positioning in the static field. The purpose of this study was to investigate influences of the MFI which depends on the subject positioning on the cortical ADC values using MRI simulator.

METHOD AND MATERIALS
We investigated the differences of ADC values in the cortex among the different patterns of MFI using digital brain phantom. We calculated MFI depending on the subject position in the static field by using the Susceptibility-Voxel Convolution method. We generated different three patterns of MFI: no inhomogeneity, and two different patterns of inhomogeneities. In each pattern of MFI, DWI was generated by MRI simulator according to single-shot echo-planar imaging sequence, and ADC map was generated from DWIs. In our simulator, the diffusion coefficient of cortex was set to 0.89 *10^-3/mm²/s. We compared ADC values in six cortical regions of interest among different three patterns of MFI.

RESULTS
In the cortical region close to frontal sinus, the average of ADC value in no inhomogeneity was 1.017 * 10^-3 mm²/s, and was higher than ideal ADC value in the cortex. The average of ADC values in other two patterns of MFI were 1.114 * 10^-3 and 0.952 * 10^-3 mm²/s, respectively. These ADC values showed significant differences among different three patterns of MFI. Although the ADC values showed statistically no significant differences in the other regions among them, ADC values showed the variation.

CONCLUSION
We have investigated influences of the MFI on the cortical ADC values using MRI simulator. Our results suggest that ADC values in the cortical region might vary due to MFI which depends on the subject positioning in the static field.

CLINICAL RELEVANCE/APPLICATION
In interpretation of cortical ADC values in neurodegenerative diseases, influences of the MFI should be taken into account in changes of ADC values.

SSG12-03 • Microstructural Integrity of Brain White Matter in Non-demented Older Adults Is Associated with Frequency of Cognitive Activity in Late Life
Christopher M Barth; Robert S Wilson PhD; Shengwei Zhang BS, BEng; David A Bennett MD; Konstantinos Arfanakis PhD (Presenter)

PURPOSE
The purpose of this study was to test the hypothesis that more frequent late life cognitive activity in a community sample of non-demented elderly subjects is associated with greater brain microstructural integrity, as assessed by diffusion tensor imaging (DTI).

METHOD AND MATERIALS
A community sample of non-demented elderly subjects (N = 379) (82 ± 7 years of age) participating in the Rush Memory and Aging Project was included in this study. All participants rated how often they were involved in various cognitively stimulating activities from childhood to middle-age (past cognitive activity, PCA), as well as within the last year (late life cognitive activity, LLCA). Participants also rated the availability of cognitive resources (CR) in their home during childhood and adulthood. T1-weighted MPRAGE, T2-weighted FLAIR and SE-EPI DTI data were collected on all participants using a 1.5 Tesla MRI scanner. White matter hyperintense (WMH) lesions were automatically segmented based on MPRAGE and FLAIR data. Correction for bulk motion and distortions due to eddy-currents and field non-uniformities, B-matrix reorientation, and diffusion tensor calculation, were all conducted using TORTOISE. The fractional anisotropy (FA), trace of the diffusion tensor, axial (AD) and radial diffusivity (RD) were calculated in each voxel. Tract-Based Spatial Statistics was used to test for voxel-wise associations of DTI parameters with LLCA, while controlling for age, sex, level of education, the presence of WMHs, PCA and CR. The null distribution was generated using the randomise tool and 5000 permutations. Differences were considered significant at p < 0.05.

RESULTS
Higher frequency of LLCA was associated with higher FA values in the corpus callosum and white matter of the left brain hemisphere, and generally lower trace, AD, and RD in the thalamus.

CONCLUSION
The present work suggests that a higher frequency of LLCA in community-dwelling non-demented elderly adults may be associated with greater microstructural integrity in white matter of the corpus callosum and left brain hemisphere.

CLINICAL RELEVANCE/APPLICATION
Frequent late life cognitive activity may play a role in protecting the microstructure of brain white matter.

SSG12-04 • Cerebral Microbleeds Are Related to Loss of White Matter Structural Integrity: The Rotterdam Scan Study
Saloua Akoudad; Marius De Groot MSC; Aad Van Der Lugt MD, PhD; Wiro Niessen PhD; Mohammad A Ikram; Meike W Vernooij MD (Presenter)

PURPOSE
Cerebral microbleeds (CMBs) are highly frequent in the general population and are increasingly recognized as a manifestation of cerebral small vessel disease (CSVD). Although CMBs appear as focal lesions on imaging, it remains unclear whether the underlying CSVD is also restricted to that focal area or that it affects the brain more diffusely. We investigated whether the presence, number, and location of microbleeds is related to loss of microstructural integrity of brain white matter, as measured by diffusion tensor imaging (DTI).

METHOD AND MATERIALS
A total of 4493 Rotterdam Scan Study participants underwent brain MRI to determine microbleed status. With DTI, global fractional anisotropy (FA) and mean diffusivity (MD) were measured in normal-appearing white matter. Multiple linear regression models, adjusted for age, sex, cardiovascular risk factors, white matter lesions and infarcts were applied to investigate the independent association between microbleeds and integrity of brain white matter. Analyses were repeated after stratification by apolipoprotein E 4 (APOE ?4) carriership.

RESULTS
Presence of microbleeds was related to a lower mean FA and higher mean MD, in a dose-dependent manner, and was already apparent for a single CMB microbleed (standardized FA: -0.13, 95% CI -0.21; -0.05; MD: 0.12, 95% CI 0.05; 0.19). For lobar microbleeds alterations in DTI measurements were solely driven by APOE 4 carriers.

CONCLUSION
Presence of microbleeds relates to poorer microstructural integrity of brain white matter, independent of cardiovascular risk and other markers of CSVD. Our data suggest that microbleeds reflect diffuse brain pathology, even when just a single microbleed is present.

CLINICAL RELEVANCE/APPLICATION
Microbleeds have emerged as a novel marker of small vessel disease. Our data indicate that the pathology underlying microbleeds is much more widespread than the focal lesions seen on MRI.

SSG12-06 • Diffusion Variations of Normal-appearing White Matter in Multiple Sclerosis Using Diffusional Kurtosis Imaging

Lemei Tang MD (Presenter) ; Ni m Fei MA ; Feng Jie MA ; Wei Qiang MA ; Miao Yanwei MD

PURPOSE
To examine whether diffusion variations of normal-appearing white matter (NAWM) in patients with multiple sclerosis (MS) are greater than those in healthy controls.

METHOD AND MATERIALS
Thirty female SJL mice were induced with experimental autoimmune encephalomyelitis, a mouse model of MS, and treated with either GA (150 ?g/day) or saline from day 1 post induction onwards. To determine effects of GA on NAWM, mice underwent MRI at 4.7T with MPO-Gd at the disease peak (day 12). Lesion numbers and volume were quantified at 60 minutes post MPO-Gd injection. MPO activity assay and flow cytometry of brain leukocytes were also performed.

RESULTS
Glatiramer acetate (GA) treatment reduced the number of lesions (6.0±0.9 vs. 2.4 ± 0.5, p < 0.01), and smaller total (669±198 vs. 123±42 mm2, p < 0.05) and mean (109±23 vs. 48±8, p < 0.05) lesion volumes compared to saline-treated mice (A+B). Brain homogenates of GA-treated mice had 60±9% MPO activity compared to saline-treated mice (p < 0.05). Flow cytometry revealed a reduced number of Ly-6C-high inflammatory monocytes in the brain with GA treatment (8.1±1.4 vs. 3.9 ±0.6 x 106 cells/brain, p = 0.48; E). Flow cytometry also revealed that GA is mostly secreted by Ly-6C high monocytes (60±1.7%), followed by neutrophils (32±2.3%; F). This reduction in MPO-secreting inflammatory monocytes explains our MRI finding of reduced MPO activity in vivo.

CONCLUSION
GA, a current first-line drug in MS directly affects monocyte subsets, decreasing the number of MPO-secreting inflammatory monocytes entering the brain. GA-enhanced MRI is sensitive to these effects of GA and provides a novel way to monitor treatment effects at the molecular level in this disease. This could advance our understanding of the molecular level evolution over the course of MS.

CLINICAL RELEVANCE/APPLICATION
Upon translation, treatment efficacy of GA, which reduces MPO-positive monocytes and thus MPO activity in the brain, could be monitored with MPO-Gd.

SSG12-07 • Fast Whole-brain Macromolecular Proton Fraction (MPF) Mapping for Quantitative Imaging of White and Gray Matter Demyelination in Multiple Sclerosis

Vasily L Yarnykh PhD (Presenter) ; James D Bowen MD ; Alexey A Samsonov PhD ; Pavle Repovic MD ; Kenneth R Maravilla MD * ; Lily K Junghenson MD ; Angeli Mayadev MD ; Beena Gangadharan PhD ; Hunter R Underhill MD, PhD ; Bart P Keogh MD, PhD

PURPOSE
To investigate whether fast whole-brain macromolecular proton fraction (MPF) mapping can be utilized for quantifying white and gray matter demyelination in multiple sclerosis.

METHOD AND MATERIALS
Images were acquired on a 3T MRI scanner from 14 healthy controls (HC), 19 relapsing-remitting (RRMS), and 11 secondary progressive (SPMS) MS patients. Neurological status was assessed with Expanded Disability Status Scale (EDSS) and Multiple Sclerosis Functional Composite (MSFC). MPF mapping protocol comprised gradient-echo sequences with and without off-resonance saturation (offset frequency 4 kHz), 3-point variable flip angle T1 mapping, and fast B0 and B1 mapping sequences. Whole-brain 3D MPF maps were obtained with 1.5x1.5x4mm3 resolution and 15 min acquisition time. Brain tissues were segmented into normal appearing white matter (NAWM), gray matter (NAGM), and lesions. Mean MPF in tissues were compared between subject groups by independent two-tailed t-test.
RESULTS
MS patients had significantly reduced (Pr=-0.70 for EDSS, r=0.81 for MSFC, Pr=-0.56, Pr=0.72, Pr=0.42, Pr=0.50, Pr=0.42, Pr=-0.57, P

CONCLUSION
MPF mapping allows quantitative assessment of microscopic demyelination in both NAWM and NAGM. NAWM and NAGM MPF abnormalities appear more clinically relevant than lesion pathology. Our results suggest a critical role of NAGM demyelination for disability progression in MS.

CLINICAL RELEVANCE/APPLICATION
Fast whole-brain MPF mapping detects demyelination in both white and gray matter and provides a promising approach for quantitative monitoring of myelin damage and repair in MS clinical studies.

SSG12-08 • Extra Cranial Venous Abnormality in MS Patients with Regard to Chronic Cerebrovascular Venous Insufficiency (CCSVI): A True Pathological Finding or an Anatomical Variant?

Satya N Patro MD (Presenter) ; Carlos H Torres MD ; Cheemun Lum MD ; Santanu Chakraborty FCR ; Thanh Nguyen MD * ; Miguel Bussiere ; Matthew Hogan MD

PURPOSE
To evaluate the extra cranial venous anatomy with contrast enhanced MR Venogram (CE-MRV) in patients without MS. To assess the prevalence of various venous anomalies such as asymmetry and stenosis in this population.

METHOD AND MATERIALS
The study was approved by our local REB and all participants gave informed consent. We recruited 100 patients without MS referred for a contrast enhanced MRI, who underwent additional CEMRV from the skull base to the mediastinum on a 3T scanner. The study started in Feb' 2012 and completed in Jul' 2010. We included patients between 18 and 60 years old with a male: female ratio of 1:1. Exclusion criteria included prior neck radiation, neck surgery, neck or mediastinal masses or significant cardiac or pulmonary disease. Two neuroradiologists independently evaluated the studies to document the presence of asymmetry and stenosis in the jugular, vertebral and azygous veins.

RESULTS
Asymmetry of the IJVs was found in 70% of patients. 91% of patients had a focal stenosis in the right IJV and 82% in the left IJV. The stenoses were found in the upper third of the vein in 95% of the cases. Stenosis of the azygous vein was found in 21% of patients. There was prominence of the external jugular veins in 39% of cases, of the anterior jugular veins in 27% and of the deep cervical veins in 22.4%.

CONCLUSION
The venous anatomy of non MS patients demonstrates multiple variants including asymmetry and stenoses of the IJVs. We believe the stenoses in the upper third of the IJVs are secondary to indentation of the vessel between the posterior belly of the digastic muscle and the occipital bone. This study will be used as a comparative data to the MS population.

CLINICAL RELEVANCE/APPLICATION
It is recommended to keep in mind the various normal variants of extra cranial venous system while evaluating MS patients with suspected CCSVI.

SSG12-09 • Quantitative Rapid Assessment of Leukoaraiosis: Fully Automated CT-based Quantification of Microangiopathic Density Reduction in White Matter in Comparison to Gold Standard MRI

Uta Hanning (Presenter) ; Georg Homann ; Ludger Feyen ; Thomas Niederstadt MD ; Volker Hesselmann MD ; Walter L Heindel MD ; Andre Kemmling MD

PURPOSE
Assessment of white matter lesions is primarily a domain of magnetic resonance imaging (MRI), however, computed tomography (CT) is the more frequently used diagnostic procedure. Particularly in stroke, a rapid objective CT based quantification of microangiopathic WM changes may prove useful to estimate risk of thrombolytic hemorrhage. We present a new CT-based fully automated rater-independent method for quantification of microangiopathic white matter changes.

METHOD AND MATERIALS
Tissue segmentation was performed in 600 normal brains MRI (3.0 Tesla, T1-3D-Turbo-Field-Echo) of two large population studies (BiDirect and SEARCH-Health Study) to obtain a probabilistic WM-tissue-map in standard MNI-152 space as published. A total of 103 patients with varying degree of leukoaraiosis excluding other lesions were retrospectively selected based on availability of CT and MR within 1 month. The tissue-specific density (Hounsfield Unit, HU) within WM-space was determined by the mean of all voxel densities weighted by WM content: S (HUxyz × Pxyz (WM))/S (Pxyz (WM) ; (HUxyz = density of voxelxyz ; Pxyz = partial WM content at voxelxyz). The reduction of HU over WM-space in CT images was correlated with gold standard MR-based WM lesion volume measurements. Results were compared with rater-based Fazekas scores for severity of WM disease.

RESULTS
The process of CT-based tissue-specific segmentation involving automated segmentation of probabilistic white matter space with quantification of WM density was reliable in 103 cases with no algorithm failures. Mean time of processing was 153 second. In comparison with MRI FLAIR-based WM-lesion volume, the CT-based HU-weighted reduction of the white matter density showed a significant correlation coefficient (r=0.87). Spearman rank correlations between MR or CT based WM lesion quantification did not differ significantly in comparison to visual Fazekas scores, respectively.

CONCLUSION
The presented method allows fully automated observer-independent quantification of microangiopathic HU-induced reduction of the white matter in CT with high correlation to gold standard MRI.

CLINICAL RELEVANCE/APPLICATION
The algorithm targets the need for a rapid objective CT based assessment of WM lesion load which may be used as as a risk score of hemorrhage in the setting of thrombolytic stroke therapy.

Physics (Quantitative Imaging I)

Tuesday, 10:30 AM - 12:00 PM • S403A

SSG13 • AMA PRA Category 1 Credit ™:1.5

Moderator
Robert M Nishikawa , PhD *

Moderator
Marc Kachelriess , PhD

SSG13-01 • Characterization of Carotid Atherosclerotic Plaque Components Based on Quantitative Phase-contrast Hounsfield
RESULTS
A total number of 80 cross-sections with 72 fibrous, 19 lipid and 24 calcified tissue containing regions were assessed. Fibrous, lipid and calcified tissues were associated with significant different mean HU-P (52.6±7.0, 21.0±9.8 and 371.5±158.0, p no overlap of HU-P between fibrous (range 44.9 – 63.3) and lipid tissue (3.1-30.1). Similarly, no overlap of HU-P was observed between calcified tissue (range 174.4 – 593.7) and the other tissue components. Figure 1 demonstrates axial phase contrast CT images (A) and corresponding histology sections (B, C, Fib=fibrous, Lip=lipid and Cal=calcified tissue; length of the scale bar = 2 mm).

CONCLUSION
In an ex-vivo experimental set-up grating-based phase contrast CT can reliably differentiate between calcified, fibrous and fatty tissue based on quantitative HU-P, indicating its high potential for improved assessment of carotid atherosclerotic disease.

CLINICAL RELEVANCE/APPLICATION
Phase-contrast computed tomography might improve characterization of carotid atherosclerotic plaque morphology compared to conventional absorption CT.

SSG13-02 • Quantitative Image Analysis of MRI for Treatment Response Assessment of Multiple Myeloma
Chuan Zhou PhD (Presenter) ; Qian Dong MD ; Daniel R Couriel ; Heang-Ping Chan PhD ; Lubomir M Hadjiiski PhD ; Jun Wei PhD

PURPOSE
It is challenging for radiologists to visualize early changes in multiple myeloma (MM) within 3-6 months after autologous bone marrow transplant (BMT) due to small amount of marrow infiltration evident on MR images. This pilot study investigated the feasibility of using quantitative image analysis to evaluate early changes of BM in MRI for assessing treatment response.

METHOD AND MATERIALS
With IRB approval, 29 cases with MM requiring BMT were evaluated retrospectively. 31 pairs of spine MRI scans performed pre- and post-BMT (3-6 months), including 2 patients underwent second BMT after 4 and 6 months of the first BMT, respectively, were collected. The vertebral body volumes in sagittal views of T1-weighted sequence were manually outlined and their adjacent disc volumes were automatically extracted using morphological operations. A 3D dynamic intensity energy transformation (DIET) method was developed to characterize BM infiltration after BMT. DIET transformed the voxel intensity of a vertebral body to an energy enhancement value (EEV), defined as the ratio of the intensity entropy at the voxel to the median intensity entropy in the adjacent discs. Treatment response was quantified by an EEV response index (EEV-RI) calculated as the percentage of vertebrae with an increase in the mean EEV over the vertebral body in the post-BMT scan. In addition, the EEV heat map accentuated the intensity distribution pattern of the vertebral body and facilitated radiologist’s visual assessment of the pre-to-post changes of BM infiltration.

RESULTS
Of the 31 follow up MRI scans, 25 were clinically diagnosed as good responders to BMT. The DIET method correctly identified 22 good responders using a decision threshold of > 40% for the EEV-RI. The agreement reached 0.903±0.14 with a kappa value of 0.74. The mean EEV increased by an average of 35.4±36.7% for the 22 good responders and decreased by 14.6±10.0% for the 6 non-responders. The mean EEV decreased by 19.0±20.5% for the 3 cases that were mistakenly identified as no response.

CONCLUSION
The substantial agreement between computer and clinical outcomes demonstrated the feasibility of using the quantitative image metric (EEV) for assessing treatment response for MM.

CLINICAL RELEVANCE/APPLICATION
Quantitative image-based biomarker may improve the accuracy and efficacy for staging and assessing treatment response for MM, allowing clinicians to optimize therapy of individual patients.

SSG13-03 • Use of a Dedicated Extremity Cone-beam CT Scanner for Evaluation of the Weight-bearing and Non-weight-Bearing Knee
Gaurav K Thawait MD (Presenter) ; Abdullah Muhit PhD ; Wojciech Zbijewski PhD * ; Joseph W Stayman PhD * ; John Yorkston PhD * ; Shadpour Demehri MD ; John A Carrino MD, MPH * ; Jeffrey H Siewerdsen PhD *

PURPOSE
To prospectively compare cone-beam CT (CBCT) examination of the knee in sitting (non-weight-bearing, NWB) position versus upright (weight-bearing, WB) position as a potential indicator of osteoarthritis (OA).

METHOD AND MATERIALS
A prototype CBCT scanner dedicated to extremity imaging was previously reported and assessed in terms of spatial resolution, contrast resolution, radiation dose, and optimal imaging protocols. An IRB approved study was performed in which 13 patients (8 females, 5 males; 31-78 yo, mean 56 yo) were prospectively enrolled for CBCT exams in NWB and WB positions using the prototype scanner. 11 were previously diagnosed with knee OA. 2 musculoskeletal radiologists measured the medial tibiofemoral (TF) joint space width and meniscal protrusion (MP) in coronal plane in consensus. Differences in such morphology were analyzed between NWB and WB images using paired Wilcoxon signed-rank test.

RESULTS
The scanner exhibited spatial resolution of ~15-17 lp/cm, depending on reconstruction technique, with high-contrast bone detail judged comparable or superior to conventional CT. Optimal scan protocol was 80 kVp, 120 mAs, imparting 9.0 mGy (dose at the center of a CTDI phantom). Isotropic sub-mm spatial resolution facilitated precise measurement of joint space morphology. For the 2 non-OA patients, the change in joint space between NWB vs WB exams appeared minor (2.67 mm vs 2.41 mm, respectively), and there was no evidence of meniscal protrusion. A greater difference in medial TF joint space was observed in OA patients: 1.91±0.83 mm for the NWB setup versus
A New Method for Automated Anatomic Landmark Detection to Aid Automated Patient-specific Radiation Dosimetry in Tube-current Modulated CT Scans

Tim O’Connell MD, MEng (Presenter) ; Maryam Khatonabadi * ; Michael F McNitt-Gray PhD * ; Aaron D Sodickson MD, PhD

PURPOSE
To develop an automated method of body part determination and body landmark detection for the purpose of characterizing regional variations in X-ray tube output and enabling regional radiation dose estimation.

METHOD AND MATERIALS
Software was created that extracts the image data from CT scans, detects the body contours, and performs thresholding to determine image tissue characteristics. The software then performs analysis on the tissue-specific attenuation curves along the Z-axis to determine body part and anatomic landmarks. If the images are from a chest CT, the software computes the position (image number) of the lung apices, and the start of the right and left hemidiaphragms. If the images are from an abdomen/pelvis CT, the software uses water equivalent diameter (Dw) and anteroposterior (DAP), lateral (DL), and effective (DEff) diameters for chest CT.

RESULTS
100% of scans were correctly identified as being either chest (50/50) or abdomen/pelvis (50/50). In the chest CT group, there was no difference in Dw and DAP between the two groups. When Dw and DAP are compared to the Effective diameters (DEff) for chest CT, there was no difference between the groups.

CONCLUSION
The ability to conduct CWB and WB exams in CBCT with a favorable dose profile and image quality sufficient for such morphological analysis could provide a valuable tool for OA diagnosis and treatment assessment.

CLINICAL RELEVANCE/APPLICATION
Weight-bearing CBCT of the knee can provide functional information and precise morphological analysis in cross sectional imaging not achieved by projection radiographs.

Evaluating Proximal Femur Bone Strength Prediction by Advanced Characterization of Trabecular Microarchitecture Using Scaling Index Computation and Support Vector Regression

Chien-Chun Yang (Presenter) ; Mahesh Nagarajan ; Markus B Huber PhD ; Felix Eckstein MD * ; Axel Wismueller MD, PhD ; Julio Carballido-Gamio PhD ; Thomas Baum MD ; Sharmila Majumdar PhD * ; Jan S Bauer MD ; Eva-Maria Lochmueller MD

PURPOSE
Biomechanical bone strength prediction in proximal femur is important for osteoporosis diagnosis and fracture risk estimation. Our study proposes using advanced geometrical scaling index bone structure characterization in combination with statistical bone mineral density (BMD) features extracted from multi-detector computed tomography (MDCT) images of proximal femur specimens, with subsequent prediction of bone strength through support vector regression (SVR). The performance of this system is compared with a standard approach that uses mean BMD and multi-regression models.

METHOD AND MATERIALS
Axial MDCT images were acquired from 146 proximal femur specimens using a 16-row scanner and a calibration phantom. Adaptive spherical volumes of interest (VOI) were positioned in the femoral head (Huber et al., Radiology 2008) for BMD conversion and image analysis. VOs of these BMD images were characterized through statistical moments as well as advanced geometrical features extracted with the Scaling Index Method (SIM) (Huber et al., IEEE-TBME 2011). The specimens were then biomechanically tested through a lateral fall on the greater trochanter, and failure load was recorded. All features were analyzed by multi-regression and SVR for predicting bone strength. The performance for different combinations of feature groups was compared using mean square error (RMSE) and coefficient of determination (R²). A Wilcoxon signed-rank test was used to compare two RMSE distributions and test for statistically significant differences in performance.

RESULTS
Combination of SIM features and mean BMD, when used in conjunction with SVR, exhibited the best prediction performance (RMSE = 0.95 ± 0.13; R² = 0.62). This was significantly better than the standard approach of using BMD and multi-regression (RMSE = 1.11 ± 0.141; R² = 0.490).

CONCLUSION
Our results show that the performance of predicting biomechanical strength in proximal femurs can be significantly improved by including SIM-derived geometrical features in addition to mean BMD, and through the use of support vector regression.

CLINICAL RELEVANCE/APPLICATION
Complementing BMD characterization on MDCT images with advanced geometrical features and machine learning can contribute to improved osteoporosis diagnosis and disease progression monitoring.
Analysis Method

Images were reduced to a bit depth of 8 and gray-level co-occurrence and run length matrices were used to extract 17 non-directional 2D features from each of the 4DCT scans. 10 patients with non-small-cell lung cancer prior to radiotherapy had their normal lung volumes segmented for quantitative analysis of lung parenchyma. The purpose of this study was to demonstrate the variation of lung texture features with the position of the right diaphragm and, as a result, we can estimate the impact of anatomic variability on the boundary of the lung.

METHOD AND MATERIALS

While image quality is often considered the main barrier to achieving valid, reproducible quantitative image biomarkers, anatomic motion during CT acquisition presents another unique challenge. The implementation of 4-dimensional CT allows us to reconstruct the lung parenchyma during the breathing cycle and, as a result, we can estimate the impact of anatomic variability on the boundary of the lung.

METHOD AND MATERIALS

For the development and testing of a fully-automated program for cartilage segmentation, we used 100 cases of knee MR images from a public open dataset (available at www.sk10.org). MR images were acquired in the sagittal plane with gradient-echo T1-weighting sequence and fat suppression at 0.4×0.4mm in-plane and 1mm slice-thickness resolution. The dataset also includes the segmentation result by experts to label and delineate the bone and cartilage of the femur and tibia. We randomly divided the 100 cases into the training set (60 cases) and the test set (40 cases).

The segmentation process was carried out in two steps, atlas-building and local-adjustment. In the atlas-building step, all training cases were registered to a test case via a non-rigid registration scheme. The final metric values from each registration were recorded for scoring. Nine best matched results were selected and merged to generate the atlas-based segmentation mask by majority voting. In the local-adjustment step, the statistical information of bone, cartilage and surrounding regions was computed from the atlas-based segmentation result. This information was used to determine seed points for a graph-cut algorithm to segment bone regions. Structurally similar points from the registered multiple atlases were identified via a Hessian analysis. Finally, a locally-weighted voting process was applied for a local adjustment. The performance of the segmentation program was evaluated in terms of dice similarity coefficient (DSC), sensitivity and specificity of segmented femoral and tibial cartilages against the reference cartilage segmentation of the test cases from the dataset.

RESULTS

The cartilages were segmented successfully in all test cases. The DSC was 0.67±0.07 for femoral and 0.53±0.08 for tibial cartilage. The segmentation performance was according to (sensitivity, specificity): (57.5±9.6%, 99.9±0.04%) for femoral and (53.0±8.4%, 99.9±0.02%) for tibial cartilage.

CONCLUSION

We have developed a fully-automated segmentation program for knee cartilage from MR images. The performance of the program on 40 test cases was highly promising.

CLINICAL RELEVANCE/APPLICATION

The fully-automated segmentation method will facilitate the quantitative measurement of cartilage.
texture features from the segmented total lung volume. The extracted features were evaluated for phase dependence relative to the end exhalation phase (50%). For each patient, Spearman’s rank correlation (\(r_s\)) was used to determine the relationship between feature and calculated lung volume from each phase image set.

RESULTS
Within an individual 4DCT scan, change in texture relative to the end exhalation phase varied up to 75.3%. Over the entire patient population, 8 of the 17 metrics showed an average change due to respiratory phase of less than 5%; however, the range of measured changes was 0.9-31.2% over all of the considered texture features. 5 of 17 features were highly correlated (|\(r_s| > 0.7\)) to lung volume.

CONCLUSION
Using 4DCT the phase dependence of texture measures was demonstrated. While some of the extracted texture features may be reasonably independent of respiratory phase, large differences were observed for others. The correlation of features to the lung volume highlights the periodic phase dependence of some of the considered texture metrics.

CLINICAL RELEVANCE/APPLICATION
As the respiratory phase influences extracted texture measures of lung parenchyma, anatomic variability must be considered in attempts to standardize quantitative imaging biomarkers.

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**Physics (Multi-energy CT)**

Tuesday, 10:30 AM - 12:00 PM  •  S403B

**SSG14 • AMA PRA Category 1 Credit ™:1.5  •  ARRT Category A+ Credit:1.5**

**Moderator**

Michael D Silver, PhD *

**Moderator**

Katsuyuki Taguchi, PhD *

**SSG14-01 • Cone-beam CT with Sparse Arrays of Photon Counting Silicon Strip Detectors: Reconstruction, Performance Characterization, and Application to Dual-energy Imaging**

Wojciech Zbijewski PhD (Presenter) *; Jennifer Xu; Steven W Tilley BS; Grace Gang; Joseph W Stayman PhD *; Katsuyuki Taguchi PhD *; Erik Fredenberg MSc, PhD *; Mats Lundqvist PhD *; John A Carrino MD, MPH *; Jeffrey H Siewerdsen PhD *

**PURPOSE**

Silicon strip (Si-strip) photon counting detectors (PCDs) entering use in mammography provide advantages of reduced electronic noise and dose, spectral imaging, and coincidence detection for reduction of charge sharing. We present a new implementation of PCDs configured for CT, investigate the design and 3D reconstruction algorithms to address sparse detector coverage, and evaluate performance in single and dual-energy (DE) CT.

**METHOD AND MATERIALS**

The PCD was a 5x25 cm2 Philips MicroDose Si-strip detector, consisting of a 21-row sensor array at 50 μm pixel pitch (~100,000 pixels) in a sparse matrix with inter-detector gaps up to 5 mm matched to pre-patient collimation. A benchtop CT system was configured with source-detector distance ~65 cm. Imaging was performed at 70 kVp (+0.2 mm Cu, +2 mm Al) at 0.06-0.12 mAs per frame. To overcome effects of sparse sampling, translate-rotate orbits were studied, ranging from single axial scan (1x360°) to six axially staggered scans (6x360°). Penalized-likelihood (PL) reconstruction was employed to address the complex sampling of the system through the built-in forward model and to provide noise reduction in DE decomposition through Total Variation (TV) regularization. Reconstruction-based DE decomposition of an ~8 cm diameter water phantom with inserts of iodine (10 mg/mL), calcium (200 mg/mL), and oil was performed from data collected in two energy windows.

**RESULTS**

The fraction of voxels sampled by less than one ray decreased from 65% for the 1x360° orbit to 18% for the 6x360° orbit for an 80x80x15 mm³ volume, with corresponding reduction in artifacts. DE CT images with TV regularization exhibited accurate decomposition with only slight variation with exposure; the fraction of correctly identified iodine voxels (true-positive fraction) increased from 73% to 77% and 83% for exposures of 0.06 mAs/frame, 0.09 mAs/frame and 0.12 mAs/frame, respectively; the false-positive fraction for iodine decreased from 5% and 0.06 mAs to 3% at 0.12 mAs.

**CONCLUSION**

The feasibility of volumetric CT with Si-strip PCDs in both single- and DE modes was established, demonstrating accurate DE classification of iodine and calcium in a single scan.

**CLINICAL RELEVANCE/APPLICATION**

High-performance PCDs translated to a benchtop CT platform enables single- and DE imaging from a single kVp scan and permits investigation of benefits in CT image quality, dose, and new applications.

**SSG14-02 • Dual Energy Breast CT for Tissue Composition Measurement**

Sabee Y Molloi PhD (Presenter) *; Huanjun Ding; Travis Johnson; Justin Ducote

**PURPOSE**

Studies have suggested the possibility to differentiate a malignant lesion from benign tissue by characterizing them according to their water, lipid and protein composition. The purpose of this study is to investigate the feasibility of a three-material compositional measurement of water, lipid and protein content of breast tissue with dual kVp cone-beam CT.

**METHOD AND MATERIALS**

40 postmortem breasts were imaged with a flat-panel based dual kVp cone-beam CT system at 50 and 120 kVp, followed by image-based tissue decomposition into water, lipid and protein contents. The mean glandular dose (MGD) from the dual kVp scans was approximately 6 mGy. The optimal imaging protocols, in terms of dual kVp tube voltages and dose distributions were first simulated with an analytical model which maximized the dual energy signal-to-noise ratio (SNR) with respect to MGD. A three-material phantom, consisting of water, vegetable oil and polyoxymethylene plastic was used for dual energy calibration for water, lipid and protein, respectively. The expected errors due to the calibration materials were also estimated by simulation. The breasts were then chemically decomposed into their respective water, lipid and protein contents after imaging to allow direct comparison with data from dual energy decomposition.

**RESULTS**

The dual energy breast tissue decomposition in terms of the volumetric percentages of water, lipid and protein contents exhibited strong correlation with data from the chemical analysis, which is considered to be the gold standard. As compared with the chemical analysis, the average root-mean-square (RMS) percentage error in tissue decomposition for all 40 breasts was calculated to be 3.6%.

**CONCLUSION**

The results of this study suggest that the water, lipid, and protein contents can be accurately measured using dual energy breast CT. The tissue compositional information can potentially improve the sensitivity and specificity for breast cancer diagnosis.
Clinical Dual Energy CT (DECT): Can Monoenergetic Imaging Remove Metal Artifacts?

Stefan Kuchenbecker MD (Presenter) ; Sebastian Faby DiplPhys ; Soren Schuller ; Matthias Baer DiplPhys ; Michael M Lell MD * ; Marc Kachelriess PhD

Purpose
DECT provides so-called monoenergetic images based on a linear combination of the original polychromatic images. At certain patient-specific energy levels \( E \sim 130 \text{ keV} \), corresponding to certain linear combination weights \( w \sim 1.6 \), a significant reduction of metal artifacts is observed. We aim at analyzing the method to identify its limitations.

Method and Materials
DECT can be used to exactly calculate virtual monochromatic images (neglecting scatter). This calculation has to be done in rawdata domain before image reconstruction. Clinical CT, however, uses a simplified version of monochromatic imaging by linearly combining the low and the high kV images, and by assigning a keV-value to that linear combination. Those pseudo monochromatic images are used by radiologists to obtain images with reduced metal artifacts. We analyzed the underlying physics and carried out a series expansion of the polychromatic attenuation equations. The resulting non-linear terms are responsible for the artifacts, but they are not linearly related between the low and the high kV scan: A linear combination of both images cannot eliminate the non-linearities, it can only reduce their impact. Scattered radiation yields additional non-cancelling non-linearities. To quantify the artifact reduction potential of pseudo monochromatic images we simulated the Forbild abdomen phantom with metal implants and we measured a semi anthropomorphic abdomen phantom with inserts of high iodine concentration using a clinical dual source CT system (100 kV, 140 kV Sn). In each case we manually selected an optimal \( w \), and we automatically computed an optimal \( w \) by minimizing the standard deviation \( S \) of the voxel values of the smoothed (to minimize the impact of image noise) soft-tissue regions around the metal implants.

Results
For the initial images \( S = 150 \text{ HU} \) (100 kV) and 59 HU (140 kV Sn). The manually setting yields \( w = 1.62 \) with \( S = 18.2 \text{ HU} \), while the automatic setting yields \( w = 1.60 \) and \( S = 18.1 \text{ HU} \). A complete artifact reduction corresponding to \( S = 3.71 \text{ HU} \) (image noise only), as achieved with rawdata-based processing, was not possible with pseudo monochromatic imaging.

Conclusion
Pseudo monochromatic imaging is able to reduce metal artifacts (at the cost of contrast-to-noise ratio) but it cannot remove them.

Clinical Relevance/Application
Artifact reduction through pseudo monochromatic imaging is helpful. But it should be avoided if alternative dedicated artifact reduction approaches are available.

Effectiveness of Synthesized Monochromatic Imaging Generated with a Fast Kilovoltage Switching Dual Energy CT Scanner for Improved Patient-to-Patient Uniformity of Aortic Enhancement during Abdominal CT Angiography: An In-Vivo and In-Vitro Study

Ghaneh Fananapazir MD (Presenter) ; Rendon C Nelson MD * ; Joshua Wilson PhD ; Kingshuk Choudhury PhD ; Daniele Marin MD

Purpose
To investigate whether virtual monochromatic imaging (VMI) generated from a fast kilovoltage-switching single-source dual-energy CT (DECT) acquisition may correct for beam hardening artifacts, improving uniformity of abdominal aortic enhancement across different body sizes.

Method and Materials
A propriety tapered hollow phantom with a bone-mimicking insert and a hollow tube mimicking the aorta was developed. The tube was filled with different iodine solutions simulating various degrees of aortic enhancement. The phantom was filled with water. Single-source DECT was performed and VMIs were synthesized at different energies (40-140keV, @ 20keV increments). The phantom was also scanned using conventional polychromatic kV settings (80-140kVp, @ 20kV increments). CT numbers in the aorta and water (noise) were measured along the entire length of the phantom. 62 consecutive patients (38 M; mean age 60 years ± 13 SD; mean BMI 30kg/m2 ± 6 SD) underwent DECT scans. Aortic attenuation was measured at polychromatic 140kVp and VMI 80keV datasets. The relationship between aortic attenuation and signal-to-noise (SNR) as a function of body diameter was assessed for the phantom and clinical patients.

Results
There was a significant negative correlation between both aortic attenuation/SNR and phantom diameter using polychromatic energy beams (-15.7HU/cm @ 80kVp to -6.8HU/cm at 140kVp) or VMI at energies equal or lower than 60keV (-18.7HU/cm @ 60keV to -5.3HU/cm @ 40keV). Aortic attenuation and SNR were nearly independent of phantom diameter at 80keV VMI (-4.3HU/cm; P = 0.160 and R² = 0.175). A complete artifact reduction corresponding to \( S = 18.2 \text{ HU} \), while the artifact reduction resulting in aortic enhancement across different body sizes, although this could come at the cost of decreased magnitude in aortic enhancement.

Conclusion
The 80keV VMI improved consistency of aortic enhancement across different body sizes, although this could come at the cost of decreased magnitude in aortic enhancement.

Clinical Relevance/Application
Lower susceptibility to beam-hardening effects using VMI increases consistency in aortic attenuation measurements across different patient body sizes.

A Fast and Noise-efficient Estimator for Material Decomposition in Multi-bin Photon Counting X-ray Detectors

Paurak L Rajbhandary BS (Presenter) ; Scott S Hsieh MS ; Norbert J Pelc ScD *

Purpose
We present a fast, noise-efficient, and accurate targeted least squares estimator (TLSE) for material separation using PCXDs with multiple energy bin capability. The proposed estimator uses a novel method of incorporating dynamic weighting that allows noise to be homogenous and close to the Cramer-Rao Lower Bound (CRLB) throughout the operating range.

Method and Materials
The TLSE estimator uses a non-iterative and adaptive least squares method followed by bias correction based on a calibration phantom. In the initial step, a generalized weighted least squares linearized at the center of the operating region is used. The second step utilizes the output from the first estimate as a pointer to localize a region in a 4-by-4 grid of operating range to extract noise-weighting statistics. This dynamically adjusts the weights of the energy bins to optimize noise properties. After this adaptive step, a localized least squares and error correction process akin to A-table method (Alvarez et al) is applied to produce the final estimate. The variance and bias of this output from the first estimate as a pointer to localize a region in a 4-by-4 grid of operating range to extract noise-weighting statistics.

Results
The proposed estimator produced an average bias of \((2.59 ± 4.66) \times 10^{-5} \) cm and variance-to-CRLB ratio of \(1.039 ± 0.039\). Using the same protocol, the gold standard Maximum Likelihood Estimator (MLE) showed average bias and variance-to-CRLB ratio of \((2.77 ± 2.25) \times 10^{-5}\) and 1.035 ± 0.037 but was 50.1 times slower in our simulation. Compared to a previous non-iterative estimator (Alvarez et al), the variance-to-CRLB of TLSE is more homogenous and its average value is reduced from 9.7% to 3.9%. Average variance-to-CRLB ratio for TLSE is lower by as much as 13% in the peripheral region.
CONCLUSION
The TLSE is a computationally efficient method for implementing material decomposition technique using multi-bin PCXDs that offers noise parameters comparable to the gold standard MLE method.

CLINICAL RELEVANCE/APPLICATION
The proposed estimator is a practical method of material decomposition that can be used in clinical applications (such as angiography, virtual pre-contrast imaging) using PCXDs.

SSG14-06 • Value of Monoenergetic Low-kV Dual Energy CT Datasets for Improved Image Quality of CT Pulmonary Angiography
Paul Apfaltrer MD (Presenter) ; Sonja Sudarski ; John W Nance MD ; Christian Fink MD ; Stefan O Schoenberg MD, PhD * ; Thomas Henzler MD ; Holger Haubenreisser ; David Schneider

PURPOSE
High vessel attenuation and high contrast-to-noise ratio (CNR) are prerequisites for high diagnostic confidence in CT pulmonary angiography (CTPA). This study evaluated the impact of reconstructed monoenergetic dual-energy (DE) CTPA datasets on vessel attenuation and CNR.

METHOD AND MATERIALS
RESULTS
CONCLUSION
Virtual 70-keV monoenergetic CTPA images significantly increase vessel attenuation and CNR of DE-CTPA studies, suggesting that clinical application of low-kV monoenergetic reconstructions may allow a decrease in the amount of iodinated contrast required for adequate image quality in DE-CTPA examinations.

CLINICAL RELEVANCE/APPLICATION
DE-low-kV monoenergetic imaging may allow reductions in iodinated contrast material without compromising image quality; this may be particularly relevant in patients with impaired renal function.

SSG14-07 • Half and Quarter Dose Dual Energy CT Enabled by Prior Image Constrained Compressed Sensing
John W Garrett MS (Presenter) * ; Stephen T Brunner BS ; Jie Tang PhD ; Guang-Hong Chen PhD *

PURPOSE
The dose in dual-energy CT (DE-CT) studies is often high due to the decomposition of the CT images, as well as the need to acquire a high and a low energy data set. The Prior Image Constrained Compressed Sensing (PICCS) algorithm may enable half or even quarter dose acquisitions in DE-CT while retaining spatial resolution and diagnostic information.

METHOD AND MATERIALS
RESULTS
CONCLUSION
DE-CT images reconstructed at half or quarter radiation dose with the PICCS algorithm are similar to the full dose FBP reconstruction in terms of noise and diagnostic information. As a result, the application of the PICCS framework in DE-CT enables half or quarter dose studies to be performed with no significant loss of diagnostic information.

CLINICAL RELEVANCE/APPLICATION
This study is clinically relevant because it offers the possibility of performing dual-energy CT studies at half or quarter dose in a clinical setting.

SSG14-08 • Application of Photon-counting CT: Metal Artifact Reduction
Radin A Nasirudin DIPLEN (Presenter) ; Kai Mei ; Petar Penchev DIPLEN, PhD ; Ernst J Rummeny MD ; Martin Fiebich ; Peter B Noel PhD

PURPOSE
Photon-counting detectors (PCD) have the ability to discriminate photons based on their energies, thus providing information on the composition of the scanned object. This work presents an algorithm called Spectral-driven Iterative Reconstruction (SPIR) that utilizes spectral information to reduce metal artifact in Computed Tomography (CT).

METHOD AND MATERIALS
RESULTS
CONCLUSION
The incorporation of spectral information into statistical reconstruction significantly improves the diagnostic quality, while providing more information on the composition of the scanned object. Thus the implementation of PCDs does not only offer significant dose reduction but also the improvement of diagnostic image quality.
The imminent clinical introduction of PCDs is a promising extension. It will lead to new clinical relevant applications, while also minimizing radiation exposure to the general population.

SSG14-09 • Effective 120 kV CT Images from Dual-energy CT Scans

Yongshuai Ge (Presenter) ; Jie Tang PhD ; Guang-Hong Chen PhD *

PURPOSE
Dual-energy CT (DECT) scans provide monochromatic CT images at different energies and effective atomic number based on the material information acquired from scanned projection data at 80kV and 140kV. However, many conventional clinical diagnostic tasks are performed based on the CT number of materials in 120 kV CT images. There are many potential benefits of generating equivalent 120 kV CT images from DECT scans.

METHOD AND MATERIALS
Using a 64-slice GE Discovery CT750HD scanner, dual energy CT imaging was performed on both a Catphan phantom and human subject studies with IRB approval. From GSI dual energy scans, monochromatic images from 40keV to 140keV were generated at 1keV intervals. A normalized effective x-ray spectrum was generated from the vendor provided 120 kV x-ray spectrum with additional filtration of a 20cm (30cm for human subjects) thick water equivalent slab. The normalized effective x-ray spectrum was used to weight and combine the GSI produced monochromatic images to generate equivalent 120 kV CT images for evaluation. The method was validated using the 120kV phantom results and 120 kV scan of the same subject. In the phantom study, CT numbers were measured in ROIs of 8 different materials with nominal CT numbers ranging from -1000 to 1000 HU. In human subject studies, CT numbers were measured from 21 ROIs in fat and soft tissue.

RESULTS
For the phantom study, the relative errors of the synthesized and 120 kV CT images are 5%, 4%, 2%, 1%, 1%, 2%, 1%, 0%, for Polystyrene, LDPE, PM, air, Teflon, Delrin, Acrylic and the background material respectively. In the Bland-Altman analysis of human subject results, the bias of CT numbers between the synthesized effective 120 kV and acquired 120 kV CT images is 0.5 HU and the limits are within 1.7 HU.

CONCLUSION
Effective 120kV CT images can be generated from a GSI dual energy CT scan with high accuracy.

CLINICAL RELEVANCE/APPLICATION
The synthesized 120 kV CT images can help clinicians make routine diagnosis together with quantitative imaging enabled by GSI imaging.

Physics (X-ray Imaging)

Tuesday, 10:30 AM - 12:00 PM • S404AB

SSG15 •AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1

Moderator
Martin J Yaffe, PhD

Moderator
Joseph Manak *

SSG15-01 • Developments to a Rapid In-clinic Peak Skin and Organ Dose Algorithm for Improved Patient Risk Management During High-dose Fluoroscopically Guided Interventions

David Borrego MS (Presenter) ; Daniel A Siragusa MD ; Wesley E Bolch PhD

PURPOSE
Data from a detailed parameterization of over 23,763 exposure conditions from high frequency and/or high-dose fluoroscopically guided interventions reveal the dynamic nature of these procedures. As such, simple point calibrations of the KAP meter and spectral data assumptions may lead to gross errors in skin and organ dose calculations. This work seeks to investigate new methods and calibrations for improved accuracy gains over previous iterations of the University of Florida’s Rapid In-Clinic Peak Skin Dose Algorithm (RIPSA).

METHOD AND MATERIALS
Calibration factor maps were developed that accounted for copper filtration, tube voltage, and current. The calibration factor maps were then coded into the RIPSA software for improved accuracy. Organ doses are further dependent on x-ray energy spectra. A first order estimation of the energy spectra was generated along with an energy spectra to match measured first and second HVLs to within ±3% with an in-house spectrum generator based on the TASMIP database. Organ doses were then calculated with the use of MCNPX transport code.

RESULTS
The only statistically significant variables affecting the calibration factor are tube voltage within each filtration based on a one-way ANOVA (F(10,97)=3.19, p=0.001, ?2=0.05). The KAP meter is highly dependent on the quality of the x-ray spectra, which can introduce errors of up to 40% without the use of the calibration factor maps. Matching spectral data to the first and second HVLs yielded a 17% improvement in organ doses within in-field organs. These additional steps in calculating organ and skin doses have a negligible computational burden on the RIPSA software, with an average time of less than two seconds to calculate skin doses following an irradiation event.

CONCLUSION
This work represents robust improvements to the University of Florida’s RIPSA software by incorporating detailed x-ray energy spectra and calibration curves for the KAP meter while also overcoming the challenges of characterizing: 1) a dynamic radiological exam and 2) the variability of a patient population when conducting a dose reconstruction that can provide the interventional physician information needed to modify behavior when clinically appropriate.

CLINICAL RELEVANCE/APPLICATION
This work is an innovative effort, overcoming previous challenges, to equip interventional radiologists with accurate organ and real-time skin dose distributions to help guide clinical decisions.

SSG15-02 • Development of a New Image Operation System with Hand Movements Using a Kinect Sensor for Angiography

Yuki Ishida (Presenter) ; Toshihiro Ogura PhD ; Norio Hayashi PhD ; Mitsuru Sato ; Mika Okajima ; Kunio Doi

PURPOSE
During angiographic examinations, interventional radiologists need various image manipulation such as paging, roaming, enlarging and fusion in order to assess vessels and sources of bleeding. However, radiologist could not touch screen by hand, because of his/her gloves to be kept clean. Usually, radiologists provide verbal instructions to technologists, who may operate to display appropriate images with various image processing. However, if technologist may not be at the console due to the preparation of the catheter or contrast agent, quick operation may not be performed. Therefore, we developed a new image operation system using a motion sensor for angiography. With this system, radiologists could operate various image processing only with movements in hands.
METHOD AND MATERIALS
We used the Kinect technique which is a gesture recognition technology to read the movement of radiologists. The Kinect sensor consisted of an infrared laser emitter, an infrared camera and an RGB camera for gesture recognition. Measurements of depth were made by triangulation using the infrared camera. For initialization, radiologist’s hands were recognized by computer for right palm forward protrusion.

RESULTS
CONCLUSION
With the image operation system using a motion sensor for angiography, various image processing can be performed with our hand movements, which would be a new technology for angiography in operating rooms.

CLINICAL RELEVANCE/APPLICATION
This system can be implemented as a useful tool to radiologists for control of image viewing without touching the workstation in existing angiography system in operating rooms.

SSG15-03 • stationary chest tomosynthesis system using distributed CNT X-ray source array

Jing Shan (Presenter) ; Andrew Tucker ; Yueh Z Lee MD, PhD * ; Michael D Heath * ; Xiaohui Wang PhD * ; David Foos MS * ; Jianping Lu ; Otto Zhou PhD *

PURPOSE
The purpose of this work is to investigate the feasibility of constructing a stationary chest tomosynthesis system using a stationary CNT source array, and to evaluate the relationship between source geometry configurations and the tomosynthesis image quality.

METHOD AND MATERIALS
A bench-top chest tomosynthesis system using a CNT source array (XinRay Systems, NC) and a flat panel detector (Carestream Health Inc. NY) was built. The CNT source array contains 75 focal spots arranged at 80kVp and 5mA anode current. The tube output and entrance dose were measured. Projection images were reconstructed using commercially available software (Realtime Tomography, Pa). System in-plane resolution and in-depth resolution were measured using a 100um cross-wire phantom at different source configurations including linear-source geometry with different angular coverage and a square-source geometry. In addition, anthropomorphic chest phantom images were acquired and reconstructed for image quality assessment.

RESULTS
CONCLUSION
The experimental results demonstrate the feasibility of stationary chest tomosynthesis. This can lead to improved system design, potentially faster imaging speed, and reduced patient motion blur. The CNT source array is capable of delivering sufficient x-ray flux and dose required for chest tomosynthesis. The square source geometry shows comparable in-plane and in-depth resolutions as linear geometry.

CLINICAL RELEVANCE/APPLICATION
Stationary tomosynthesis system can improve image quality and reduce image acquisition time, which can improve the workflow and benefit the detection of small lung nodules and other chest pathology.

SSG15-04 • Comparison of Microcalcification Detection in Digital Mammography and Breast Tomosynthesis Using a Hybrid Technical-clinical Test Method

Lesley Cockmartin (Presenter) ; Gwen Aerts ; Federica Zanca PhD ; Nicholas Marshall ; Eman Shaheen ; David Dance PhD ; Kenneth C Young PhD ; Hilde Bosmans PhD *

PURPOSE
To compare the detectability of microcalcifications in patient images for digital mammography (2D) and breast tomosynthesis (BT) using a hybrid technical-clinical method.

METHOD AND MATERIALS
Spherical microcalcifications (CaCO₃), in groups of 5 in the Voxmam phantom (Leeds Test Objects, UK), were imaged in 2D and BT mode. Templates of microcalcifications embedded in different thicknesses of polymethyl methacrylate (PMMA), were created for 2D and BT projections by dividing exposures of the Voxmam phantom containing microcalcifications in PMMA by images of homogeneous PMMA. The templates were multiplied into projection images of patients with equivalent breast thicknesses and then processed/reconstructed. Four groups of microcalcification diameters were used: 354-224, 283-180, 226-150, and 177-106 μm. All microcalcifications were imaged at 2 different heights (z-positions) above the detector. For the detection study, 511 2D images and 511 BT series were viewed: 355 with microcalcifications and 156 without. Seven observers scored the presence or absence of the microcalcification group in the center of a highlighted area via a 5 point confidence rating scale and counted how many microcalcifications were visible. Detection performance of 2D and BT was compared via ROC analysis with sub-analyses for microcalcification size, breast thickness and z-position.

RESULTS
Peak contrast in the projections ranged from 1.3% to 16% for 2D and from 0.8% to 11% for BT templates. Preliminary ROC results showed a better detection of microcalcifications in 2D compared to BT (p with an area under the curve (AUC) of 0.95 compared to 0.85. A statistically significant difference was found for the two intermediate size groups only. The AUC in 2D and BT were significantly different only for higher breast thicknesses (>5cm). Higher z-positions (>3cm) showed higher significant differences between 2D and BT. Finally, the Wilcoxon matched pairs test indicated a significant difference (p between the counts for 2D and BT.

CONCLUSION
Detection performance of 2D and BT for all microcalcification sizes depends on breast thickness and z-position, suggesting the need for further optimization of acquisition and reconstruction in BT for thicker breast and higher z-positions.

CLINICAL RELEVANCE/APPLICATION
This hybrid method can quantify detectability differences between 2D and BT and allows investigation of influential parameters using real clinical backgrounds.

SSG15-05 • Digital Breast Tomosynthesis: Reader Study of the Effects of Acquisition Geometry on the Perception of Contrast-detail Test Objects

Mitchell M Goodsitt PhD (Presenter) * ; Heang-Ping Chan PhD ; Lubomir M Hadjiliski PhD ; Emmanuel G Christodoulou PhD ; Sandra Larson PhD ; Paul I. Carson PhD * ; Scott Zelakiewicz * ; Andrea Schmitz * ; Mark A Helvie MD * ; Chintana P Paramagul MD ; Colleen H Neal MD *

PURPOSE
A reader study was performed to evaluate the impact of acquisition geometry (total angle and number of projection views (pv)) on the perception of contrast-detail (CD) objects in digital breast tomosynthesis (DBT).

METHOD AND MATERIALS
Modular breast phantoms consisting of slabs that mimic the composition and parenchymal pattern of breast tissue were imaged using a GE prototype DBT system. Two slabs, one with a homogeneous and one with a heterogeneous background were machined to include CD arrays of 25 holes, 1-5 mm in diameter and 0.2-1 mm in depth. Slabs were arranged to create four different 5cm thick phantoms with the heterogeneous CD slab and 1 with the homogeneous CD slab. Each phantom was imaged with 12 different acquisition geometries (total angles: 16-64, pv: 9-21). Two acquisitions were repeated to study reproducibility. 12 x-ray technique factors were used with a mean glandular dose of a digital mammogram (~1.2mGy). Focal slices of the SART-reconstructed CD arrays were selected. 91 image pairs (IPs) were formed from the 14 geometries for each phantom, resulting in a total of 1,291 IPs.

RESULTS
A reader study was performed to evaluate the impact of acquisition geometry (total angle and number of projection views (pv)) on the perception of contrast-detail (CD) objects in digital breast tomosynthesis (DBT).
in a total of 455 IP comparisons in a reader preference study. The IPs were randomized and evaluated by 4 trained readers on a 3 point scale (1 = preferred image, 0.5 = similar, 0 = not preferred). The total % scores for all images and readings for each geometry were compared.

RESULTS
For the heterogeneous CD slab, the 3 highest scoring geometries and percent preferred were: 60°21pv(98%), 64°17pv(98%), and 40°17pv(98%). The lowest scoring were: 16°17pv(10%), 24°9pv(18%), and 24°3pv(35%). For the homogeneous CD slab, the highest scoring were: 60°21pv(87%), 32°17pv(82%), and 48°17pv(79%). The lowest scoring were: 16°17pv(1%), 40°11pv(18%), and 24°9pv(20%). Average % scores for repeat scans were within 4% in the homogeneous CD images and 7% in the heterogeneous CD images.

CONCLUSION
In general, CD objects are better perceived with wide-angle than narrow-angle DBT. For this study, the 60°21pv acquisition yielded the best perception of CD objects. These results may be applicable to mass perception. The optimal acquisition geometry should be a compromise that accounts for perception of calcifications and soft tissue lesions and scan time.

CLINICAL RELEVANCE/APPLICATION
DBT systems can be designed with a range of acquisition angles and angle increments. This study demonstrates the perception of contrast-detail objects and possibly masses is best with wide-angle DBT.

SSG15-06 • Cascaded-systems Analyses for Describing the DQE of Low-Z, High-Z and Double-Z Detectors

Seungman Yun ; Jesse Tanguay ; Ho Kyung Kim ; Ian A Cunningham PhD (Presenter) *

PURPOSE
The development of theoretical models of x-ray interaction physics is a critical step in optimal detector design and assessment. While cascaded-systems analyses (CSA) are often used to describe image signal and noise in many systems, past work has considered detectors consisting of a single element (single Z) even though most commonly used and promising candidates are compound materials. In addition, the effects of coherent and incoherent scattering on image quality are usually ignored which can be a poor assumption in low-Z materials.

METHOD AND MATERIALS
A parallel-cascade approach is used to describe photoelectric, coherent and incoherent interactions in low-Z, high-Z and double-Z detectors. This is achieved using an "energy-labeled reabsorption" process introduced to describe incoherent scatter and allowing for reabsorption of the high-Z characteristic emission by the low-Z atom. Analytic expressions of signal and noise transfer are developed to describe the detective quantum efficiency (DQE) in terms of the modulation transfer function (MTF) and Wiener noise power spectrum (NPS). The model was validated using Monte Carlo calculations for Si, Se, CsI and Pb, and by experimental measurements of the DQE using narrow spectra above and below the K-edge energies with a high-resolution CMOS-based CsI detector. Results were compared with a simpler single-Z model to determine the need for the complex double-Z model in each case.

RESULTS
Excellent agreement was obtained with both Monte Carlo and experimental results for all conditions tested. It is shown that a combination of two single-Z models, weighted by the atomic weight of each material, gave equivalent results to the comprehensive double-Z model within a few percent. Incoherent interactions have the potential to produce a substantial low-frequency drop in the MTF and DQE of low-Z detectors.

CONCLUSION
These results show that combining two simple single-Z models is adequate for a description of the double-Z detectors and the effect of incoherent scatter must be considered for low-Z materials. We believe that this CSA model of the DQE is useful for an optimal design of conventional radiography detectors and the estimation of x-ray imaging performance of novel photodiode constrictor materials.

CLINICAL RELEVANCE/APPLICATION
Development of comprehensive models of the DQE is necessary to ensure high quality images and low patient exposures with new detector designs.

SSG15-07 • Volumetric Breast Density Quantification Using Spectral Mammography

Sabee Y Molloi PhD (Presenter) * ; Huanjun Ding ; Elin Moa MS * ; Stephen A Feig MD *

PURPOSE
Breast density is a significant risk factor in developing breast cancer. Breast density is currently reported by radiologists using BI-RADS categories, which is known to have a large inter-observer variability. The purpose of this study is to evaluate spectral mammography for quantification of breast density.

METHOD AND MATERIALS
Four-view mammograms for 93 women from a previous study using a prototype Philips MicroDose Mammography SI system were used and all images were arranged in a random order for a blind comparison study. The system uses a photon counting detector to acquire energy resolved images in a single exposure with no additional dose to the patient. Four-category BI-RADS rankings were assigned independently by 10 radiologists based in the USA and the UK. The four-category ranking was converted to breast density scales (0 ~ 100%) using a linear relationship. Area-based breast density measurements were also performed by a physicist using Cumulus 4 and by an automatic image segmentation method based on a fuzzy C-mean clustering (FCM) technique. Volumetric breast density was calculated with a dual energy decomposition technique using the available spectral information.

RESULTS
Excellent agreement was obtained with both Monte Carlo and experimental results for all conditions tested. It is shown that a combination of two single-Z models, weighted by the atomic weight of each material, gave equivalent results to the comprehensive double-Z model within a few percent. Incoherent interactions have the potential to produce a substantial low-frequency drop in the MTF and DQE of low-Z detectors.

CONCLUSION
These results show that combining two simple single-Z models is adequate for a description of the double-Z detectors and the effect of incoherent scatter must be considered for low-Z materials. We believe that this CSA model of the DQE is useful for an optimal design of conventional radiography detectors and the estimation of x-ray imaging performance of novel photodiode constrictor materials.

CLINICAL RELEVANCE/APPLICATION
Development of comprehensive models of the DQE is necessary to ensure high quality images and low patient exposures with new detector designs.

SSG15-08 • Clinical Potential of High-energy Phase Sensitive Mammography

Hong Liu PhD (Presenter) ; Xizeng Wu PhD

PURPOSE
The objective of this study is to demonstrate the potential clinical benefits of high kVp phase sensitive x-ray breast imaging through a comparison with conventional mammography.
RESULTS
For almost equal mean glandular doses, the measured disk SNR values were about three-times higher for the phase-map images than the images acquired with the clinical mammography system. Observer based contrast-detail analyses also demonstrated improved detectability by the high-energy phase sensitive mammography for both a similar and a reduced dose, as compared to the low energy conventional images.

CONCLUSION
This preliminary phantom study demonstrates the technical potential of high-energy in-line phase sensitive mammography in improving the lesion detectability and reducing radiation dose to patients.

CLINICAL RELEVANCE/APPLICATION
The study demonstrates the technical feasibility and potential clinical benefits of high-energy phase sensitive x-ray imaging as compared to conventional digital mammography.

SSG15-09 • The Comparison between 2D Digital Mammography and Digital Breast Tomosynthesis for Morphological Assessment of Microcalcification Clusters: A Simulation Study

Eman Shaheen (Presenter) ; Chantal Van Ongeval MD ; Federica Zanca PhD ; Lesley Cockmartin ; David Dance PhD ; Kenneth C Young PhD ; Hilde Bosmans PhD *

PURPOSE
The detection and characterization of microcalcifications play an important role in the early diagnosis of breast cancer. Morphology and number of microcalcifications are two important determinative factors of the differential diagnosis between benign and malignant calcifications. Therefore, we focused on describing microcalcification clusters based on these parameters in a comparative study between 2D full field digital mammography (FFDM) and breast tomosynthesis (BT).

METHOD AND MATERIALS
Image data was collected from 46 patients. Fifty microcalcification clusters were simulated into raw projection images of 2D and BT at the same insertion positions for the same patient. The projections were then processed (2D) or reconstructed (BT). The simulated clusters were validated for realistic appearance by radiologists in a previous study where no significant difference was found between real and simulated clusters. In this study, six radiologists evaluated the clusters using the following parameters: morphology in terms of the Le Gal classification determining the dominant type, and the number of calcifications counted in the cluster. 2D and BT images were read in separate sessions. The observed agreement and a corresponding p-value were reported for the dominant Le Gal type for every observer. The Wilcoxon rank test and linear regression were applied to compare the number of microcalcifications. P-value < 0.05 indicates significant difference.

RESULTS
For the dominant Le Gal, the observed agreements ranged from 0.34 to 0.84 and p-values from 0.076 to 0.61 indicating no statistically significant difference between 2D and BT for all observers. The Wilcoxon test showed significant differences, regarding the number of calcifications in 2D compared to BT, for all observers (p-values < 0.05).

CONCLUSION
Our results show that no significant difference was found comparing 2D FFDM and BT for the morphological description based on the Le Gal classification, but 2D outperformed BT in the number of microcalcifications. Further development in BT will address this.

CLINICAL RELEVANCE/APPLICATION
No systematic change in Le Gal classification was found between 2D and BT but the number of counted calcifications was lower in BT suggesting future clinical studies examine microcalcifications in BT.

Radiation Oncology and Radiobiology (Genitourinary) Tuesday, 10:30 AM - 12:00 PM • S104A Back to Top

SSG16 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5 Moderator Phuoc T Tran, MD, PhD *

SSG16-01 • Real-time Prostate Tracking during VMAT Delivery Incorporating Prostate Rotation Estimation Based on a Single Projection Image

Ling Zhuang PhD (Presenter) ; Jun Zhou PhD ; Xiaochao Xu PhD ; Di Yan

PURPOSE
To develop a method to track the prostate 3D translations and rotations during VMAT delivery based on a single projection image.

METHOD AND MATERIALS
Centroid positions of three fiducial markers implanted in patient’s prostate were extracted from 3D planning CT image through thresholding. The 3D translations and rotations of the prostate were determined through minimizing the summation of distances between the markers’ centroid projection positions and their detected projection positions on a single projection image. The accuracy of the method was evaluated using simulated experiments. Three real patients’ prostate motion patterns were used to drive the 3D markers’ translation, while the markers continuously tilt around the left-right axis (0~20°, denoted by RX). The markers’ 2D locations on the projections were simulated by projecting the moving 3D markers in the kV imaging plane with a frame rate of 30 frames per gantry angle. To simulate marker detection uncertainties, Gaussian random variations (σ=0.0mm, S=0.5, 1.0 and 2.0 mm) were added to each marker’s projection position. For each direction, tracking errors were calculated as the difference between the estimated value and the actual value. The correlations between the accuracy of the proposed method and the adding noise level were investigated.

RESULTS
The overall errors are 0.1±0.3, 0.2±0.3, 0.2±0.3, and 0.3±0.6 mm in LAT, AP, SI and RX respectively. The Pearson correlation between noise and error are 0.63, 0.61, 0.67, and 0.76 in LAT, AP, SI, and RX respectively. The correlations between noise and error in SI and RX are relatively high because there are approximately linear dependencies between SI motion/RX rotation and the markers’ projection position shifts.

CONCLUSION
The approach proposed can accurately detect prostate’s translations and rotations based on a single kV projection.

CLINICAL RELEVANCE/APPLICATION
Our method can be further used to track the prostate motion during treatment delivery, thus allowing the possibility to adjust the treatment if the prostate motion is out of a pre-defined tolerance.
SSG16-02 • Study of Selecting Optimal Monochromatic Level for Artifacts Reduction Using Spectral CT Imaging after 125I Radioactive Particles Implantation

Qiuxia Yang (Presenter); Sheng Peng; Rong Zhang; Jing Wu; Mingyan He; Chuanmiao Xie; Fujun Zhang

PURPOSE
To select the optimal monochromatic level for gemstone spectral imaging (GSI) to minimize both the image noise and metal artifacts caused by 125I radioactive particles after 125I particles implantation in non-enhanced CT scan.

METHOD AND MATERIALS
Nine patients (8 males, 1 female, average age: 57.8, 5 cases of hepatocellular carcinoma, 1 case of cholangiocellular carcinoma, 3 cases of metastatic tumor) after 125I radioactive particles implantation underwent spectral CT examinations using Discovery CT750 HD scanner to evaluate the implant position and treatment. Both conventional 140kVp polychromatic and monochromatic images (40-140keV, interval 5keV) were generated from GSI scan acquisition and non-enhanced CT series were evaluated. The CT value and standard variations were measured in the region of 5mm and 10mm distance from particles while the background noise was measured in region of same tissue without artifacts. The artifact index (AI) is defined as the square root of the squared noise difference between the region with and without artifact of the same tissue. All the measurements were recorded and statistically compared.

RESULTS
For the non-enhanced abdominal spectral CT images, 40keV was found the highest noise and Artifact Index of monochromatic images (SD=27.38, AI=206.40). Slope of AI curve (k value) from 75keV images was smaller (k=1.02) than that of rest lower keV images. The optimal monochromatic level was found at 75 keV which can provide almost the least image noise (SD=10.01) and good performance of artifact reduction. The noise (SD=27.38, AI=206.40) was decreased by 82.6, 65.9, 54.7 and 43.7%, respectively. Similar data only. Discrepancies in prostate volume and associated Planning Target Volume (PTV) were variable, highlighting the advantage of metal artifacts reduction using spectral CT imaging after 125I radioactive particles implantation.

CONCLUSION
Monochromatic images obtained with spectral CT imaging can substantially reduce metal artifacts caused by 125I radioactive particles and provide more accurate CT images for estimating the efficacy of the treatment.

CLINICAL RELEVANCE/APPLICATION
Clinical relation: Spectral CT showed its potential applications in monitoring disease progressions after 125I radioactive particles implantation.

SSG16-03 • Clinical Results of Salvage Radiation Therapy after Prostatectomy for Patients with Prostate Cancer-Single Institute Experience

Tomonari Sasaki MD, PhD (Presenter); Katsumasa Nakamura MD, PhD; Yoshiyuki Shioyama; Saiji Ohga MD; Tadanori Yoshikita MD; Hiroshi Honda MD; Makoto Shinoto; Kotaro Terashima; Kaori Asai; Keiji Matsumoto; Hideki Hirata

PURPOSE
This study attempts to evaluate the efficacy of salvage radiation therapy (RT) after radical prostatectomy (RP) for patients with prostate cancer in our institute, and to identify specific operative and pre-RT characteristics associated with eventual success in this population.

METHOD AND MATERIALS
We performed a retrospective analysis of 80 males who received salvage RT after RP from 2005 to 2011 at our hospital. All patients had elevation of prostate specific antigen (PSA) level or clinical recurrence after RP. Patients who received hormone therapy concurrently with RT and who had short follow-up period less than 6 months were excluded.

RESULTS
A median dose of 66 Gy was delivered to the prostate bed. Sixty-nine patients irradiated to prostatic bed alone. Eleven patients received small or whole pelvic irradiation. After a median follow-up period of 60 months, 31 patients had experienced biochemical failure, and 5 of them had clinical failure (one regional, 4 distant). Actuarial 5-year overall, clinical relapse-free and biochemical relapse-free survival estimates were 96.7%, 93.3% and 60.2%, respectively. On uni- and multi-variate analyses, Gleason score was a significant factor affecting biochemical relapse-free survival. Failure was diagnosed with 40keV. There was significant difference in CT value and variations between the region of inner 5mm and outer 5mm distance from particles (P=0.017).

CONCLUSION
Salvage RT after RP for patients with prostate cancer is safe and feasible. Patients with Gleason’s score 8-10 prostate cancer or with pre-RT PSA greater than 0.4 ng/ml have an increased risk for biochemical relapse after salvage RT.

CLINICAL RELEVANCE/APPLICATION
Salvage radiation therapy after radical prostatectomy for patients with prostate cancer is safe and feasible.

SSG16-04 • Vagueness of Time-fixed Bladder Volume Control Assessed during Proton Beam Irradiation of Prostate Cancer

Shigeyuki Takamatsu MD, PhD (Presenter); Kazutaka Yamamoto MD, PhD; Mariko Kawamura; Satoko Asahi; Tamaki Kondou; Tsuyoshi Takehara MD, PhD; Yuji Tameshige; Yoshikazu Maeda; Makoto Sasaki; Hiroyasu Tamamura

Joseph M Baisden MD,PhD (Presenter); Dana O Olson MD

PURPOSE
This study highlights the usefulness of magnetic resonance imaging (MRI) in the treatment of prostate cancer with implications for screening. MRI was used for planning prostate cancer radiation treatment and to evaluate the value of periodic limited MR during the course of therapy. This was evaluated in the community clinic setting.

METHOD AND MATERIALS
Planning CT images were acquired and individual treatment plans were planned for localized prostate cancer patients. MR images were acquired at 1.5 T at the community hospital. T2-weighted axial images were fused for planning purposes, and a second plan was generated using the fused images. Patients were treated with IMRT with daily CT image guidance using helical tomotherapy to a total dose of 81 Gy. Periodic limited MR imaging, including T2, diffusion and STIR were acquired twice weekly to evaluate the dynamic MR response to therapy.

RESULTS
Rectal doses were decreased significantly for the patients as treated with fused-MR planning, compared to plans generated with CT data only. Discrepancies in prostate volume and associated Planning Target Volume (PTV) were variable, highlighting the advantage of MR over CT in delineated prostate anatomy. There was a 29.3% decrease in mean prostate volume with MR compared to CT. Regarding rectal dose, the V90, V70, V50 and V50 were decreased by 82.6, 65.9, 54.7 and 43.7%, respectively. 51% of patients tolerated the treatments with no Grade 3 or higher acute toxicities. The MR imaging during the course of therapy demonstrated changes including a general decrease in MR prostate spatial frequency and mild gland enlargement.

CONCLUSION
Fusion of MR for planning purposes results in significant sparing of normal organs for prostate cancer IGRT/IMRT in the community setting. Patients tolerated 81 Gy with side effect profiles consistent with other reports. Further dose escalation is being pursued. Periodic limited MR imaging may be useful for ongoing therapy guidance and the changes noted may provide a useful approach to using this technology as an effective screening tool.

CLINICAL RELEVANCE/APPLICATION
MR serves a valuable role in prostate cancer therapy, both guidance and outcome assessment. MR allows more accurate radiation targeting and normal organ sparing, permitting safe dose escalation.

SSG16-06 • Comparison of Testicular Dose Delivered by Intensity-modulated Radiation Therapy (IMRT) and Volumetric-modulated Arc Therapy (VMAT) in Prostate Cancer Patients
Jeffrey J M Martin MD (Presenter) ; Elizabeth Handorf ; George Cherian ; Mark K Buyyounouski MD * ; David Y Chen MD ; Alexander Kutikov MD ; Robert IA Price PhD ; Eric M Horwitz MD

SSG16-07 • Comparison of Image Guidance Techniques for the Post-prostatectomy Patient
Matthew E Johnson MD (Presenter) ; Tianyu Li ; Richard E Greenberg ; Alexander Kutikov ; Mark K Buyyounouski MD * ; Marc Smaldone ; Mark L Sobczak ; Eric M Horwitz MD

SSG16-08 • Prognostic Factors for Toxicity in Prostate Cancer Patients Treated with Arc Radiation Therapy
Jose Lopez ; Raul Matute ; Fernando Puebla ; Jose C Ardauan MD, PhD (Presenter) ; Nicolas Isa ; Catalina Acebedo ; Rafael Lengua ; Maria Jose Ortiz Gordillo ; Javier Jaen ; Juan Manuel Praena-Fernandez ; Mercedes Arduan Perez ; Ignacio Azinovic

SSG16-09 • A Prospective Feasibility Study of Hypofractionated Radiotherapy in Localised Prostate Cancer in Indian Scenario
Shilpa Reddy (Presenter) ; Vijay Anand Palkonda ; Sajal Kakkar MD ; Kausik Bhattacharya ; Vinitha Reddy MD ; Prashanth Upadhyay MD ; Nanditha Sesikeran ; Shantling Nigudgi MD ; Vinod Reddy Maddireddy MBBS

SSG17-01 • Hepatic Radiofrequency (RF) Ablation-induced Stimulation of Distant Subcutaneous Tumor Growth: Suppression with a c-MET Kinase Inhibitor
Muneeb Ahmed MD (Presenter) ; Gaurav Kumar PhD ; Marwan Moussa MD ; Nir Rosenblum MA ; S. Nahum Goldberg MD *

PURPOSE
To determine if hepatic radiofrequency ablation (RFA)-induced stimulation of distant subcutaneous tumor growth can be suppressed with an adjuvant c-MET kinase inhibitor in a small animal tumor model.

METHOD AND MATERIALS
Single R2320 adenocarcinoma subcutaneous tumors were implanted in Fisher 344 rats (total n=38). At diameters of 10-11mm, tumors were randomized to receive standardized RFA (120g electrode, 1 cm active tip, tip temperature 70ºCx5min) or sham procedure (electrode placement without RFA) to normal liver (2 groups, n=13 each) and then with adjuvant intraperitoneal PHA-665752 (c-MET inhibitor) administered 3d after RFA (2 groups, n=6 each). Animals were sacrificed and tumors harvested 7d post-treatment. Tumor growth analysis (absolute diameter, change in diameter, and growth curve slope) and evaluation of proliferative indices (Ki-67 % positivity) was performed.

RESULTS
With RFA of normal liver, distant subcutaneous tumors were substantially larger at 7d compared to sham (17.1±2.2mm vs. 13.7±0.9mm, p < 0.05). Tumor viability assessment demonstrated that inhibition of PI3K-mTOR enhanced heat stress induced HCC cell killing.

CONCLUSION
RF ablation of normal liver can stimulate distant subcutaneous tumor growth in this animal model. This effect can be successfully suppressed with an adjuvant c-MET kinase inhibitor.

CLINICAL RELEVANCE/APPLICATION
Achieving an ablative margin during hepatic RFA may stimulate distant tumor growth. The c-met pathway is one potential mechanism that can be targeted to suppress these deleterious effects.

SSG17-02 • Inhibition of PI3K-AKT-mTOR Signaling Enhances Heat Stress Induced HCC Cell Killing
Scott M Thompson BA (Presenter) ; Matthew R Callstrom MD, PhD * ; Joseph P Grande MD, PhD ; Lewis R Roberts MBChB, PhD * ; David A Woodrum MD, PhD

PURPOSE
AKT and ERK signaling pathways are frequently dysregulated in hepatocellular carcinoma (HCC) and promote HCC cell survival. The aim of the present study was to test the hypothesis that inhibition of PI3K-AKT-mTOR and/or MEK-ERK signaling enhances heat stress induced HCC cell killing.

METHOD AND MATERIALS
Intentional partial laser or sham ablation was performed on orthotopic N151 HCC tumors under US-guidance and liver/tumor tissue assessed for phospho-AKT and ERK immunostaining at 6 or 24 hours post-ablation (N=8). The HCC cell lines N151 and AS30D were pre-treated for 1-hour with small molecule inhibitors against PI3K-mTOR, MEK, both or vehicle control followed by sublethal heat stress (45.0°C) or control (37°C) for 10 minutes and recovered up to 48 hours in complete media at 37°C (N=3). Samples were assessed for heat stress induced AKT and ERK signaling immediately post-heat stress by western immunoblotting and cell viability at 48 hours post heat stress by WST-1 assay.

RESULTS
Immunohistochemical analysis of the ablation zone demonstrated markedly increased AKT and ERK phosphorylation at the tumor ablation margin but not at the liver ablation margin. There was no evidence of increased AKT or ERK phosphorylation in the tumor or at the margin between liver and tumor in the sham ablation group. Western immunoblotting demonstrated that inhibition of PI3K-mTOR and/or MEK blocked constitutive and heat stress induced AKT and ERK phosphorylation, respectively, in both the N151 and AS30D HCC cell lines. Viability assessment demonstrated that inhibition of PI3K-mTOR enhanced heat stress induced HCC cell killing over heat stress or drug alone in both cell lines (p < 0.05).

CONCLUSION
These data demonstrate that thermal ablation induces AKT and ERK phosphorylation at the tumor ablation margin in vivo and that inhibition of PI3K-mTOR prevents heat stress AKT signaling and enhances heat stress induced HCC cell killing.

CLINICAL RELEVANCE/APPLICATION
Inhibition of PI3K-AKT-mTOR signaling may be a promising therapeutic target in combination with thermal ablation as a method to enhance ablation induced HCC cell killing.

SSG17-03 • Optimizing Pulsed Irreversible Electroporation Deposition
Ayelet Wandel MD (Presenter) ; Muchamad Faruja MD ; Isaac Nissenbaum BSc ; Eliel Ben-David MD ; Liat Appelbaum MD ; S. Nahum Goldberg MD *

PURPOSE
To determine optimal settings for creating large zones of IRE-induced ablation.
RESULTS
For a 15 min application time, optimal ablation of 6.7 ± 0.2 x 3.3 ± 0.1 cm was produced at 100 pulses of 100 μsec and 3000V with 160 - 300 sec intervals. This was substantially larger than the 5.5 ± 0.2 x 2.0 ± 0.3 cm produced by continuous application at otherwise controlled parameters (p < 0.01). Varying the time interval between cycles of IRE application from 100 to 900 seconds altered both the maximum resistance and the diameter of treatment in a dose-dependent manner. For example, for 4 cycles of 50 pulses, 100 - 300 sec interval delay between cycles decreased the active resistance by 30 ± 9.6 ohms and produced a diameter of 3.6 ± 0.2 with 600 - 900 sec delay showing virtually no change in resistance and producing a diameter of 3.0 ± 0.3 (p < 0.01). Altering the number of pulses or voltage for a constant 100 sec interval delay also produced dose dependent changes in max resistance (210-320 ohms range) and short-axis coagulation diameter (from 2.4 ± 0.3 – 3.1 ± 0.4 cm).

CONCLUSION
These results establish that IRE not only induces tissue ablation, but also dynamically alters tissue characteristics in ways that can be used to further improve the treatment effect. Introduction of relatively short refractory period can indeed create larger, more clinically useful zones of ablation than continuous application.

CLINICAL RELEVANCE/APPLICATION
Optimization of IRE ablation parameters will enable the creation of larger volumes of treatment effect in the most efficient manner.

SSG17-04 • Early Residual Tumor Differentiation from Benign Periablational Thermal Injury after Radiofrequency Ablation by Dual-energy Computed Tomography: A Phantom and Animal Study
Yuekao Li (Presenter) ; Gaofeng Shi MD ; Runze Wu

PURPOSE
The inflammatory reaction to the thermal injury after the radiofrequency ablation (RFA) makes it difficult to timely determine the treatment response using conventional computed tomography (CT). In this study, we applied iodine quantification with Dual-Energy CT (DECT) in VX2 carcinoma after incomplete RFA to distinguish benign periablational reactive tissue from residual tumor and evaluated the therapeutic response of RFA.

METHOD AND MATERIALS
A phantom with ten tubes which contain solutions of varying iodine concentration was scanned with DECT to evaluate the feasibility of iodine quantification. Iodine concentration was calculated and compared with the true iodine concentration. In animal study, triple-phase contrast-enhanced DECT data on 24 rabbits with VX2 carcinoma were assessed by 2 reviewers independently after 3-day (n=6), 1-week (n=6), 2-week (n=6) and 3-week (n=6) of incomplete RFA. The iodine map images were obtained based on the multi-material decomposition theory after post-processing to CT images. Regions of interest (ROI) were positioned on the iodine image over the lesion and aorta as a reference, for the recording of iodine concentration in the lesion and in the aorta respectively. The pathologic specimens were sectioned in the same plane as CT imaging. The differences of lesion iodine concentration and lesion-to-aorta iodine ratio between residual tumor and benign periablational reactive tissue were statistically analyzed.

RESULTS
The calculated iodine showed excellent correlation with the true iodine concentration (R2 = 0.999, P < 0.0001) in the phantom study. The lesion iodine concentration and lesion-to-aorta iodine ratio in residual tumor were significantly higher than that in benign periablational reactive tissue in 2-week group during the arterial phase (AP) (P < 0.01), and in 3-week group during both AP (P < 0.05) and portal venous phase (PVP) (P < 0.05). There was no significant difference of lesion iodine concentration or lesion-to-aorta iodine ratio between them in 3-day and 1-week groups.

CONCLUSION
The results of this study indicated that iodine quantification with DECT is accurate in the phantom study and could be used to differentiate benign periablational reactive tissue from residual tumor in VX2 carcinoma 2 weeks after RFA.

CLINICAL RELEVANCE/APPLICATION
The iodine quantification with DECT could be performed 2 to 3 weeks after RFA clinically to early evaluate therapeutic response.

SSG17-05 • Clinical Utility of Automatic Real-time Fusion System for Radiofrequency Ablation in Target Localization, Electrode Placement and Monitoring of Ablation Procedure
Jeong-Min Lee MD (Presenter) * ; Jeong Hee Yoon MD ; Dong Hyeon Kim MD ; Joon Koo Han MD ; Byung Ihn Choi MD, PhD

PURPOSE
To prospectively evaluate clinical utility of automatic multimodality image fusion for radiofrequency ablation(RFA) procedures, and to determine clinical outcomes of fusion-guided RFA procedures.

METHOD AND MATERIALS
80 patients (M:F=66:14) with 89 liver malignancies (80 HCCs and 9 metastases) were treated with switching monopolar RFA using multiple electrodes under the guidance of image fusion system (PercuNav system, Philips Healthcare). Image fusion system was used in IRE undergoing RFA to assist in target localization, electrode placement, and procedure monitoring. A preprocedural CT scan was obtained at slight inspiration phase with six sterile passive fiducial markers on the skin. Visibility of target tumor, planning of safe access route, operator’s confidence for technical feasibility were graded by an operator using conventional B-mode ultrasound and using the image fusion system. In addition, registration time was recorded. Technique effectiveness, local recurrence rate and remote recurrence rate at 1, 6, 12, and 18 months were evaluated using the Kaplan-Meier method.

RESULTS
Real-time fusion of US with CT/MR provided information crucial for successful execution of the RFA procedure in 43.8% (35/80) patients, and may enable procedures that are not feasible with US guidance in 23.8% of cases. Total additional setup time for the navigation system was 3.7 min ± 1.9. Tumor visibility was significantly improved on fusion system compared with B mode US and (p < 0.0001). In addition, image fusion system provided better planning of safe access route without a risk for major vascular injury than CT alone. Operator’s confidence for technical feasibility compared with B-mode ultrasound (p < 0.0001). Technique effectiveness rate, determined 1 month after RFA was 100%. Local tumor progression rates at 6, 12 and 18 months were 2.5%, 6%, and 6%. In addition, intrahepatic recurrence rates at 6, 12 and 18 months after RFA were 12%, 16.5%, 22.4%.

CONCLUSION
Real-time multimodality fusion system provided information crucial for successful execution of the RFA procedure in 43.8% (35/80), and automatic real time fusion guided RFA safely provided successful local tumor control, and therefore, improved survival may be achieved with this technique.

CLINICAL RELEVANCE/APPLICATION
CONCLUSION
RFA ablation using a multiple-electrode switching system is safe and effective for treatment of lung tumors measuring 2cm or larger.

CLINICAL RELEVANCE/APPLICATION
RFA ablation using a multiple-electrode switching system can be useful when the lung tumor is 2cm or larger.

SSG17-07 • Nanoparticle Distribution after Treatment of Rabbit VX2 Hepatic Tumor with Nanoparticle Embolization and Irreversible Electroporation (IRE) or Radiofrequency Ablation (RFA)
Alda L Tam MD (Presenter) * ; Marites P Melancon PhD ; Joe Ensor * ; Laura Pageon DVM ; Mohamed E Abdelsalam MD ; Tomas Appleton Figueira MD ; Katherine Dixon RT ; Jennifer J Miller ; Amanda McWatters ; Chun Li PhD ; Sanjay Gupta MD

PURPOSE
To investigate the intratumoral uptake of radiolabeled, hollow gold nanoparticles loaded with doxorubicin (64Cu-labeled PEG-HAunS-DOX) after IRE or RFA in rabbit VX2 hepatic tumors.

METHOD AND MATERIALS
Twelve VX2 tumor-bearing rabbits were randomized to three treatment arms: (i) nanoembolization with 64Cu-labeled PEG-HAunS-DOX (NE only); (ii) NE followed by IRE (NE+IRE); (iii) NE followed by RFA (NE+RFA). PET/CT imaging was obtained at 18-hours after intervention, after which animals were euthanized and tissue samples were collected for autoradiograph and TEM analysis. Dunnett’s multiple comparison procedure was performed to evaluate differences in the mean uptake of nanoparticles in the tumor.

RESULTS
Based on PET/CT evaluation, the uptake and retention of the nanoparticles in the tumor following NE+RFA was significantly greater than following NE (p<0.02) but there was no difference in the uptake and retention of the nanoparticles following NE+IRE when compared to NE (p=0.75). The autoradiograph analysis demonstrates that following NE+IRE, there is nanoparticle deposition in the tumor, in the ablated tissues adjacent to the tumor and in normal liver; whereas, following NE or NE+RFA, there is nanoparticle deposition around the tumor but not in it. The TEM results indicate that following NE+IRE, intracellular uptake of nanoparticles was noted in tumor, ablated and normal liver cells. There was no intracellular uptake of nanoparticles following NE or NE+RFA.

CONCLUSION
Combining NE with IRE or RFA results in the retention of the nanoparticles in or around the tumor for up to 18-hours post-intervention; however, nanoparticles are found inside cells only after IRE.

CLINICAL RELEVANCE/APPLICATION
A combined nanoembolization and ablation treatment technique for liver tumors is feasible.

SSG17-08 • Renal Cryoablation: A New Paradigm for Nearly Any Tumor Location
Hussein D Aoun MD (Presenter) ; Peter J Littrup MD * ; Barbara A Adam MSN ; Evan N Fletcher MS, BA ; Mark J Krycia BS

PURPOSE
To assess technical feasibility, efficacy and complication rates of CT guided percutaneous renal mass cryoablation in a large series on long term follow up.

METHOD AND MATERIALS
CT and/or CT-US fluoroscopic-guided percutaneous cryoablations were performed in 247 procedures on 262 tumors (210 RCC, 45 metastases, 6 oncocytomas and 1 angiomylolipma) in 214 patients noting tumor size and location. Thirty-seven patients had multiple renal tumors ablated. Follow-up CT or MRI was utilized to assess efficacy and evaluate for local recurrences or new multicentric tumors. Hydrodissection with normal saline/contrast (60:1) solution was performed to protect adjacent vital structures such as bowel, ureter or pancreas. Complications followed the grading system of the National Institutes of Health, Common Terminology of Complications and Adverse Events (CTCAE 4.0).

RESULTS
All the procedures were performed under conscious sedation and were virtually painless during and after the procedure. Average tumor size at ablation size was 3cm and 5cm, respectively, with the largest 10.4cm. Hydrodissection was performed in 73 procedures. Major complication (only grade 3) rate attributable to the procedure was 2.4% (6/247). Of the major complications, 3 (3/5) were related to hemorrhage requiring transfusion (Grade 3). A ureteral stricture prior to ureteral stent placement for central tumors and bowel injury prior to protective hydrodissection techniques were observed early on in our experience. Median follow-up was 1.8 years with 72 patients having >3 year follow-up and 36 patients having >5 year follow-up. Local recurrence rate was 2% (6/262), with 4 technical failures and 2 tract recurrences. Of the local recurrences, 4 were re-ablated (2 tract and 2 technical) without residual disease on follow-up for a secondary efficacy of 99%.

CONCLUSION
Renal cryoablation has established low complication and local recurrence rates which do not appear to be significantly affected by
necrosis

3. This exhibit will help for understanding of functional method of tumour viability which eventually helps to differentiate it from radiation recurrence of brain tumor is relatively high and requires a precise and early diagnosis for better outcome...

SUMMARY
• Future direction and summary
• Review of PET MRI findings for local tumour recurrence, radiation necrosis or co-existent pathologies
• Correlation of PET imaging with structural images of MRI for evaluation of functional changes
• Limitations of conventional mode of imaging including MRI and MR perfusion

CONTENT ORGANIZATION
3. To describe the pattern of local recurrence of brain tumors and radiation necrosis
2. To evaluate the accuracy of PET MRI in different recurrent brain tumors
1. To review specific imaging of recurrent Brain tumor and radiation necrosis

PURPOSE/AIM
Laxmi V Bhobe
Mrunali l Shah
Manas Mayank
Megha Sanghvi
Ankur Shah

Recurrence of Brain Tumors v/s Radiation Necrosis: PET MRI as a Rescue

Molecular Imaging - Tuesday Posters and Exhibits (12:15pm - 12:45pm) Tuesday, 12:15 PM - 12:45 PM • SS03AB

RCC Perfusion before and after Radiofrequency Ablation Measured with DCE-MRI: A Pilot Study

Tze M Wah MBChB, FRCR (Presenter) ; Steven Sourbrøn PhD ; Daniel Wilson MS ; Derek Magee PhD ; Walter Gregory PhD ; Peter J Selby MD, Dsc ; David L Buckley PhD

PURPOSE
The treatment efficacy of radiofrequency ablation (RFA) of renal cell carcinoma (RCC) is usually assessed with contrast enhanced CT or MRI. The lack of contrast enhancement in the zone of ablation is usually interpreted as successful ablation. However, the zone of ablation typically exhibits some enhancement rather than no enhancement at all, and it is this variability that can pose a clinical dilemma when deciding whether there is complete tumor cell death. Dynamic contrast enhanced (DCE) -MRI is routinely performed in our institution to assess the treatment effect for patients undergoing RFA. This pilot study aims to investigate if early treatment effects of RFA in RCC can be detected with DCE-MRI perfusion measurements.

METHOD AND MATERIALS
Twenty patients undergoing percutaneous RFA of their twenty one RCCs were evaluated with DCE-MRI immediately before and at one-month after RFA treatment. DCE-MRI was performed with volume acquisition under free breathing. The tumor perfusion was estimated using the maximum slope technique in two independent fittings. Blood flow to the renal tumors was correlated with total RF treatment time. This study was granted approval by our institution IRB.

RESULTS
DCE-MRI examinations were successfully evaluated for 21 renal tumors (size from 1.3 to 4 cm) with RFA time (7.4 to 63.4 minutes). The perfusion measurement of the RCCs decreased significantly (p=0.5) CONCLUSION
It is feasible to measure RCC perfusion before and after RFA using DCE-MRI. Pre-RFA tumor blood flow may be used to predict RFA time which may help planning treatment. Perfusion values significantly decrease in the zone of ablation, suggesting they may be useful for the assessment of treatment.

CLINICAL RELEVANCE/APPLICATION
It is feasible to measure RCC perfusion with DCE-MRI before and after RFA to assess treatment effect; blood flow to the RCC before RFA may be used to predict required ablation time.

Molecular Imaging - Tuesday Posters and Exhibits (12:15pm - 12:45pm) Tuesday, 12:15 PM - 12:45 PM • SS03AB

CL-MIS-TUSA Hemant T Patel , MD
Ankur Shah , MD
Megha Sanghvi , MD
Manas Mayank , MD
Mrunali I Shah , MBBS
Laxmi V Bhobe , DMRD

PURPOSE/ AIM
The purpose of this exhibit is: 1. To review specific imaging of recurrent Brain tumor and radiation necrosis 2. To evaluate the accuracy of PET MRI in different recurrent brain tumors 3. To describe the pattern of local recurrence of brain tumors and radiation necrosis using PET MRI

CONTENT ORGANIZATION
• Pathophysiology of recurrent brain tumors after surgery and radiotherapy
• Limitations of conventional mode of imaging including MRI and MR perfusion
• Correlation of PET MRI imaging with structural images of MRI for evaluation of functional changes
• Review of PET MRI findings for local tumour recurrence, radiation necrosis or co-existent pathologies
• Future direction and summary

SUMMARY
Major teaching points of this exhibit are: 1. Recurrence of brain tumors is relatively high and requires a precise and early diagnosis for better outcome 2. PET MRI is a very sensitive modality to depict recurrent brain tumor with high positive predictive value 3. This exhibit will help for understanding of functional method of tumour viability which eventually helps to differentiate it from radiation necrosis

Molecular Imaging - Tuesday Posters and Exhibits (12:15pm - 12:45pm) Tuesday, 12:15 PM - 12:45 PM • SS03AB

CL-MIS-TUA • AMA PRA Category 1 Credit ™ :0.5 Host Michael S Gee , MD, PhD
CL-MIS-TUA1A • In Vivo Monitoring of NIS-induction and Tumor Phenotyping Using Extrathyroidal Tumor Xenograft Mouse Models

Eva J Koziolek DO (Presenter) ; Iyavla Apostolova ; Agnieszka Tarkowska ; Winfried Brenner * ; Udo Schumacher ; Gerhard B Adam MD ; Michael G Kaul

PURPOSE
Despite the method of gene transfer, all trans retinoic acid (atRA), a vitamin A derivative, in combination with glucocorticoids has been used to stimulate sodium iodide symporter (NIS) expression in thyroid and breast cancer models. To apply I131 therapy to extrathyroidal tissue, functional and sufficient NIS-expression is a pre-condition. The purpose of this study was to evaluate the potential of atRA and prednisol (PRED) to induce functional NIS-expression in a NIS-negative pancreatic cancer model ii) enhance functional NIS in a NIS-transfected breast cancer model.

METHOD AND MATERIALS
Mouse tumor xenograft models BxPC3 (pancreas), HT29 (colon) and NIS-transfected MCF7 (breast) were established over the right side of the flank. Daily injections of atRA/PRED (1.3/0.7 mg/day) treatment were given subcutaneously for up to 7 days. SPECT was performed on day 0, 5 and 7 using a nanoSPECT/CTplus (Bioscan/Mediso) and 100 MBq/mouse Tc99m pertechnetate. Tumor phenotyping (T2w, ADC, DCE-MRI) was performed prior to the treatment using a 7T MRI (ClinScan, Bruker).

RESULTS
In vivo imaging of tumor-specific NIS-induction after 5 and 7 days of atRA/PRED treatment was performed by SPECT and resulted in an increase in Tc99m-uptake. The NIS-negative pancreatic cancer model showed an up to 3 fold increase in tracer uptake (n=4) above the background or when compared to HT29 tumor xenografts. As expected, the NIS-transfected breast cancer model (n=4) showed an initial strong tracer uptake in the tumor tissue (3 and 4 % ID/ml) and further increased by 30-50%, on day 7 of treatment. T2w MR imaging allowed a precise delineation of tumor mass, and was used to place the ROI with high accuracy for SPECT analysis. Tumor phenotyping allowed a detailed characterisation of the tumour tissue prior to atRA/PRED treatment.

CONCLUSION
Functional NIS-expression in extrathyroidal tissues can be stimulated by atRA/PRED treatment and further increased in already NIS-transfected tissues, when tissues initially respond with NIS-expression after atRA treatment. In vivo tumor-specific NIS-induction can be visualized by SPECT/CT using a NIS-specific tracer. Multimodal imaging including SPECT and MRI generates useful complementary data.
CL-MIS-TU2A • Optimization for Combination of Peptide Receptor Radionuclide Therapy (PRRT) and Temozolomide Therapy Using SPECT/CT and MRI; A Mouse Study

**Purpose**
Successful treatment of patients with somatostatin receptor overexpressing neuroendocrine tumors (NET) with Lutetium-177-labelled octreotate, (PRRT) or temozolomide (TMZ) as single treatments has been described. Their combination might result in additive response, so we studied tumor characteristics and therapeutic responses after different administration schemes in mice to obtain the optimal strategy to combine PRRT and TMZ.

**Method and Materials**
Initially we performed imaging studies of nu/nu mice (n=5-8) bearing somatostatin receptor-expressing human H69 small cell lung carcinoma xenografts, after single administration of PRRT (30MBq/µg) or TMZ therapy (50mg/kg/day (d) 5x/week for 2 weeks). Once a week tumor perfusion was measured by DCE-MRI and SPECT/CT images were acquired to determine tumor uptake. Based on imaging results, seven groups were included in a combination therapy study: 1: control (saline), 2: TMZ, 3: PRRT 4: PRRT + TMZ d1, 5: PRRT d1, TMZ from d15, 6: TMZ from d1 PRRT d15, 7: PRRT d1 and d15. Study endpoint was tumor volume >1800-2000 mm³.

**Results**
Single treatment with PRRT or TMZ therapy resulted in reduction of tumor size, which led to changes in MRI characteristics such as intrinsic T2, T2* and perfusion values. Moreover, TMZ treatment not only showed a reduction in tumor size 9d after start of treatment and an increase in MRI perfusion parameters but also an increasing uptake of 111In-octreotide till d15 followed by a decrease thereafter. In the combination therapy study no complete cure was found in control, single TMZ and single or double PRRT groups, while in the TMZ/PRRT combination groups resp. 44%, 38% and 55% of mice (groups 4, 5 and 6) showed cure without recurrence of tumor growth during follow-up. The median survival time (MST) was vastly improved in combination with TMZ and PRRT in comparison to single dose groups. Controls showed the lowest MST.

**Conclusion**
MRI and SPECT/CT studies showed that administration of PRRT 15d after start of TMZ treatment to be optimal for TMZ and PRRT combinations, resulting in the best anti-tumor effects. All three combination groups, including fractioned PRRT administration, showed additional anti-tumor effect compared to the single treatment groups.

**Clinical Relevance/Application**
From our results, treatment with TMZ prior to PRRT might be the best option in clinical practice to increase tumor responses in NET patients as well.

CL-MIS-TU3A • New Molecular Imaging Index Derived from Dynamic Susceptibility-weighted Contrast Enhanced MR Perfusion Imaging May Indicate p53 and IDH Mutation in Glioblastoma

**Xiang Liu** MD (Presenter); **Wei Tian** MD, PhD; **Sven E Ekholm** MD

**Purpose**
The p53 and IDH mutations are important genetic biomarkers in glioblastomas, as they had been reported to be associated with secondary GBM and longer survival. The dynamic susceptibility-weighted contrast enhanced MR perfusion imaging (DSC-MR PWI) is the most widely used clinical pre-operative molecular imaging technique. This study is to evaluate whether the DSC-MR PWI findings could be associated with p53 and IDH mutations in glioblastoma.

**Method and Materials**
DSC-PWI images (GRE sequence, TR/TE = 1500/50 milliseconds; flip angle, 80°; FOV = 24x24cm²; matrix = 96 x 128; thickness = 5 mm and gap=0mm) in 65 pathology confirmed glioblastomas were reviewed. Maximal relative cerebral blood volume (rCBV) ratio and percentage of signal recovery (PSR) were measured. The p53 immunostaining and IDH mutations were analyzed.

**Results**
There were 13 glioblastomas with PSR higher than 1 (mean value=1.26±0.17, range: 1.13-1.52), the PSR in other 56 cases was lower than 1 (mean value=0.74±0.22, range: 0.62-0.9). There was no significant difference of rCBV ratio between two groups (p=0.58, M-W U test). The 4/13 glioblastomas with higher PSR presented negative IDH mutation; in contrast to 9/13 cases with lower PSR (mean value=0.74±0.22, range: 0.62-0.9). There was no significant difference of rCBV ratio between two groups (p=0.047) after adjustment for age, tumor size, tumor number, resection extent, and post-operation therapies.

**Conclusion**
The PSR is a novel molecular imaging biomarker, which may potentially indicate information of IDH mutation status.

**Clinical Relevance/Application**
Novel non-invasive DSC-PWI derived index of PSR mya reveal IDH mutation induced pathologic changes.

CL-MIS-TU4A • Spectral Molecular Imaging of Multiple Intrinsic and Gold Nano-particle Labelled Bio-markers in Ex-vivo Atheroma in Diagnostic Energy Range

**Nigel G Anderson** MBCh, FRANZCR (Presenter) *; **Raj Kumar Panta** PhD; **Karen Alt**; **Christopher Bateman**; **Raja Aamir** BSc; **Joe Healy**; **Niels De Ruiter**; **Christoph Hagemeyer**; **Karlheinz Peter**; **Steven Gieseg**; **Anthony P Butler** MBChB *

**Purpose**
Spectral molecular imaging is a new x-ray based 3D imaging modality which can specifically identify and measure components of biological tissues due to its energy resolution. We aimed to simultaneously distinguish multiple intrinsic and gold nanoparticles labelled biomarkers in ex-vivo vulnerable plaque in the diagnostic energy range.

**Method and Materials**
Excised human carotid plaques were incubated in specific single chain anti-LIBS antibodies (scFv) containing 30nm gold nanoparticles which specifically target get activated platelets. A MARS small animal spectral molecular imaging scanner incorporating a Medipix3RX energy-resolved (spectral) photon counting x-ray detectors bonded to CdTe or GaAs sensor layer with a pixel pitch of 110 µm was used to acquire energy resolved images of the intact plaques. Multiple projections, with eight lower threshold energies of 30, 35, 40, 45, 50, 60, 70 and 80 KeV at 120 kVp x-ray tube voltage were acquired by placing a 10 mm Aluminium filter at the exit window of the x-ray tube. The filter was used to simulate energy absorption of a human neck. Images were reconstructed with algebraic reconstruction methods. Quantification of calcium deposits, soft tissue components (water-like and lipid-like) and gold nanoparticles was performed by analysing their spectral attenuation profiles.

**Results**
Gold labelled antiplatelet antibody-antigen complexes, calcium and iron, lipid-like, and water-like components of plaque have...
Spectral molecular imaging of carotid plaque is feasible. When spectral molecular imaging is available clinically, it could be used to detect vulnerable plaque then monitor efficacy of its treatment.

**Clinical Relevance/Application**

Spectral imaging of carotid plaque is feasible. When spectral molecular imaging becomes available clinically, it could be used to detect vulnerable plaque and monitor its treatment efficacy.

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**METHOD AND MATERIALS**

We retrospectively analyzed data acquired within one week from 18FDG- and 18FAZA-PET/CT images of 18 patients with non-small cell lung cancer. The general external shape of the lung fields was determined by global registration in DIR using a block-matching algorithm. The interior of the lung field region was matched by local registration using a free-form deformation algorithm. The amount of displacement between the two types of images was calculated using DIR vector fields and applied to the deformation of two concomitant PET images. The accuracy of registration was evaluated using a Dice coefficient (DC) of consistency between the reference and deformed CT images. Uptake areas, heterogeneity, and maximum standardized uptake values (SUVmax) were compared with the distribution of 18FDG and 18FAZA within the tumors.

**RESULTS**

The reference and deformed CT images of the tumors were very consistent, with DC values of 0.85–0.95. The area of distribution within tumors was narrower for 18FAZA than for 18FDG, and tended to be heterogeneous. Although the correlation between 18FDG and 18FAZA uptake was slightly lower (r = 0.60), the two PET/CT images provided quite different types of information.

**CONCLUSION**

We accurately registered two separate PET/CT image sets and compared the intratumoral distribution of 18FDG and 18FAZA.

**Clinical Relevance/Application**

This new method will gain insight into the biological mechanism underlying hypoxia-related tumor resistance to radiotherapy by determining the intratumoral distribution of 18FDG and 18FAZA.

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**CL-NMS-TU3A • Of Malignancy in Correlation with Ultrasonography**

**Purpose**

This study compares the intratumoral distribution of fluorodeoxyglucose (18FDG) and fluoroazomycin arabinoside (18FAZA) by registering tumor locations in two PET/CT studies using deformable image registration (DIR).

**Method and Materials**

We retrospectively analyzed data acquired within one week from 18FDG- and 18FAZA-PET/CT images of 18 patients with non-small cell lung cancer. The general external shape of the lung fields was determined by global registration in DIR using a block-matching algorithm. The interior of the lung field region was matched by local registration using a free-form deformation algorithm. The amount of displacement between the two types of images was calculated using DIR vector fields and applied to the deformation of two concomitant PET images. The accuracy of registration was evaluated using a Dice coefficient (DC) of consistency between the reference and deformed CT images. Uptake areas, heterogeneity, and maximum standardized uptake values (SUVmax) were compared with the distribution of 18FDG and 18FAZA within the tumors.

**Results**

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**Conclusion**

We accurately registered two separate PET/CT image sets and compared the intratumoral distribution of 18FDG and 18FAZA.

**Clinical Relevance/Application**

This new method will gain insight into the biological mechanism underlying hypoxia-related tumor resistance to radiotherapy by determining the intratumoral distribution of 18FDG and 18FAZA.
RESULTS
Although both 4DST and FLT showed little uptake in the normal brain, 4DST uptake was somewhat higher than FLT uptake in the normal brain. Both 4DST PET and FLT PET detected all brain tumors. The mean (±SD) value of SUV in the tumor on 4DST PET (3.37±1.93) was significantly higher than that on FLT PET (2.29±2.96) (p < 0.0001, respectively); however, there were no significant differences when assessed by [F-18]-FDG and [C-11]-Methionine. At a 1.9 threshold, 4DST PET had a sensitivity of 0.96 (95% confidence interval: 0.91–0.99) and a specificity of 0.95 (95% confidence interval: 0.92–0.97). The sensitivity of FLT PET was 0.98 (95% confidence interval: 0.94–1.00) and the specificity was 0.95 (95% confidence interval: 0.92–0.97).

CONCLUSION
These preliminary results indicate that 4DST PET is a potentially useful tracer for proliferation imaging in brain tumors.

CLINICAL RELEVANCE/APPLICATION
4DST PET may be a potentially useful tracer for proliferation imaging in brain tumors.

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**CL-NMS-TU4A • Identification and Lateralization of Diseased Parathyroid Glands in Complicated Patients: Preoperative Dual-tracer Scintigraphy (SC) Compared to Intraoperative Gamma Probe**

**Aurela Clark** MD (Presenter); **Courtney Y Lee** MD; **Partha Sinha** MBBS; **Gary R Conrad** MD; **M. Elizabeth Oates** MD

**PURPOSE**
To compare the performance of dual tracer sцинтigraphy (SC) to intraoperative gamma probe (IGP) in identifying and lateralizing diseased parathyroid glands (DPG) in complicated patients with primary hyperparathyroidism (PHPT).

**METHOD AND MATERIALS**
Medical records were retrospectively reviewed for 18 patients (17F:1M, average age 58 years) with PHPT complicated by one or more of the following: concomitant thyroid disease in 14 (11 nodular goiter, 3 hypothyroidism), multiglandular parathyroid disease (MGD) in 9, recurrent PHPT in 3. All patients had routine preoperative [99mTc] sestamibi/ [99mTc] pertechnetate scintigraphy and intraoperative IGP. SC was considered positive when images showed persistent sestamibi-avid foci or discordance; IGP was considered positive when ex vivo DPG counts measured >20% in vivo counts. Glands were considered diseased based on one or more of the following: intraoperative gross findings, intraoperative parathormone (PTH) drop >50% from baseline and into normal range, pathology, and/or postoperative symptoms. Based on correct identification and lateralization of DPG removed at surgery, diagnostic performances of SC and IGP were classified as follows: successful (SCF), partially successful (PSCF), or unsuccessful (USCF).

**RESULTS**
A total of 28 DPG weighing 89-6225 mg were removed. 12 (67%) patients had a single DPG and 6 (33%) had 2 (n=2) or 3 (n=4) DPG (MGD). In the single DPG group (10 with thyroid disease, 2 with recurrent PHPT), SC was SCF in 10 and USCF in 2, while IGP was SCF in 11 and USCF in 1. In the MGD group (2 with goiter, 1 with recurrent PHPT), SC was SCF in 2, PSCF in 2, and USCF in 2, while IGP was SCF in 5 and USCF in 1. At follow-up, 17/18 patients were cured; 1 patient with MGD remained hypercalcemic.

**CONCLUSION**
In these complicated patients with PHPT, SC was successful in identifying and lateralizing single DPGs in virgin necks with/without concomitant thyroid disease. SC performed less well in MGD and recurrent PHPT; IGP was an essential surgical tool in these subgroups.

**CLINICAL RELEVANCE/APPLICATION**
Intraoperative gamma probe appears to outperform preoperative scintigraphy in localizing culprit parathyroid glands in multiglandular disease and/or recurrent primary hyperparathyroidism.

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**CL-NMS-TUSA • [Cu-62]-ATSM PET-CT Study as Hypoxic Imaging in Patients with Gliomas: Comparison with Multitracer Approach Using [F-18]-FDG and [C-11]-Methionine**

**Ukhide Tateishi** MD, PhD (Presenter); **Kensuke Tateishi**; **Ayako Shishikura**; **Tomohiro Yoneyama**; **Ikku Torii**; **Tomio Inoue** MD, PhD; **Nobutaka Kawahara**

**PURPOSE**
The purpose of study was to investigate multitracer approach by [Cu-62]-diacetylbis (N4-methylthiosemicarbazone) ([Cu-62]-ATSM) PET-CT as hypoxic imaging comparing with [F-18]-FDG PET-CT and [C-11]-Methionine PET-CT for differentiation of tumor grade in patients with glioma.

**METHOD AND MATERIALS**
Multitracer PET-CT studies using [Cu-62]-ATSM, [F-18]-FDG and [C-11]-Methionine were performed in 32 patients with glioma prior to surgery. The maximum standardized uptake value (SUV max), tumor/ background ratio (TBR), and volumetric analysis were quantitatively assessed. Distribution of trace uptake was qualitatively evaluated in comparison with MR images. To confirm tissue hypoxia, the transcription factor hypoxia inducible factor-1alpha (HIF-1alpha) utilized as a hypoxic marker was also assessed.

**RESULTS**
There were 17 glioblastoma multiformes (GBM) and 15 grade II or grade III gliomas. Of these, 19 (59.4%) patients were newly diagnosed. The SUVmax and TBR of [Cu-62]-ATSM were significantly higher in GBM than in non-GBM gliomas (p = 0.003 and 0.0001, respectively); however, there were no significant differences when assessed by [F-18]-FDG and [C-11]-Methionine. At a TBR threshold of 1.9, [Cu-62]-ATSM was the most predictive of GBM with 94.1% sensitivity and 80.0% specificity. The mean TBR was significantly higher in HIF-1alpha positive tumors than those with HIF-1 negative tumors (p < 0.001).

**CONCLUSION**
Our results demonstrated that [Cu-62]-ATSM PET-CT provides the valuable information to discriminate GBM. [Cu-62]-ATSM appears to be a suitable tracer establishing attractive therapeutic strategies for hypoxic imaging in GBM.

**CLINICAL RELEVANCE/APPLICATION**
[Cu-62]-ATSM is a suitable biomarker establishing attractive therapeutic strategies for hypoxic imaging in GBM.

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**CL-NME-TU6A • Alpha Therapy of Prostate Cancer Bone Metastases with Radium-223 Chloride**

**Hossein Jadvar** MD, PhD (Presenter); **David I Quinn** MD, PhD

**PURPOSE/AIM**
To review the biological basis, clinical studies, and operational procedure for targeted alpha particle radioonucleic therapy of prostate cancer bone metastases with Radium-223 chloride.

**CONTENT ORGANIZATION**

**SUMMARY**
This educational exhibit will present information about the alpha radiopharmaceutical, Radium-223 chloride (a natural calcium mimetic), for targeted treatment of bone metastases in men with castrate-resistant prostate cancer. It will review the evidence that demonstrated survival benefit in these patients and summarizes the issues related to mechanism of action, therapy administration, and radiation protection.

**CL-NME3054-TUA • Is Imaging the Extremities with PEM Feasible? A Novel Application for a High Resolution Positron...**
Pediatric Radiology - Tuesday Scientific Posters and Exhibits (12:15pm - 12:45pm) Tuesday, 12:15 PM - 12:45 PM

Sireesha Yedururi MBBS (Presenter) ; Nancy E Fitzgerald MD ; Ajaykumar C Morani MD ; Padmahasta Pilla MBBS ; Gregory W Gladish MD ; Pete Anderson MD ; Dennis Hughes MD, PhD ; Najat C Daw Bitar MD

PURPOSE/AIM
The purpose of this exhibit is to illustrate:
1. Radiologic findings of cardiovascular metastases of osteosarcoma (OS)
2. Temporal evolution of pulmonary vascular metastasis from a mineralized dilated pulmonary artery terminal branch to the left heart
3. How to differentiate between tumor thrombus and bland thrombus

CONTENT ORGANIZATION
1. Patient demographics
2. Natural history
3. Common sites: Systemic and pulmonary vessels and the heart
4. Imaging findings: Early and serial imaging findings
5. Role of PET/CT, cardiac MRI and serial chest CT in localizing and confirming a tumor thrombus
6. Prognosis
8. Pitfalls: Endobronchial metastases and tumor along bronchovascular lymphatics mimic tumor thrombus
9. Future direction

SUMMARY
The main teaching points are:
1. Cardiovascular metastases are rare in OS and occur in the setting of advanced disease
2. Tumor thrombus should be considered in OS patients presenting with systemic venous or pulmonary thromboembolism and should not be misinterpreted as bland thrombus.
3. Dilated and mineralized terminal pulmonary arterial branch is an early indication of vascular metastasis which may progress to involve draining pulmonary veins and the left heart.

CL-PDS-TU2A • The Optimal Dose Reduction Level Using Iterative Reconstruction with Prospective ECG-triggered Volume Cardiac CT Angiography Using 640-slice MDCT in Little Swine Model

Pengfei Zhao (Presenter) ; Yang Hou MD ; Qin Liu MA, BA ; Yisha Fan ; Qiyong Guo MD

PURPOSE
To evaluate the radiation dose and image quality (IQ) of an iterative reconstruction (AIDR3D) in combination with SureExposure 3D on a 640-slice CT and determine the optimal dose reduction using AIDR3D for cardiac CTA that can provide IQ comparable to filtered back projection (FBP).

METHOD AND MATERIALS
A series of 22 normal swine (body weight 8.0 ± 3.2kg) underwent 640-slice MDCT cardiac CTA (Aquilion One, Toshiba) for 4 times with 80Kvp and different mAs. SureExposure 3D technique was used and the Index of noise was set to SD20 (Group A, routine dose), 25, 30, 35 (Group B-D) to reduce dose successively. Group A were reconstructed with FBP. Group B-D were reconstructed using AIDR3D (strong level). Two radiologists graded IQ by reviewing both cardiac and vascular structures using a 5-point scale in a blinded manner. Quantitative IQ parameters of image noise, signal-to-noise (SNR), contrast-to-noise (CNR) were measured in each group. A receiver-operating characteristic (ROC) analysis was performed to establish a radiation reduction threshold up to which comparable IQ (score=4) was maintained.

RESULTS
Group B, C and D had significantly lower noise (p

CONCLUSION
Using AIDR3D technique, 80Kvp with SureExposure 3D (SD30) can provide comparable or even better IQ than routine dose with FBP reconstruction, and 54% ED reduction can be acquired in little swine model.

CLINAL RELEVANCE/APPLICATION
The results of swine model may be applied to reducing radiation dose of cardiac CTA scanning in infants and little children with congenital heart disease (CHD).
Purpose
To evaluate the value of dual energy CT with application of Lung Vessels, a dedicated algorithm color-coding software which was developed to discriminate non-enhancing subsegmental pulmonary arteries from enhancing ones by using dual energy iodine extraction data, in diagnosing pulmonary embolism (PE) of children.

Method and Materials
47 patients with nephrotic syndrome and aged =18 years old (32 male, 15 female, mean age 15 years). Two radiologists detected the presence or absence of emboli and counted the clots on a per-patient and per-lobe basis with Lung Vessels, respectively. With conventional CT pulmonary angiography (CTPA) as reference standard, sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) were computed to detect PE for two readers with Lung Vessels application. Inter-reader agreement was also calculated.

Results

Conclusions
Dual energy CT with Lung Vessels application has a high sensitivity and negative predictive value for PE detection in children. More clots were detected with Lung Vessels application than conventional CTPA, which deserved further investigation.

Clinical Relevance/Application
Implications for patient care: Dual energy CT with Lung Vessels application has a promising application in children with suspected pulmonary embolism.

CL-PDS-TU4A • Evaluation of Organ-specific Dose Reduction (OSDR) in Pediatric Chest Computed Tomography (CT)

Johannes Boos (Presenter); Patric Kroepil MD; Philipp Heusch MD; Dirk Klee MD; Gerald Antoch MD*; Rotem S Lanzman MD

Purpose
Organ-specific dose reduction (OSDR) algorithms can significantly reduce the radiation exposure to radiosensitive tissues. The purpose of this study was to assess the impact of a novel OSDR algorithm on image quality of pediatric chest computed tomography (CT).

Method and Materials
Twenty pediatric patients (8 male, 12 female; mean age 12.4 ± 5.6 years (range 3-17 years)) undergoing contrast-enhanced chest CT examinations on a 128-row-CT scanner were included in this study. CT scans were performed at 100 kV using automated tube current modulation and a novel OSDR algorithm (XCare, Siemens AG, Forchheim, Germany). Nine patients had a previous chest examination performed on a 64-row-CT scanner at 100 kV without the OSDR algorithm. Subjective image quality was assessed using a five-point-scale (1= not diagnostic; 5= excellent) in all patients. In 9 children who underwent CT scans with and without OSDR, ROI measurements were performed in order to assess the contrast-to-noise ratio (CNR) and signal-to-noise ratio (SNR) in the aorta. Furthermore, CTDIvol was determined in order to compare the radiation dose.

Results
In 20 patients, mean subjective image quality was 4.3 ± 0.7. In 9 patients that were also examined without OSDR, subjective image quality was comparable with OSDR (4.4 ± 0.5) and without OSDR (4.2 ± 0.4) (p>0.05). Furthermore, there was no significant difference in mean SNR and CNR of the aorta with OSDR (31.6 ± 17.1 and 22.3 ± 15.0, respectively) and without OSDR (27.4 ± 13.3 and 18.8 ± 12.4, respectively) (p>0.05). CTDIvol did not differ significantly between acquisitions with OSDR (2.3 ± 0.9 mGy) and without OSDR (2.6 ± 1.9 mGy) (p>0.05).

Conclusion
Organ-specific dose reduction does not seem to impact the image quality of pediatric chest CT examinations. It can therefore be used in clinical routine in order to reduce the radiation exposure to radiosensitive tissues as the breast or thyroid gland.

Clinical Relevance/Application
Organ-specific dose reduction algorithms can be recommended for pediatric chest CT examinations as image quality does not seem to be affected.

CL-PDS-TUSA • Utility of MDCT MIP Post-processing Reconstruction Images in Children with Hereditary Hemorrhagic Telangiectasia (HHT)

Emilio Inarejos Clemente MD (Presenter); Felix Ratjen; Giuseppe A Latino; David E Manson MD

Purpose
To determine whether the use of MIP post-processing reconstructions images can increase the detection of pulmonary nodules and AVM's in the lungs in children with HHT. To evaluate whether MIP images improve the detection of the feeding artery and draining vein for definite AVM's.

Method and Materials
We reviewed the chest CT scans in 39 children (ages 0-18) with genetically and clinically proven HHT who underwent a chest MDCT examination between 2005 to 2012. The images were retrospectively reviewed blinded and independently by 2 radiologists, one pediatric radiologist with experience in MDCT (DM) and one senior pediatric radiologist fellow (EIC). Initial standard 3 plane 2.5mm slices were first evaluated on a lung algorithm for the presence of nodules and/or overt AVM's, and the ability to identify feeding arteries and draining veins from the AVM's. Three plane sliding MIP post-processing reconstruction images were then blindly reviewed for the same findings. Discrepancies were resolved by consensus. Parameters assessed: number of definitive nodules, number of definitive AVM and visibility of the feeding artery or draining vein in both conventional and MIPs.

Results
Statistically significant differences were obtained in the ability to identify the feeding artery and draining vein between standard 2.5mm slices and MIP images (p<0.05).

Conclusion
MDCT in children with HHT should routinely include 3 plane sliding MIP reconstruction images to help to analyze the anatomy of AVM’s for planning future embolization.

Clinical Relevance/Application
MDCT with 3 plane sliding MIPs can be used to follow children with HHT induced AVM’s and can be used to simplify therapeutic angiographic embolization.

CL-PDE-TU6A • Pediatric Body MRI in the 3rd Dimension: Making SPACE for 3-D T2 Weighted Imaging in the Abdomen and Pelvis

Eric C Ehman MD (Presenter); Peter A Marcovici MD; Andrew S Phelps MD; Pauline W Worters PhD*; John D MacKenzie MD; Jesse L Courtier MD

Purpose/Aim
3-D T2 weighted MRI (CUBE [GE]/SPACE[Siemens]/VISTA [Phillips]) now allows for thin slice, high resolution imaging in the abdomen/pelvis with multiplanar reformating capability. In pediatric patients, this allows for improved depiction of smaller anatomic structures and reduced scan time. This exhibit will describe the technique, performance, and multiple applications of this sequence.
SUMMARY
This exhibit provides the viewer with a guide on how to implement 3-D T2 weighted imaging into their current Pediatric MR abdomen / pelvis protocol. Illustrative case examples are provided demonstrating the utility of this sequence in multiple clinical scenarios. Tips for overcoming technical challenges are given. FIGURE Coronal oblique 3DT2 weighted MRI in a 7 year-old showing a dilated pancreatic duct and multiple small stones (white arrows).

CL-PDE-TU7A • Serial Magnetic Resonance Imaging of Hypothermia Treated Neonatal Hypoxic Ischemic Encephalopathy: Brain Injury Pattern and Temporal Evolution

Yauk Lee MD (Presenter) ; Alex C Penn MD ; Mahesh R Patel MD * ; Rajul P Pandit MD ; Dongli Song ; Bo Yoon Ha MD

PURPOSE/AIM
1) To review common patterns of neonatal hypoxic ischemic encephalopathy after therapeutic hypothermia during the acute phase
2) To review interval development and evolution of ischemic changes during the subacute phase
3) To review sequelae of disease during the chronic phase

CONTENT ORGANIZATION
1) Illustrate common patterns on initial MRI (1-2 days of life): predominately peripheral white matter injury, predominately deep gray nuclei injury, and diffuse global injury
2) Illustrate cases of interval development and evolution of ischemic changes on follow-up MRI (3-10 days of life), including later pseudo-normalization of mean diffusivity
3) Illustrate cases of long-term sequelae such as hemorrhagic conversion and encephalomalacia

SUMMARY
1) Hypothermia treated brain injury in the setting of neonatal hypoxic ischemic encephalopathy may exist along a spectrum of patterns with delayed evolution of injury compared to normothermic neonates in the literature
2) Diffuse global injury is associated with long-term sequelae on imaging including atrophy and encephalomalacia

Siemens Healthcare: Leading. With MAGNETOM. Innovations for MRI Tuesday, 12:15 PM - 01:00 PM • South Building Hall A Booth 3314 Back to Top EPT06 Sarah Moore

Nikolaus Bolle

LEARNING OBJECTIVES Siemens Healthcare continues to advance human health with cutting-edge MRI innovations. We invite you to join us for giving you insight into how our innovations can change clinical care.

Breast - Tuesday Posters and Exhibits (12:15pm - 12:45pm) Tuesday, 12:15 PM - 12:45 PM • Lakeside Learning Center Back to Top [ ] LL-BRS-TUA • AMA PRA Category 1 Credit ™:0.5 Host Sheila S Lee ; MD

LL-BRS-TU2A • Breast Cancer Phenotype and Ki67 Status Influence the Diagnostic Performance of MRI in Prediction of Response to Neoadjuvant Chemotherapy

Enida Bufi (Presenter) ; Paolo Belli MD ; Marialuisa Di Matteo ; Antonio Cipriani ; Melanina Costantini MD ; Lorenzo Bonomo MD

PURPOSE
The estimation of response to neoadjuvant chemotherapy (NAC) is useful for the surgical decision in breast cancer. We addressed the diagnostic reliability of conventional MRI vs. Diffusion Weighted Imaging (DWI) according to different tumor subtypes, including HER2 positive/HR positive (Hybrid phenotype), and to Ki 67 expression.

METHOD AND MATERIALS
Two-hundred-twenty-five patients underwent MRI before and after NAC, including morphological assessment (RECIST classification) and DWI with apparent diffusion coefficient (ADC). The complete pathological response – pCR (outcome variable) was assessed (Mandard classification).

RESULTS
The diagnostic reliability of MRI in predicting the response to NAC depends on the tumor phenotype and on Ki 67 expression. Care must be taken when establishing by MRI the pCR status in the Luminal and Hybrid subgroups and in patients with lower Ki 67 expression. In these cases, calculation of the ADC may facilitate the diagnosis.

CLINICAL RELEVANCE/APPLICATION
Conventional MRI has limited diagnostic reliability in specific patients categories (Luminal/Hybrid subgroups and lower Ki67 expression); DWI may be helpful in these cases.

LL-BRS-TU2A • Positive Predictive Value of Foci and Influences of Background Parenchymal Enhancement

Sheetal M Bhalani MD (Presenter) ; Dipti Gupta MD ; Sonya Bhole MD ; Ellen B Mendelson MD *

PURPOSE
A strong association between increased MR imaging background parenchymal enhancement (BPE) and breast cancer risk has been proposed in the literature (King et al). As the positive predictive value (PPV) of biopsied foci in the literature is highly variable, we sought to study the PPV of foci at our institution as well as to identify whether BPE influences the positive biopsy rate of foci.

METHOD AND MATERIALS
This IRB approved retrospective HIPAA compliant study included 325 MRI guided core biopsies performed on patients who underwent MRI for extent of disease and high risk screening between March 2012 and February 2013. Original MRI reports were reviewed for study indication, type of enhancing lesion (focus, mass, or non mass enhancement), BPE, location, and kinetics. Pathology reports were reviewed for biopsy results. Information was organized and analyzed in Excel.

RESULTS
61/325 MRI guided core biopsies were recommended for suspicious foci. Benign pathology was demonstrated in 49/61 (80.3%) lesions, high risk surgical lesions were identified in 7/61 lesions (11.5%), and malignancy was identified in 5/61 lesions (8.2%). 3/5 malignant lesions were ipsilateral to the index lesion and 4/7 high risk lesions were ipsilateral to the index lesion. 0/10 foci biopsied in high risk screening patients were positive. Of the 38 foci in minimal or mild BPE, 3 (7.8%) lesions were malignant and 2 were high risk surgical lesions. Of the 23 foci in moderate or marked BPE, 2 (8.6%) lesions were malignant and 5 were high risk surgical lesions. Visually assessed kinetic patterns were not significant predictors of carcinoma.

CONCLUSION
Positive predictive value for enhancing foci at our institution is low at 8.2% and even lower when the focus is in the contralateral
breast (3.2%). Although increased BPE has been suggested to be an important risk factor, our study demonstrated that the malignancy rate of foci is not significantly different in minimal/mild BPE compared to mod-marked BPE.

CLINICAL RELEVANCE/APPLICATION
Given the low positive predictive value of foci in the contralateral breast (3.2%), short interval MRI imaging follow up could be considered if supported by a larger sample size.

LL-BRS-TU3A • Analyzing Spatial Heterogeneity in DCE-MRI Parametric Maps to Optimize the Prediction of Therapeutic Response in Breast Cancer

Xia Li (Presenter); Lori R Arlinghaus PhD; Anuradha Bapsi Chakravarthy MD *; Richard G Abramson MD *; Vandana G Abramson MD, MS; Jaime Farley; Thomas Yankeelov PhD *

PURPOSE
To determine if analyzing the spatial heterogeneity in quantitative DCE-MRI pharmacokinetic parametric maps after the first cycle of treatment can improve the ability to separate pathologic complete responders (pCRs) from non-pCRs in breast cancer patients undergoing neoadjuvant chemotherapy (NAC).

METHOD AND MATERIALS
33 patients underwent DCE-MRI at baseline (t1) and after one cycle of NAC (t2). At surgery, 12 patients were pCRs and 21 patients were non-pCRs. The DCE-MRI data were analyzed with the extended Tofts-Kety model which returned the efflux constant (Kep). The histogram of Kep at t2 was then analyzed through the leave-one-out method as follows: 1) select one patient, 2) compute the Euclidean distance between the patient’s Kep histogram and the histogram obtained from all tumor voxels of the non-pCRs (dnon_pCR), and between the patient and the histogram obtained from the pCRs (dpCR). 3) define the patient as “non-pCR” if dpCR < dnon_pCR, otherwise define as “pCR”, 4) repeat the procedure for all patients. The Wilcoxon rank sum test and receiver operator characteristic (ROC) analysis were performed to determine the ability of the Kep histogram at t2 to predict treatment response. The Kep maps at t1 and t2 were then spatially registered to determine the voxels which displayed an increased Kep from t1 to t2. Those voxels were selected and the corresponding histograms were again analyzed using the same method described above.

RESULTS
Without registration, the histogram of Kep at t2 can separate the pCRs significantly (p = 0.007) and predict treatment response with the area under the ROC curve of 0.73. After registration, the ability of the Kep histogram to predict treatment response was improved (p = 0.001, AUC = 0.80). The sensitivity, specificity, accuracy, and precision were 83%, 67%, 73%, and 59%, respectively, before registration. Those statistical values improved to 83%, 76%, 79%, and 67% after registration.

CONCLUSION
The quantitative DCE-MRI parameter Kep can predict pCR in breast cancer patients after the first cycle of NAC. After serial registration, the histograms of the spatially registered data improve the ability to differentiate between eventual responders and non-responders.

CLINICAL RELEVANCE/APPLICATION
Analysis of the spatial heterogeneity of early changes in DCE-MRI data are able to improve the ability to predict complete pathologic response in breast cancer patients after the first cycle of therapy.

LL-BRS-TU4A • Can the Low Energy Mammogram Done during Contrast-enhanced Digital Mammography Replace Standard Mammography?

Mark A Francescone MD (Presenter); Maxine S Jochelson MD; D. David Dershaw MD; Janice S Sung MD; Mary Hughes MD; Chaya Moskowitz; Junting Zheng; Elizabeth A Morris MD

PURPOSE
To compare the low energy contrast-enhanced digital mammography (CEDM) image done after intravenous iodine injection to standard mammography.

METHOD AND MATERIALS
This was an IRB approved HIPAA compatible study. Low-energy CEDM images of 170 breasts in 88 patients (6 unilateral mastectomies) were compared to standard digital mammograms performed within 6 months. Images were qualitatively assessed side-by-side by a non-blinded reader. The following parameters were tabulated: posterior nipple line to pectoral muscle (PNL) distance; compression force on the MLO projection; compression thickness on the MLO projection. Wherever possible, the following additional parameters were tabulated: the number or extent of dominant calcifications; the size of masses, asymmetries, or distortions. Parameters were summarized using median, range, mean and standard deviation (SD). A mixed linear regression using a generalized estimating equation (GEE) method was performed to examine whether each parameter was different between two image techniques, intra class correlation coefficient (ICC) along with the 95% confidence interval (95%CI) were estimated for continuous measurements, and kappa statistics were estimated for the count of calcifications.

RESULTS
No qualitative difference or statistical difference was found in any of the image parameters between the two imaging techniques. The two techniques had excellent agreement on compression thickness; PNL distance; calcification size or extent; and mass, asymmetry or distortion size (ICC range from 0.817-0.997). The count of calcifications perfectly agreed between two image techniques (kappa = 1.000). There was slight agreement on compression force (ICC = 0.287).

CONCLUSION
The same equipment and technical settings are used in both studies, and the Kedge of iodine is above the kV of the low energy CEDM. As expected, low energy CEDM images demonstrate excellent agreement with standard digital mammography despite the prior administration of intravenous contrast, and could be used for routine breast imaging.

CLINICAL RELEVANCE/APPLICATION
Since there is no substantial difference between the images, low energy CEDM could replace the standard mammogram.

LL-BRS-TUSA • Adjunct Diagnosis of Dual-energy Contrast Enhanced Subtracted Mammography in Women with Dense Breasts: Interobservers Blind Reading Analysis

Yun-Chung Cheung MD (Presenter); Yu-Ching Lin MD; Yung-Liang Wan MD; Pei-Chin Huang; Kee-Min Yeow; Yung-Feng Lo MD; Hsiu-Pei Tsai; Shir-Hwa Ueng; Chee-Jen Chang

PURPOSE
Dense breast parenchyma potentially obscures a breast lesion. This study was to analyze the adjunct diagnosis of dual-energy contrast enhanced subtracted mammogram (CESM) in dense breasts.

METHOD AND MATERIALS
Reviewed 156 CESM examinations from Feb/2012 to Dec/2012, 89 cases with BIRADS 3 or 4 dense breasts were enrolled for the study. CESM of breast examinations was specifically performed with sequence of cronicauldoviews and mediolateral oblique views respectively within 2 to 3 minutes and 3 to 6 minutes after bolus contrast medium injection (rate = 3 ml/sec, dose = 1.5 ml/kg). Four radiologists with different experiences of mammographic reading (29 years, 17 years but quit in recent 5 years, 6 years and 2 years) blindly read the Mx alone, and then followed with CESM. Suspicious benign (BIRADS 1,2,3) and malignancy (BIRADS 4,5)
RESULTS
Total 100 lesions (28 benign lesions and 72 breast cancers) had histologic proved. Averagely, enhancement was observed in 96.87% cancers and 44.64% in benign lesions. Combining with CSEM improved cancer diagnosis in 19.82% sensitivity (71.47% to 92.7%), 16.07% specificity (51.78% to 67.85%) and 19.82% accuracy (65.93% to 85.75%) as comparing to Mx. The diagnosis consistency of interobservers was much higher in Mx + CSEM than Mx alone (0.6235 VS 0.3869 by kappa ratio). The probability of correct prediction would be achieved from 80% to 90% after 75 consecutive case readings.

CONCLUSION
CSEM high-consistently improved the sensitivity, specificity and accuracy in dense breasts than Mx alone. Benign contrast enhancement was occasionally present, however the diagnosis prediction could be mended by a loaded cases reading.

CLINICAL RELEVANCE/APPLICATION
Additional CSEM is easily learned to improve the cancer diagnosis in dense breasts, with high consistency in wide-ranged mammographic experiences.

LL-BRS-TU6A • Breast Density and Its Correlation with Invasive Breast Cancer Prognostic Indicators

Gary Esses BS (Presenter) ; Shabnam Jaffer MD ; Janet R Szabo MD ; Steven J Esses MD ; Emily B Sonnenblick MD ; Neesha Patel ; Laurie R Margolies MD

PURPOSE
To determine the correlation between dense breasts (DB) and invasive breast cancer prognostic indicators

METHOD AND MATERIALS
IRB approved retrospective review identified 159 women > 30 who were diagnosed with an invasive breast cancer within 2 years of receiving a mammogram. Density data from the mammogram reports were divided into dense (BI-RADS 3 and 4) and not dense (BI-RADS 1 and 2) categories and correlated with pathological characteristics of the tumors in these women. The pathology characteristics were taken from pathology reports of biopsies and tumor resections and included estrogen, progesterone and her2 receptor status. Additionally, the stage of the tumors was determined using TNM data from the pathology reports.

RESULTS
Median age at diagnosis for invasive cancer was 61 years (range 33-89). 67/93 (72%) patients in the not dense category and 40/66 (61%) in the dense category were diagnosed with stage 1 cancer. The remaining patients 26/96 (28%) in the not dense category and 26/66 (39%) in the dense category had Stage 2 or greater cancer. Her2 receptor positivity was positively correlated with the dense group (p=0.003). Tumors that were both Her2 and estrogen receptor positive were also positively correlated (p=.023) with the dense group. There was no statistically significant association with the dense group and positive receptor status for the estrogen receptor (p=0.092) or positive receptor status for the progesterone receptor (p=0.863).

CONCLUSION
Patients with dense breast tissue (BI-RADS 3 and 4) who are diagnosed with invasive cancer have poorer prognostic indicators than patients who are not dense (BI-RADS 1 and 2). Dense breast patients are more likely to be diagnosed with a cancer more advanced than stage 1 and are more likely to have tumors positive for her2 and estrogen receptors, a sign of poor prognosis, than not dense breast patients.

CLINICAL RELEVANCE/APPLICATION
As those with DB are detected with cancer at later stages and with poor prognostic indicators, additional screening methods might help women with DB achieve the full benefit of early detection.

LL-BRS-TU7A • Dedicated Dual-Head Molecular Breast Imaging (MBI) as an Adjunct to Mammography in Patients with Dense Breast Tissue and/or Elevated Risk for Breast Cancer

Robin B Shermis MD (Presenter) ; Keith D Wilson MD

PURPOSE
Purpose: The aim of this study was to retrospectively evaluate the potential benefits of dedicated dual-head molecular breast imaging (MBI) as an adjunct in patients with difficult mammograms due to dense breast tissue and/or elevated risk of developing breast cancer.

METHOD AND MATERIALS
Materials and Methods: MBI was performed on patients with mammographically dense breast tissue and/or elevated risk of developing breast cancer. Patients ranged in age from 33-88 with an average of 53.7 years. Menopausal status was reported on 80 patients. Breast density was BI-RADS D3 or D4 (breast density > 50%) in 89% (79 of 94) making mammography interpretation difficult. Risk assessment was calculated in 83 of 95 patients using modified GAIL model, 29% (28 of 83) were high to very high risk (>15% increased risk). All of the patients underwent bilateral MBI scanning after intravenous injection of 8mCi Tc-99m- sestamibi. Imaging acquisition was initiated within 5 minutes using the LumaGEM dual head, planar, solid state digital system with cadmium zinc telluride (CZT) technology. Standard cranio-caudal and medio-lateral oblique views of each breast were obtained.

RESULTS
Median age at diagnosis for invasive cancer was 61 years (range 33-89). 67/93 (72%) patients in the not dense category and 40/66 (61%) in the dense category were diagnosed with stage 1 cancer. The remaining patients 26/96 (28%) in the not dense category and 26/66 (39%) in the dense category had Stage 2 or greater cancer. Her2 receptor positivity was positively correlated with the dense group (p=0.003). Tumors that were both Her2 and estrogen receptor positive were also positively correlated (p=.023) with the dense group. There was no statistically significant association with the dense group and positive receptor status for the estrogen receptor (p=0.092) or positive receptor status for the progesterone receptor (p=0.863).

CONCLUSION
Patients with dense breast tissue (BI-RADS 3 and 4) who are diagnosed with invasive cancer have poorer prognostic indicators than patients who are not dense (BI-RADS 1 and 2). Dense breast patients are more likely to be diagnosed with a cancer more advanced than stage 1 and are more likely to have tumors positive for her2 and estrogen receptors, a sign of poor prognosis, than not dense breast patients.

CLINICAL RELEVANCE/APPLICATION
As those with DB are detected with cancer at later stages and with poor prognostic indicators, additional screening methods might help women with DB achieve the full benefit of early detection.

LL-BRE-TU8A • A Customizable Breast Phantom for Practicing Interventional Procedures Utilizing 3D Printing Technologies and Materials Engineering

Ramin Javan MD (Presenter)

PURPOSE
The purpose was to develop a customizable breast phantom for practicing ultrasound-guided biopsies and cyst aspirations as well as stereotactic biopsies and needle localizations.

METHOD AND MATERIALS
Materials and Methods: A custom breast phantom was designed using 3D printing technology. The phantom allows for the introduction of various biopsy needles and catheters to simulate real-world scenarios. It also incorporates a variety of tumor configurations to mimic different cancer stages. The phantom is designed to be used in a clinical setting to train practitioners on the techniques needed for interventional procedures.
Autodesk 3D Studio Max was used to design a mold of the left breast. A grid with a radial pattern was also designed representing a clock-face with holes that were each one-centimeter apart radially. Cysts were created using latex finger cots filled with colored water. Masses of high or low echogenicity were created by injecting sodium alginate solution mixed with food coloring with or without hydrogel particles into calcium chloride solution. The breast parenchyma was made with ballistic grade gelatin after being poured into the breast mold that was 3D printed using ceramic material. Ceramics were used to allow for easy separation of the breast model from the mold after congealing. The grid was 3D printed using polyamide material, which allows for high level of detail and rigidity. The masses and cysts were then mounted onto the tip of long needles of varying length, which had been passed through the desired holes of the grid. This process allows for a coordinate of clock-face, anteroposterior distance from the chest wall and radial distance from the nipple for each mass or cyst. The grid was then placed onto the mold in an upside-down fashion, submerging the masses and cysts into the gelatin before it was placed in cold temperature. Particles of gypsum were also used at the tip of some needles for simulating breast calcifications.

RESULTS
A dual-modality customizable breast interventional phantom was successfully created using a combination of 3D printing and materials engineering techniques. A limitation is the use of gelatin, which is not durable and multiple passages of biopsy needles leave air tracks behind, creating artifacts for subsequent use. As an alternative, polyvinyl alcohol (PVA) cryogel can be implemented for a more durable model. This, however, requires a controlled set of freeze-thaw cycles of dissolved fully-hydrolzed PVA, which can be cumbersome.

CONCLUSION
Models for practicing ultrasound and stereotactic breast interventional procedures may be created using 3D printing techniques and a variety of low-cost materials.

CLINICAL RELEVANCE/APPLICATION
Trainees can use this model as a bridge to performing procedures on actual patients. This can also be used in hands-on workshops or for examining purposes.

LL-BRE-TU9A • Seeing through the Fog: A Review of the Hot Topic of Breast Density
Phoebe E Freer MD (Presenter)

PURPOSE/AIM
(1) To bring the radiologist up-to-date with evidence suggesting density as a risk factor for cancer; (2) To review the evidence for screening dense breasts including mammography, ultrasound, MRI, and emerging modalities; (3) To give the radiologist a context and increased understanding of this hot topic to be able to appropriately respond to recent legislative changes in many states (including California, Connecticut, Texas and Florida) regarding breast density.

CONTENT ORGANIZATION
This review will define breast density and correlate breast density with pathology and the historical perspective. Evidence discussing breast density as a risk factor for breast cancer will be reviewed. Screening literature will be reviewed with a focus on density for different modalities, including mammography, ultrasound, and MRI. The review of the evidence will include DMIST, ACRIN 6666 as well as the emerging evidence of newer modalities such as automated whole breast ultrasound, nuclear medicine, and tomosynthesis. A review of the recent state legislation will focus on the evidence to support these legislative changes. Future questions and need for further studies will be proposed.

SUMMARY
The radiologist will improve their understanding of the current hot topic, and will be better able to respond to questions from patients, the media, and the government regarding breast density.

Cardiac - Tuesday Posters and Exhibits (12:15pm - 12:45pm) Tuesday, 12:15 PM - 12:45 PM • Lakeside Learning Center Back to Top (a) LL-CAS-TUA • AMA PRA Category 1 Credit ™:0.5 Host Bernd J Wintersperger, MD * Host E. Kent Yucel, MD LL-CAS-TU1A • Feasibility of Phase-contrast Computed Tomography to Differentiate Types of Coronary Atherosclerotic Plaque in Comparison with Histopathology
Fabian Bamberg MD, MPH (Presenter) *; Tobias Saam MD *; Christopher Habbel; Julia Herzen; Marian Willner; Holger Hetterich MD; Michael Chabior; Franz Pfeiffer

PURPOSE
Phase-contrast computed tomography (PCT) is a novel imaging technology providing high-resolution, non-destructive histopathology with improved soft-tissue contrast. Early evidence indicates that atherosclerotic plaque components, such as fibrous and lipid-rich tissue can be visualized. In this ex-vivo validation study we determined the ability of a laboratory-based PCT to differentiate atherosclerotic plaque lesions as classified histopathologically according to the American Heart Association (AHA).

METHOD AND MATERIALS
In this ex-vivo validation study we examined ten human coronary artery specimens using a laboratory-based PCT set-up consisting of X-ray tube (35kV) and grating-interferometer with an effective pixel size of 100µm). Following histopathology (1 mm sections), image data sets were matched independently using anatomical landmarks. Atherosclerotic plaques were classified using modified AHA criteria as normal/type I-II, III, IV/V, VI, VII or VIII by an experienced vascular pathologist. Conventional measures of diagnostic accuracy applying histopathology as the goldstandard were derived taking into account the clustered data structure.

RESULTS
A total of 286 corresponding histopathology/PCT sections were included in the analysis, 25 (8%) were excluded due to impaired image quality. In histopathology, the prevalence of plaque was high (>10% for all plaque types) with 19.3% sections were classified normal/type I-II. Overall, PCT detected all sections with any atherosclerotic change (sensitivity: 100%) with high level of agreement across all lesion types (κ: 0.78). Specifically, the diagnostic accuracy was highest for type VII and type VI lesions (sensitivity: 100% and 93%; specificity: 95% and 91%; respectively), and lowest for type VIII lesions (82% and 79%). Also, the diagnostic accuracy for normal/type I-II was high (85%, specificity: 80%).

CONCLUSION
Our initial results suggest that in an experimental laboratory set-up PCT can accurately visualize and differentiate atherosclerotic lesions types in human coronary arteries.

CLINICAL RELEVANCE/APPLICATION
Phase-contrast computed tomography might provide high-resolution coronary atherosclerotic plaque imaging with improved soft-tissue resolution in an ex-vivo setting.

LL-CAS-TU2A • Three-dimensional Phase-sensitive Inversion Recovery Sequence in the Evaluation of Left Ventricular Myocardial Scar: Comparison to Three-dimensional Inversion Recovery Sequence
Tomoyuki Kido (Presenter); Masashi Nakamura; Yuki Tanabe; Rami Yokoyama; Takuya Matsuda; Yoshiko Nishiyama MD; Naoto Kawaguchi MD; Teruhito Kido; Masao Miyagawa MD, PhD; Teruhito Mochizuki MD

PURPOSE
The most widely used pulse sequence type to depict late gadolinium enhancement (LGE) in myocardium is inversion recovery (IR) method. Recently, the phase-sensitive inversion recover (PSIR) method has been developed to detect LGE. The aim of this study
was to compare 3D PSIR to an established 3D IR method for to detect myocardial scar caused in ischemic and non-ischemic cardiac diseases.

METHOD AND MATERIALS
A hundred consecutive patients who were suspected of myocardial scar were prospectively examined LGE magnetic resonance image (MRI) on a 3 Tesla MR scanner using IR followed by PSIR method. The image quality was scored by two independent readers using a four-point scale. The volume of the LGE was calculated using a semi-automated method based on signal-intensity thresholds with dedicated software. The distribution area of LGE in 16-segment was scored by the proportion of LGE to each segment (0%, 1−25%, 26−50%, 51−75%, 76−100%). The volume and distribution area of LGE was quantitatively compared between the two methods.

RESULTS
The image quality score did not differ significantly in both methods (p=0.22, Wilcoxon test). PSIR improved the image quality in 6/7 patients whose image quality was poor or fair in IR. LGE were detected and the image quality was acceptable in 58 patients (21 patients with ischemic cardiac disease, 37 patients with non-ischemic cardiac disease). There was strong correlation in LGE volume between the IR and PSIR results (R²=0.96; P

CONCLUSION
The 3D PSIR method improves the diagnostic performance and quantitative assessment of LGE in patients with non-ischemic cardiac disease.

CLINICAL RELEVANCE/APPLICATION
The PSIR sequence is a promising approach to assess left ventricular myocardial scar.

LL-CAS-TU3A • Evaluation of the Efficacy of Vector Dynamic Analysis on Motion Artifact Reduction of Coronary CT Angiography

Junichi Kishimoto (Presenter); Yasutoshi Ohta MD; Yasuhiro Kaetsu; Toshihide Ogawa MD

PURPOSE
The aim of this study was to evaluate the efficacy of vector dynamic analysis on motion artifact reduction of coronary CT angiography.

METHOD AND MATERIALS
A total of 60 patients underwent coronary CT angiography using multidetector CT scanner (DiscoveryCT 750HD, Freedom Edition: GE) with ECG-gated helical scan. Motion artifact collection software (Snap Shot Freeze: SSF, GE) was applied to reduction of motion artifact. Two datasets with and without SSF between 30% and 85% of the R-R interval in 5% increments were reconstructed. For both images with and without SSF, the motion artifact was evaluated on a 3-point scale (0=no motion artifact, 1=visible motion artifact but clear visualization of coronary lumen, 2=blurring of coronary lumen which can make evaluation of coronary lumen stenosis impossible) for each coronary artery (right coronary artery; RCA, left main trunk; LMT, left anterior descending coronary artery; LAD, left circumflex coronary artery; LCX). The score of 0 or 1 was considered as clinically acceptable. The worst score of the arterial segment was assigned to the score of the each coronary artery. The worst score of the each coronary artery was assigned for the patient score.

RESULTS
CONCLUSION
SSF using vector dynamic analysis in coronary CT angiography is useful for motion artifact reduction in a wide range of cardiac cycle.

CLINICAL RELEVANCE/APPLICATION
Motion artifact collection software based on vector dynamic analysis can improve the image quality and success rate of coronary CT angiography.

LL-CAS-TU4A • T1 Contrast in the Myocardium and Blood-pool: A Quantitative Assessment for Gadofosveset Trisodium and Gd-DTPA at 1.5 T and 3 T

Kai Lin MD, MSc (Presenter); Donald Lloyd-Jones MD; Bruce Spottiswoode PhD *; Xiaoming Bi PhD *; Ying Liu MD, PhD; Biao Lv MD; Huadan Xue MD; Yining Wang MD; Debiao Li PhD; James C Carr MD *

PURPOSE
To assess T1 contrast (T1c) evolution between major cardiovascular tissues, common used contrast media and standard magnetic field strengths.

METHOD AND MATERIALS
This HIPPA compliant study was IRB approved and written informed consent was obtained from all participants. Eight healthy volunteers were recruited to undergo 4 consecutive MR scans with the same imaging parameters. Scans 1 and 2 were performed on a 3 T MR scanner and scans 3 and 4 were performed on a 1.5 T MR scanner. Gadofosveset trisodium (0.03mmol/Kg) was injected for scans 1 and 3, and Gd-DTPA (0.01mmol/Kg) was applied for scans 2 and 4. Modified Look-Locker Inversion recovery (MOLLI) T1 maps with a mid-ventricular short-axis view were acquired pre-contrast and repeated every 5 minutes until 45 minutes after the contrast agent administration. T1c-tissue (T1-myocardium - T1-blood), T1c-media (T1-Gd-DTPA - T1-Gadofosveset) and T1c-field (T1-3T - T1-1.5T) were calculated and compared by using t-tests.

RESULTS
The 3 T scanner provided a significantly larger T1c-tissue between the myocardium and blood-pool than did the 1.5 T scanner at 9 post-contrast time points induced by both gadofosveset trisodium (205.7 ± 30.0 ms vs. 189.0 ± 24.3 ms, p < 0.001) and Gd-DTPA (118.4 ± 46.1 ms vs. 91.6 ± 37.3 ms, p < 0.001). The T1c-tissue induced by Gd-DTPA decayed more rapidly than that induced by gadofosveset trisodium at both 1.5 T (94.2 ± 24.3 ms vs. -8.1 ± 27.8 ms, p < 0.001) and 3 T (100.3 ± 21.8 ms vs. -1.22 ± 24.9 ms, p < 0.001) during the 45-minute time window. The 1.5 T scanner provided a significantly larger T1c-media between the myocardium and blood-pool (214.9 ± 40.7 ms vs. 189.0 ± 24.3 ms, p < 0.001) and gadofosveset trisodium at both 1.5 T (94.2 ± 24.3 ms vs. -8.1 ± 27.8 ms, p < 0.001) and 3 T (100.3 ± 21.8 ms vs. -1.22 ± 24.9 ms, p < 0.001). The T1c-tissue induced by Gd-DTPA decayed more rapidly than that induced by gadofosveset trisodium at both 1.5 T (94.2 ± 24.3 ms vs. -8.1 ± 27.8 ms, p < 0.001) and 3 T (100.3 ± 21.8 ms vs. -1.22 ± 24.9 ms, p < 0.001) during the 45-minute time window. The 1.5 T scanner provided a significantly larger T1c-field in the myocardium (214.9 ± 40.7 ms vs. 189.0 ± 24.3 ms, p < 0.001) than did Gd-DTPA. See figure 1 for the trends of T1c evolutions and a typical case.

CONCLUSION
Post-contrast T1c is affected by timing, contrast agent type and magnetic field strength under general physical conditions. Our results provided useful benchmark data describing different T1c evolutions for two contrast media at standard magnetic field strengths.

CLINICAL RELEVANCE/APPLICATION
The behavior of T1c is useful for optimizing MR imaging protocols for the quantitative evaluation of cardiovascular diseases in clinical studies.
PURPOSE
Breast cancer survivors after radiation therapy (RT) have increased rates of cardiac morbidity and mortality. We sought to investigate whether accelerated coronary artery disease (CAD) is to blame by comparing coronary calcium scores (CCS) in breast cancer survivors with and without RT.

METHOD AND MATERIALS
334 women with history of breast cancer were included. 67 patients underwent chest CT studies =6 months after the start of RT (noRT), while 239 patients had a CT scan either prior to or without undergoing RT (noRT). Indications for performing CT studies varied, and involved contrast enhanced acquisitions. Coronary calcium was quantified by applying a threshold-based automated algorithm using a dedicated workstation. Statistical analysis included the Fisher’s exact test, Wilcoxon-Mann-Whitney Test, and the Siegel-Tukey Test. Cox regression analysis was performed to evaluate the risk of a positive CCS, adjusted for time between diagnosis/RT and CT imaging.

RESULTS
Mean age at diagnosis for the noRT group was 57.1±11.9 years, versus 58.4±12.9 years for the RT group (p=0.05). The groups showed no significant differences in race, smoking history, laterality of breast cancer, or cancer stage. Median interval between diagnosis/RT and CT image acquisition was 119 (25th, 75th percentile: 50, 238) days for the noRT group and 449 (211, 979) days for the RT group (p=0.05). The median CCS for both groups was 0 (25th, 75th percentile: 0; 4; p=0.05). When adjusting for the time between diagnosis/RT and CT, RT patients had a significantly lower risk of a positive CCS compared to noRT patients, with a hazard ratio of 0.54 (95% confidence interval, 0.32-0.93, p<0.05). The CCS for both groups was 0 (25th, 75th percentile: 0, 4; p=0.05).

CONCLUSION
Breast cancer survivors after RT are not more likely to show coronary calcifications on subsequent CT imaging. Our preliminary results thus do not support radiation-induced accelerated CAD as an explanation for higher rates of heart disease in this group. However, suboptimal CT technique for evaluation of CCS along with a limited patient population may have influenced our results.

CLINICAL RELEVANCE/APPLICATION
The search for a culprit should be widened to include other potential causes of higher heart disease rates in breast cancer survivors after RT.

LL-CAS-T66A ● Value of Late Gadolinium Enhancement Cardiac Magnetic Resonance (LGE-CMR) to Predict Non-Sustain Ventricular Tachyarrhythmia (NSVT) and Sustain Ventricular Tachyarrhythmia (SVT) in Hypertrophic Cardiomyopathy (HCM)

Guido Ligabue MD (Presenter); Serena Bertugno; Luca Nocetti PhD; Andrea Barbieri; Antonio Esposito MD; Francesco A De Cobelli MD; Federica Fiocchi; Pietro Torricelli MD

PURPOSE
To investigate the role of LGE-CMR to predict the risk of NSVT and SVT in HCM patients throughout a LGE% cut-off determination.

METHOD AND MATERIALS
LGE-CMR was performed in 140 consecutive HCM patients (mean age: 56±16; 73% males) using a 1.5T scanner to determine cardiac functional parameters. LGE images were obtained 15 min after injection of 0.2 mmol/kg of Gadolinium. LGE was quantified by using SSD method. Indexed end-diastolic left ventricular (EDDLV) mass was assessed and LGE extension was defined as percentage of EDDLV mass. Patients were followed prospectively for a mean of 40.2±11.1 months, during which period occurrence of NSVT and SVT were recorded. Multivariate analysis was performed to determine independent CMR parameters with a statistically significant correlation with NSVT or SVT. ROC analysis was performed to determine the optimal cut-off value for the parameter already individuated.

RESULTS
The mean IEDLV mass was 89±27 g/m2. On LGE-CMR, 114 (82%) patients showed myocardial scar (mean LGE%: 7.5±7.5). During the follow-up period 28 (20%) NSVT and 13 (9%) SVT were recorded. Multivariate analysis revealed that only LGE% was independently associated with NSVT and SVT. According to the ROC curve, patients with a LGE% higher than 8%, have a high risk to present NSVT, with a sensitivity of 82% and a specificity of 67% whereas considering SVT, the LGE% cut off to select HCM patients with high risk was 8% with a sensitivity of 92% and a specificity of 62%. Respective AUC were 0.792 for NSVT and 0.790 for SVT (figure 1).

CONCLUSION
Extension of fibrosis on LGE-CMR predicts the occurrence of NSVT and SVT in HCM patients.

CLINICAL RELEVANCE/APPLICATION
We suggest the LGE% cut-off, assessed by LGE-CMR, as a new tool to select HCM patients with a high arrhythmic risk.

LL-CAS-T76A ● Histopathologic Correlates of Delayed Enhancement in Hypertrophic Cardiomyopathy: A Comparison of Cardiac Magnetic Resonance Imaging Findings and Myectomy Specimens

Celia P Corona-Villalobos MD (Presenter); Mark Halushka *; Linda C Chu MD; Neville Gai PhD; David A Bluemke MD, PhD *; Theodore Abraham MD; Ihab R Kamel MD, PhD *; Stefan L Zimmerman MD

PURPOSE
Myocardial fibrosis is common in hypertrophic cardiomyopathy (HCM) and is thought to contribute to sudden cardiac death and heart failure. Delayed enhancement (DE) on cardiac MRI (CMR) has been used to estimate myocardial fibrosis in HCM, however, evidence correlating DE to histopathology is limited. Therefore, the purpose of this study was to determine the histopathologic correlates of DE in HCM.

METHOD AND MATERIALS
This retrospective study was approved by our internal IRB. Subjects from the Johns Hopkins HCM registry who underwent CMR and surgical septal myectomy were identified. Inclusion criteria were a CMR that included post-contrast T1 scout and DE images and an adequate myectomy specimen. DE and myocardial T1 times in the basilar and mid-anteroseptum were quantified using dedicated software (Mass, Medis, Netherlands). Myectomy specimens were assessed by a cardiac pathologist for quantification of fibrosis and related findings.

RESULTS
Twenty-nine subjects were included; 20 males (69%) and 9 females (31%), with mean age 48±14 years. Myectomy specimens demonstrated mean replacement fibrosis of 11±16%, myocardial disarray of 4±4%, interstitial fibrosis of 42±21%, vacuolated myocytes of 15±21%, and 36±21 of dysplastic vessels per specimen. On CMR, 16 subjects had DE and 13 did not. Among those with DE, the mean percentage of DE in the basilar and mid-anteroseptum was 20.2 ± 12.2% (Table 1). Mean septal myocardial T1 time for our cohort was 370 ±67ms. There was good correlation between DE percentage for the mid anteroseptum by CMR and percent of replacement fibrosis in myectomy specimens (r=0.54, p=0.02), however, not for the basilar anteroseptum. Subjects with myocardial DE showed a strong trend to greater percent replacement fibrosis than subjects without DE (Table 1). Vacuolated myocytes, a non-specific finding due to myofibril abnormalities, were also more common in subjects with DE. There was no significant correlation of normalized T1 times with percent replacement or interstitial fibrosis.

CONCLUSION
HCM subjects with DE in the septum tend to have more extensive replacement fibrosis in myectomy specimens, supporting the
Rearrangements of the anaplastic lymphoma kinase (ALK) gene are found in ~5% of lung adenocarcinomas and are associated with a more favorable clinical prognosis.

**PURPOSE**
To investigate anatomical variations of left atrial appendage (LAA) on 256-slice spiral computed tomography coronary angiography (coronary CTA) in order to improve imaging diagnosis as well as clinical management for patients with LAA-related diseases.

**RESULTS**

The most common types were Types 2c, 2b, 2a and 2d found in 38.4% (n = 257), 21.8% (n = 146), 9.7% (n = 65) and 6.7% (n = 45), respectively, followed by Type 5, Type 1a, Type 4, Type 6, Type 3, Type 1b, and Type 7 found in 5.5% (n = 37), 4.9% (n = 33), 4.0% (n = 27), 3.7% (n = 25), 3.1% (n = 21), 1.3% (n = 9) and 0.7% (n = 5), respectively. Only Type 5 was more frequently found in women than men (P < 0.001).

**CONCLUSION**
Coronary CTA can objectively evaluate the morphological structure of multiple LAA variations and has the potential to improve clinical management for patients with LAA-related diseases.

**CLINICAL RELEVANCE/APPLICATION**
Understanding the variations of LAA before invasive treatments has the potential to increase the success rate and to avoid post-procedure's complications for patients with LAA-related diseases.

**LL-CAE-TU9A • Effective Ways of Using Iterative Reconstruction Algorithms in Routine Clinical Practice**

Sadahiro Yamamura (Presenter) ; Seitaro Oda MD ; Daisuke Utsunomiya MD ; Hideaki Yuki MD ; Yoshinori Funama PhD ; Yasuyuki Yamashita MD *

**PURPOSE/AIM**
Iterative reconstruction algorithms for CT are now widely used in clinical examinations. We aim to demonstrate the effectiveness of iterative reconstruction algorithms in improving image quality and reducing radiation dose.

**CONTENT ORGANIZATION**

1. Principles of iterative reconstruction algorithms
   - First-generation iterative reconstruction
   - Hybrid iterative reconstruction
   - Knowledge-based iterative reconstruction
2. Combined use with low tube voltage techniques
   - Reduction in radiation and contrast material dose
   - Protocol optimization
3. Combined use with high-resolution kernel
   - CT angiography of the peripheral arteries
   - Improved coronary in-stent visualization
4. Combined use with ultra high resolution scan mode
5. Application to obese patients
6. Application to pediatric examinations

**SUMMARY**
There are various effective ways to use iterative reconstruction algorithms. These techniques can improve the image quality and diagnostic performance, and reduce the radiation and contrast material dose.

**LL-CHS-TU2A • Evaluation of CT Pulmonary Angiography and Transthoracic Echocardiography for Correlation of Imaging**
PURPOSE
To compare CT Pulmonary Angiography (CTPA) and transthoracic echocardiography (TTE) in the assessment of right ventricular (RV) size and the prognosis of 30-day PE-related mortality in patients with acute pulmonary embolism (PE).

METHOD AND MATERIALS
From all consecutive CTPAs with acute PE performed between Aug 2003 and May 2010 (n=1744) at a single, urban teaching hospital, 785 patients had TTE performed within 48 hours of the diagnostic CTPA and formed the study cohort. The CT RV/LV diameter ratio (4-chamber reformatting) was correlated with qualitatively assessed RV size on TTE. The association of CT RV/LV diameter ratio and RV strain detected by TTE (defined as the presence of RV enlargement, RV hypokinesis, or elevated pulmonary arterial pressure) with PE-related 30-day mortality was assessed using multivariate logistic regression. The predictive ability (Area under the Curve; AUC) was compared between the model including CT RV/LV and that including TTE RV strain.

RESULTS
There was good correlation (Spearman’s rank coefficient=0.54, p<0.001) between CT and echocardiography determined RV enlargement. RV strain on TTE and increase in CT RV/LV diameter ratio were independent predictors of PE-related 30-day mortality with similar prognostic ability.

CONCLUSION
In patients with acute PE, both CT and echocardiographic assessment of RV enlargement are well correlated, and the two modalities have similar prognostic significance.

LL-CHS-TU3A • Negative CT Pulmonary Angiography Reports: What Factors Contribute to a Definitive versus Limited Impression?

Shun Yu BS ; Gopi Nayak MD (Presenter) ; Jeffrey M Levsy MD, PhD ; Linda B Haramati MD, MS *

PURPOSE
It is unclear which patient or radiologist-related variables are associated with limitations in a radiologist’s ability to exclude pulmonary embolism (PE) on CT. The present study examines factors and outcomes associated with qualification of negative PE reports as “limited.”

METHOD AND MATERIALS
Reports of all CTs performed in 2011-2012 at our inner city hospital were reviewed and categorized based on report impression as: 1) positive, 2) definitive negative, 3) limited negative or 4) non-diagnostic. Limited negative reports excluded PE only to the central or segmental level, or had a limitation mentioned in the impression. We evaluated the relationship of the report impression to radiologist subspecialty (cardiothoracic vs. other), inpatient status, age, gender, ethnicity, BMI, Charlson score, other comorbidities, and vital signs, using univariate and multivariate analysis.

RESULTS
CTs were performed on 2652 patients (mean age 55yrs, 66% W): 269 (10%) were positive, 1459 (55%) definitive negative, 269 (33%) limited negative, and 56 (2%) non-diagnostic for PE. The most common limitations reported were motion (45%) and poor opacification (32%). Patients with limited negatives were more likely to be obese (p<0.001). Limited negative impressions on CT reports are strongly associated with patient-related factors such as obesity, tachypnea, mechanical ventilation and higher comorbidity status, but not with radiologist subspecialization. Patients with limited negative CTs are more likely to receive anticoagulation and undergo additional V/Q scans.

CONCLUSION
Limited negative CT reports for PE have a false negative rate similar to definitive negative reports. The clinical value of these patients’ higher anticoagulation rates should be explored.

LL-CHS-TU44 • Is a Chest Radiograph Necessary after Percutaneous Lung Biopsy When Pneumothorax Is Absent on the Immediate Post Procedure CT Scan?

Michael G Johnson MD (Presenter) ; Lawrence Pan MD ; Turgut Berkmen

PURPOSE
To determine if a chest radiograph following CT guided lung biopsy has an impact on patient management when no pneumothorax is present on immediate post biopsy CT images.

METHOD AND MATERIALS
We retrospectively reviewed 754 CT guided lung biopsies. Six hundred thirty five patients met our inclusion criteria. Immediate post-biopsy CT scans were followed by CXRs obtained 1 - 2 hours after the biopsy. Medical records were reviewed to determine if the CXR changed management in the absence of a pneumothorax on immediate post-biopsy CT. Characteristics such as age, gender, needle gauge, core versus aspiration biopsy, emphysema, lesion location, size and depth were analyzed.

RESULTS
Two hundred thirty three (36.7%) patients developed pneumothorax. Forty two (18.0%) required a chest tube. Two hundred twenty four (96.2%) pneumothoraces were detected on immediate post-biopsy CT scan. Four patients (0.6%) who did not have a pneumothorax on CT scan or CXR subsequently developed symptomatic pneumothoraces between 5 days and 9 days post procedure and required a chest tube. Five pneumothoraces were detected only on CXR; none of these required a chest tube. Four hundred eleven patients without pneumothorax received 446 CXRs and spent an average of 116 minutes in the hospital. Statistically significant risk factors for pneumothorax were female gender, smaller needle gauge, increased lesion depth and smaller lesion size.

CONCLUSION
Following transthoracic needle biopsy of the lung, the risk of missing a pneumothorax on CT that requires an intervention is extremely low and is not associated with significant morbidity or mortality.

CLINICAL RELEVANCE/APPLICATION
Patients without a pneumothorax on immediate post-biopsy CT may be discharged without a post biopsy CXR, which will decrease the cost and clinical time associated with a majority of the procedures.

LL-CHS-TUSA • The Implementation of a Lung Nodule Registry to Manage and Track Lung Nodules

Debra S Dyer MD (Presenter) ; Elizabeth Kern MD, MS ; David A Lynch MBBCch *

PURPOSE
Compliance with Fleischner Society Guidelines is variable among radiologists, reported between 35 - 61% (Eisenberg et al, Radiology 2010). A Lung Nodule Registry was implemented to improve consistency in lung nodule management, facilitate utilization of Fleischner Society Guidelines and as a quality safety net to track patient follow-up.
Changes in Ordering of Radiological Studies Since the Implementation of 24 Hour in-house Attending

Shuman MD * ; Sudhakar N Pipavath MD (Presenter) * ; Gregory Kicska MD, PhD * ; J. D Godwin MD ; Eric J Stern MD ; William P Shuman MD * ; Gautham P Reddy MD

PURPOSE
The implementation of a Lung Nodule Registry facilitates the utilization of Fleischner Society Guidelines and tracking lung nodule follow-up. A substantial number of patients do not return for lung nodule follow-up CT on time.

CLINICAL RELEVANCE/APPLICATION
Management of lung nodules is inconsistent. Use of a Lung Nodule Registry can facilitate the use of Fleischner Society Guidelines and track lung nodule follow-up.

RESULTS
Between July 1, 2011 - March 31, 2013, 2945 patients were identified as having a lung nodule. Median age was 64%, 56% were female, 47% deemed high risk. 91% of the nodules were solid and 9% were subsolid. Of the total patients, 646 did not return for follow-up due to small nodule size and not being high risk. 2089 patients were noted to need a follow-up CT. Other diagnostic work-up such as PET-CT or biopsy was recommended in 210 patients. An early audit showed that the radiologists were 96% sensitive and 100% specific in the use of the tracker phrases. Among the 2089 patients needing follow-up CT, 622 (30%) patients completed follow-up CT recommendations, 606 (29%) were identified as pending follow-up with CTs scheduled, 29 (1%) died and 832 (40%) patients were found to be overdue for their follow-up CT. A reminder letter system was initiated to notify patients and referring physicians of overdue status.

CONCLUSION
The implementation of a Lung Nodule Registry facilitates the utilization of Fleischner Society Guidelines and tracking lung nodule follow-up. A substantial number of patients do not return for lung nodule follow-up CT on time.

Digital Tomosynthesis (DTS) Pulmonary Angiography and Upper Extremity venography: Is It Feasible?

Sudhakar N Pipavath MD (Presenter) * ; Gregory Kicska MD, PhD * ; J. D Godwin MD ; Eric J Stern MD ; William P Shuman MD * ; Gautham P Reddy MD

PURPOSE
To evaluate DTS as a diagnostic pulmonary angiographic modality and as a venographic method for assessment of DVT.

METHOD AND MATERIALS
Prospective digital tomosynthesis (DTS) examination of 12 healthy male volunteers was performed after injecting 100cc of iodinated contrast in the antecubital vein at 5cc/sec. Female subjects were excluded by design as inclusion would entail radiation exposure to the breast tissue without any added advantage. All scans were performed on Volume Rad (GE Healthcare, Waukesha, WI). Four radiologists reviewed studies and rated the quality of enhancement on a 3-point ordered scale for each branch level of pulmonary arteries as (1) non-diagnostic, (2) diagnostic for disease other than pulmonary embolism (PE), or (3) diagnostic for PE. Veins of the upper extremity on the injected side were scored as (1) non-diagnostic, (2) diagnostic for disease other than deep vein thrombosis (DVT), or (3) diagnostic for DVT. Inter-observer agreement was evaluated using weighted Cohen’s ? and linear weights.

RESULTS
Subject ages ranged from 19 to 55 years (median: 35 years). All pulmonary artery branches were rated as diagnostic for PE in 46% of readings, and diagnostic for disease other than pulmonary embolism in 92% of the readings. The enhancement of upper extremity veins was diagnostic for DVT in 77% of readings and diagnostic for disease other than DVT in 100%. Inter-observer agreement for pulmonary artery ratings was poor (k=0.05 (95% CI: -0.02, 0.12)). However, inter-observer agreement improved when diagnostic for vascular diseases other than PE and diagnostic for PE were grouped into a single category (k=0.13 (95% CI: -0.35, 0.56)). Agreement for the assessment of upper extremity veins was moderate (k=0.47 (95% CI: 0.32, 0.60)).

CONCLUSION
DTS pulmonary angiography is feasible and may be diagnostic for non-PE vascular diseases. DTS may be a potential low dose alternative to CT venography and a quicker alternative to MR venography. Further study will be required to assess DTS in patients who have pulmonary vascular disease or DVT.

CLINICAL RELEVANCE/APPLICATION
DTS pulmonary angiography can be used to evaluate pulmonary vasculature. DTS venography is a potential new way of assessing upper extremity venous system.

Emergency Radiology - Tuesday Posters and Exhibits (12:15pm - 12:45pm) Tuesday, 12:15 PM - 12:45 PM • Lakeside Learning Center

Trends in MDCT Utilization and Its Impact on Radiation Dose for Diagnosis of Urolithiasis in an Emergency Setting

Surabhi Bajpai MBBS, DMRD (Presenter) ; Brian H Eisner MD ; Garry Choy MD, MS ; Dushyant V Sahani MD

PURPOSE
We investigated the MDCT utilization trends in the emergency department in patients being suspected of having urolithiasis and its impact on CT radiation dose exposure.

METHOD AND MATERIALS
In this IRB approved study, we reviewed consecutive unenhanced abdomen MDCT scans performed between Jan 2007 to Dec 2011 for urolithiasis in an emergency setting. Of the total 8378 unenhanced abdomen MDCT scans, studies for urolithiasis indications accounted in 4334 patients (51.96%). The medical records and CT images were reviewed for patient demographics, diagnostic yield and radiation dose. The dose measurements were compared to evaluate the impact on CT dose with the introduction of dose reduction strategies.

RESULTS
There was 6%/year reduction in abdomen MDCT scan volume between 2007 and 2011 (1722 vs 1619) with a greater reduction in scans for diagnosis of suspected urolithiasis (18% reduction, 947 vs 775). The reasons for decreased MDCT utilization included awareness of radiation risks and increasing use of ultrasound for stone diagnosis. The yield of MDCT for stone diagnosis was 55.4% with alternate diagnosis made in 4.2%. The most common alternate diagnosis was diverticulitis (0.7%) and appendicitis (0.4%). There was a substantial reduction in radiation dose exposure in patients with alternate diagnosis and also provides an alternate diagnosis in patients presenting with renal colic. There has been a reduction in the MDCT utilization in an emergency setting in the past 5 yrs with substantial reduction in the utilization of MDCT scans for diagnosis of urolithiasis. This trend reflects the increasing awareness of radiation dose associated with MDCT scans. However, continued efforts need to be made for coming up with strategies in radiation dose reduction.

CLINICAL RELEVANCE/APPLICATION
Increasing radiation dose exposure concerns has resulted in decreased MDCT utilization in an emergency setting particularly in patients with urolithiasis.
Radiologist Coverage Overnight in the ER
Samuel Nirmalnath MD (Presenter) ;  J. Michael Zerin MD

PURPOSE
The purpose of this study is to determine what influence 24 hour in-house attending coverage has had in the overnight volume and types of studies ordered in the ER in three large academic hospitals.

METHOD AND MATERIALS
Three large hospitals within the Detroit Medical Center campus (Detroit Receiving Hospital, Harper Hospital, and Sinai Grace Hospital) were analyzed. All imaging studies that were ordered from the Emergency Rooms between 12am to 7am during June and December of 2011 (before implementation of 24 hour in-house attending radiologist coverage) and June and December of 2012 (after implementation) were included.

RESULTS
A 21% increase was noted in the total amount of studies ordered overnight in the ER since the implementation of 24 hour in-house attending coverage without a significant change in the total ER visits during the months analyzed.

CONCLUSION
Since the implementation of 24 hour in-house attending coverage, a disproportionate increase in overnight volume as well as more advanced studies has been ordered through the ER when compared to the total ER visits. Reasons for this increase could be due to diagnostic imaging trends as well as the perceived availability of the radiology department. Further inquiry into resident impact, ER decision making, as well as patient outcome should be further investigated.

CLINICAL RELEVANCE/APPLICATION
Increasing after hours imaging and demand for rapid report turn around are challenging in an era of decreasing reimbursement.

LL-ERS-TU3A • Usefulness of Cervical Spine Radiographs in the Evaluation of Acute Cervical Spine Trauma
Brian Haas MD (Presenter) ;  Lewis Hahn ;  Isabel B Oliva MD

PURPOSE
Plain radiography of the cervical spine is used as a screening test for trauma patients at low risk for fracture. The lateral projection provides valuable information about vertebral alignment and aids in detection of unstable injuries. There is little agreement on the utility of performing AP, odontoid, and oblique views, and institutional protocols vary widely. As well, most research on cervical radiography was performed prior to the widespread use of CT for evaluation of patients in the emergency setting. We aim to evaluate the diagnostic yield of performing these views in addition to the lateral view in the modern era where radiographs are performed only on low risk patients.

METHOD AND MATERIALS
In this IRB approved, HIPPA complaint study, we reviewed the records of all patients aged 19 years and older who received cervical spine radiographs in the emergency room of a tertiary medical center between November 22, 2003 and January 17, 2012. After review of the lateral projection by a radiologist, the technologist proceeded to obtain AP, odontoid, and bilateral oblique views. If the lateral radiograph was abnormal or unsatisfactory CT was performed. Exam reports and images were reviewed to determine which patients had fractures and on which view they were identified.

RESULTS
Six fractures were detected in 7218 exams. Three of these fractures were identified on the lateral radiograph, and three of these fractures were found on the additional views. The yield of these additional views is 1 fracture per 9470 radiographic views (95% confidence interval of 0 to 3 per 10,000 views). These additional fractures were identified on the odontoid view in one case and the oblique views in two cases. For two of the patients with fractures identified on the lateral view, an additional fracture was found on the subsequent CT.

CONCLUSION
Performing additional views of the cervical spine including AP, odontoid, and bilateral oblique projections in trauma patients with low pretest probability of fracture augments the diagnostic yield of lateral radiographs. Collectively, inclusion of the AP, odontoid, and bilateral oblique radiographs performed in conjunction with the lateral view doubled the sensitivity of the lateral view alone.

CLINICAL RELEVANCE/APPLICATION
Considering the potential for devastating neurological outcomes from missed cervical fractures, addition of AP, odontoid, and oblique views continues to detect fractures at a low rate.

LL-ERS-TU4A • Dual Energy CT in Acute Knee Trauma: Correlation with MRI and Surgical Findings
Paul I Mallinson MBChB (Presenter) ;  Sharon Gershony MD ;  Patrick McLaughlin FFRRCSI ;  Savvas Nicolaou MD ;  Peter L Munk MD ;  Hugue A Ouellette MD ;  Hong Chou MBBS, FCRC ;  Clemens Reisinger MD

PURPOSE
CT is a popular initial imaging modality for assessing the knee in acute trauma, to exclude and characterise bony injuries and aid pre-operative planning. Diagnostic information on osseous structures is superior, but soft tissue detail is limited. The advent of dual energy CT (DECT) has allowed additional information to be gathered regarding the morphology of collagen based structures in the soft tissue. In this study we evaluate the clinical value of this additional information by correlation with MRI and surgical findings.

METHOD AND MATERIALS
A double read of the DECT images of 35 sequential patients, who had suffered acute trauma of the knee was performed by 2 radiologists. Exam reports and images were reviewed to determine which patients had fractures and on which view they were identified.

RESULTS
Six fractures were detected in 7218 exams. Three of these fractures were identified on the lateral radiograph, and three of these fractures were found on the additional views. The yield of these additional views is 1 fracture per 9470 radiographic views (95% confidence interval of 0 to 3 per 10,000 views). These additional fractures were identified on the odontoid view in one case and the oblique views in two cases. For two of the patients with fractures identified on the lateral view, an additional fracture was found on the subsequent CT.

CONCLUSION
This preliminary study of DECT shows potential for the assessment the more macroscopic types of soft tissue injuries such as major tendon tears. Accuracy in assessment of smaller tears and collagen based structures was poor.

CLINICAL RELEVANCE/APPLICATION
Dual energy CT can demonstrate significant soft tissue injuries which cannot be seen on conventional CT, but accuracy for smaller structures and injuries is limited.

LL-ERE-TUSA • Imaging of Anorectal and Perineal Emergencies
Adam Schneider MD (Presenter) ;  Vijayanadh Ojili MD
Purpose/Aim

1. To provide a brief review of various traumatic and non-traumatic anorectal and perineal emergencies.
2. To discuss the role of imaging in the accurate diagnosis and characterization of a broad spectrum of acute conditions involving the anorectal and perineal region.

Content Organization

1. Introduction and pertinent normal anatomy of the anorectal and perineal region
2. Epidemiology, pathophysiology and imaging findings of various traumatic and non-traumatic anorectal and perineal emergencies (anorectal foreign bodies, traumatic rectal perforation, perirectal/perianal abscess, Fournier's gangrene, perforated rectal ulcer, perforated anorectal malignancy etc.)
3. Role of imaging in optimal triage and management of these patients.

Summary

A wide variety of traumatic and non-traumatic acute conditions affecting the anorectal and perineal region may present in the emergency setting. Cross-sectional imaging studies, especially MDCT provides superior anatomical and pathological information, correctly direct the attention to an acute process and facilitates patient management.

LL-ERE-TU6A • Triple Rule-out CT Angiography; Three for the Price of One; A Review of Cardiac CT Angiography

Morris Hayim MD (Presenter); Randy Yeh MD; Michael Nguyen MPH; Saravanan K Krishnamoorthy MD; Akash D Shah MD

Purpose/Aim

Accurate ED triage of chest pain is essential for safe and cost-effective patient management. The high prevalence of chest pain accounted for 6,392,000 ED visits and 1,976,000 hospital admissions in 2006. With the advent of 64-128 slice multidetector CT, radiologists can now play a central role in the chest pain algorithm. Vascular pathology including acute myocardial infarction, pulmonary embolism, and aortic dissection can all present emergently with chest pain. Recently, coronary CTA in low to moderate risk patients has been proven safe and cost-effective. Newer scanning parameters have also decreased the radiation dose to minimize stochastic risks.

Content Organization

1. Coronary Arteries
2. Aorta/Great vessels
3. Pulmonary Arteries
4. Extra-cardiac structures

• Utilization/cost-effectiveness
• Radiation exposure and risk

Summary

Triple Rule Out CT Angiography has been gaining acceptance as a safe and effective method of evaluation of chest pain. Radiologists should be familiar with clinical indications of TRO, state of the art protocols with radiation-sensitive scanning parameters, and guidelines for image interpretation.

LL-ERE1186-TUA • Tricky Talus: A Radiologist's Guide to Timely Diagnosis and Classification of Talar Fractures and Dislocations

Robert A Mackey MD, MBA (Presenter); Yulia Melenevsky MD; Norman B Thomson MD

Purpose/Aim

To provide radiologists with a high yield resource for identifying and differentiating between different types of talar injuries in order to facilitate proper management.

Content Organization

1. General concepts: relevant anatomy, epidemiology and mechanisms of injury, imaging work up
2. Overview and classifications of talar injuries with discussion of management options:
   • Fractures: head, neck, body, dome, lateral and posterior processes
   • Dislocations

Summary

Familiarity with the imaging findings is essential for timely diagnosis of talar injuries. Accurate delineation and classification of talar fractures and dislocations is necessary for guiding effective management decisions and optimizing treatment outcomes.
ShearWave Elastography Assessment of Liver Tumours Following Radiofrequency Ablation (RFA) and Irreversible Electroporation (IRE)

Wenshuo Tian (Presenter); Behzad Mokri-Moayyed; Xiaoyan Xie MD; Zuofeng Xu MD, PhD; Mark Abel MBBS; Edward Leen MD, FRCR *

PURPOSE
SWE has been shown to be useful in monitoring response following RFA. IRE is a novel non-thermal technique of ablating tumours. Objective is to compare the elastography changes of liver tumours following radiofrequency ablation (RFA) and irreversible electroporation (IRE) ablation using ShearWave elastography (SWE).

METHOD AND MATERIALS
A total of 43 patients with liver tumours who had undergone RFA (n=26) and IRE (n=17) were studied using the Aixplorer scanner (Supersonic Imagine) with a SC6-1 transducer; SWE of the lesions were measured before, day-1 and day-14 after ablation. A mean value of 3 acquisitions was calculated following placement of the region of interest over the whole lesion and the ablation zone at their maximal diameter. Inter and Intra-observer variability were also assessment in 15 subjects.

RESULTS
SWE was significantly higher at day-1 after RFA (34±14 kPa vs 70±17 kPa; P < 0.05). The impact of IRE ablation of liver tumours on SWE is significantly different from that of RFA and may also be used to monitor response. The changes following IRE ablation reflects the mechanism of cellular apoptosis. SWE is also reproducible.

CONCLUSION
1) SWE may be used to assess response following both RFA as well as IRE at day-1 but RFA alone at day-14. 2) SWE value is limited in evaluating IRE ablation response at day-14.

CLINICAL RELEVANCE/APPLICATION
1) SWE may be used to assess response following both RFA as well as IRE at day-1 but RFA alone at day-14. 2) SWE value is limited in evaluating IRE ablation response at day-14.

Diagnostic Accuracy of Iodine Tagging Computed Tomographic Colonography with Low-dose Bowel Preparation to Detect Colorectal Neoplasias in Patients with Positive Fecal Immunochemistry

Kenichi Utano MD (Presenter); Koichi Nagata MD; Tetsuro Honda MD; Takashi Kato MD; Michio Asano; Michiaki Hirayama MD; Hideharu Sugimoto MD

PURPOSE
This prospective multi-center study evaluates the diagnostic accuracy of computed tomographic colonography with low-dose bowel preparation in detecting colorectal neoplasms in a population at increased risk.

METHOD AND MATERIALS
We recruited 321 participants aged = 40 years with positive fecal immunochemical findings at seven institutions between December 2011 and September 2012. They were all assessed by computed tomographic colonography (CTC) with low-dose bowel preparation and optical colonoscopy on the same day. Low-dose bowel preparation comprised the consumption of polyethylene glycol (PEG; 400 mL), iohdinated oral contrast agent (20 mL) and mosapride (20 mg) after breakfast and dinner on the day before CTC. Three experienced observers independently assessed all CTC images. Per patient sensitivity, specificity, and positive and negative
predictive value were calculated as the reference standard colonoscopy by board-certified endoscopists.

RESULTS
Fourteen patients withdrew informed consent to participate and three others were excluded due to incomplete procedures. We thus evaluated 304 patients. No clinically significant complications developed during or after CTC. We identified 22 colorectal carcinomas in 20 patients. The sensitivity, specificity, positive and negative predictive values of CTC at a cut-off of 6 mm (lesion size) were 0.93, 0.98, 0.91 and 0.99, respectively, and those at a cutoff of = 6 mm were 0.90, 0.93, 0.82 and 0.96, respectively, per patient.

CONCLUSION
Adenomas = 6 mm were accurately detected by CTC with low-dose bowel preparation.

CLINICAL RELEVANCE/APPLICATION
CTC with low dose bowel preparation could be an efficient triage technique for patients with positive findings of fecal occult blood due to its high negative predictive ability.

LL-GIS-TU3A • Abdominal CT: Is Dual-source, Dual-energy more Radiation Dose Efficient than Single-energy?

Matthias Benz (Presenter) ; Michele Pansini MD ; Balazs Kovacs ; Robert Bolt ; Dorothee Harder ; Georg M Bongartz MD * ; Zsolt Szucs-Farkas MD, PhD ; Sebastian T Schindera MD *

PURPOSE
To assess the image quality and low-contrast detectability of simulated liver lesions in abdominal CT using a dual-source, dual-energy and a single-energy technique at similar radiation dose in a phantom.

METHOD AND MATERIALS
A custom liver phantom with 43 hypodense tumors (diameters of 5, 10 and 15 mm; tumor-to-liver contrast of -10, -25, and -50 HU) was placed in a cylindrical water container that mimicked an intermediate-sized patient. The phantom was scanned with a dual-source CT scanner (Somatom Definition Flash, Siemens) using a single-energy protocol (120 kVp, 150 reference mAs) and a dual-energy protocol (tube A, 100 kVp, 190 reference mAs; tube B, 140 kVp, 162 reference mAs). Automatic tube current modulation was used for both CT protocols. The radiation dose was assessed with the volume CT dose index (CTDIfol). The image noise was measured, and the contrast-to-noise ratio (CNR) of the tumors was calculated. Tumor detection was independently performed by three blinded radiologists. Statistical analysis included analysis of variance and non-parametric tests.

RESULTS
The CTDIfol measured 14.9 mGy for the single-energy protocol and 14.6 mGy for the dual-energy protocol. The image noise was significantly lower in the dual-energy compared to the single-energy protocol (14.4 vs. 17.8 HU, respectively; P < 0.01). The CNR of the dual-energy protocol was significantly higher compared to the single-energy protocol (3.8 vs 3.1, respectively; P < 0.01). The overall sensitivity for tumor detection measured 74.4%, and 82.2% for the single-energy and dual-energy protocol, respectively (P = 0.45).

CONCLUSION
At similar radiation dose, abdominal dual-source, dual-energy CT demonstrates a significantly improved quantitative image quality and trend for improved low-contrast detectability compared to single-energy CT.

CLINICAL RELEVANCE/APPLICATION
Abdominal dual-source, dual-energy CT improves radiation dose efficiency compared to single-energy CT.

LL-GIS-TU4A • Solid-pseudopapillary Tumors of the Pancreas: Multimodality Imaging Predictors of Aggressive Behavior

Siva P Raman MD (Presenter) ; Satomi Kawamoto MD * ; Joanna Law MD ; Amanda Blackford MSc ; Anne M Lennon MD ; Christopher L Wolfgang MD ; Ralph H Hruban MD * ; Elliot K Fishman MD *

PURPOSE
Solid-pseudopapillary neoplasms (SPN) are low-grade malignancies with the potential for local spread and metastatic disease. Despite this, the prognosis for SPN is excellent with a five-year survival up to 97%. In this study, we detail our institution’s experience with the diagnosis and treatment of SPN, including patient presentation, tumor markers, tumor stage at diagnosis, and patient survival, with a focus on imaging findings on MDCT, MRI, US, and EUS, as well as potential predictors of aggressive tumor behavior.

METHOD AND MATERIALS
The pathology database was searched for all cases of SPN since 1988, yielding 51 patients. The electronic medical record was searched for clinical and demographic information, including age, gender, presenting symptoms, type of surgery, post-operative length of stay, tumor markers, and post-surgical follow-up. All available imaging was reviewed for several different parameters, including 30 patients with MDCT, 9 with MRI, 3 with conventional ultrasound, and 11 with endoscopic ultrasound.

RESULTS
84% of patients were female, with a mean age of 33 years. Preoperative bilirubin and CA 19-9 levels were overwhelmingly normal. Prognosis was excellent, with a mean follow-up of 3 years without recurrence. All 51 patients developed metastatic disease 8 years after surgery. 10 patients were found to have ‘aggressive’ histology at presentation (T3 tumor, nodal involvement, perineural invasion, or vascular invasion). On CT, lesions tended to be large (5.3 cm), well circumscribed (29/30), round/oval (20/30), and encapsulated (23/30), often demonstrated calcification (14/30), and typically resulted in no appreciable biliary/pancreatic ductal dilatation, or pancreatic atrophy. Lesions ranged from completely cystic to completely solid. On MRI, lesions were well-documented, often demonstrated a capsule (6/9), and demonstrated blood products internally (5/9). No demographic, clinical, or imaging features were statistically significant as predictors of aggressive histology.

CONCLUSION
Certain imaging features can be highly suggestive of the diagnosis of SPN, although it is not possible to predict aggressive histology on the basis of imaging findings, clinical presentation, or patient demographic features.

CLINICAL RELEVANCE/APPLICATION
It is not possible to predict aggressive SPT histology on the basis of imaging findings, clinical presentation, or patient demographic features.

LL-GIS-TUSA • Comparison of Modified Dixon-Sequences and H1-Spectroscopy for Quantitative Assessment of Liver Steatosis in Patients with Gestational Diabetes

Nora N Kammer MD (Presenter) ; Charlotte Luetke Daldrup ; Eva M Coppenrath MD ; Andreas Lechner MD ; Tobias Saam MD * ; Uta Ferrari MD ; Maximilian F Reiser MD ; Stefan Wirth MD * ; Holger Hetterich MD

PURPOSE
Patients with gestational diabetes have a substantial increased risk of overt type II diabetes in comparison to the general population. Liver steatosis has been identified as an independent risk factor for the development of diabetes. H1-spectroscopy is an established non-invasive method to measure liver fat content but is restricted to small voxel elements, long acquisition time and complicated post-processing. Fast modified Dixon sequences (mDixon) have been shown to be an alternative for liver fat assessment. The aim of this study was to compare mDixon with H1-spectroscopy for the quantitative assessment of liver fat content in patients with a history of gestational diabetes.
1. Tumor localization and mapping

• Indications for IOUS

CONTENT ORGANIZATION

• Discuss common technical issues and solutions
• Review the indications, relevant anatomy, ultrasound equipment and scanning protocol for each procedure
• Educate the viewer on the diverse roles of intra-operative ultrasound (IOUS) in oncologic surgical treatment

PURPOSE/AIM

Tara L Sagebiel MD; Leonardo P Marcal MD; Tharakeswara Kumar Bathala MD; Catherine E Devine MD; Priya R Bhosale MD; Deepak G Bedi MBChB

LL-GIS-TU6A • Liver Fat Content is Negatively Associated with Atherosclerotic Carotid Plaque in Type 2 Diabetic Patients

Denis Krause MD; Louis Estivelet; Violaine Capitan; Jean P Cercueil MD; Romaric Loffroy (Presenter)

PURPOSE

Nonalcoholic fatty liver disease (NAFLD) is independently associated with atherosclerosis in nondiabetic individuals. In type 2 diabetic patients, the link between fatty liver and atherosclerosis is less clear. Here, we assessed whether liver fat content evaluated using 1H-magnetic resonance spectroscopy (1H-MRS) was independently associated with prevalent carotid plaque as a marker of atherosclerosis in type 2 diabetic patients.

METHOD AND MATERIALS

144 prospectively enrolled patients with type 2 diabetes underwent liver fat content measurement using 1H-MRS and carotid plaque assessment using ultrasound. Multiple logistic regression was used to identify factors associated with carotid plaque.

RESULTS

Mean ± SD liver fat content was 9.86 ± 8.12%. Carotid plaque prevalence was 52.1% (75/144). Patients without plaque were younger (P=0.006) and had a smaller visceral fat area (P=0.015), lower reported prevalence of previous cardiovascular events or current statin therapy (P=0.002), and higher liver fat content than those with plaque (P=0.009). By multivariable logistic regression, increased liver fat content independently predicted the absence of carotid plaque (Odds Ratio, 0.94; 95% confidence interval, 0.89-0.99; P=0.017).

CONCLUSION

Liver fat content measured by 1H-MRS is higher in type 2 diabetic patients without carotid plaque compared to those with plaque. This study suggests that increased liver fat content could be associated with a relative protection against carotid atherosclerosis in patients with type 2 diabetes mellitus. Longitudinal studies are necessary to determine whether liver fat content in type 2 diabetic patients is associated with long-term cardiovascular morbidity and mortality.

CLINICAL RELEVANCE/APPLICATION

Liver fat content evaluated using 1H-magnetic resonance spectroscopy (1H-MRS) is independently associated with prevalent carotid plaque as a marker of atherosclerosis in type 2 diabetic patients.

LL-GIS-TU7A • Role of Preoperative Imaging with Multidetector Computed Tomography in the Management of Patients with Gastroesophageal Reflux Disease Symptoms after Laparoscopic Sleeve Gastrectomy

Marco Rengo MD (Presenter); Damiano Caruso MD; Davide Bellini MD; Carlo Nicola De Cecco MD; Paola Lucchesi; Andrea Laghi MD *

PURPOSE

To evaluate if multidetector computed tomography (MDCT) can be helpful and useful in the decision-making process in sleeve patients with gastroesophageal reflux disease (GERD) symptoms and to demonstrate the reproducibility and accuracy of the technique.

METHOD AND MATERIALS

Twenty-three patients submitted to laparoscopic sleeve gastrectomy (LSG), complaining upper GI symptoms and/or weight regain and candidates to laparoscopic surgical revision were investigated. All patients underwent upper GI barium study, endoscopy and multidetector computed tomography (MDCT) for the identification of esophageal dilatation, neofundus development, thoracic sleeve migration, sleeve dilatation and/or antrum dilatation. Selected patients underwent laparoscopic sleeve revision, cruroplasty and/or fundectomy according to MDCT findings. Surgical findings were considered as "gold standard". Symptoms persistence or resolution was investigated after 6 months with a standard clinical questionnaire.

RESULTS

A total of 21 patients with sleeve migration or dilatation and neofundus underwent laparoscopic revision. A strong correlation between MDCT preoperative findings and intraoperative findings was observed. The presence of sleeve migration was significantly underestimated by both conventional radiology and upper GI endoscopy (sensitivity of 57.1% and 50% respectively). Symptoms remission was observed in 19 out of 21 patients at 6 months. In two cases surgical revision was not indicated on the basis of MDCT findings.

CONCLUSION

MDCT is more accurate the conventional radiology and endoscopy for the detection of morphological alteration causing GERD symptoms after LSG and can be considered a valid non invasive method to guide surgery and monitoring patients following revision.

CLINICAL RELEVANCE/APPLICATION

MDCT is an accurate non-invasive method for the identification of GERD related complications after LSG.

LL-GIE-TU8A • The Role of Intra-Operative Ultrasound in Oncologic Therapy

Tara L Sagebiel MD (Presenter); Leonardo P Marcal MD; Tharakeswara Kumar Bathala MD; Catherine E Devine MD; Priya R Bhosale MD; Deepak G Bedi MBChB *

PURPOSE/AIM

• Educate the viewer on the diverse roles of intra-operative ultrasound (IOUS) in oncologic surgical treatment
• Review the indications, relevant anatomy, ultrasound equipment and scanning protocol for each procedure
• Discuss common technical issues and solutions

CONTENT ORGANIZATION

• Indications for IOUS

1. Tumor localization and mapping
PURPOSE
Tumor hypoxia is a poor prognostic indicator in cervical cancer and tissue oxygenation is requisite for optimal effectiveness of radiation therapy. The purpose of this study is to determine if there is a difference in tissue oxygenation between cervical tumors.

CLINICAL RELEVANCE/APPLICATION
The post CRT MRI assessment of tumour regression grade correlates well with disease free and overall survival. Post CRT MRI prediction of the CRM involvement is also predictive of the risk of local recurrence. Post CRT MRI is able to differentiate the good from the poor responders. As phase II trials are evaluating the option of surgical deferral in the good responders, radiologists should be well versed with the MR appearance of rectal cancers post CRT and be able to accurately grade tumor regression.

RESULTS
Lymphoma patients age ranged 34-79y. Five had testicular involvement in sistemic disease; 21 had primary disease. Two had bilateral involvement. Patients with inflammatory mimics had pathology proven non-specific inflammation (n=2), granulomatous orchitis (n=2) Brucellosis (n=2) and tuberculosis (n=1). Involvement of the testis was focal in 12/26 patients with lymphoma, distributed in the lesion. Inclusion criteria were met by 33 patients, 26 with pathologically-proven lymphoma and 7 in whom lymphoproliferative disease was suspected on clinical and US ground and pathology or clinical evolution showed non-neoplastic disease.

CONCLUSION
In patients over 60 and/or with history of lymphoproliferative disease presenting with a testicular mass lymphoma must be considered; Demonstration of normal testicular vessels with straight course crossing the lesion. Inclusion criteria were met by 33 patients, 26 with pathologically-proven lymphoma and 7 in whom lymphoproliferative disease was suspected on clinical and US ground and pathology or clinical evolution showed non-neoplastic disease.

SUMMARY
The post CRT MRI assessment of tumour regression grade correlates well with disease free and overall survival. Post CRT MRI prediction of the CRM involvement is also predictive of the risk of local recurrence. Post CRT MRI is able to differentiate the good from the poor responders. As phase II trials are evaluating the option of surgical deferral in the good responders, radiologists should be well versed with the MR appearance of rectal cancers post CRT and be able to accurately grade tumor regression.

CONTENT ORGANIZATION
1. Relevant anatomy
2. Pre-operative review of other imaging findings
3. Optimal transducer
4. What to convey to surgeon

• Cases performed at our institution
• Procedure guidelines

Examples of pathology
• Common problems and solutions

SUMMARY
IOUS has a wide range of applications in oncologic treatment, including incision guidance, lesion localization, survey for multifocal disease and lesion characterization. This exhibit reviews the techniques and relevant anatomy and pathology for each procedure.

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**METHOD AND MATERIALS**

This was a HIPPA compliant, IRB approved retrospective study. MRI of the pelvis was performed, on a 1.5T MR scanner (GE Healthcare, Waukesha, WI) in eight female patients with cervical cancer (ave age 51.4 yrs) between 8/27/2012 and 3/4/2013. Seventeen patients with MRI of the pelvis and a normal cervix (ave age 54.7 years) were selected from the same time frame to serve as a control group. BOLD imaging was performed in an axial plane through the cervix in all patients. All patients were imaged while breathing room air. R2* values (1/sec) were obtained by manually placing a region of interest (ROI) over the tumor or normal cervix in the controls. R2* values of the right psoas muscle were also measured in a similar fashion. Student t-test was used to determine differences between normal cervix, tumor and the right psoas muscle.

**RESULTS**

In the control patients, the mean R2* values of the normal cervix and psoas muscle were 31.10/s (±4.67) and 33.45/s (±4.67) respectively, p=0.12. In the patients with cervical cancer, the mean R2* values of the cervical tumor and psoas muscle are 18.54/s (±6.84) and 36.62/s (±2.48) respectively. The R2* of cervical tumor is significantly less than that of skeletal muscle (p<0.0001).

**CONCLUSION**

This preliminary study suggests that there is a significant decrease in the R2* values of cervical cancer compared to skeletal muscle and normal cervical stroma. These data imply that tissue oxygenation of cervical cancer is significantly higher than that of normal cervical stroma and skeletal muscle.

**CLINICAL RELEVANCE/APPLICATION**

BOLD imaging of the cervix can detect differences in tissue oxygenation and may ultimately be useful in determining which tumors will be most likely to respond to radiation therapy.

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**LL-GUS-TU3A • Prospective Clinical Trial of MRI-US Fusion Guidance versus Visual Guidance in Performance of MR-Targeted Prostate Biopsy**

**James Wysock (Presenter) ; Andrew B Rosenkrantz MD ; Samir S Taneja MD * ; Fang-Ming Deng MD, PhD**

**PURPOSE**

The optimal method for targeting MRI-suspicious regions (mSR) during prostate biopsy remains unknown. We report results of an IRB-approved prospective clinical trial comparing targeted biopsy yield between MRI-US fusion and visual guided mSR targeting techniques.

**METHOD AND MATERIALS**

Prospective evaluation of targeted biopsy was performed in 125 men with mSR identified on pre-biopsy 3T MRI comprising T2-weighted, diffusion-weighted, and dynamic-contrast enhanced sequences. A single radiologist identified all mSR and scored the level of suspicion for tumor. EigenProFuse™ software was used to decenter mSR prior to biopsy. Transrectal US was performed using a BK™ endfire probe and MRI-US fusion was then performed using the ei-Nav|Artemis™ system. Two fusion guided cores per mSR were performed by one operator and targets were then blinded. Two visual guided cores per mSR and a standard 12 core biopsy were then taken by a second operator. Biopsy yield was compared between fusion and visual techniques.

**RESULTS**

172 mSR were identified with 20 (11.6%) very high, 38 (22.1%) high, 48 (27.9%) equivocal, and 66 (38.4%) low suspicion respectively. Mean diameter (mm per lesion) and cross-sectional area (cm^2 per lesion) per mSR for very high and high suspicion were 15.2 ± 7.0 and 1.76 ± 1.11 respectively. This was significantly larger than equivocal and low suspicion mSR; 9.52 ± 4.3 and 0.52 ± 0.35 respectively (p=0.0001 for cross-sectional area and diameter). MRI-fusion guided targeted biopsies were positive in 77 (44.8%) and visual guided targeted biopsies were positive in 60 (34.9%) of 172 mSR, respectively (p=0.0072). There were no significant differences in cancer grade detected or cancer core length between targeting techniques. For both techniques, targeted biopsy yield increased as the level of suspicion of the mSR increased, approaching 100% for mSR scored as very high suspicion.

**CONCLUSION**

Utilization of MRI-US fusion guided biopsy of mSR resulted in significantly increased biopsy yield as compared to visual guided targeting of the same mSR. Increased biopsy yield did not demonstrate an increase in significant cancer detection. Increase suspicion level of mSR demonstrated larger mean diameter and area and increased biopsy yield when compared to low and equivocal suspicion mSR.

**CLINICAL RELEVANCE/APPLICATION**

MR-US fusion improves biopsy yield as compared to visually guided targeting and is recommended for targeted biopsy.

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**LL-GUS-TU4A • Feasibility and Preliminary Experience of Quantitative T2 Star Mapping at 3.0 T for Detection and Assessment of Aggressiveness of Prostate Cancer**

**Xiao-Xi Chen (Presenter) ; Lian-Ming Wu ; Weibo Chen MSc ; Jianrong Xu**

**PURPOSE**

To assess the feasibility of quantitative T2 star mapping at 3.0 T for prostate cancer detection and to investigate the use of T2 star values to characterize tumor aggressiveness, with whole mount step-section pathologic analysis as the reference standard.

**METHOD AND MATERIALS**

Prostate multi-echo T2 star was performed in Fifty-five consecutive patients with prostate cancer using a multishot fast field echo (mFFE) sequence at 3.0 T MRI. T2 star mapping was obtained by exponentially fitting the multi-echo T2 star images pixel-by-pixel with different echo times for each slice. Generalized estimating equations were used to test the T2 star value difference between benign and malignant prostate regions and the association between T2 star value and tumor Gleason scores.

**RESULTS**

The T2 star values of the cancerous prostatic regions (mean: 42.51 ± 0.65 ms) were significantly lower (P<0.0001) than those of the benign and malignant prostate regions (mean: 58.12 ± 4.3 and 51.05 ± 2.35 ms) respectively. Significant differences in cancer grade detected or cancer core length between targeting techniques. For both techniques, targeted biopsy yield increased as the level of suspicion of the mSR increased, approaching 100% for mSR scored as very high suspicion.

**CONCLUSION**

BOLD imaging of the cervix can detect differences in tissue oxygenation and may ultimately be useful in determining which tumors will be most likely to respond to radiation therapy.

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**LL-GUS-TU5A • Diagnostic Accuracy of the Placenta Accreta by Non-contrast Enhanced MR Imaging**

**Yuko Nakamura MD (Presenter) ; Naoyuki Toyota MD ; Shuji Date ; Yoko Kaichi ; Yukiko Honda MD ; Kazuo Awai MD * **

**PURPOSE**

Placenta accreta (PA), a significant factor in maternal morbidity and mortality, is the most common reason for emergent postpartum hysterectomy. Dynamic MRI is useful for the prenatal diagnosis of PA because it helps to distinguish between chorionic villi and decidual basalis, however, the use of contrast material in gravid patients is controversial due to its unknown half-life in the fetus. The purpose of this study was to investigate the diagnostic accuracy of non-enhanced MRI for PA.

**METHOD AND MATERIALS**

Using 1.5T MR scanners we obtained sagittal and axial T2WI in 21 gravid patients (mean age 32.9 years, range 25 - 42). Two board-certified radiologists visually evaluated the presence of the placenta previa, uterine bulging, dark intraplacental bands on T2WI, and focal interruptions in the myometrial wall. They also scored the homogeneity of the signal intensity (SI) within the...
performing MR arthrography in a busy musculoskeletal division?

Host Center: Health Services - Tuesday Posters and Exhibits (12:15pm - 12:45pm)

Purpose
To describe diffusion-weighted imaging (DWI) appearance of gestational trophoblastic disease (GTD) and to compare apparent diffusion coefficient (ADC) values of hydatidiform mole (HM), persistent trophoblastic neoplasia (PTN) and nonmolar early pregnancy bleeding (NMEPB).

Method and Materials
Institutional ethics committee approved the study and patients provided informed consent. During a period of 6 months, 28 women with early pregnancy bleeding (mean age 28.9 ± 3.8 years, gestational age 10.8 ± 2.9 weeks) with preliminary diagnosis of GTD based on ultrasound and βHCG levels underwent 1.5T MRI (T2 and DWI; b = 50, 400, 800; sagittal and perpendicular to endometrium, and T1 tse axial images). Patients underwent 7-12 months follow-up for PTN. ADC values were measured by free hand ROI tracing of the endometrial outline. Images were evaluated for diffuse versus focal (vesicular or crescentic) diffusion restriction (representing focal hemorrhage), sharpness of endometrial outline and myometrial invasion (defined as T2 high signal lesion with/without diffusion restriction). PTN group included 2 patients with metastatic and 3 with nonmetastatic disease. Patient age, GA and ADC values were compared between HM and PTN, also between GTD and NMEPB using Mann Whitney U test.

Results

Conclusion
Focal vesicular/crescentic hemorrhage is more common in GTD. Direct myometrial invasion was not seen in PTN. DWI appearance and ADC values were not useful to differentiate PTN and HM.

Clinical Relevance/Application
Unlike many tumors, due to low cellularity, ADC values were not significantly higher in PTN. Observing myometrial invasion might be less common than previously reported.

Health Services - Tuesday Posters and Exhibits (12:15pm - 12:45pm) Tuesday, 12:15 PM - 12:45 PM • Lakeside Learning Center Back to Top [ ] LL-HPS-TUA • AMA PRA Category 1 Credit ™:0.5 Host Paul P Cronin MD, MS

Host Party Pandharipande, MD, MPH
LL-HPS-TUA • The Right Tools for the Job: Can Smaller Contrast Agent Packaging Improve the Cost Effectiveness of Performing MR Arthrography in a Busy Musculoskeletal Division?

Sandra Rutigliano MD (Presenter); Adam C Zoga MD; Andrea J Frangos MPH; William B Morrison MD *

Purpose
Given the packaging of gadolinium-based contrast agents currently available in our department, 4.8–19.8 ml is wasted per MR arthrogram. We sought to establish the potential savings if Gd-based contrast became available in a packaging size more suitable for use in direct MR arthrography.

Method and Materials
The number of MR arthrograms performed in our MSK division from 7/1/11 to 6/30/12 was tallied. The “contrast cost” for each exam was calculated based upon the contrast agent, packaging and pricing specific for each site. The amount of waste was also estimated.

We then examined 2 potential packaging changes:
1. Multi-dose vial to be used for all arthrograms in a single day, then discarded at the end of the day. (est. 5ml, $20)
2. Single dose vial more appropriately sized for MR arthrography. (est. 0.5ml, $5)

Results

Conclusion
Available packaging for Gd-based contrast agents is disproportionately oversized for use in MR arthrography, resulting in excess waste and expense. More reasonable packaging would significantly reduce costs for imaging centers, hospitals, and ultimately, patients.

Clinical Relevance/Application
More appropriately sized packaging of gadolinium-based contrast for use in MR arthrography would save our institution $29,000, which could have significant economic impact in widespread application.

LL-HPS-TU2A • Preparing Radiology for Future Bundled Inpatient Hospital Service Payments: A National Analysis of Medicare Part Spending on Medical Imaging

David A Rosman MD (Presenter) *; Nadia Bilal; Danny Hughes PhD; Richard Duszak MD

Purpose
As healthcare payment systems evolve from traditional fee for service to various bundled payment methodologies, much attention is
focused on inpatient hospital episodes. Little is known, however, about the appropriate allocation of spending on medical imaging in such models. We seek to identify allocation methodologies for radiology to understand its attribution of Medicare Part A dollars.

**METHOD AND MATERIALS**

Using a 2011 5% national random sample of Medicare fee for service beneficiaries, we examined inpatient claims by all 744 Medicare Severity Diagnosis Related Groups (MS-DRGs) in our data set. We estimated both total charges and imaging charges for each MS-DRG and estimated both the average charge and average imaging charge per claim in each MS-DRG. Using this data, we derived the ratio of imaging charges to total charges between and within each inpatient MS-DRG. We identify the top 10 MS-DRGs by total dollars, by total dollars attributed to imaging, and by highest percentage of dollars to imaging.

**RESULTS**

Analysis yielded 744 unique MS-DRGs and 319,125 unique beneficiaries associated with 527,506 unique inpatient claims. Imaging spent for $1.98B or 7.56% of the total spend of $25.88B. The top 10 services by total spend accounted for $5.48B or 20.76% of total spend for all DRGs, but imaging accounted for only 4.16% ($223MM) of these. The top 10 services by imaging spend accounted for $2.98B or 11.3% of total spend, but imaging accounted for only 11.9% ($347MM) of these. The top 10 services by imaging share in the MS-DRG accounted for only 0.61% ($208MM) of the total spend, but imaging accounted for 28.95% (only $60MM) of these.

**CONCLUSION**

Little is currently known about how MS-DRG spending is attributable to different specialty services for inpatient hospitalizations. While focusing on heavily imaging-weighted MS-DRGs may be tempting, our analysis demonstrates that this simplistic approach may be misguided. The top 10 MS-DRGs by overall imaging spend account for 5.8 times more dollars for imaging than the top 10 by percent share attributable to imaging. While only 4.16% of the total spend in the top 10 MS-DRGs is imaging-related, the bottom line impact of high spend services is profound.

**CLINICAL RELEVANCE/APPLICATION**

Quantifying the share of imaging within MS-DRGs will be invaluable in accurately identifying the appropriate allocation of funds for medical imaging for inpatient hospitalization encounters.

**LL-HPS-TU3A ● Professional Efficiencies for Diagnostic Imaging Services Rendered by Different Physicians: Analysis of Recent Medicare Multiple Procedure Payment Reduction Policy**

**Richard Duszak MD (Presenter) ; Ezequiel Silva MD ; Angela Kim ; Robert M Barr MD ; William D Donovan MD ; Pamela Kassing ; Geraldine B McGinty MD ; Bibb Allen MD**

**PURPOSE**

To quantify potential physician work efficiencies and appropriate Multiple Procedure Payment Reduction (MPPR) for different same-session diagnostic imaging studies interpreted by different physicians in the same group practice.

**METHOD AND MATERIALS**

Medicare Resource Based Relative Value Scale data were analyzed to determine relative contributions of various pre-, intra-, and post-service physician diagnostic imaging work activities. An expert panel quantified potential duplications in professional work activities when separate examinations were performed during the same session by different physicians within the same group practice. Maximum potential work duplications for various imaging modalities were calculated and compared to those used as the basis for Centers for Medicare and Medicaid Services (CMS) payment policy.

**RESULTS**

No potential intra-service work duplication was identified when different examination interpretations were rendered by different physicians in the same group practice. When multiple interpretations within the same modality were rendered by different physicians, maximum potential duplicated pre- and post-service activities ranged from 5.0% (radiography and fluoroscopy [RF] and nuclear medicine [NM]) to 13.6% (computed tomography [CT]). Maximum mean potential duplicated work Relative Value Units ranged from 0.0049 (RF) to 0.0413 (CT). This equates to overall potential total work reductions ranging from 1.39% (NM to RF) to 2.73% (CT). Across all modalities, this corresponds to maximum Medicare professional physician fee reductions of 1.23 ± 0.38% (range 0.95% to 1.87%) for services within the same modality, well less than an order of magnitude smaller than those implemented by CMS. For services from different modalities, potential duplications were too small to quantify.

**CONCLUSION**

While potential efficiencies exist in physician pre- and post-service work when same-session same-modality imaging services are rendered by different physicians in the same group practice, these are relatively miniscule, and have been grossly overestimated by current CMS payment policy. Greater transparency and methodological rigor in government payment policy development are warranted.

**CLINICAL RELEVANCE/APPLICATION**

Current CMS MPPR policy grossly overestimates physician work efficiencies when same-session imaging services are rendered by different physicians in the same group practice.
Digital Watermark and Steganography Technique

**LL-INS-TU1A • Security Model for Medical Image Data Hidden Using a New Digital Watermark and Steganography Technique**

Informatics - Tuesday Posters and Exhibits (12:15pm - 12:45pm)

Results

4,115 provider groups were certified during the targeted period. In the resulting model, the slopes were $39.235$ and $-69.948$ for the pre- and post-certification periods, respectively, with y intercepts of $10,691$ for the former and $11,115$ for the latter. The average cost difference per time segment of the expected (based on a linear slope of pre-certification trend) to observed in the post-certification period was $617$, or a percent difference of $5.4$. The secular trend pattern was flat, supporting the linear assumption. The plan did not institute a price change that would have significantly affected these results, and non-parametric analysis based on percentiles yielded similar results (affirming that outlier claims did not skew averages in the model).

Conclusion

Certifying imaging providers significantly reduces the amount billed for imaging procedures. Further research may elucidate the reason for this relationship.

Clinical relevance/application

This model may be used to project savings from imaging certification.

**LL-HPE1087-TUA • Incidentalomas on Abdominal and Pelvic CT: What the Radiologist and Clinician Need to Know**

Purpose

To review the complex and growing problem of diagnosis and management of 'incidentalomas' identified on abdominal and pelvic CT examinations; to show representative examples of incidentalomas ranging from benign, unimportant findings to highly clinically relevant - to demonstrate the importance of abduction, lung, muscularkeletal, breast, and lung, and to overdub the controversies and emerging recommendations from the recent literature as to how the radiologist and clinician should handle such incidentalomas.

Content organization

- General issues - including ethical, malpractice, economic/practice management, reporting/communication - will be overviewed.
- Examples from each organ/organ system will be demonstrated on A/P CT, ranging from the benign/unimportant, to the highly clinically relevant - to include SUV, breast, lung, muscularkeletal, lymphatic, liver, spleen, adrenal, kidney, pancreas, bowel, bladder, and gynecologic - with brief reviews of the literature, including the ACR white paper - Examples from specific indications/protocols - to urography, colonography; trauma; suspected appendicitis - with review of the literature - The clinicians' perspective will be provided by a colorectal surgeon and gastroenterologist.

Summary

Guidance will be provided for the radiologist and clinician as to how to handle the incidentaloma on A/P CT.

**Informatics - Tuesday Posters and Exhibits (12:15pm - 12:45pm)**

Tuesday, 12:15 PM - 12:45 PM • Lakeside Learning Center

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**LL-INS-TUA • AMA PRA Category 1 Credit ™ - 0.5 Host George L Shih, MD, MS * Security Model for Medical Image Data Hidden Using a New Digital Watermark and Steganography Technique**

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**LL-INS-TUA • Security Model for Medical Image Data Hidden Using a New Digital Watermark and Steganography Technique**

**Tokuo Umeda PhD (Presenter) ; Akiko Okawa MD, RN ; Tsutomu Gomi PhD ; Kenta Miwa RT ; Shuji Yamamoto PhD ; Taku Yamashita RT**

Purpose

The number of images included in a single image series is increasing with the development of multi-detector computed tomography (MDCT). In addition, the application of information and communication technology (ICT) techniques, such as tele-image-reading and external archiving, has been introduced in the medical field. Therefore, there is increasing risk at the time of archiving images and transmission of electronic patient records (EPR). We present information hiding system developed using digital watermarking and steganography technologies.

Method and materials

1. Digital watermarking technology

Chest CT images of 512×512×16 bits (67 slices) were used. The EPR data, the hash value of the regions of interest (ROI), name of the institute, and the data of the patient support system were hidden in the regions of non-interest (RONIs) in a chest CT image series in the Digital and Communication in Medicine (DICOM) format.

2. Steganography technology

A body CT image series of 512×512×16 bits (100 slices) was used for steganography. These CT images were stored in a subfolder after 7-Zip compression. This folder was then embedded in the cover image of a scene photograph. The cover image with the embedded images was then transmitted to other medical institutions.

Results

When part of the ROIs was altered during transmission, the hash value decoded from the received cover image had a different value from that before cover image transmission. The structural similarity (SSIM) and the peak signal to noise ratio (PSNR) of the watermarked image with 4000 words embedded were 0.99 and 65.3 dB, respectively. In addition, when the medical information was embedded in the low-bit plane, such as the first- and second-bit plane, the radiologist was unable to identify the embedded information. In our technology, there was no change in the image capacity of CT images or cover image before and after...
CONCLUSION
Using digital watermarking and steganography technologies, we developed a medical information hiding system that ensures the copyright of the images, and protects privacy and safety of the EPR. Both technologies are applicable not only to CT images but to all digital images.

CLINICAL RELEVANCE/APPLICATION
This process scheme would allow central management of medical images and EPR values, and thus facilitate efficient handling of medical information.

LL-INS-TU2A • Radiology Reports: What YOU Think You're Saying and What THEY Think You're Saying
Matt Whitehead MD (Presenter) ; Ryan Forsbess MD ; Bonmyong Lee MD

CONCLUSION
Sound physician communication is a critical component of quality healthcare delivery. Certain words and phrases carry different meanings for radiologists and clinicians. With structured reporting becoming more prevalent, the radiology lexicon should be defined in a more concrete manner. Ambiguous terms should be eliminated all together.

Background
Image interpretation and translation into written language is an imperfect process. Yet, the radiology report represents the link between radiologist's opinion and patient's images. Increased access to images through remote viewing stations has made direct communication between radiologists and clinicians less commonplace. We are interested in how accurately the descriptive contents within radiology reports convey the feelings of the radiologist to the referring clinician. We hypothesize that certain words and phrases hold different connotations for radiologists and clinicians.

Evaluation
A two part survey was designed. Medical specialty, level of training, and number of radiology reports read/week was contained in part I. Part II concerned the quantification of radiologists' diagnostic confidence in range percentages based on specific words and phrases. These voluntary surveys were emailed to all faculty at a single university medical center. Additional paper surveys were randomly distributed to medical students, residents, and physicians. A total of 100 completed surveys were collected (33 radiologists and 67 non-radiologists). Data was exported to EXCEL for statistical analysis. Direct comparisons were made between the survey answers from radiologists and non-radiologists.

Discussion
Percentile ranges for most radiologists and non-radiologists were in agreement in 26/36 questions. However, the absolute percentage value was somewhat variable. 10/36 questions generated discrepancy between radiologists and non-radiologists. The following words and phrases were in disagreement: "suggestive of", "evidence of", "probable", "no apparent", "none detected", "normal", "consider", "recommend", "suboptimal evaluation", and "mildly limited".

LL-INS-TU3A • An All-encompassing Multi-specialty Incidentaloma Decision Support Tool for the Daily Practice of Radiology
Ramin Javan MD ; Bryan S Jeun MD (Presenter) ; Christopher J Roth MD

CONCLUSION
A compilation of tables and algorithms regarding incidental imaging findings was created in hopes of assisting radiologists in making more up-to-date and uniform recommendations for further management.

Background
Incidental imaging findings are encountered daily and their management can be challenging and at times controversial. Use of decision support tools appears on the horizon in all aspects of radiology, especially as part of the Imaging 3.0 movement by the American College of Radiology (ACR). With the current focus on cost reduction in health care as well as attempts to improve quality of patient care, a unified and systematic multi-specialty approach to incidental findings seems inevitable.

Evaluation
An array of tables, algorithms, recommendations and figures were collected from the most recent peer-reviewed literature as well as guidelines from various societies, such as the ACR and SRU, regarding incidental imaging findings. These were categorized by body part and are listed as follows. Abdomen and pelvis: Incidentalomas in liver, pancreas, adrenal glands, and kidneys on CT, ovarian cyst on CT, ovarian and paraovarian cyst on US, gallbladder polyp on US, focal gallbladder wall calcification, renal cyst on lumbar MRI, short segment bowel intussusception, mesenteric lymph nodes and misty mesentery, 22 hypointense adnexal lesions on MRI. Thorax: Fleischner pulmonary nodule follow-up, subsolid pulmonary nodules, enlarged mediastinal lymph nodes on CT, coronary artery calcification on CT, breast nodule on CT, pulmonary nodule in abdominal CT, pulmonary nodule on cardiac CTA including small field-of-view, extracardiac incidental findings on cardiac MRI, pleural effusion on screening breast MRI. Brain and Head and Neck: Thyroid nodule on PET and on CT, carotid disease in soft tissue neck CT, parathyroid incidentaloma on thyroid ultrasound, brain MRI incidentalomas, pituitary incidentalomas.

Discussion
The ultimate goal is to use this collection as the backbone for a stand-alone or web-based all-encompassing incidentaloma decision support tool. Ideally, this tool can manually or semi-automatically be updated by creating alerts when relevant publications or guidelines become available.

LL-INS-TU4A • Is It Possible to Track Radiologists' Gaze When They Scroll Through Stacked CT Images? Eye Tracking Analysis of Radiologists' Reading Computed Tomography for Metastases Detection
Thomas Sanzalone (Presenter) ; Olivier Rouviere MD ; Caroline Tilikete ; Yves Berthezene MD, PhD

PURPOSE
To assess an eye-tracking device recording eye movements during interactive scrolling of stacked CT images.

METHOD AND MATERIALS
The study used 10 CT examinations of chest, abdomen and pelvis acquired with a similar protocol in patients with melanoma. Seven CTs were abnormal, one with more than 20 obvious metastases and six with 1 to 3 metastases considered difficult to detect by experts. Nine metastases ("target lesions") were prospectively selected from these 6 CTs. 74 radiologists interpreted 1 to 3 examinations randomly chosen from the 10 CTs, using a dedicated DICOM-viewer. They were free to scroll up and down through the images. Eye movements were recorded using a remote eye-tracker and synchronized with the image scrolling. 190 interpretations were registered. Regions of interest (ROIs) were then placed on the 9 "target lesions" and on 9 equivalent areas on the 3 normal CTs. Dedicated software calculated the percentage of radiologists whose gaze was recorded into the ROIs and the dwell time in them.

RESULTS
The average time for each interpretation was 6 minutes and 48 seconds [2 min 19 sec – 16 min 31 sec]. 45 interpretations with radiologist’s gaze properly recorded during less than 75% of the interpretation length were excluded, leaving 145 valid interpretations with an average percentage of properly recorded data of 90.16%.

On average, 66.2% [13.3% - 100%] of “target lesions” were detected, with an average dwell time of 3.84 sec [0.14 sec – 7.89 sec]. The average percentage of visualization of equivalent ROIs on normal CTs was 40.3% [2% - 90.2%], with an average dwell time of 0.33 sec [0.02 sec – 0.68 sec].
Two metastases were detected by 80% and 100% of radiologists when equivalent normal areas were visualized by only 9.8% and 3% of readers suggesting a role of the peripheral vision in their detection. On the other hand, one poorly-contrasted metastasis, detected by only 50% of radiologists, was located in an area visualized by 90.2% of radiologists on normal CTs.

CONCLUSION
Eye-tracking during interactive scrolling of stacked images is feasible and compatible with routine CT interpretation. Peripheral vision may play a role in metastases detection, as well as the contrast and location of the metastases themselves.

CLINICAL RELEVANCE/APPLICATION
Eye-tracking studies during CT interpretation could become a useful tool for analyzing factors influencing metastases detection and thereby improving routine practice.

**LL-INS-TUSA ● Using SQL to Create a Searchable Database of Radiology Reports for Research**

**Adeel Siddiqui MBBS (Presenter) ; Ari M Blitz MD * **

**CONCLUSION**
In our study, we were able to create an SQL database of radiology reports after a one time data transfer. This created a research tool that could be used for multiple research projects. Investigators had a tailor made search engine that was suited for research purposes and more robust than traditional RIS/PACS search engines. Combining this approach with pathology and electronic health record information can lead to the formation of even better tools to identify patient cohorts and potential research targets.

**Background**
Research work can be greatly increased if there are robust tools to search the radiology report database. This need is even more imperative if there is only a unique subset of patients or studies that research is being done for, and querying the entire PACS can become cumbersome. However, searching for specific reports within a RIS system is often met with limitations. These include but are not limited to lack of direct physician access to search reports, robustness of the RIS in handling system queries, and limitations in ways the information can be extracted from the RIS.

The focus of this abstract was to see whether extraction of the radiology reports onto a separate SQL database would be an attractive alternative to query the pacs repeatedly for each research project.

**Evaluation**
327 patients underwent a novel skull base MRI protocol between 2010 and 2012 at Johns Hopkins Hospital. The exact MRI protocol used are beyond the scope of this abstract. 315 MRI exams of 327 patients were successfully transferred from the RIS query to an SQL server running Microsoft SQL express. Two tables were created. One table containing patient name, medical record number, etc and the second table containing the entire radiology report text linked to the Accession number. Using a dot-net and visual basic framework, a front end for entering patient data was created (fig 1).

**Discussion**
All the report text was easily searchable through the front end software. We were able to instantly identify separate cohorts such as patients with specific tumor types and also to distinguish patients based on demographic factors such age, sex, and race.

**LL-INT-TUSA ● Design and Validation of Automated, Customized Clinical History Searches for Imaging Interpretation**

**Shaan-Chirag Gandhi DPhil (Presenter) ; Roy G Bryan MD, MBA ; Sarita Nair MS ; Abraham Lin BS ; Arun Krishnaraj MD, MPH **

**Background**
Clinical practice increasingly relies upon imaging to provide rapid complementary data in the care of patients. While a brief clinical history often accompanies an imaging request, detailed knowledge of a patient’s past medical history and presenting symptoms often relate to specific and critical challenges associated with the study interpretation. The electronic medical record (EMR) manually is time-consuming and may lead to lower-quality, less-efficient interpretations due to overlooking relevant history. To address this difficulty, we describe a process for developing customized search queries of the EMR built upon the Queriable Patient Inference Dossier (QPID) health record intelligence platform at the Massachusetts General Hospital.

**Evaluation**
Through literature reviews and interviews with referring providers, a list of relevant past medical history search parameters specific to three MRI exams (liver, prostate and rectal) was developed. Sixty-two patient records selected at random were searched across nine liver, prostate and rectal MRI exams. Two independent reviewers compared the QPID-driven search results to their manual EMR review to assess positive and negative predictive values. In addition, a graphical user interface (GUI) incorporating interpretation guidelines was developed and presented to the end user to assist in image interpretation.

**Discussion**
The average search time per query was 3.4 ± 1.1 seconds and the inter-observer agreement between reviewers (Cohen’s κ) was 0.90. The pooled average positive predictive value (PPV) was 0.86 and negative predictive value (NPV) was 0.91 across all three exam types. For critical searches, such as medication lists or pathologic diagnoses, the PPVs and NPVs for individual exams approached unity.

**CONCLUSION**
This study demonstrates and validates the utility of constructing automated search queries of a patient EMR and displaying results within a GUI to optimally assist in clinical data gathering for use in enhancing speed and quality of image interpretation. Future directions include a prospective demonstration of the impact of QPID-based searches on the efficiency and quality of imaging interpretation.
Discussion
Recently, there have been documented cases of QR code misuse and abuse around the globe. Advantage and disadvantage of the QR code including security risks of the QR code area discussed in this exhibit. In the near future, smartphone will change to the advanced form such as glasses smartphone. The future of the QR code is also discussed compared with next generation technologies such as mobile visual search (MVS) and augmented reality (AR).

CONCLUSION
QR code management system for radiologists is feasible approach to bridge between online smart devices and intranet HIR/RIS terminals with secure network environment.

LL-INE3211-TUA • When Is Your CT Dvol Too High? Teaching Recognition and Interpretation of CT Scan Parameters Using Web-based Quiz Modules

Mindy Licurse MD (Presenter) ; Susan Hilton MD ; Tessa S Cook MD, PhD

PURPOSE/AIM
The purpose of this exhibit is to educate radiologists and technologists to properly identify and understand CT radiation dose parameters, and how to modify such parameters to optimize radiation dose during the performance of a diagnostic CT exam.

CONTENT ORGANIZATION
Dose sheets and CT images will be presented in quiz format. The scenarios will include:

- Inappropriate kVp or quality reference mA parameter settings
- Situations in which parameters should have been modified for patient considerations such as size
- Longer than necessary scan length resulting in increased patient radiation exposure
- Suboptimal patient positioning leading to increased radiation exposure
- CT scanner parameters that exceed conventional thresholds
- Suboptimal parameter adjustment resulting in improper ECG triggering or contrast bolus triggering

SUMMARY
Optimizing CT protocols is an important responsibility for radiologists and technologists. An online quiz module can be an effective educational tool to simulate daily scenarios in which the radiologist and technologist must understand and modify scan parameters in order to decrease the amount of radiation necessary to produce diagnostic-quality CT exams.

LL-INE3174-TUA • Automatic Extraction of Patient Characteristics from Clinical Reports

Jean Garcia-Gathright (Presenter) ; Corey W Arnold ; Alex A Bui MS, PhD

Background
The extraction of specific data elements from unstructured free-text documents is a critical task for a range of clinical and research activities, including data mining and disease registry construction. To enable such applications for imaging-based application domains, we have developed a set of natural language processing (NLP) annotators for the automatic extraction of patient characteristics and the subsequent population of a database. The use of this framework is demonstrated for lung cancer screening.

Evaluation
Our input corpus comprises the entire set of medical reports for patients who have undergone a biopsy of an indeterminate lung nodule. We targeted several data elements, including location of tumor, biopsy results, family history of cancer, and smoking history. Extraction performance was evaluated against a manually-annotated gold standard of 112 cases. Precision and recall were as high as 95% for certain data elements, such as location of tumor.

Discussion
An investigation of the input corpus revealed that most of the data elements of interest were found in radiology reports, pathology reports, and oncology consultations. We found that rule-based logic was sufficient for very good annotation performance. Our framework was implemented in Apache UIIMA (Unstructured Information Management Architecture) and includes mechanisms for database querying, section detection, and information extraction based on regular expressions.

CONCLUSION
The successful implementation of these annotators represents an important step in the analysis of unstructured clinical documents. The rules and regular expressions we have developed can be used to further structured reporting templates and other free-text based analyses. Future work also includes the implementation of interactive web-based visualizations of the extracted data to support integrated radiology/pathology reporting and tumor board meetings.

LL-INE3176-TUA • A Semi-automated System for Communicating Subcritical Results: Follow Up

Melinda J Yeh MD (Presenter) ; Stephanie W Hou MD ; David E Avrin MD, PhD * ; Thomas H Urbania MD

Background
Subcritical imaging findings—those which require follow up but don't pose an immediate threat—create a challenge in the radiologist workflow. In 2011, a semi-automated system for communicating subcritical results was implemented. Subcritical reports are flagged using an XML keyword, and dedicated support staff communicate subcritical findings to the responsible clinician. Our purpose is to assess the performance of this system by analyzing the follow up and significance of flagged radiological findings.

Evaluation
IRB approval was obtained. Retrospective review of consecutive subcritical alerts from 3/21/11 through 2/19/12 was performed (n=2805). The most common study types were CT abdomen/pelvis (17.3%, n=484), PET/CT (8.6%, n=242), CT chest (7.9%, n=222), and US pelvis (7.9%, n=221). In all cases, the responsible physician was contacted, most often on the next business day. The first 253 consecutive subcritical results were analyzed to assess follow up rates and significance of the result (defined as resulting in a change in patient management or outcome). Overall, 62% of findings were followed up (n=156), and 33% of those findings were significant (n=52). When specific follow up recommendations were made (n=119), adherence was 81% (n=96). Additionally, 63% of findings were incidental (n=159) (defined as being unrelated to the study indication). Incidental findings had a lower rate of follow up (48%) compared to non- incidental findings (84%), as well as a lower rate of significance (20% versus 45%).

Discussion
A substantial proportion of patients being imaged at our facilities did not receive all their medical care within our network, so the percentages above likely underestimate the true rates of follow up and significance. The lower rate of follow up for incidental findings (48%) is of concern given that 20% of these findings were clinically significant in our sample.

CONCLUSION
A semi-automated system for communicating subcritical findings allows for prompt notification of referring clinicians, a relatively high rate of follow up, and frequently identifies issues that affect patient care. Further refinements should focus on increasing the rate of follow up for incidental findings.

LL-INE3213-TUA • Mobile Apps in Radiology - A Structured Online Repository of Mobile Applications in Radiology

Roland S Talanow MD,PhD (Presenter) ; Andras Szekely MD
Background
Smartphones and tablets offer new opportunities for diagnostic imaging practitioners; these easy-to-use devices equipped with excellent display may be used for diagnostic reading, reference, learning, consultation, and for communication with patients. However, the mobile market is growing exponentially and for the mobile 'inexperienced' professional it becomes overwhelming to find the right application for the right purpose in its daily work.

Evaluation
A search was performed on iTunes, Android Market, Blackberry App World, and Windows Phone Marketplace for mobile applications pertinent to the field of diagnostic imaging. Over 100 applications were found. Based on the results we created a web-accessible database of available mobile applications in the field of Radiology. We structured the data based on categories such as Medical books, Journal access, Interactive encyclopedias, News and Magazines, Diagnostic reading, Decision support. For each application, specific information was entered such as platform, title, company, description, publication year, price (if not for free), website for more details, screenshots and others. We also implemented a rating system based on the following criteria: Ease of use, Quality and Price/value ratio. An editorial review has been also provided.

Discussion
This web-accessible database allows the user to search for Radiology relevant mobile applications for different mobile platforms (iOS, Android, Blackberry etc.). In addition it provides a comprehensive description and evaluation of each of these applications. The database can be either browsed by categories or other criteria or the user can actively search for keywords. Users can also share their opinions and rate the applications based on the aforementioned criteria, so that other users can make their own informed decision which application is most suited for their needs.

CONCLUSION
We provide a web-based repository of available mobile applications that are useful in different areas of the daily Radiology work. Comprehensive information, relevant ratings and reviews help users finding the application that suits most their individual needs.

Musculoskeletal - Tuesday Posters and Exhibits (12:15pm - 12:45pm) Tuesday, 12:15 PM - 12:45 PM • Lakeside Learning Center  Back to Top  [x]  LL-MKS-TUA  •  AMA PRA Category 1 Credit ™:0.5 Host Bethany U Casagranda, DO
LL-MKS-TUA  •  Whole Body MRI versus 99mTc-Methylene Diphosphonate Scintigraphy in Detection of Skeletal Metastases

Sherif Abdel fattah MD, PhD (Presenter) ;  Hassan Kassem MD ;  Osama Raslan

PURPOSE
The aim of work is to compare the ability of whole body MRI, with that of 99mTc-phosphonate-based scintigraphy to detect skeletal metastases in cancer patients.

METHOD AND MATERIALS
23 patients with pathologically proven primary malignant tumors were referred from different medical, surgical, oncology and nuclear medicine departments, and suspected or known skeletal metastatic disease. The patients were subjected to both Whole-Body MRI and Technetium Methylene Diphosphonate bone scintigraphy (BS). WB-MRI was mainly obtained using 4 contiguous coronal stations for body coverage using the body coil, and 2 contiguous sagittal stations for the spine with the CTL Coil, using both Fast Spin Echo Inversion Recovery (FSE-IR) and T1-Weighted Fast Spine Echo (T1w-FSE) sequences .

RESULTS
15 out of 23 cases had skeletal metastases, while 8 cases were free from metastases. When using data analysis based on region by region comparison the over all sensitivity , positive predictive value ,specificity, negative predictive value and accuracy for whole body MRI are 93.5%,100%,100%,97.2% and 98% respectively however for bone scan are 57.6%,95.7%,98.8%,83.4% and 86.1% respectively .
WB-MRI had higher sensitivity ,specificity ,positive ,negative predictive value and accuracy than BS in detection of metastatic deposits at lumbar, dorsal, cervical, sacral spine, pelvis and both extremities. WB-MRI was slightly better at the sternum. BS was better than WB-MRI in detecting metastatic deposits at the ribs , while both modalities were equal at the skull and shoulder. Whole body MRI detected 35 tumor non related extraskeletal lesions.

CONCLUSION
WB-MRI is a powerful and effective tools that showed higher sensitivity, specificity and accuracy than BS in various types of primary tumors and in various situations including solitary metastatic focus, diffuse extensive metastases and skeletal metastases from a second primary, not to mention its uniqueness in staging of malignancies during pregnancy

CLINICAL RELEVANCE/APPLICATION
WB-MRI is a powerful and effective tools that showed higher sensitivity, specificity and accuracy than BS in various metastatic skeletal neoplastic diseases

LL-MKS-TUA  •  The Malignant Bone Tumor Margin on PROPELLER DWI: Correlation with Pathology

Zeng Jie Wu MBA (Presenter)

PURPOSE
To explore the accuracy of PROPELLER diffusion-weighted imaging (DWI) and apparent diffusion coefficient (ADC) value in estimating the extent of malignant bone tumor.

METHOD AND MATERIALS

RESULTS

CONCLUSION

CLINICAL RELEVANCE/APPLICATION

The PROPPLER DWI displays tumor margin more objectively and accurately compared with conventional MRI sequences and it can be used for guiding clinical operation to avoid overestimation and underestimation.

LL-MKS-TUA  •  Material Decomposition from Spectral CT in Differentiation of Osteogenic Bone Metastases and Bone Islands

Yue Dong (Presenter) ;  Shaowei Zheng ;  Bing Wang ;  Ruxin Wang ;  Lifei Sun

PURPOSE
To quantitatively evaluate the feasibility of material decomposition (MD) for the differential diagnosis of osteogenic bone metastases and bone islands in patients with bronchogenic carcinoma.

METHOD AND MATERIALS

RESULTS

The fat (bone) and water (bone) concentrations of osteogenic bone metastases (201.17±243.43mg/cm³, 223.28±270.25mg/cm³)
were significantly higher than that of bone islands (\(41.89 \pm 29.49 \text{mg/cm}^3, 46.57 \pm 32.74 \text{mg/cm}^3\)) (\(p_2, 1206.07 \pm 380.82 \text{mg/cm}^3\)) were significantly lower than that of bone islands (\(1574.91 \pm 436.86 \text{mg/cm}^3, 1579.68 \pm 469.80 \text{mg/cm}^3\)) (\(p_3, 1208.07 \pm 380.82 \text{mg/cm}^3\)) were significantly lower than that of bone islands (\(1574.91 \pm 436.86 \text{mg/cm}^3, 1579.68 \pm 469.80 \text{mg/cm}^3\)) (\(p_3, 1208.07 \pm 380.82 \text{mg/cm}^3\)) were significantly lower than that of bone islands (\(1574.91 \pm 436.86 \text{mg/cm}^3, 1579.68 \pm 469.80 \text{mg/cm}^3\)).

CONCLUSION
There is significant difference of MD quantification between osteogenic bone metastases and bone islands using spectral imaging, which is reliable for differential diagnosis.

CLINICAL RELEVANCE/APPLICATION
Material decomposition technique is reliable for differential diagnosis of osteogenic bone metastases and bone islands.

**LL-MKS-TU4A • Diagnosis of Rotator Cuff and SLAP Tears with 3T MR Arthrography: Saline Arthrography Compared to Conventional Gadolinium Arthrography**

**Chang Woo Chun MD (Presenter); Won-Hee Jee MD; Joon-Yong Jung MD; So-Yeon Lee MD; Won Sun Hong; Yang Soo Kim**

PURPOSE
To retrospectively compare the reliability and accuracy of saline versus gadolinium shoulder magnetic resonance (MR) arthrography in the diagnosis of rotator cuff and superior labral anterior posterior (SLAP) tears at 3T shoulder MR imaging.

METHOD AND MATERIALS
RESULTS
CONCLUSION
WITH posterior approach, saline shoulder MRA is comparable with gadolinium MRA for detecting rotator cuff and SLAP tears at 3T.

CLINICAL RELEVANCE/APPLICATION
Diagnostic performance of posterior approach saline MR arthrography of the shoulder is comparable with conventional gadolinium MR arthrography regarding rotator cuff and SLAP tears at 3T.

**LL-MKS-TUSA • Real-time MR-guided Cervical Periradicular Injection Therapy Using an Open 1.0 Tesla MRI System - An Outcome Study**

**Martin H Maurer MD (Presenter); Tony Hartwig; Diane M Renz MD; Nils F Schreiter; Bernd K Hamm MD *; Florian Streitparth**

PURPOSE
To evaluate the accuracy, safety and efficacy of MR-guided cervical nerve root injection therapy using an open 1.0 Tesla MRI system.

METHOD AND MATERIALS
RESULTS
CONCLUSION
CLINICAL RELEVANCE/APPLICATION
The MR-guided technique may be a promising alternative to fluoroscopy- or CT-guided infiltrations at the cervical spine, especially in young patients and in a serial therapeutic regimen.

**LL-MKS-TU6A • Fibrocartilage of the Temporomandibular Joint Disc - A Feasibility Study Using Delayed Gadolinium-enhanced MRI**

**Elisabeth Schoenbauer MD (Presenter); Elisabeth Pittschieler DMD; Pavol Szomolanyi PhD; Martina Schmid-Schwap MD, DMD; Monika Egerbacher; Siegfried Trattnig MD**

PURPOSE
The purpose of this study was: 1) to test the feasibility of delayed Gadolinium-Enhanced Magnetic Resonance Imaging of Cartilage (dGEMRIC) at 3T in the temporomandibular joint disc; 2) to determine the optimal delay of the articular cartilage measurement in the TMJ disc after i.v. contrast agent (CA) administration; and 3) to compare the regional intradiscal T1 relaxation time differences with histology.

METHOD AND MATERIALS
RESULTS
CONCLUSION
1) were significantly higher than that of bone islands (\(41.89 \pm 29.49 \text{mg/cm}^3, 46.57 \pm 32.74 \text{mg/cm}^3\)) (\(p_2, 1206.07 \pm 380.82 \text{mg/cm}^3\)) were significantly lower than that of bone islands (\(1574.91 \pm 436.86 \text{mg/cm}^3, 1579.68 \pm 469.80 \text{mg/cm}^3\)) (\(p_3, 1208.07 \pm 380.82 \text{mg/cm}^3\)) were significantly lower than that of bone islands (\(1574.91 \pm 436.86 \text{mg/cm}^3, 1579.68 \pm 469.80 \text{mg/cm}^3\)).

CONCLUSION
The MR-guided technique is reliable for differential diagnosis of osteogenic bone metastases and bone islands.
Clinical relevance/application

Our results suggest that dGEMRIC of TMJ is feasible and represent different measurable biochemical parameter, which may help in diagnostics of early stage of TMJ disorders.

**LL-MKE-TUBA • In Vivo Magnetic Resonance Imaging of the Skin**

**Rachid Kechidi** MD ; **Bruno A Kastler** MD, PhD ; **Philippe Humbert** PhD ; **Sebastien L Aubry** MD, PhD (Presenter)

**Purpose/Aim**

The purpose of this exhibit are: 1) To remind technical aspect of MRI of the skin. 2) To describe the normal features of the skin. 3) To discuss challenges in diagnosis of skin disorders. 4) To present the principal applications of MRI for the in vivo characterisation of the biochemical properties of the skin.

**Content organization**


**Summary**

MRI of the skin is a recent imaging technique that has several advantages over other non-invasive imaging techniques of the skin. MRI is a non-radiating imaging modality, that is also reproducible and non-operator dependent. Because of its wide field of view than ultrasound, its spatial resolution under 100μm and its excellent contrast, MRI allows high quality imaging of every skin layers. In addition to morphological analysis, it is also able to study some physical and biochemical properties of the skin.

**Multisystem/Special Interest - Tuesday Posters and Exhibits (12:15-12:45pm) Tuesday, 12:15 PM - 12:45 PM • Lakeside Learning Center Back to Top**

**Neuroradiology/Head and Neck - Tuesday Posters and Exhibits (12:15pm - 12:45pm) Tuesday, 12:15 PM - 12:45 PM • Lakeside Learning Center Back to Top**

**LL-NRE-TU10A • When Percutaneous Spinal Procedures Go Wrong: What the Radiologist Needs to Know**

**Noushin Yahyavi-Firouz-Abadi** MD (Presenter) ; **Michael V Friedman** MD ; **Franz J Wippold** MD

**Purpose/Aim**

Review the complications following percutaneous spinal procedures and their imaging features

**Content Organization**

1. Introduction 2. Common percutaneous spinal procedures and their complications: Percutaneous vertebroplasty, kyphoplasty and sacroplasty, radiofrequency tumor ablation, image-guided epidural injection, nerve root and facet injection, discography and disc decompression, percutaneous biopsies and drainage catheter placement. 3. Imaging features of complications following procedures: cement leak and emboli, spinal cord infarction, intramedullary injection, epidural hematoma, perivertebral hematoma and abscess, vascular injury, pneumothorax 4. Summary and Conclusion

**Summary**

Spinal symptoms such as pain are extremely common and diagnostic and therapeutic procedures are commonly performed. Percutaneous procedures are rapidly evolving and replacing many open surgical procedures due to low morbidity and cost. Radiologists play an important and expanding role in these image guided procedures. Additionally, radiologists should be able to diagnose imaging features of complications or failure of these procedures. In this exhibit, we will review possible complications of percutaneous spinal procedures and their imaging features.

**LL-NRE-TU11A • MR Manifestations of Radiation Injury to the Brain: The Good, the Bad and the Ugly**

**Francis J Cloran** MD, MS (Presenter) ; **Deepak M Sampathu** MD, PhD ; **Suyash Mohan** MD

**Purpose/Aim**

1. To discuss radiotherapeutic modalities for treatment of intracranial disorders. 2. To highlight radiation induced pathology with attention to acute, subacute and chronic manifestations. 3. To illustrate, in an interactive case based manner, radiation induced pathology to include vascular, inflammatory and neoplastic entities with attention to imaging findings and clinical manifestations.

**Content Organization**

Review intracranial conditions for which radiotherapy/radiosurgery is utilized and the different modalities employed. Illustrate the timeline of radiation-induced pathology to hone the differential diagnosis. Imaging manifestations of radiation-induced pathology: Images will be shown in an interactive case based review format with relevant clinical data, differential considerations and discussion. Some of the entities to be presented include: 1. Radiation necrosis and pseudoprogression. 2. Radiation-related vasculopathy 3. Radiation-related cavernomas 4. Radiation-induced meningiomas and sarcomas 5. Intravascular papillary endothelial hyperplasia

**Summary**

This interactive case review highlights conditions encountered after intracranial radiotherapy/radiosurgery. Knowledge of treatment history, imaging appearance of complications and temporal relationship of these complications related to their treatment is essential in management of these patients.

**LL-NRS-TU1A • Clinical and Volumetric MRI Associations in Multiple Sclerosis Using Fully-automated Software**

**Joe B Baker** MD (Presenter) ; **Mariko Kita** MD ; **Joanna Haug** MS, MPH ; **Justin A Siegal** MD ; **Allen S Nielsen** MD, MMEdSc

**Purpose**

Cerebral atrophy is considered a neuroimaging biomarker of multiple sclerosis (MS) and has been shown to be an independent predictor of physical and cognitive disability. Several automated and semi-automated methods for quantifying cerebral atrophy using volumetric magnetic resonance imaging (vMRI) have been developed, although only one is currently FDA approved for clinical use (NeuroQuant, CorTechs Labs, Inc.). Small cohort studies have shown significant correlations between cerebral atrophy and clinical disability in MS, but none have been of sufficient size to generate a set of normative data to assist in the clinical evaluation of patients with MS.

**Method and Materials**

We retrospectively analyzed vMRI data from a heterogeneous MS cohort of 526 patients at a single institution during an 18-month period (female 422/526=80%) obtained using the NeuroQuant software package including segmental analysis of multiple brain regions. This data was then compared to clinical metrics obtained through focused chart review to determine the degree of correlation between volumetric data and clinical disability based on Expanded Disability Status Scale (EDSS). We plan to model independent predictors of physical disability including vMRI and other relevant clinical metrics.

**Results**

We found significant correlations between EDSS and lateral ventricle volume (mean volume=28.9 cm^3, SD=17.5, Pearson
In our large cohort we showed significant correlations between EDSS and the volumes of several distinct brain regions that may allow use of vMRI as a predictor of MS-related disability in the clinical setting. We also generated a set of normative vMRI data to assist clinicians in interpreting brain volumes obtained during clinical workup as a marker for disability in MS.

CONCLUSION

Normative segmental vMRI data generated from this large MS cohort can assist clinicians in interpreting brain volumes that can be used as predictors of clinical MS-related disability.

**LL-NRS-TU2A • Arterial Spin Labeling in Semantic Dementia: Hypoperfusion's Detection and Diagnostic Accuracy. Could It Make as Well as FDG-PET?**

**Aurore Esquevin** MD ; **Jean-Christophe Ferre** MD, PhD ; **Florence Le Jeune** MD, PhD ; **Helene Raoult** MD (Presenter) ; **Isabelle Corouge** PhD ; **Aymeric Stamm** ; **Catherine Merck** ; **Elise Bannier** ; **Christian Barillot** ; **Serge Belliard** MD ; **Jean-Yves Guvvrut** MD

**PURPOSE**

Semantic dementia (SD) is a rare subtype of frontotemporal lobar degeneration. Structural MRI usually shows temporal lobe atrophy predominantly on the left side but it could be insufficient. Fluorodeoxyglucose-positron emission tomography (FDG-PET) is known to improve the diagnostic accuracy. Nevertheless, Arterial spin labeling magnetic resonance imaging (ASL-MRI) is a new perfusion MRI technique, which has recently shown great diagnostic potential in dementia, yet not in SD. The aim of this work was first to study diagnostic accuracy and hypoperfusion’s detection with ASL-MRI in semantic dementia and secondly to compare it with FDG-PET.

**METHOD AND MATERIALS**

The study was approved by the local Ethics Committee. All participants provided written informed consent and underwent neuropsychological tests. Twelve SD patients were included and underwent FDG-PET and 3T ASL-MRI (PICORE Q2TIPS). Twelve healthy subjects matched for age and sex, were selected from the Alzheimer’s Disease Neuroimaging Initiative (ADNI). The analysis was performed by a visual analysis, by 4 readers with a reading grid, in a blinded manner, in order to depict abnormalities in each modality and to provide a forced diagnosis. Then, ASL-MRI was compared with FDG-PET. A non-parametric variance analysis was performed and differences were considered significant at a threshold of p< 0.05. The value of sensitivity, specificity, predictive positive value were also calculated. A quantitative analysis was then performed in order to confirm this results.

**RESULTS**

The hypoperfusions, detected by visual and quantitative analysis with ASL-MRI affected mostly the left temporal anterior lobe. Similarly, FDG-PET yielded hypometabolisms in the same regions. The value of sensitivity, specificity, predictive positive value were all higher than 90.0% for ASL-MRI and similar to FDG-PET.

**CONCLUSION**

Our results show the potential of ASL-MRI in SD diagnostic by highlighting a specific pattern of hypoperfusion and by providing a good diagnostic accuracy, similar to FDG-PET.

**CLINICAL RELEVANCE/APPLICATION**

ASL-MRI exhibits good diagnostic accuracy, similar to FDG-PET and shows a specific patterns of hypoperfusion. This could provide support for diagnosis of semantic dementia from non-invasive MRI.

**LL-NRS-TU3A • Resting State fMRI Assessment of Language Networks in Epilepsy Patients: Initial Report**

**Ali Murat Koc** MD (Presenter) ; **Ali Yusuf Oner** MD ; **Murat Ucar** ; **Melike Guryildirim** ; **Zeynel Baran** PhD ; **Fatih Oncu** ; **Halil Ozer** ; **Turgut E Tali** MD

**PURPOSE**

Preoperative language network assessment through task - based functional MRI has been widely used in epilepsy patients. Using resting-state fMRI to define language networks, especially motor and sensory language areas (Wernicke & Broca) is an alternative technique. The purpose of this paper is to compare conventional task-based functional MRI and "task free" resting state fMRI results on refractory temporal lobe epilepsy (TLE) patients at 3T.

**METHOD AND MATERIALS**

An institutional review board approval was obtained for this study. A total of 10 refractory TLE patients, referred for presurgical evaluation were included in this study. First a "task free" resting state data then the "task-based" functional MRI data via two language tasks were acquired on a 3T scanner. T1 and T2W images on axial and coronal planes are than acquired to define the extend of epileptogenic region. Data driven from "task-based" and resting state fMRI were processed with BrainVoyager (QX 2.2, Brain Innovation). Following evaluation of the language network related signals and their distance to the epileptic regions, these two methods were compared via Independent Component Analysis (ICA). Region of Interest (ROI) analysis for Wernicke and Broca areas of language networks were done to assess spatial comparison.

**RESULTS**

Language network signals in the context of Wernicke and Broca areas were successfully defined on all patients with both fMRI techniques. Distance of these areas to the epileptogenic zones obtained with both techniques were comparable. Activation signals recorded with both methods showed good spatial correlation.

**CONCLUSION**

Resting state fMRI can be used as a promising alternative to conventional "task-based" fMRI. This new technique can be recommended in neurologically and/or visually impaired patients.

**CLINICAL RELEVANCE/APPLICATION**

Resting state fMRI for preoperative workup of language networks in TLE patients is a promising technique which is expected to extend the spectrum of patient profiles and to ease their evaluation.

**LL-NRS-TU4A • Quantitative Susceptibility Mapping in Patients with Systemic Lupus Erythematosus: Detection of Abnormalities in Normal-appearing Basal Ganglia**

**Atsushi Ogasawara** (Presenter) ; **Shingo Kakeda** MD ; **Keita Watanabe** ; **Tian Liu** PhD ; **Yi Wang** PhD ; **Yukunori Korogi** MD, PhD

**PURPOSE**

Although the substantial population of the systemic lupus erythematosus (SLE) have neuropsychiatric symptoms, many of them may not show abnormal brain MR findings, probably because the metabolic and/or functional alterations of the disease usually precede the anatomical disturbance. Quantitative susceptibility mapping (QSM) is a novel technique to compute quantitative maps of the corresponding underlying magnetic susceptibility distribution. Our aims were to evaluate whether QSM can detect the abnormalities within normal-appearing basal ganglia at conventional MRI in the patients with systemic lupus erythematosus.

**METHOD AND MATERIALS**

The institutional review board approved this study. All studies were performed with a 3T MRI system (Signa EXCITE 3T; GE Healthcare). Twenty-three SLE patients with (n =7) or without (n = 16) neuropsychiatric symptoms were enrolled; all of them
showed no abnormalities in the basal ganglia at conventional MR study. The age-sex-matched Z3 controls were also enrolled. For SLE patients and controls, two radiologists independently measured mean susceptibility values and R2* rates in seven brain structures (thalamus, putamen, caudate, globus pallidus, pons, splenium of corpus callosum, and frontal white matter) that appears normal on conventional MR images.

RESULTS
In the putamen and globus pallidus, the mean susceptibility values were significantly higher for the SLE patients than for the controls (p<0.05).

CONCLUSION
In the SLE patients with normal basal ganglia at conventional MRI, QSM detected the subtle susceptibility changes more sensitively than R2* mapping.

CLINICAL RELEVANCE/APPLICATION
In the patients with neuropsychiatric SLE, QSM seems useful for the detection of subtle tissue changes of the basal ganglia, which may lead to early diagnosis at their subclinical stage.

**LL-NRS-TUSA • Feasibility Study of Internal Carotid Artery (ICA) Balloon Occlusion Test prior to Endovascular Treatment of Ophthalmic Artery Aneurysm; As a Preliminary Study for Preserving Visual Function**

Byung-Joon Kim MD ; Wooll Kim (Presenter) ; Pyoung Jeon ; Keon Ha Kim ; Sung Tae Kim MD ; Hong Sik Byun MD ; Hyung-Jin Kim MD ; Jihoon Cha MD ; Yi Kyung Kim MD ; Ji Young Lee MD

PURPOSE
We evaluate the usefulness of internal carotid artery (ICA) balloon occlusion test prior to endovascular treatment of ophthalmic artery aneurysm as a preliminary examination for assessment of preserving visual function.

METHOD AND MATERIALS
From 2008 through 2012, Twenty-three patients with ophthalmic artery aneurysms underwent ICA balloon occlusion test prior to endovascular treatment. Hyperemic balloon was used to occlude ICA on the same side of the aneurysm and common carotid artery (CCA) angiography was then obtained. Communication between branches of the external carotid artery (ECA) with the ophthalmic branch of the ICA was evaluated on the post-occlusion CCA angiography. We performed coil embolization with or without stent placement only to the patients with communication between ECA with the ophthalmic branch of the ICA. Visual function test was followed immediately, 1 month and 6 months after the procedure. And follow up imaging study for evaluation of technical success was achieved 1 month and 6 months later.

RESULTS
21 patients had communication between ECA and the ophthalmic branch of the ICA. One patient lacked ophthalmic artery opacification or choroidal blush on post-occlusion CCA angiography. The other patient showed facial paralysis during the balloon occlusion test. Coil embolization with or without stent placement was performed to the 21 patients with collateral flows. Among them, ophthalmic artery was occluded during the procedure in 3 patients. However, opacification of ophthalmic artery or choroidal blush via collaterals was demonstrated on post-embolization angiography and visual function test was also normal in all 3 patients. On follow up brain MR or MR angiography 6 months later, 5 cases were showing small neck remnants and no evidence of recanalization was revealed on the other 16 cases. No major recanalization or retreatment was reported during the follow-up period.

CONCLUSION
ICA balloon occlusion test was useful to determine whether to perform endovascular treatment of ophthalmic artery aneurysm containing latent risk of sacrificing its perforating branch.

CLINICAL RELEVANCE/APPLICATION
ICA balloon occlusion test prior to endovascular treatment of ophthalmic artery aneurysms can be performed as preliminary inspection for preserving visual function.

**LL-NRS-TUSA • Neuromyelitis Optica (NMO): An Initial Diffusion Kurtosis Imaging (DKI) Study**

Thomas M Doring MSc (Presenter) ; Fernanda C Lopes MD ; Vanessa G Itagiba MD ; Ralph Strecker * ; Jian Xu * ; Margareth C Kimura MD ; Tadeu T Kubo MSc ; Romeu C Domingues MD ; Emerson L Gasparetto MD ; Gustavo Tukamoto

PURPOSE
In patients with NMO standard magnetic resonance images appear normal or demonstrate unspecific T2 hyperintense white matter (WM) lesions. Studies using DTI that depicted several diffusion parameters identified extensive WM lesions. DKI is a new technique that quantifies the deviation from non-Gaussian diffusion behavior of water molecules and that might be more adequate to describe restricted diffusion. The purpose of this study is to evaluate DKI in comparison to DTI in patients with NMO.

METHOD AND MATERIALS
13 patients with NMO and 13 healthy controls underwent MR imaging at 3T. Additionally to sagittal T1W and axial FLAIR sequences, a works-in-progress DKI sequence was measured (30 directions, b=0,1000,2000s/mm2, TR/TE=5300/90, FOV=220mm, matrix=62x62, slicethickness 2.7mm, no gap). Parametric maps of fractional anisotropy (FA), mean diffusion (MD), axial diffusivity (AD), radial diffusivity (RD), mean kurtosis (MK), axial kurtosis (AK) and radial kurtosis (RK) were calculated. All subject data was analyzed using 1)TBSS performing tract-based-spatial-statistics for each parameter and 2)ROI-based statistics by placing manually ROIs in the splenium and body of corpylcalamus (CC), cerebral peduncles (CP), optic radiations (OR) and corticospinal (CS) and performing statistical group analysis (t-test).

RESULTS
TBSS-DKI: Significant reduction in FA in multiple areas (p <0.049) and CC (p=0.031), highly significant increase of MK in right corticospinal tract (p=0.004) and increase in AD in CC (p=0.05).

CONCLUSION
NMO patients showed significant alterations of FA and RD in the CC when compared to controls, in agreement to previous results (Lopes et. al, 2012). DKI presented sensitivity to “occlude” brain tissue damage in normal-appearing WM in RK and MK. An increase in MK may relate to an initial inflammatory process where high cellularity restricts diffusion following non-Gaussian behavior.

CLINICAL RELEVANCE/APPLICATION
The alteration in Diffusion Kurtosis Imaging WM parameters may provide more insight in the specific underlying disease.

**LL-NRS-TU7A • Diffusion Imaging Genomic Mapping Identifies Genomic Targets Involved in Invasion and Poor Prognosis**

Rivka R Colen MD (Presenter) ; Omar Ashour MD ; Pascal O Zinn MD

PURPOSE
To create an imaging genomic map, linking MR imaging traits with gene- and miRNA expression profiles, in patients with GBM to determine genomic correlates of a MR diffusion radiophenotype to possibly find new genomic targets for GBM treatment. Decreased in diffusion in tumors, specifically GBM, is associated with increase in cellular density and high nuclear to cytoplasm (N:C) ratio.

METHOD AND MATERIALS
In patients with GBM (n=21), we performed diffusion imaging genomics to generate an imaging genomic map, linking MR imaging traits with gene- and miRNA expression profiles, in patients with GBM. Diffusion imaging genomics was performed by extracting genomic regions containing targetable genomic biomarkers in GBM.
METHOD AND MATERIALS
We identified 60 treatment-naïve GBM patients from The Cancer Genome Atlas (TCGA) who had both gene- and microRNA expression profiles and pretreatment MR-neuroimaging specifically ADC maps. Two neuroradiologists did morphological analysis of the studies using Slicer 3.6 (slicer.org), where regions of FLAIR hyperintensity, contrast enhancement, and necrosis were segmented to obtain accurate tumor volumetric data. Nordic ICE was used for functional diffusion analysis using the region-of-interest (ROI) and volume segmentation methods. ADC values were calculated. VOIs corresponding to the different FLAIR and post-gad T1 segmented volumes were also analyzed for their median ADC values, as well as through histogram analysis. Biostatistical analysis was performed for gene and miRNA sets, where median ADC value and histogram cutoffs for each morphological region were defined to separate high from low groups and analyzed by Comparative Marker Selection. All the genomic data was also analyzed to determine the most upregulated mRNAs/miRNAs using ingenuity pathway analysis (IPA).

RESULTS
IPA identified molecular networks, as well as canonical and functional pathways highly associated with cancer and invasion in those patients with low ADC values (areas of restricted diffusion).

CONCLUSION
The diffusion radiophenotype identified genes and miRNAs and corresponding molecular networks that were highly associated with tumor invasion. By these means we were able to identify possible key genes and miRNAs involved in the latter regulation. The uncovered genes and miRNAs represent new insight into tumors with restricted diffusion seen on MRI.

CLINICAL RELEVANCE/APPLICATION
The discovery of imaging biomarkers reflecting specific genomic compositions associated with presence of restricted diffusion are clinically relevant as they can determine tumor aggressivity/growth.

LL-NRE-TU9A • Eyes Half Shut: A Pictorial Review of the Causes of Horner Syndrome
Hilary L Purdy MD (Presenter); Michelle M Miller-Thomas MD; Mudassar Kamran MD

PURPOSE/AIM
I. Review the pathophysiology of Horner syndrome including the anatomy of the oculosympathetic pathway. II. Illustrate the causes of Horner syndrome at the level of the first, second, and third order neurons. III. Review an imaging strategy for the evaluation of Horner syndrome based on symptomatology and clinical presentation.

CONTENT ORGANIZATION
I. Horner syndrome
   A. Pathophysiology
   B. Anatomy of the oculosympathetic pathway
II. Comprehensive review of the various causes of Horner syndrome
   A. First order neuron pathology: demyelinating lesions, lateral medullary infarction, syringomyelia, spinal cord trauma
   B. Second order neuron pathology: pancoast tumor, thyroid goiter, metastases
   C. Third order neuron pathology: carotid dissection, carotid pseudoaneurysm, glomus jugulare, neuroblastoma, cavernous sinus thrombosis
III. Imaging strategy for the evaluation of Horner syndrome based on symptomatology and clinical presentation

SUMMARY
Miosis, ptosis, and anhidrosis comprise the classic neurologic syndrome known as Horner syndrome. Resulting from the interruption of the oculosympathetic pathway, the causes of Horner syndrome range from benign to life-threatening. This pictorial review provides insight into the complex anatomy of the neuronal pathway and the diverse causal entities.

LL-NRE-TU9A • Cutaneous Vascular Malformations and Hemangiomas in the Head and Neck: Classification, Imaging Features, and Treatment
Christina Danial BA; Mark D Mamlok MD (Presenter)

PURPOSE/AIM
1. To define the classification of cutaneous vascular malformations and hemangiomas. 2. To illustrate the MR imaging features and pearls for differentiation. 3. To discuss the clinical course and treatment options with support from dermatologic images.

CONTENT ORGANIZATION

SUMMARY
1. Cutaneous vascular malformations and hemangiomas in the head and neck need to be appropriately characterized to streamline ensuing management. 2. High vs low-flow characterization is an important differentiating feature and can be assessed with contrast-enhanced time-resolved MRA. 3. Collaboration with a Vascular Anomalies team composed of clinical subspecialists will provide the best management in these patients with complex diseases.

LL-NRE3148-TUA • Imaging Genomic Mapping in Brain Tumors: An Introduction
Omar Ashour MD (Presenter); Pascal O Zinn MD; Rivka R Colen MD

PURPOSE/AIM
The purpose of this exhibit is to
1. Introduce and detail the concept and history of imaging genomics and imaging genomic mapping in brain tumors,
2. Show the ability of imaging genomics to provide biomarkers that reflect underlying molecular cancer compositions,
3. Illustrate examples of an imaging surrogate and a clinical classification derived from the first large scale study in this field, as well as their clinical significance, and their future implications

CONTENT ORGANIZATION
Background and Emergence of Imaging Genomics Materials and Methods Results of Imaging-genomic Correlation
- MRI-FLAIR as surrogate for Invasion
- VAK Classification

Summary and Future Directions

SUMMARY
The major teaching points of this exhibit are:
1. Imaging genomics/Radiogenomics is a relatively new field which links specific imaging traits (radiophenotypes) with gene-expression profiles, and vice versa,
2. MRI- FLAIR is an imaging surrogate to non-invasively detect specific genomic components responsible for migration and
ECG Pad for Efficient Cardiac MR Gating

Nanda Deepa Thimmappa MD, MBBS (Presenter) ; Mitchell Anthony Cooper ; Silvina P Dutruel MD ; Keigo Kawaji PhD ; Thanh D Nguyen PhD ; Yi Wang PhD

PURPOSE
To assess the feasibility and reliability of ECG gated cardiac MRI with a simplified reusable electrode design that does not touch the skin.

METHOD AND MATERIALS
A silicon positioner holding up to 4 ECG leads was developed to allow detection of ECG signals from the back without requiring shaving, adhesive or even removal of the gown. The patient lies down on the device such that the patient’s weight ensures good contact of the leads against the patient’s gown and electrode Gel diffusing through the gown provides electrical contact with the skin (figure). Leads were tested at 1.5 T (GE Signa EXCITE) using axial double IR, SSFP, fgrt perfusion, delayed IR. 12 subjects (females: 5), mean age: 41 years (27-81yrs) were evaluated with both traditional disposable leads and this reusable ECG pad. Comparison of electrical signals and time for set up was recorded.

RESULTS
The total setup time (initial setup before the scan and the time to take off the leads after scanning) was 7:24 minutes with the leads compared to 4:56 minutes with the pad with a mean difference of 2:28 minutes (31%, p=0.005). The ECG signal and image quality was comparable for the two techniques. Volunteers preferred the ECG pad, finding it to be comfortable and convenient.

CONCLUSION
This simplified approach to ECG gating is more convenient and comfortable for patients without sacrificing ECG signal quality.

CLINICAL RELEVANCE/APPLICATION
Robust and comfortable ECG gating with this reusable silicon lead holder that does not require skin contact improves cardiac gated MRI by eliminating uncomfortable disposable adhesive ECG leads.
CONCLUSION

Conclusion: Patients with the culture negative disc space infection have obvious marrow edema and endplate erosion, more frequency of disc fluid and long complaint days and less frequency of facet fluid. Follow up MR at more than 1 month can find these lesions with significant absorption or shrinkage, while within 1 month follow-up maybe not.

Background

Objective: As many disc space infections are culture negative, as there is increasing evidence that a subgroup of end plate reactive changes actually represent indolent infections, we sought to compare the MR findings of disc space infections with and without positive cultures

Evaluation

Methods: the clinical and MR imaging of 26 patients with disc space infections, of which 9 cases (15 discs) who were blood and local tissue culture negative, and 17 cases (21 disc) who were culture positive, were retrospectively evaluated by two radiologists. All patients had the histological confirmation, the negative group have the follow up MR, performed within 1 month in 5 cases, 1-3 months in 7 and more than 3 months in 5 and responded appropriately to antibiotic treatment; the positive group were histological diagnosis as the acute inflammation. MR findings, epidemiology were compared. Statistical analysis consisted of T and chi squared tests

RESULTS

The classifier’s performance gave an AUC value of 0.93 (SE=0.02) in the task of differentiating mass lesions from non-mass-like enhancement breast lesions. The main lesion features incorporated into the classifier included Sphericity (shape), Time to Peak (kinetic), Variance (texture), Sum Entropy (texture), and Average Gray-Level (texture). Also, incorporation of the pre-processing step in our CADx algorithm yielded a statistical significant improvement in the malignant and benign classification task. AUC values of 0.88 (SE=0.03) and 0.95 (SE=0.02) were obtained in the task of distinguishing between malignant and benign lesions on the entire dataset and mass lesions only (p-value=0.04).

CONCLUSION

Automated quantitative image analyses of breast MRI can yield features sufficient for identifying lesions as mass or non-mass-like lesions prior to application of CADx algorithms.

CLINICAL RELEVANCE/APPLICATION

In order to improve CADx diagnostic accuracy, computer algorithms (as do radiologists) should recognize lesions as mass or non-mass-like lesions prior to assessing likelihood of malignancy.

PURPOSE

To develop a pre-processing method for automatically identifying mass and non-mass-like lesions on breast MRI for subsequent separate analysis in the task of distinguishing between malignant and benign lesions

METHOD AND MATERIALS

Our dataset included 123 biopsy-proven lesions from 103 MRI studies acquired between January 2009 and April 2010, including 35 benign mass, 50 malignant mass, 11 benign non-mass-like and 27 malignant non-mass-like lesions. Each MRI underwent computerized 3D lesion segmentation and feature extraction to extract lesion characteristics of morphology, texture, and kinetics. Our system from the system yielded the probability of the lesion being a mass (as opposed to a non-mass-like lesion) from a Bayesian artificial neural network (BANN). Classification performance was evaluated with a leave-one-case-out method using ROC analysis with area under the ROC curve as the figure of merit.

RESULTS

The classifier's performance gave an AUC value of 0.93 (SE=0.02) in the task of differentiating mass lesions from non-mass-like enhancement breast lesions. The main lesion features incorporated into the classifier included Sphericity (shape), Time to Peak (kinetic), Variance (texture), Sum Entropy (texture), and Average Gray-Level (texture). Also, incorporation of the pre-processing step in our CADx algorithm yielded a statistical significant improvement in the malignant and benign classification task. AUC values of 0.88 (SE=0.03) and 0.95 (SE=0.02) were obtained in the task of distinguishing between malignant and benign lesions on the entire dataset and mass lesions only (p-value=0.04).

CONCLUSION

Automated quantitative image analyses of breast MRI can yield features sufficient for identifying lesions as mass or non-mass-like lesions prior to application of CADx algorithms.

CLINICAL RELEVANCE/APPLICATION

In order to improve CADx diagnostic accuracy, computer algorithms (as do radiologists) should recognize lesions as mass or non-mass-like lesions prior to assessing likelihood of malignancy.

PURPOSE

Patients with ICD may require lead extraction if there is presence of lead fibrosis and calcification but such procedure requires specialist equipment and skills and is associated with high mortality. We investigated the effectiveness of several image acquisition, reconstruction and processing methods for metal artifact reduction in CT to facilitate its use for pre-procedural identification of lead calcification.

METHOD AND MATERIALS

A dual coil ICD lead (St Jude Medical) with radiopaque beads attached was inserted into the right ventricle of an excised pig heart. The heart was filled with water and scanned in approximately the same orientation as in patients with a single energy CT (SECT) protocol using 120 kV, 120 mAs and 0.625 mm collimation on a Discovery 750HD scanner (GE Healthcare). The scan was repeated with a dual energy CT (DECT) protocol using 140/80 kV alternating every 0.2 ms and 210 mAs. Three sets of 0.625-mm-thick cardiac images were generated using the DECT scan data: (1) monochromatic 70 keV, (2) 70 keV plus ASIR (Adaptive Statistical Iterative Reconstruction), (3) 70 keV plus MARS (Metal Artifact Reduction Software, GE). Image set (1) to (3) were used to reduce artifacts from beam hardening, projection noise and projection truncation induced by the lead respectively. Artifacts in each image set were compared against those in the 0.625 mm and 10 mm averaged SECT images.

RESULTS

DECT 70 keV and 70keV+ASIR images manifested intense shading and streaking artifacts that were minimally different from those of the 0.625 mm SECT image and the lead was not visible in all these images. 70keV+MARS image exhibited less artifacts but the lead region was invisible. The 10 mm averaged SECT image showed the least artifacts while the lead with the attached beads was clearly seen.

CONCLUSION

DECT+MARS showed better artifact removal than DECT without MARS or with ASIR suggesting projection truncation was the dominant cause of the lead artifacts. However, MARS is unable to restore the lead image adequately. The averaging method cancelled out the artifacts while restoring the lead image with minimal compromise of the axial resolution.

CLINICAL RELEVANCE/APPLICATION

Lead extraction is complicated and associated with significant mortality and morbidity. The proposed method facilitates the use of CT for assessing lead calcification and the need of lead extraction.

PURPOSE

To develop a pre-processing method for automatically identifying mass and non-mass-like lesions on breast MRI for subsequent separate analysis in the task of distinguishing between malignant and benign lesions
LL-PHS-TU6A • Artifact Analysis in Digital Breast Tomosynthesis (DBT)

Paola Enrica Colombo (Presenter) ; Lorenzo Radici ; Stefano Pasetto ; Annalisa Trianni ; Alberto Torresin MPH

PURPOSE
Digital Breast Tomosynthesis (DBT) systems have been recently introduced. Limited angular sampling is responsible for ghost artifacts in off-focus planes: an object is visible very far from the in-focus plane. In this work a methodology and special designed phantom for full characterization of DBT artifacts are presented and applied to three commercial systems (Hologic, Siemens, IMS).

METHOD AND MATERIALS
The methodology proposed describes the artifacts behaviour in off-focus planes by means of:
- artifact punctual propagation in z-direction using the Artifact Spread Function (ASF) (WU (2004));
- integral information of the dishomogeneity produced by artifact evaluating standard deviation of a suitable ROI containing both ghost feature and background.
- geometric extension in tube-motion direction by measuring artifact line profiles;
A gel phantom containing spherical features of various materials and diameters is developed. Parameters are expressed as function of vertical plane position.

RESULTS
ASF depends linearly on sphere diameter but not on sphere material (contrast) and it is affected on system’s angular range. The Standard Deviation parameter depends on sphere diameter but also on contrast and the trend is different for the three systems. Profiles extension shows different behaviour for the three systems and doesn’t depend on sphere diameter and contrast.

CONCLUSION
ASF, standard deviation of a suitable ROI and profile analysis are an adequate set of measurements to describe artifact behaviour, which depends mainly on system design.

CLINICAL RELEVANCE/APPLICATION
Artifacts are always visible in Digital Breast Tomosynthesis images. Their extent depend mainly on system design.

LL-PHS-TU7A • MR-T2-weighted Signal Intensity: A New Imaging Marker of Prostate Cancer Aggressiveness

Anna Vignati (Presenter) ; Valentina Giannini ; Simone Mazzetti ; Filippo Russo MD ; Christian Bracco PhD * ; Michele Stasi ; Daniele Regge MD

PURPOSE
Improving accuracy of risk assessment in prostate cancer (PCa) patients represents today a compelling clinical need. While it is well know that PCa usually shows a lower signal intensity (SI) than non-neoplastic prostatic tissue on T2-weighted (T2w) magnetic resonance imaging (MRI), its value in differentiating PCA aggressiveness is unknown. The propose of this study is to investigate if T2w SI correlates with the pathological Gleason Score (pGS), the reference standard for measuring the biological activity of PCa.

METHOD AND MATERIALS
The study dataset comprises 31 men (64 y, mean age) with biopsy proven PCa including: 9 men with pGS 3+3 tumours, 11 with pGS 3+4, 5 with pGS 4+3, and 6 with pGS 4+4. All patients underwent multiparametric MRI with a 1.5 T scanner and endorectal coil, including a T2w axial scan (TR/TE, 2960/85 ms; FOV, 16 cm; slice thickness, 3 mm; acquisition matrix, 384 x 288). Data were processed with in-house developed software packages based on C++ algorithms and ITK libraries. First, intensity inhomogeneity correction field was performed by the combination of a phantom intensity profile and a proper median smoothing of the original T2w image. Second, from the central 2D image of the T2w volume, the coil was segmented by a Hough transformation. Finally, a correction field was performed by the combination of a phantom intensity profile and a proper median smoothing of the original T2w image. The Pearson correlation coefficient (R) was calculated to assess if processing a sustainable dose reduction the effective dose values were statistically analyzed with respect to protocol type, diagnostic indication, and patient population.

RESULTS
Mean value ± SD of T2 values for the different pGS group were: 2.63±0.67 for pGS 3+3; 2.19±0.57 for pGS 3+4; 1.74±0.31 for pGS 4+3; 1.81±0.13 for pGS 4+4. R showed a moderate correlation (R=-0.63) between tumours with pGS 3+3 and those with 4+4.

CONCLUSION
Preliminary findings suggest that T2 SI could be a reliable imaging marker to predict PCa risk of progression. T2 SI may be considered as an additional feature in computer-aided diagnosis (CAD) schemes.

CLINICAL RELEVANCE/APPLICATION
An imaging marker of cancer aggressiveness, measurable before surgery, could contribute to stratify patients with PCa according to their progression risk, thus improving individual treatment strategy.

LL-PHS-TU8A • In Ovo Serial Monitoring of Different Organ or Tissue’s Structural Evolvement in Developmental Chicken Embryo Using DTI

Zien Zhou MD (Presenter) ; Weiwei Ma ; Lei Li ; Jia Hua ; Jianrong Xu ; Jiani Hu ; Wenjin Wang ; Yunqi Yan

PURPOSE
Evaluation of 15000 computed tomography (CT) examination to investigate if iterative reconstruction (IR) reduces sustainably radiation exposure.
METHOD AND MATERIALS

Eight fertile Hy-Line White eggs were placed into an automatic digital incubator with temperature (37.8°C) and humidity (60%). From days 6 to 18, five normally developing eggs were scanned every 24 hours (T2WI and DTI). The dual-cooling technique (eggs were cooled at 4°C for one hour before imaging and wrapped in a piece of Techni-Ice during imaging) was used to suppress motion artifact. MR scans were performed using the 3.0 T Philips Achieva System (Philips Medical Systems, Best, Netherlands) with a four-channel dedicated animal coil. The sequence parameters of T2WI and DTI are shown in Table 1. All imaging planes were sagittal. Different organ and tissues (hind limb, gizzard, heart, brain and eye) were recognized according to the anatomical position and signal difference in T2WIs, which were also used to guide the placement of ROIs for DTI analysis. FA was automatically calculated using the Dti-Studio v2.4 software (Johns Hopkins University, USA). Three ROIs were put in each organ or tissue, and the average FA was used as the structural anisotropy of that organ or tissue. The incubation day-dependent changes in structural anisotropy of these organs were obtained according to the average data of all five embryos in every experimental day.

RESULTS

The average FAs of the five eggs in hind limb, gizzard, heart, brain and eye from day 6 to 18 are shown in Table 2. The gizzard in day 6 and the heart in day 6,7,8,9 is too small to be discriminated in DTI. The incubation day-dependent linear regression of structural anisotropy in these organ or tissues is shown in Figure 1. The FA value shows a progressive linear increase in hind limb, gizzard, heart and brain with the increasing days of incubation, and the FA value in eye shows no change. Figure 2 is an example of ROIs drawing in hind limb, gizzard, heart, brain and eye according to T2WI and corresponding FA maps of DTI at incubation day 12,14,17.

CONCLUSION

MRI has the potential to observe the structural development of different organ of tissue in chicken embryo without sacrifice for histological examination.

CLINICAL RELEVANCE/APPLICATION

A widely-available (3.0 T) MRI system can be used as a powerful investigative tool to evaluate embryonic development with DTI.

LL-PHS-TU9A Impact of Breast Glandular Description on Average Glandular Dose and Radiation Risk Assessment in Mammography

Nausikaa Geeraert MSc, DiplPhys (Presenter) ; Remy Klausz DiplEng ; Lionel Desponts PhD ; Serge L Muller PhD ; Isabelle Bloch ; Hilde Bosmans PhD

PURPOSE

Originally introduced by Hammerstein in 1979 for comparing doses delivered with different radiographic techniques to the average breast in mammography, Average Glandular Dose (AGD) is the dosimetry quantity generally recommended for collective risk assessment. Conversion factors from Entrance Surface Air Kerma (ESAK) to AGD were computed by different authors using Monte Carlo computation on reference breast models of homogeneous glandularity. We want to investigate more in detail AGD applicability to individual risk assessment and in particular the influence of the breast glandular quantity and distribution.

METHOD AND MATERIALS

Four semi-cilindrical phantoms are defined. Phantom 1 is the reference breast model used by Dance (1990), i.e. 8 cm radius, 45 mm thick, 10 mm skin, 50% homogeneous glandularity intra-skin. Phantom 2 differs from 1 by a doubled surface (11.3 cm radius), Phantom 3 glandularity is 0%. Phantom 4 has 50% average intra-skin glandularity, but contains a 75 cm² x 3.5 cm region with 59% glandularity embedded in 0% glandularity resulting in a surfacic glandularity (SG) of 75%, a peak glandularity (PG) as used by the automatic exposure control of 46%, a thickness-based glandularity (TG) from tables in Dance (2000) of 41% and an image-based VG of 34% including skin. AGDs are compared for the same exposure (0.45 mm Al Half-Value-Layer) resulting in an AGD of 1mGy for phantom 1.

RESULTS

AGDs are 1mGy (phantoms 1 and 2), 1.2mGy (phantom 3). AGD for phantom 3 is the highest in spite there is no glandular tissue at risk. AGD for phantom 2 is the same as phantom 1; however the quantity of glandular tissue at risk is doubled. AGD of phantom 4 depends on the selected glandularity: 0.90 mGy (SG), 1.03 mGy (PG), 1.05 mGy (TG) and 1.08 mGy (VG).

CONCLUSION

As shown by our phantom studies, AGD does not reflect the individual risk. For AGD computation the glandular content is not correctly described by a single quantity. Recently developed mammographic image-based glandularity computation methods could be used to improve the AGD computation. Moreover access to the description of glandular quantity and distribution will make the practical development of metrics for individual risk assessment possible.

CLINICAL RELEVANCE/APPLICATION

Demonstrate limitations of the current use of AGD and propose improvements to individual radiation risk assessment using image-based volumetric glandularity computations.
Conclusions:
The exact mechanism of GBM metastasis outside the central nervous system is not well understood but likely involves the invasion of structures such as bone, lymphatics, and vasculature, especially veins. Above-average survival time and repeated surgical intervention may place GBM patients at higher risk for these unusual metastases.

**LL-ROS-TU4A • Comparison of Intra-fractional Prostate Shifts with or without an Immobilization Device for the External Beam Radiation Therapy of Prostate Cancer**

**Hiraku Sato** MD (Presenter); **Eisuke Abe**; **Kensuke Tanaka**; **Gen Kawaguchi**; **Kaidu Motoki**; **Hidefumi Aoyama** MD, PhD

**ABSTRACT**

**Purpose/Objective(s):** To evaluate the effect of using an immobilization device on the intra-fractional prostate shifts in the external beam radiation therapy of prostate cancer.

**Materials/Methods:** The subjects were 33 patients with localized prostate cancer treated between November 2010 and February 2013 at our institution. Nineteen patients were treated with a customized vacuum immobilization device in intensity-modulated radiotherapy (IMRT), and fourteen patients were treated without the device in three-dimensional conformal radiotherapy (3D-CRT). Each patient underwent simulation in the supine position using a computed tomography (CT) scanner. Both plans were generated using the Eclipse treatment planning system. All patients were treated on a Novalis-Tx system. In both IMRT and 3D-CRT, after an initial set-up, bony-structure matching was carried out using a fluoroscopy-based set-up system (ExacTrac®). After that, in IMRT, cone-beam CT (CBCT) was taken, and soft-tissue matching using the prostate-rectal interface as a landmark was carried out. A shift of the coordinates of the isocenter was recorded in the anterior-posterior (AP), superior-inferior (SI), and left-right (LR) axes. Post-treatment CBCT was also taken once a week to measure the intra-fractional shift. In 3D-CRT, after every bony-structure matching, pre- and post-treatment CBCTs were taken once a week without soft-tissue matching. In both IMRT and 3D-CRT, the time from pre- to post-treatment CBCT was recorded. Intra-fractional shifts were analyzed using each of the 131 pre- and post-treatment CBCTs in IMRT, and each of the 37 CBCTs in 3D-CRT.

**Results:** The median and standard deviation of the intra-fractional prostate shifts and bony-structure shifts, and the median of the time from soft-tissue matching to post-treatment CBCT, and the time from pre-to post-treatment CBCT were compared (Table 1). There was no significant difference in the intra-fractional prostate shifts between IMRT with the use of the immobilization device and 3D-CRT without the use of the device.

**Conclusions:** In IMRT, despite the fact that time from pre- to post-treatment CBCT was double that needed for 3D-CRT, and despite the larger intra-fractional bony-structure shifts compared with those measured during 3D-CRT, using the immobilization device and soft-tissue matching might minimize the intra-fractional prostate shifts.

<table>
<thead>
<tr>
<th>Intra-fractional shifts</th>
<th>IMRT with the immobilization device (n=131)</th>
<th>3D-CRT without the immobilization device (n=37)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostate shifts</td>
<td>median 6.6 min. (from soft-tissue matching)</td>
<td>median 6.2 min. (from pre-treatment CBCT)</td>
<td></td>
</tr>
<tr>
<td>in AP</td>
<td>-0.3±1.4 mm</td>
<td>0.1±1.7 mm</td>
<td>p=0.20</td>
</tr>
<tr>
<td>in SI</td>
<td>-0.1±1.2 mm</td>
<td>0.2±1.0 mm</td>
<td>p=0.09</td>
</tr>
<tr>
<td>in LR</td>
<td>-0.1±0.7 mm</td>
<td>0.0±1.0 mm</td>
<td>p=0.09</td>
</tr>
<tr>
<td>Bony-structure shifts</td>
<td>median 12.5 min. (from pre-treatment CBCT)</td>
<td>median 6.2 min. (from pre-treatment CBCT)</td>
<td></td>
</tr>
<tr>
<td>in AP</td>
<td>0.8±1.7 mm</td>
<td>-0.5±0.7 mm</td>
<td>p</td>
</tr>
<tr>
<td>in SI</td>
<td>-0.8±1.6 mm</td>
<td>-0.1±0.5 mm</td>
<td>p</td>
</tr>
<tr>
<td>in LR</td>
<td>0.0±0.8 mm</td>
<td>0.1±0.6 mm</td>
<td>p=0.18</td>
</tr>
</tbody>
</table>

**LL-ROS-TUSA • Evaluation of Artifacts Reduction and Image Quality Improvement Using Spectral CT Imaging after 125I Radioactive Particles Implantation**

**Qiuixia Yang** (Presenter); **Rong Zhang**; **Sheng Peng**; **Jing Wu**; **Mingyan He**; **Chuanmiao Xie**; **Fujun Zhang**

**PURPOSE**

To evaluate the performance of artifact reduction and image improvement around particles between monochromatic images with and without MARs after 125I particles implantation compared with polychromatic images.

**METHOD AND MATERIALS**

25 patients (18 males, 7 females, average age: 61, 10 cases of hepatocellular carcinoma, 1 case of cholangiocellular carcinoma, 14 cases of metastatic tumor) after 125I radioactive particles implantation were enrolled in this study. Each patient underwent enhanced spectral CT imaging and after a delay time of 15s, traditional 120kVp scan was performed focus on several slices of particles. Conventional 120kVp images and mono images of 75keV with and without MARs generated from GSI scan acquisition were evaluated. Images were also scored according to the visualization of 125I radioactive particles, artifact severity and surrounding tissue details. Comparison of percentages of diagnostic images (score=3) were performed. Iodine concentration was also used evaluating tissue response around particles. All the measurements were recorded and statistically compared.
RESULTS
There were 45 lesions found in 25 patients. Artifact was visible in 45 cases of traditional 120kVp CT images and 75keV images but invisible in 7 cases of 75keV images with MARs. The proportion of diagnostic images (score=3) for traditional 120kVp images, 75 kV images and 75keV images with MARs was 24.44%(11/45), 48.89%(22/45), 62.22%(28/45), respectively. Compared with 120kVp images, tissue evaluation around particles by using mono images plus mono images with MARs can increase the proportion of diagnostic images from 24.44%(11/45) to 84.4%(38/45). Patients were follow-up confirmed with good-response and it was found that iodine concentration of these 45 lesions were equivalent with normal tissue.

CONCLUSION
75keV images (with and without MARs) obtained with spectral CT imaging can substantially reduce metal artifacts caused by 125I radioactive particles and improve image quality around the particles. Spectral CT can provide more accurate CT images for estimating the efficacy of the treatment after 125I radioactive particles implantation.

CLINICAL RELEVANCE/APPLICATION
Spectral CT showed its potential applications in monitoring disease progressions after 125I radioactive particles implantation.

**LL-ROS-TUSA • The Impact of Baseline Nutrition Status on Treatment Compliance and Toxicities of Adjuvant Chemoradiation in Locally Advanced Gastric Cancer**
Qiwen Li (Presenter) ; Guichao Li MS ; Zhen Zhang ; Yanong Wang ; Ziwen Long ; Xiaowen Liu

**PURPOSE**
Whole breast irradiation (WBI) leads to acute and late toxicities, which can be worse with plan dose inhomogeneities. This has been of particular concern for large breast patients, especially with hypofractionation. Two approaches of 3-D modulation of the radiation beam profile to optimize dose distribution and improve homogeneity are commonly employed. One is field-in-field forward planning wherein up to 3 or 4 subfields are generated within the initial radiation field. The other is inverse-planning IMRT, which typically utilizes 5 or more segments. In this study, we compare dosimetric parameters of WBI using the field-in-field technique with up to 3 subfields (3D-FiF) compared with inverse planning IMRT in large breasted patients.

**METHOD AND MATERIALS**
10 large-breasted patients (planning target volume [PTV] >2500 cc) treated between 2007-13 with WBI in the prone position with hypofractionation (42.4 Gy in 16 fractions) were selected. For each, an inverse planning IMRT and a 3D-FiF plan were created for the entire treated breast. Plans were normalized so that PTV coverage was the same (V95% = 95%). Dose-volume histograms were evaluated for volumes receiving > 105% (V105) and >107% (V107) of prescribed dose, and maximum dose (Dmax).

**RESULTS**
Median PTV volume was 3443cc (2675-3875) and the median separation distance at the chestwall posterior field edge was 25.9cm (23.7-27.3). IMRT significantly (p < 0.05) 3D-FiF can achieve a maximum point dose under 110% of prescribed dose with similar target coverage to IMRT for most large breast patients. However, IMRT can significantly reduce the V105 and V107 in these women. Improved dose homogeneity is expected to provide a meaningful benefit in terms of acute skin toxicities and late breast fibrosis in such large breasted women receiving WBI with hypofractionation, however further study is needed to prove its true clinical benefit.

**CLINICAL RELEVANCE/APPLICATION**
IMRT when compared to 3D-FiF technique can improve dose homogeneity by reducing V105 and V107 for large breast cancer patients treated in the prone position.

**LL-ROS-TUSA • Partial Breast Irradiation Using Stereotactic Body Radiotherapy to Deliver Adjuvant Treatment after Lumpectomy**
Ken Dornfeld (Presenter)

**PURPOSE**
To determine the feasibility and safety of stereotactic body radiotherapy for adjuvant partial breast irradiation after lumpectomy.

**METHOD AND MATERIALS**
Women over 60 years old with T1N0M0 ER+ invasive ductal carcinomas resected with negative margins were invited to participate in a single arm prospective study. Adjuvant partial breast irradiation was delivered using CyberKnife® to a dose of 38.5 Gy in 10 fractions over 5 treatment days. Fiducial markers were placed in proximity to the lumpectomy cavity to account for target motion during irradiation. Tumor control was assessed by standard period exam and imaging. Toxicity was scored clinically using the Harvard and RTOG toxicity scales.

**RESULTS**
16 women were enrolled, 14 completed treatment, one excluded after enrollment due to unacceptably high predicted skin dose after treatment planning, one declined further treatment after two doses. Treatment was delivered using a median of 146 unique beams (range 77-172). Median follow up is 12 months. RTOG scores for skin toxicity at the most recent assessment compared to pre-irradiation worsened for 5 patients, improved for one patient and was stable for 9 patients. RTOG scores for subcutaneous toxicity worsened for 5 patients and were stable for 9 patients compared to pre-irradiation assessments. Overall cosmetic scores remain stable for 11 patients and worsened slightly for 3 patients. Clinical toxicity scores for most patients reached a peak at 1 month post-treatment with subsequent improvement. Lumpectomy volumes ranged from 5 ccs to 135 ccs with a median of 37 ccs. The patient with the largest target volume developed a hematoma 3 months after radiation treatment. She underwent evacuation and is now doing well. No other significant toxicities were encountered. No recurrences have been noted.

**CONCLUSION**
Follow up is short but stereotactic body radiotherapy appears a safe and effective alternative for partial breast irradiation. Side effects may be dependent on lumpectomy volume and location.
A retrospective descriptive study using data from the imaging guided biopsies register from 2011-2012. Eighty patients presented subsequent appearance of indeterminate lesions and underwent percutaneous image-guided biopsy. The histopathologic result were obtained and compared with the primary malignancy.

RESULTS
From the 80 patients included, 83.7% were positive for recurrent metastatic disease and 15% were positive for second primary cancer. Among the patients that presented a secondary primary tumor 66% had history of breast cancer, being gastric cancer the most common secondary malignancy. None of the patients were negative for malignancy. The most common primary cancer was breast cancer followed by cervical cancer. Frequently subsequent lesions sites were lung, mediastinum and ovaries.

CONCLUSION
Image guide percutaneous biopsy of subsequent lesions is justified on the basis of the risk of being a second primary tumor, instead of assuming to be secondary to the known primary tumor.

CLINICAL RELEVANCE/APPLICATION
Considering the risk and distinguishing whether new lesions represents a metastasis or a second cancer is important in terms for treatment and prognosis.

LL-VIS-TU2A ● The Combined Effect of Hypertension and Type-2 Diabetes Mellitus on Aortic Stiffness and Brachial Endothelial Dysfunction: An Integrated Study with 3.0T MRI
Yan Shan (Presenter) ; Jiang Lin MD, PhD ; Pengju Xu ; Mengsu Zeng MD, PhD

PURPOSE
The purpose of this study was to investigate the combined effect of hypertension and type-2 diabetes mellitus (DM2) on aortic stiffness and endothelial dysfunction by using an integrated 3.0 T MRI approach.

METHOD AND MATERIALS
A total of 31 non-hypertensive DM2 patients(mean age 55.4±8.5 years; 19 male, 12 female) and 31 hypertensive DM2 patients (mean age 58.3±6.1 years; 18 male, 13 female) underwent noninvasive 3.0 T MRI. Aortic distensibility(AD), aortic arch pulse-wave velocity (PWV) and brachial artery flow-mediated dilation (FMD) were assessed. Independent-Samples t-test and the Mann-Whitney U test were used to compare variables between groups as appropriate, while the chi-squared test was used for categorical variables. Pearson correlation analysis was performed to determine the relationship between measured parameters and to analyse the association between measured parameters and blood pressure. Univariable and multiple linear regression was used to determine the independent predictors of the measured parameters.

RESULTS
Compared with the non-hypertensive patients, the hypertensive patient showed lower AD at multiple levels (ascending aorta(AA): 2.07±0.98 ×10^{-3} mm Hg^{-1} vs. 3.21±1.70 ×10^{-3} mm Hg^{-1}, p=0.001 vs. 3.58±1.47×10^{-3} mm Hg^{-1} , p=0.001 vs. 4.27±1.75 ×10^{-3} mm Hg^{-1}, p

CONCLUSION
Hypertension has a contributive effect on aortic stiffness and endothelial dysfunction in DM2 patients. Direct quantification of both aortic stiffness and endothelial dysfunction using one-stop high-resolution MRI may help stratify cardiovascular risks in DM2 patients.

CLINICAL RELEVANCE/APPLICATION
Our results suggested that high-resolution MRI may help stratify cardiovascular risks in DM2 patient with direct quantification of both aortic stiffness and endothelial dysfunction.

LL-VIS-TU3A ● Percutaneous Catheter Drainage versus Needle Aspiration for Pyogenic Liver Abscess: A Meta Analysis
Zhihui Chang BMEdSc, MMed (Presenter) ; Zhaoyu Liu ; Zaiming Lu MD ; Qiyong Guo MD

PURPOSE
To assess the effectiveness of Percutaneous catheter drainage(PCD) versus needle aspiration for patients with pyogenic liver abscess. This will be determined by the effects on treatment success rate, mortality rate and total hospital stay.

METHOD AND MATERIALS
MEDLINE, EMBASE, Cochrane library and some other databases, from January 1966 to March 2013, were searched for initial studies. We planned to include data from randomized controlled trials(RCTs) comparing the effectiveness of PCD and needle aspiration in the treatment of pyogenic liver abscess. Two authors independently extracted the data and assessed trial quality. Trialists were contacted to obtain missing information.

RESULTS
Two randomised clinical trials were eligible for inclusion in this review. Both trials compared PCD versus needle aspiration for pyogenic liver abscess. The trials included a total of 124 patients. There was no statistically significant difference between the two groups for treatment success rate (RR 1.14, 95% CI 0.98 to 1.32).The total hospital stay was about three days shorter (weighted mean difference (WMD), random effects -3 days, 95% CI -3.9 to -2.3) in the needle aspiration group compared with the PCD group. There was no mortality in both of the trials.

CONCLUSION
No significant differences were observed in treatment success rate and mortality rate between PCD and needle aspiration. Needle aspiration is associated with a significantly shorter hospital stay compared with the PCD. However, this cannot be recommended routinely based on the limited available evidence. More randomised clinical trials are needed to address these issues.

CLINICAL RELEVANCE/APPLICATION
Needle aspiration is probably as effective as percutaneous catheter drainage for the treatment of pyogenic liver abscess.

LL-VIS-TU4A ● ECG Gated Thoracic Computed Tomography Angiography with Individualized Contrast Protocol: Effects on Radiation Dose and Image Quality
Charbel Saade MS (Presenter) ; Ali A Haydar MD, FRCR ; Fadi M El-Merhi MD ; Mukbil H Hourani MD

PURPOSE
To investigate a reduced contrast protocol and its effects on radiation dose and image quality during gated thoracic CTA.

METHOD AND MATERIALS
Gated thoracic CTA was performed in 100 patients with acute aortic syndrome using a 64 channel computed tomography scanner and a dual barrel contrast injector. Patients were subjected in equal numbers to one of two contrast regimens. Patient age and gender were equally distributed across both groups. Regimen A, the department's standard protocol, consisted of a caudocranial scan direction with 120 mL of contrast intravenously injected at a flow rate of 4.5 mL/s; Regimen B involved a caudocranial scan direction with a novel contrast formula based on measured patient cardiovascular dynamics, using 50 mL of saline at 4.5 mL/s. The mean cross-sectional opacity of nine anatomical segments within the thoracic aorta and two within thoracic veins were measured for each patient and arteriovenous contrast ratio (AVCR) calculated. Regimens were compared using Mann-Whitney U non-parametric statistics. Receiver operating characteristic (ROC) analysis and visual grading characteristic (VGC) was performed.

RESULTS
Mean vessel opacification in the segments of the ascending aorta, transverse, and descending aorta were up to 18% higher (p < 0.05).

CONCLUSION
Caudocranial scan direction, reduced contrast volume, and injection timing based on vessel dynamics can significantly improve vessel opacification and visualization, whilst reducing radiation dose.

CLINICAL RELEVANCE/APPLICATION
Matching contrast injection timing with vessel dynamics significantly improves vessel opacification, reduces contrast and radiation dose in the assessment of acute aortic syndrome.

LL-VIS-TUSA • Clinical Application of Lower Extremity Arterial CT Angiography Using a Low Concentration Contrast Agent (270 mg I/ml): A Preliminary Study

Xie Dexuan (Presenter) ; Zhang Jinling ; Xiao Xigang MD ; Jia Yulin MD

PURPOSE
To investigate the feasibility of lower extremity arterial CT angiography with a low concentration contrast agent (270 mg I/ml).

METHOD AND MATERIALS
5 patients with lower extremity atherosclerosis for treatment in vascular surgery were selected undergo CTA on an HDCT(Discovery CT750 HD, GE, USA). 100 to 130 ml of the 270 mg I/ml concentration contrast agent was injected intravenously with the flow rate of 3.5-4 ml/s, followed by 40 ml of saline. Scan started at 4s after the CT value in the popliteal artery reached the threshold of 100HU. Scanning parameters included 80kV, automatic tube current modulation, rotation time of 0.8s, pitch of 1.375:1. Images were reconstructed with 50%ASIR. A 3-point ranking scale was used to assess the image quality of the 21 anatomic segments with score of 1 for strong homogenous enhancement of all the lower arterial segments and weak venous enhancement; 2 for the fading of the contrast enhancement of all arterial segments with no or weak venous enhancement of superficial or deep veins. 1 for the absent of contrast enhancement in some parts of the arterial segments, or strong venous enhancement of superficial or deep veins. A score of =2 was considered as diagnostically acceptable. The vascular enhancement was assessed quantitatively by measuring the CT value in the regions of interest (ROIs) positioned within the vessel lumen.

RESULTS
100 of the 105 lower extremity artery segments were scored =2 for the evaluable rate of 95.23%. The average CT values for the abdominal aorta, iliac artery, femoral artery, popliteal artery and tibial artery was 406±23HU, 413±37HU, 379±56HU, 342±49HU, 296±73HU respectively.

CONCLUSION
It is feasible to achieve good image quality for lower extremity arterial CTA using 270mg I/ml contrast agent in combination with 80kV low dose scanning.

CLINICAL RELEVANCE/APPLICATION
The image quality for lower extremity arterial CTA using 270mg I/ml contrast agent is as good as the high concentrations one. It may be applied as a routine protocol for patients with PAD.

LL-VIE-TU6A • Percutaneous Radiologic Placement of Continuous Ambulatory Peritoneal Dialysis (CAPD) Catheters: ‘How to Do It’

Young Ho Kwon (Presenter) ; Se Hwan Kwon MD ; Joo Hyeong Oh MD

PURPOSE/AIM
To review the techniques of percutaneous radiologic placement of continuous ambulatory peritoneal dialysis (CAPD) catheters, potential complications, and management of complications associated with these catheters.

CONTENT ORGANIZATION
a. Introduction and background of CAPD
b. Type of CAPD catheters
c. Preprocedure evaluation (Anatomy, Indications and Contraindications)
d. Techniques of percutaneous radiologic placement of CAPD catheters
e. Postprocedure management
f. Complications and radiologic management

SUMMARY
This exhibit will review
a. The general concept of percutaneous radiologic placement of CAPD catheter
b. The technique of percutaneous radiologic placement of CAPD catheter
c. The complication and management of CAPD catheter

LL-VIE-TU7A • Sacroplasty: šCæA Remedy for Pains in the Butt?šÇ½ś?

Malay Bhatt (Presenter) ; Katie Adler BS, DO ; Lisa A Strand RN ; Brandt C Wible MD *

PURPOSE/AIM
Sacroplasty may be applied as a routine protocol for patients with PAOD.

CLINICAL RELEVANCE/APPLICATION
Caudocranial scan direction, reduced contrast volume, and injection timing based on vessel dynamics can significantly improve vessel opacification, reduces contrast and radiation dose in the assessment of acute aortic syndrome.

CONCLUSION
Mean vessel opacification in the segments of the ascending aorta, transverse, and descending aorta were up to 18% higher (p < 0.05).

CONCLUSION
Caudocranial scan direction, reduced contrast volume, and injection timing based on vessel dynamics can significantly improve vessel opacification, whilst reducing radiation dose.

CLINICAL RELEVANCE/APPLICATION
Matching contrast injection timing with vessel dynamics significantly improves vessel opacification, reduces contrast and radiation dose in the assessment of acute aortic syndrome.

LL-VIS-TUSA • Clinical Application of Lower Extremity Arterial CT Angiography Using a Low Concentration Contrast Agent (270 mg I/ml): A Preliminary Study

Xie Dexuan (Presenter) ; Zhang Jinling ; Xiao Xigang MD ; Jia Yulin MD

PURPOSE
To investigate the feasibility of lower extremity arterial CT angiography with a low concentration contrast agent (270 mg I/ml).

METHOD AND MATERIALS
5 patients with lower extremity atherosclerosis for treatment in vascular surgery were selected undergo CTA on an HDCT(Discovery CT750 HD, GE, USA). 100 to 130 ml of the 270 mg I/ml concentration contrast agent was injected intravenously with the flow rate of 3.5-4 ml/s, followed by 40 ml of saline. Scan started at 4s after the CT value in the popliteal artery reached the threshold of 100HU. Scanning parameters included 80kV, automatic tube current modulation, rotation time of 0.8s, pitch of 1.375:1. Images were reconstructed with 50%ASIR. A 3-point ranking scale was used to assess the image quality of the 21 anatomic segments with score of 1 for strong homogenous enhancement of all the lower arterial segments and no venous enhancement; 2 for the fading of the contrast enhancement of all arterial segments with no or weak venous enhancement of superficial or deep veins. 1 for the absent of contrast enhancement in some parts of the arterial segments, or strong venous enhancement of superficial or deep veins. A score of =2 was considered as diagnostically acceptable. The vascular enhancement was assessed quantitatively by measuring the CT value in the regions of interest (ROIs) positioned within the vessel lumen.

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It is feasible to achieve good image quality for lower extremity arterial CTA using 270mg I/ml contrast agent in combination with 80kV low dose scanning.

CLINICAL RELEVANCE/APPLICATION
The image quality for lower extremity arterial CTA using 270mg I/ml contrast agent is as good as the high concentrations one. It may be applied as a routine protocol for patients with PAD.
Meaningful Use: Experience from Private Radiology Practices

Tuesday, 12:30 PM - 02:00 PM • S501ABC

ICII32 • AMA PRA Category 1 Credit ™ • ARRT Category A+ Credit:1.5 • Moderator: J. Raymond Geis, MD

James Whitfill, MD • Alberto P Goldszal, PhD, MBA

Alan D Kay, Presenting

LEARNING OBJECTIVES
1) Learn how various radiology practices have approached Meaningful Use to date. 2) Understand the challenges of achieving Meaningful Use compliance with existing vendor products available today. 3) Explore ways to participate with either your hospital or multi-specialty practice to achieve Meaningful Use. ABSTRACT

Display Technology Tuesday, 12:30 PM - 02:00 PM • S401AB

ICII32 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5 • David S Hirschorn, MD

Michael J Flynn, PhD

Elizabeth A Krupinski, PhD

Appreciate that displays have undergone significant changes in recent years - primarily a shift towards incorporating color displays into primary interpretation environments, using pairs of displays (2MP or 3MP) vs double wide displays (4MP or 6MP), and total number of pixels to pixel impact and the impact that has of which display you need to buy. 2) Understand the importance of assessing and balancing the key physical properties of displays when engaged in the purchasing process. ABSTRACT Displays have undergone significant change over the past 3-4. Specifically, the changeover to mostly color displays, including why some are resistant to the change, using pairs of displays (2MP or 3MP) vs double wide displays (4MP or 6MP), the shift of focus from total number of pixels to pixel impact and the impact that has of which display you need to buy (e.g., 2 MP vs 3MP, which is almost double the price), the need for replacement of requiring 5 MP for mammography, special needs for tomosynthesis (need short response time for high frame rate, i.e., video sequence) which is relatively new, benefits of centralized monitoring of a fleet of displays (conformance, especially in light of new state laws requiring such records, and even things like properly budgeting for end of life equipment). What is in the future for displays - touch screens, organic LEDs which have astounding contrast ratios because the blacks are so black (which is not always a good thing). Displays are the only special hardware of PACS that radiologists look at all day long and it is important to understand their features in order to optimize them and make the best purchasing decision.

Molecular Imaging - Tuesday Posters and Exhibits (12:45pm - 1:15pm) Tuesday, 12:45 PM - 01:15 PM • S503AB

ICII32 • AMA PRA Category 1 Credit ™:0.5 • James Whitfill, MD • Moderator: J. Raymond Geis, MD

Felix Nensa MD • Thorsten D Poeppel • Ercan Tezgah • Philipp Heusch MD • Kai Nassenstein • Thomas W Schlosser MD

PURPOSE
To design and implement a method for quantification and comparison of myocardial 18F-FDG uptake and late gadolinium-enhancement (LGE) in cardiac PET/MRI and to assess its feasibility in patients with acute myocardial infarction (AMI).

METHOD AND MATERIALS
Volumetric PET data and segmented 2D inversion recovery Turbo-FLASH sequences for the assessment of myocardial LGE in contiguous short-axis views were simultaneously acquired on an integrated 3 Tesla PET/MRI system in 10 patients with AMI. PET data was registered to match the slice thickness used for the LGE images using OsiriX imaging software (OsiriX Foundation, Geneva, Switzerland). The left ventricular myocardium (LVM) was delineated in LGE images and the resulting regions of interest were transferred to the corresponding PET images. LVM areas showing LGE were detected using an automated thresholding algorithm. Cylindrical sampling perpendicular to the long-axis was performed in all PET and LGE slices (100 segments/slice). The fraction of enhancing myocardium was calculated for each segment in LGE images. The mean standardized uptake values (SUVmean) were calculated for each segment in LGE images normalized with the maximum standardized uptake value (SUVmax) of the entire left ventricle. The sampled data was mapped to color space using lookup tables and rendered into polar coordinate system plots. Segment wise inter-method correlation was calculated using weighted Spearman's rank correlation ?. Binary inter-method agreement in infarct delineation was calculated using Cohen's ?.
RESULTS
The software successfully produced visually conclusive LGE and PET polar plots in all examinations. A negative segment wise correlation between LGE fraction and SUV mean with moderate to good correlation coefficients ($\tau$: -0.47 to -0.74) was found. Binary inter-method agreement was substantial ($\tau$=0.63) to very good ($\tau$=0.81).

CONCLUSION
A new software for the standardized and semi-automatic translation of image data from two inherently different cardiac imaging modalities into a unified data representation was created. This enables consistent and reproducible comparison of LGE and PET on a visual and quantitative level in simultaneously acquired PET/MRI data.

CLINICAL RELEVANCE/APPLICATION
The introduction of cardiac imaging on integrated PET/MR devices requires new tools allowing for the cohesive interpretation of PET and MR images based on a unified data representation.

CL-MIS-TU3B • Patterns of MR Dynamic Susceptibility-weighted Contrast Enhanced MR Perfusion Imaging and Diffusion Tensor Imaging in Patients with Progressive/Recurrent Glioblastomas after Bevacizumab Treatment

Xiang Liu MD (Presenter); Wei Tian MD, PhD; Ali Hussain MD, FRCR; Sven E Ekholm MD

PURPOSE
Bevacizumab-induced MRI changes are still full of conflicting controversies, including findings of advanced imaging techniques of MR dynamic susceptibility-weighted contrast enhanced MR perfusion imaging (DSC-PWI) and diffusion imaging. The purpose of this study was to evaluate patterns of DSC-PWI and diffusion tensor imaging (DTI) in patients with progressive/recurrent glioblastomas after Bevacizumab treatment.

METHOD AND MATERIALS
52 cases with pathology or radiological confirmed progressive/recurrent glioblastomas after Bevacizumab treatment were reviewed. Serial DSC-PWI and DTI examinations were performed after Bevacizumab treatment. The maximal rCBV ratios and minimal apparent diffusion coefficient (ADC) value in the examinations when the glioblastomas presenting minimal enhancement after Bevacizumab treatment and recurrence/progression were evaluated.

RESULTS
The mean maximal rCBV ratio of reference in glioblastomas after Bevacizumab treatment was 1.65±0.52; there were 41 patients with the mean maximal rCBV ratio of recurrent/progressive glioblastomas was significant higher, 6.11±4.58, p value of paired t test was 0.013. There were 11 patients whose maximal rCBV ratio at recurrence/progression was relative lower, 1.26±0.29, without significant difference compared to reference, p =0.71. All patients showed new restricted diffusion after Bevacizumab treatment. The mean minimal ADC value of reference was 0.49±0.17, the mean minimal ADC value of 41 and 11 patients at recurrence/progression were 0.63±0.19 and 0.71±0.57 respectively, and there was no significant difference compared to reference, p value of 0.22 and 0.09 respectively.

CONCLUSION
There are different patterns of MR PWI/DTI changes in recurrent/progressive glioblastomas after Bevacizumab treatment. Combing multiple imaging biomarkers is necessary for imaging interpretation.

CL-MIS-TU4B • 1HMRS Characteristics of Cerebral Alveolar Echinococcosis

Jian Wang (Presenter)

PURPOSE
Purpose: To evaluate the 2D multi-voxel proton magnetic resonance spectroscopy (1HMRS) Characteristics in patients with Cerebral Alveolar Echinococcosis (CAE).

METHOD AND MATERIALS

RESULTS
Multi-voxel 1HMRS can reflect pathological characteristics of CAE. 1HMRS provides metabolic information for diagnosis of CAE and may be a necessary supplement of routine magnetic resonance examination.

CLINICAL RELEVANCE/APPLICATION
Understanding patterns of MR PWI/DTI changes in patients with recurrent/progressive glioblastomas after Bevacizumab treatment is important for imaging diagnosis and clinical management.

CL-MIS-TU3B • 1HMRS Characteristics of Cerebral Alveolar Echinococcosis

Padma Priya Manapragada MD; Devaki Shilpa Surasi MD; Fathima Fijula Palot Manzil MBBS; Janis P O'Malley MD; Samuel E Almodovar- Reteguis MD (Presenter)

PURPOSE/AIM
Main aims of this presentation are to review the physical/chemical properties of alpha particles, to discuss alpha particle emitters used in clinical practice and to provide an overview of newer treatment agents currently being developed. Radiation safety concerns regarding the use and disposal of alpha emitter radiopharmaceuticals will also be reviewed.

CONTENT ORGANIZATION
1. Introduction and overview of alpha decay and properties of alpha emitters.
2. Historical perspective of alpha particle mediated therapies.
3. Review of currently used alpha particle emitters, including clinical indications and their role in oncologic management. Specifically, this presentation will discuss clinical applications of Astatine 211, Bismuth 212, Actinium 225, Radium 223 and Lead 212.
4. Overview of future alpha particle emitter radiopharmaceuticals currently under development.
5. Discussion of radiation safety considerations pertinent to alpha particle mediated therapies.

SUMMARY
This presentation will provide a better understanding of the growing role of alpha emitters, particularly in the treatment of cancer, and radiation safety considerations pertinent to this therapies.

CL-MIS-TU1B • FDG Uptake Heterogeneity Evaluated by Fractal Analysis Improves the Differential Diagnosis of Pulmonary Nodules

China Chemistry - Tuesday Posters and Exhibits (12:45pm - 1:15pm) Tuesday, 12:45 PM - 01:15 PM • SS03AB Back to Top
CL-NMS-TU3B • 44C-[methyl-11C]thiothymidine (4DST) PET for Proliferation Imaging in Head and Neck Cancer: Comparison with 18F-FLT PET

Yuka Yamamoto MD, PhD (Presenter) ; Yukito Maeda ; Yoshihiro Nishiyama MD

PURPOSE
Although 3'-deoxy-3'-18F-fluorothymidine (FLT) has been used for imaging cell proliferation with PET, it is not incorporated into DNA. A new tracer, 4'-[methyl-11C]-thiothymidine (4DST), has been developed as an in vivo cell proliferation marker based on the DNA incorporation method. The purpose of this study was to investigate the feasibility of 4DST PET, compared with FLT PET, for the detection of head and neck cancer.

METHOD AND MATERIALS
Five patients with head and neck squamous cell carcinoma were examined with both 4DST PET and FLT PET. Tumor lesions were identified as areas of focally increased uptake, exceeding that of the surrounding normal tissue. PET results were evaluated by visual and semi-quantitative analyses. For semi-quantitative analysis, the maximal standardized uptake value (SUV) was determined from each lesion.

RESULTS
4DST uptake in tumors peaked before 3 minutes and reached a constant level at approximately 10 minutes after injection. Physiological uptake in salivary glands of 4DST was stronger than that of FLT. Both 4DST PET and FLT PET detected all head and neck tumors. There was no significant difference between the mean (±SD) value of SUV in the tumor using 4DST PET (8.00±5.03) and FLT PET (10.63±10.29). A significant correlation was observed between SUV in the tumor on 4DST PET and FLT PET (r=0.959, P<0.001).

CONCLUSION
These preliminary results indicate that 4DST PET is a potentially useful tracer for proliferation imaging in head and neck cancer.

CL-NMS-TU4B • RAIU Underestimation due to off Axis Thyroid Positioning

Sean Reynolds MD (Presenter) ; James B Allison MD ; Marleen Moore MS ; Christin E Young ; Janusz K Kikut MD

PURPOSE/AIM
The effect on radioiodine uptake (RAIU) related to displacement of the thyroid off the thyroid probe axis will be demonstrated.

CONTENT ORGANIZATION
Advances in ultrasound and thyroid assays led to decline in utilization of scintigraphy. RAIU is still used to calculate I131therapeutic dose for the hyperthyroid. A thyroid probe with NaI crystal and flat field collimator is commonly used. It produces flat isoresponse probe axis will be demonstrated.

RESULTS
Physiological uptake in salivary glands of 4DST was stronger than that of FLT. Both 4DST PET and FLT PET detected all head and neck tumors. There was no significant difference between the mean (±SD) value of SUV in the tumor using 4DST PET (8.00±5.03) and FLT PET (10.63±10.29). A significant correlation was observed between SUV in the tumor on 4DST PET and FLT PET (r=0.959, P<0.001).

CONCLUSION
These preliminary results indicate that 4DST PET is a potentially useful tracer for proliferation imaging in head and neck cancer.

CL-NMS-TU5B • Value of 11C-choline PET/CT for Lymph-node Staging in Patients with High and Intermediate Risk Primary Prostate Cancer or Biochemical Relapse: A Retrospective Analysis with Histopathological Correlation

Christina Pfannenberg MD ; Michael Brosi ; Sergios Gatidis MD (Presenter) ; Cornelia Brendle MD ; Bernhard Klumpp MD ; Nina Schwenzer MD ; Claus D Claussen MD ; Daniel Zips ; Arndt-Christian Muller ; Matthias Reimold MD

PURPOSE
To evaluate the accuracy of 11C-Choline PET/CT for preoperative lymph-node (LN) staging in patients (pts) with prostate cancer (PCA) or PSA relapse and to compare it with histological results after extended lymph-node dissection (eLND).

METHOD AND MATERIALS
Retrospective analysis of 22 pts (mean 64y, range 51-75y) with histologically proven primary PCA (n=16, 13 high risk, 2 intermediate risk, 1 low risk) and 29% risk of nodal involvement (Roach formula) or biochemical relapse (n=6). All pts underwent preoperative 11C-Choline PET/CT with a standard protocol (600 MBq, uptake time 5 min, 3min/bed, contrast-enhanced CT) and a
Quantification of Brain Phenylalanine Levels in Hyperphenylalaninemia Patients by MRS at 3T: A Preliminary Report

Ali Yusuf Oner MD (Presenter) ; Aynur Kucukcongar ; Murat Ucar ; Fatih Ezgu ; Turgut E Talı MD *

PURPOSE
Hyperphenylalaninemia (HPA) is an inborn error of metabolism in which the hydroxylation of phenylalanine (Phe) to tyrosine is disturbed. Accumulation of Phe leads to severe mental and psychomotor retardation. Magnetic resonance spectroscopy (MRS) is a non-invasive method to quantitate Phe concentration in HPA patients. The aim of this study is to investigate the correlation between blood and brain Phe levels, before and following treatment in HPA patients.

METHOD AND MATERIALS
Intestinal review board approval and informed consent was obtained from all patients. Totally ten patients diagnosed with HPA were studied, including five boys and five girls (age ranging from 2 to 19 years). The patients were divided into two groups: Tetrhydrobiopterin (BH4) responsive (n = 4) and non-responsive (diet group, n = 6). Multivoxel MRS at 3T were performed to measure brain Phe levels using creatine as an internal reference in all patients, before and after treatment (Phe-restricted diet or BH4). Blood Phe levels were simultaneously measured by High-performance liquid chromatography.

RESULTS
The blood Phe levels were found to be statistically significant between pre and post-treatment measurements in all cases (p = 0.008). Following treatment, brain Phe levels in the diet group were found to be significantly decreased (p=0.027). For the second group there was no statistically significant difference between two brain Phe measurements recorded (p=0.068). Significant positive correlation between blood and brain Phe level was present for both group, but with only statistically significance in the diet population.

CONCLUSION
MRS can be used to non-invasively quantitate intracerebral Phe concentrations in HPA patients. Preliminary findings suggest that interindividual variations in the kinetics of Phe uptake and metabolism do exist. MRS can therefor provide proper objective standards for better diagnosis and treatment of HPA patients.

CLINICAL RELEVANCE/APPLICATION
Quantification of brain Phe is important in treatment monitoring of HPA patients. MRS can be used in non-invasive evaluation of brain Phe levels in this patient population.

Dual Source Pediatric Cardiac Computed Tomography-Techniques and Radiation Dose

Torel Ogur MD ; Patrick T Norton MD (Presenter) ; Juan Carlos Ramirez Giraldo PhD ; Klaus D Hagspiel MD *

PURPOSE
To compare the radiation dose and image quality of pediatric cardiac computed tomography angiography (CCTA) examinations using existing scan modes on dual source (DS) scanners.

METHOD AND MATERIALS
CCTA scans of 56 pediatric patients (age range 1d - 18yrs, mean 7.8±7.9 yrs) were reviewed retrospectively. Scans were performed on first or second generation DS CT systems. Scans were divided into 3 groups according to scan mode: retrospective ECG-gated helical (RETRO) (n=33), prospective ECG-triggered sequential (PR0) (n=8) and high-pitch spiral (FLASH) (n=15). The impact in
radiation dose of automated dose-optimized selection of x-ray tube voltage (CARE kV), available in second generation DS scanner, was also assessed, relative to manual tube voltage selection in first generation DS. Size-specific dose estimate (SSDE) and effective dose were calculated. Image quality was assessed qualitatively by two radiologists on a 5 point Likert scale.

RESULTS
For RETRO scans, PRO scans and FLASH scans the mean effective dose values (mSv) were 3.90±2.98, 3.33±2.13, and 2.01±1.05 and mean SSDE values (mGy) were 13.90±9.52, 13.85±12.14, and 4.23±2.69. The differences in effective doses between RETRO and FLASH modes were statistically significant (p Conclusion
Using high pitch spiral mode, low RD pediatric DS CCTA can be performed without sacrificing quality. The use of automated dose-optimized selection of kV resulted in the lowest doses.

CLINICAL RELEVANCE/APPLICATION
When using DS scanners for pediatric cardiac CTA, high pitch spiral mode and automatic kV selection should be employed to produce high quality examinations with the minimal radiation dose possible.

CL-PDS-TU4B • Diagnostic Accuracy of Ultrasonography (US) Examination for the Evaluation of Nutcracker Syndrome (NS): Comparison with Multidetector-row Computed Tomography (MDCT) as a Reference Standard

Minho Park MD; Sung Kyoung Moon (Presenter); Seong Jin Park MD, PhD; Joo Won Lim; Dong Ho Lee MD; Young Tae Ko MD, PhD

PURPOSE
To assess the diagnostic accuracy of US for the evaluation of pediatric NS patients with urinanalysis abnormality (UA) compared with MDCT as a reference standard.

METHOD AND MATERIALS
This study included 66 pediatric patients with UA who underwent MDCT and US for the past 7 years. Eighteen patients with other biopsy-proven or clinically diagnosed renal diseases were excluded. MDCT and US images of 48 patients were reviewed retrospectively. By CT, AP diameters of the left renal vein (LRV) at the hilum (CDh) and aortomesenteric space (AMS, CdA) and the diameter ratio (CDh/a) were assessed. The presence of a beak sign of LRV at AMS and corticomedullary enhancement difference between both kidneys (CMD) in the portal phase were assessed. Patients were grouped as Gr 1 (high NS probability) and Gr 2 (low NS probability) according to the following CT criteria: 1) CDh/a>4; 2) presence of beak sign; and 3) presence of CMD. Patients with two or more criteria were categorized as Gr 1. By US, the AP diameters of LRV at the hilum (UDa) and AMS (UDa), diameter ratio (UDa/a), flow velocity at the hilum (Vh) and AMS (Va), and flow velocity ratio (Vh/a) were assessed. Twenty-four-hour urine proteinuria tests and US parameters were compared using an independent t-test.

RESULTS
Gr 1 and 2 comprised 30 and 18 patients, respectively. The mean CDh, CdA, and CDh/a in Gr 1 were 9.9±1.2 mm, 1.9±0.5 mm, and 5.9±3.2 mm, respectively. The mean CDh, CdA, and CDh/a in Gr 2 were 9.0±1.5 mm, 2.9±0.8 mm, and 3.4±1.1 mm, respectively. A significant difference existed in the 24-h urine proteinuria level between the groups (p=0.05). Vh, Va, and Vh/a showed no significant difference (Gr 1 vs. Gr 2: 22.5±7.6 cm/s vs. 22.0±6.7 cm/s, 135.0±30.4 cm/s vs. 122.1±37.7 cm/s, and 7.8±9.0 cm/s vs. 5.9±3.2 cm/s, respectively; P>0.05).

CONCLUSION
Based on MDCT, precise diagnosis of NS by US is difficult. Thus, US should be performed with care in patients who may have NS.

CLINICAL RELEVANCE/APPLICATION
When NS is doubtful in US, MDCT should be considered for a more accurate diagnosis, even in pediatric patients.

CL-PDS-TU5B • Specific Features of Pediatric Crohns Disease Detected at MRE

Najwa Al Ansari MD (Presenter); Francesca Maccioni MD; Valentina De Marco MD; Valeria Buonocore; Carlo Catalano MD

PURPOSE
To retrospectively describe Crohn’s disease (CD) in paediatric patients (PP) in terms of the location and activity of intestinal lesions.

METHOD AND MATERIALS
70 children (mean age 15 years) with proven CD underwent magnetic resonance enterography (MRE), after the administration of negative or biphasic contrast agent, according to age and compliance of the patients, to localize lesions and detect their activity in 9 segments of the small and large bowel. The results were analyzed on a per patient and per segment basis. Ileo-colonoscopy was performed in all patients.

RESULTS
Involvement of terminal ileum was observed in 60 % of PP. The colon was diseased in 87 % of PP. In particular, left colonic segments were significantly involved in PP (descending colon 58 %; rectum 68 % sigmoid colon 58 %). The maximal disease activity was found in the left colonic segments.

CONCLUSION
MRE detected significant features of CD in PP, showing a more extensive and severe involvement of the left colon than distal ileum, differently from adult patients. The causes of the severe left colonic disease in children are unknown and may have relevant clinical-diagnostic implications.

CLINICAL RELEVANCE/APPLICATION
MRE detected significant features of CD in PP, showing a more extensive and severe involvement of the left colon than distal ileum, differently from adult patients.

CL-PDE-TU6B • Aćaе Single Ventriclei¿? Demystified - A Radiologist Perspective

Kianoush Ansari Gilani MD; Ravi Ashwath MD; Prabhakar Rajiah MD, FRCR (Presenter)

PURPOSE/AIM
“Single ventricle” refers to a heterogeneous group of congenital cardiac malformations that is characterized by both the atria related to a functionally single ventricle. The purpose of this exhibit is 1. To understand the various entities that constitute single ventricle. 2. To understand the various surgical options and timings for single ventricle. 3. To illustrate the MR imaging appearances of several types of single ventricle. 4. To describe the key MRI findings which are vital in influencing management.

CONTENT ORGANIZATION
1. Nomenclature
2. Cardiac MRI protocols
3. Sample cases: True single ventricle, Hypoplastic left heart, Double inlet LV/RV, Mitral/tricuspid atresia, AV canal defect, Heterotaxy
4. Review and illustration of key factors in anatomic characterization- Atrial situs; Ventricular situs; Great artery relationship, Atrioventricular relationship; AV connection (single, double, or common); AV morphology (straddling/overriding); morphologic LV vs RV; Rudimentary vs functioning ventricles
CL-PDE-TU7B • Pediatric Gynecological Masses: Diagnostic Imaging Approach

Ajaykumar C Morani MD (Presenter) ; Khaled M Elsayes MD ; Srinivasa R Prasad MD ; Ramon Sanchez MD ; Farzin Eftekhar MD

PURPOSE/AIM
1. Review the wide spectrum of pediatric gynecologic masses
2. Describe imaging findings of these masses including imaging algorithm and diagnostic approach.

CONTENT ORGANIZATION
Introduction Histogenesis Classification with imaging illustrations A. Gonadal 1. Tumors a. Germ cell tumors (GCTs) • Gonadal • Extragonadal (Sacroccoygeal, retroperitoneal) b. Non-GCTs • Sex cord stromal tumors • Epithelial tumors c. Miscellaneous (e.g. Metastases, PNET) 2. Non-neoplastic masses a. Ovarian torsion b. Corpus luteum cyst c. Endometriosis B. Uterocervical masses 1. Tumors (e.g. Endometrial, PEComa) 2. Non-tumors (Hydrometrocolpos, Endometritis, Mullerian anomaly) C. Vaginal masses 1. Tumors (e.g. Rhabdomyosarcoma (RMS), PEComa) 2. Non-tumors (Hydrometrocolpos, Mullerian anomaly/cyst) D. Micromasses (e.g. mesenchymal, desmoplastic)

SUMMARY
'Children are not young adults'. Many pediatric gynecologic masses are benign and include hydrometrocolpos, ovarian torsion, mullerian anomalies and endometriosis. One can reach the pertinent differential diagnosis by considering the age, serum markers and distinguishing imaging features of these masses. GCTs constitute majority of pediatric ovarian masses; epithelial and sex cord ovarian tumors appear mostly after age 15. RMS typically involves the vulvo-vaginal region.

Breast – Tuesday Posters and Exhibits (12:45pm - 1:15pm) Tuesday, 12:45 PM - 01:15 PM • Lakeside Learning Center

Breast MR Imaging of Breast before and after Neoadjuvant Chemotherapy: Does Breast Parenchymal Enhancement in the Contralateral Normal Breast Change after Chemotherapy?

Aliko Shimauochi MD (Presenter) ; Hiroyuki Abe MD ; Federico Pineda BS ; David V Schacht MD ; Charlene A Sennett MD ; Gillian M Newstead MD * ; Kirti M Kulkarni MD

PURPOSE
To investigate the change of breast parenchymal enhancement (BPE) on MRI, in the contralateral normal breast of patients who received neoadjuvant chemotherapy (NAC) for breast cancer.

METHOD AND MATERIALS
20 patients with breast cancer (mean age, 57 years; age range, 35-87 years) treated with NAC who had pre-chemo and post-chemo (pre-surgery) MRI between Jan 2010 and Jan 2012 were reviewed retrospectively. BPE of the contralateral normal breast was analyzed using Dynacad. Regions of interest (ROIs) were traced manually on pre and 5 dynamic TIWI post contrast series, at the same 4 locations of the normal breast on pre-NAC and post-NAC scans. Average relative increase in intensity (%) compared to the initial intensity of precontrast images within the ROIs was evaluated at each of the 5 post contrast time points, and the values for the 4 ROIs were averaged to give a single mean relative signal increase per scan. The effect of NAC on the change of BPE was evaluated using the student t test. Change in categorical scales (minimal, mild, moderate or marked) to rate BPE by radiologists was also evaluated, using the Chi-square test.

SUMMARY
The average relative signal increase at the 5 time points were 15.2, 31.1, 39.7, 46.2 and 50.5% on pre-NAC scans, and 5.7, 14.9, 20.1, 23.4 and 26.2% on post-NAC scans. Statistically significant differences were found at all time points (p=0.013, 0.002, 0.001, p<0.05). In both premenopausal and post menopausal subgroups, a statistically significant decrease in average relative signal increase was found at the 2nd through 5th time points.

CONCLUSION
BPE in the contralateral normal breast showed a statistically significant decrease after NAC compared to pre-NAC scans, both in early and delayed postcontrast images. The significant decrease was seen regardless of menopausal status.

CLINICAL RELEVANCE/APPLICATION
Evaluation of functional changes in breast tissue due to NAC may improve the understanding of the influence of NAC on hormonal levels and hemodynamics in pre and post menopausal breast cancer patients.

LL-BRS-TU2B • Frequency of Malignancy and Imaging Characteristics of Probably Benign Lesions Seen on Breast MRI

Andy Anderson MD ; Sujata V Ghate MD (Presenter) ; Jay A Baker MD * ; Sora C Yoon MD

PURPOSE
To evaluate BI-RADS 3 MRI lesions and accurately characterize them using the latest BI-RADS MRI lexicon.

METHOD AND MATERIALS
We retrospectively reviewed breast MRI exams with final assessment of probably benign (BI-RADS 3) from among 4,279 consecutive breast MR exams performed between Jan. 2005 and Dec. 2009. Studies with at least 2-years follow-up imaging confirming stability or resolution of lesion and cases with biopsy confirmation were included. Cancer yield was compared to imaging characteristics.

RESULTS
Of 4,279 breast MRI exams, 282 (6.6%) with 332 lesions were assessed as BI-RADS 3. 280 lesions [121 (43.2%) foci, 84 (30.0%) masses and 74 (26.4%) non-mass enhancements (NME)] had adequate follow up. 12 of 280 lesions were malignant with a cancer yield of 4.3%. One (0.4%) lesion was characterized as nipple retraction and skin thickening. Foci were characterized as multiple (at least 3) or single (fewer than 3). None of the 52 cases of multiple foci were malignant regardless of kinetics. Of 69 individual foci, 3 (4.3%) were malignant, including 1.9% (1 of 53) with persistent kinetics and 12.5% (2 of 16) with plateau or washout kinetics (ns; p=0.13; Fischer Exact test). Among all NME labeled probably benign, 5.1% (3 of 61) with persistent enhancement were malignant compared with 18.8% (3 of 163) with plateau or washout kinetics which approached statistical significance (p=0.06).

NME was further characterized as symmetric vs asymmetric. No cases (0 of 16) of symmetric NME were malignant compared with 18.8% (3 of 16) with plateau or washout kinetics (ns; p=0.07). For 84 masses assigned BI-RADS 3, 3.4% (2 of 61) demonstrating persistent, 6% (0 of 14) plateau, and 11.1% (1 of 9) washout kinetics were malignant (ns; p=0.37).

CONCLUSION
The 4.3% risk of malignancy for these BI-RADS 3 MRI lesions is slightly higher than the accepted 2% risk for mammographic lesions. Results suggest kinetics should be considered when assigning BI-RADS 3 final assessment, particularly for foci and NME, although a larger sample size could confirm these findings.

CLINICAL RELEVANCE/APPLICATION
Further knowledge of imaging characteristics and outcomes of BI-RADS 3 lesions on breast MRI could help determine which lesion...
PURPOSE

The purpose of this study was to evaluate the capabilities of sonoelastography to monitor neoadjuvant chemotherapy of breast cancer and to determine correlation between reduction stiffness of cancer and grade of pathology response.

METHOD AND MATERIALS

Compression sonoelastography was performed after the conventional sonography. The elasticity image was evaluated by using the scoring system described by Itoh et al. and for all lesions the Strain-Ratio (StR) was calculated. Statistical analysis was performed using the 'Statistics' 6.1.

A total of 36 women were included in the group. The measurement of maximum diameter and stiffness values of breast cancer were calculated three times: before treatment, after 2 cycles of chemotherapy and after finishing the treatment. The response of breast cancers to neoadjuvant chemotherapy was evaluated by using the histological grading system discibed by I.D. Miller.

RESULTS

CONCLUSION

CLINICAL RELEVANCE/APPLICATION

Compression sonoelastography, strain-ratio, neo-adjuvant chemotherapy, breast cancer.
LL-BRS-TU6B • Effect of Reduced Radiation Dose on Breast Density Estimation in Digital Mammography: Data from the ACRIN 4006 Trial

Despina Kontos PhD (Presenter) ; Jae Y Choi DPhil ; Brad M Keller PhD ; Emily F Conant MD * ; Andrew D Maidment PhD *

PURPOSE
Accurate breast density estimation is becoming increasingly important for personalized breast cancer screening recommendations. We investigate the feasibility of obtaining reliable density measures from digital mammograms acquired at reduced radiation dose.

METHOD AND MATERIALS
Bilateral, raw digital mammography (DM) images (Selenia, Hologic Inc.) from the ACRIN 4006 trial were retrospectively analyzed. For each exam, one set of DM images was acquired with standard dose, while another was acquired with about 15% reduction relative to the standard dose, per ACRIN 4006 protocol. Breast density was measured quantitatively with fully-automated FDA-cleared software (Quantra™ v.2.0, Hologic, Inc.), including BIRADS density, area percent density (PD%), and volumetric percent density (VD%). The agreement between BI-RADS density categories from standard-dose and low-dose images was estimated using Cohen's weighted kappas. Linear regression and the Pearson correlation were used to test agreement for the continuous PD% and VD% estimates between standard-dose and low-dose mammograms.

RESULTS
Seventy-four image sets, each from a different study participant, were available for analysis (a total of 592 bilateral CC and MLO images). High agreement (k = 0.87, 95% CI 0.83-0.91) was observed for BIRADS density estimates from standard-dose and low-dose mammograms. The correlation between standard-dose and low-dose PD% and VD% was r = 0.94 (p = 0.95 (p R² values of the linear regression for PD% were 0.95±0.01, 1.41±0.48, and 0.90±0.04, respectively; while for VD% were equal to 0.92±0.02, 0.86±0.23, and 0.90±0.02, respectively.

CONCLUSION
Our results show strong agreement between density estimates from standard-dose and low-dose digital mammograms acquired at a 15% reduction of radiation dose. This suggests that reliable density estimation is feasible from images obtained at reduced dose. Larger studies are needed to validate these findings at lower radiation dose levels.

CLINICAL RELEVANCE/APPLICATION
Reliable density estimates at lower radiation dose could be used for purposes such as evaluating response to risk-reduction interventions and triaging women to the most appropriate screening modality

LL-BRS-TU7B • Breast Cancer Staging: Comparison of Whole-body Hybrid MR/PET and PET/CT Imaging: Initial Experience

Onofrio A Catalano MD (Presenter) ; Carlo Iannace MD ; Maria Lepore MD ; Alexander R Guimaraes MD, PhD * ; Bruce R Rosen MD, PhD * ; Dushyant V Sahani MD ; Peter F Hahn MD, PhD * ; Mark Vangel PhD ; Angelo Luongo ; Emanuele Nicolai ; Andrea Soricelli MD ; Marco Salvatore MD

PURPOSE
To compare the diagnostic staging performance and SUV measurement accuracy of whole-body hybrid MR/ PET with PET/CT in patients with breast cancer.

METHOD AND MATERIALS
In this prospective IRB approved study, 23 consecutive patients with breast cancer underwent whole-body hybrid FDG PET/CT (Gemini TF, Philips) and same day MR/PET (Biograph mMR, Siemens). PET/CT and MR/PET studies were independently evaluated by two readers. Attenuation correction of MR/PET images was performed with Dixon sequences. The tumor with the highest FDG uptake (primary cancer or metastases) -to-liver SUV ratios were calculated and compared between PET/CT and MR/PET.

RESULTS
MR/PET imaging of breast cancer is feasible and provides diagnostic image quality in the assessment of the primary cancer and of possible metastases. MR/PET did not understage any patient when compared to PET/CT. Similar lesion characterization and tumor stage were found in comparing PET/CT and MR/PET images in 18/23 patients.

CONCLUSION
MR/PET might represent an innovative and valid tool for accurate staging of breast cancer patients.

CLINICAL RELEVANCE/APPLICATION
MR/PET might represent an innovative and valid tool for accurate staging of breast cancer patients.

LL-BRE-TU8B • Imaging Presentation of Variant Breast Diseases on Contrast-enhanced Tomosynthesis: Comparison with Conventional Breast Imaging Techniques and Correlation with Histology Results

Chia-Ling Chiang (Presenter) ; Chen-Pin Chou MD *

PURPOSE/AIM
At the end of this review, radiologists will be familiar with
1) the common imaging features of variant breast diseases on conventional digital mammography, breast tomosynthesis, contrast-enhanced mammography, contrast-enhanced breast tomosynthesis, and MR images, and histology correlation,
2) the advantage and disadvantage of different contrast-enhanced breast imaging modalities.

CONTENT ORGANIZATION
The common features of imaging presentation of variant breast diseases on contrast-enhanced mammography and tomosynthesis, comparison with conventional non-enhanced mammography, tomosynthesis, and MR imaging, and correlation with histology results.
- benign (fibroadenoma, fibrocystic disease, radial scar and tubular adenoma),
- malignant (DCIS, invasive lobular carcinoma, and invasive ductal carcinoma), and
- premalignant (atypical ductal hyperplasia, atypical lobular hyperplasia) breast lesions are reviewed.

The advantages and disadvantages of different contrast-enhanced breast imaging modalities are discussed.

SUMMARY
Contrast-enhanced mammography and tomosynthesis are new-developed diagnostic tools that provide information acquisition including 3D morphology, microcalcification and vascularity of suspicious breast lesion in one modality.

LL-BRE1147-TUB • MRI Appearance of Breast Cancer Treated with Neoadjuvant Chemotherapy (NAC): Influence of Receptor Status and Pathologic Residual Cellularity

Kirsten Gaarder MD (Presenter) ; Kirti M Kulkarni MD ; Jeffrey Mueller MD ; Hiroyuki Abe MD ; Charlene A Sennett MD ; David V Schacht MD ; Akiko Shimauchi MD ; Gillian M Newstead MD *

PURPOSE/AIM
- To review the influence of receptor profile and residual cellularity on MRI findings in breast cancer patients undergoing
neoadjuvant chemotherapy (NAC).

- To better identify patients showing residual invasive cancer post-NAC despite no or minimal enhancement on MRI and to understand factors influencing this rad-path discrepancy.
- To better delineate extent of residual disease and determine appropriate surgical treatment post NAC.

CONTENT ORGANIZATION
1. 10 cases of breast cancer will be shown with pre- and post-NAC MRI and histopathologic images.
2. Differences in imaging response associated with different receptor profiles and patterns of pathologic response to therapy will be reviewed.
3. Pathologic staging of post-NAC breast cancers will be discussed.

SUMMARY
Major teaching points:
1. Some breast cancers become less cellular post NAC without significantly decreasing in size. These cancers may have no or minimal contrast enhancement on MRI. Evaluation of non-subtracted contrast and delayed images is of increased importance in order to evaluate the extent of residual tumor.
2. ER+Her2- cancers more often have subtle imaging findings after treatment as compared to triple negative and Her2+ cancers.
3. Evaluation of different tumor morphologies and patterns of response to NAC can be helpful in surgical planning.

CARDIAC - Tuesday Posters and Exhibits (12:45pm - 1:15pm)

Tuesday, 12:45 PM - 01:15 PM • Lakeside Learning Center

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1. Determination of Myocardial Triglyceride Content in Patients with Fabry Disease by Localized High-field 1H-Magnetic Resonance Spectroscopy

**Bernhard Petritsch** (Presenter); **Michael Horn**; **Andreas M Weng**; **Jan P Goltz** MD; **Julian Donhauser** MD; **Christian O Ritter** MD; **Dietbert Hahn** MD; **Meinrad J Beer** MD*; **Thorsten A Bley** MD; **Herbert Koestler** PhD*

**PURPOSE**

In Fabry disease progressive deposition of sphingolipids in different organs has been reported. High-field 1H-MR-spectroscopy (MRS) allows non-invasive determination of myocardial lipid content. This study investigates the role of myocardial steatosis in the complex pathomechanism of Fabry cardiomyopathy.

**METHOD AND MATERIALS**

In 14 patients (9 female, 5 male; 39 ± 13 years [range 17-52 years]) with genetically proven Fabry disease, myocardial triglycerides were quantified by 1H MRS (respiratory motion compensated, ECG triggered) in vivo using a 3 T scanner (Magnetom TRIO, Siemens Sector HealthCare, Germany). Single-voxel-spectroscopy was performed with and without water suppression. The voxel was positioned in the interventricular septum using a four-chamber and short-axis orientation at end systole to avoid signal contamination by epicardial fat. Two triglyceride peaks were measured (methylene groups at 1.3 ppm, methyl groups at 0.9 ppm) relative to the resonance from tissue water at 4.7 ppm. The myocardial lipid content was expressed as triglycerides-to-water ratio (%). In addition left ventricular (LV) mass and ejection fraction (EF) were assessed by MRI. Nine healthy volunteers (4 female, 5 male) without a history of cardiac or metabolic disease served as control group.

**RESULTS**

In all patients 1H spectra were successfully acquired. In patients the mean triglyceride-to-water ratio was 1.7% (min. 0.1%; max. 6.2%). On average the control group showed a lower (p=0.05) triglyceride-to-water ratio of 0.49% (min. 0.1%; max. 1.9%). Compared to healthy controls, LV mass (mean ± standard deviation; 120 ± 36 g) tended to be higher in Fabry patients (FP) (142 ± 43.9 g) (p=0.1). Mean EF was similar in both groups (67 % in FP vs. 66 % in controls).

**CONCLUSION**

High-field 1H-MR-spectroscopy using 3T scanners allows non-invasive assessment of myocardial lipid content in FP. In a relatively small patient collective we observed an elevated myocardial triglyceride content. This finding warrants further studies with larger patient groups, especially concerning sub-group analysis of LE positive and negative FPs.

**CLINICAL RELEVANCE/APPLICATION**

Besides data regarding functional and morphological alterations MRS delivers new insights into myocardial lipid metabolism in FP. This might help to further optimize the therapy for this rare disease.

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2. Sensitivity and Accuracy of Measures for Discrimination of Myocardial Fibrosis

**Neville Gai** PhD (Presenter); **Marcelo S Nacif** MD, PhD; **Christopher Sibley**; **Songtao Liu** MD; **David A Bluemke** MD, PhD*

**PURPOSE**

To determine accuracy and sensitivity of post-contrast myocardial T1, partition coefficient (?) and ECV in discriminating healthy tissue from diffuse fibrotic tissue in heart failure (HF) subjects.

**METHOD AND MATERIALS**

Nine healthy and seventeen subjects (age and sex matched) with heart failure (HF) underwent cardiac MRI on 3T scanners after administration of 0.15mmol/kg of gadopentetate dimeglumine. Pre- and post-contrast T1 mapping was done using the MOLLI sequence. The measured T1 values in myocardium and blood pool were used to determine (? and ECV (as defined in literature) at two post-contrast time points — 12 min and 25 min. Coefficient of variation (COV) at each time point in each group (healthy or HF) and for each of the three measures was determined as a surrogate for accuracy. Similarly, a Student’s t-test for the three measures between healthy and HF subjects for each time point served as a marker of sensitivity. In addition, COV and t-test were also performed on T1 values obtained at time = (12, 25) min which were corrected to time = (25, 12) min for both normals and HF subjects using a previously described analytical model.

**RESULTS**

The mean COV for the post-contrast T1, ? and ECV at the two time points was 0.0896, 0.0962 and 0.1158 for normals; COV was 0.0935, 0.1091 and 0.103 for HF. A lower value of COV reflects better homogeneity in the two separate populations (healthy and HF) which indirectly reflects on the accuracy of the three measures. Student’s t-test between normal and HF subjects resulted in mean p-values (one tailed) of 0.0211, 0.0551 and 0.0883 for post-contrast T1, ? and ECV, indicating better sensitivity of post-contrast T1 values. Despite employing a previously described analytical correction for time, mean COV for post-contrast T1 values (healthy and HF) was 0.0917 while mean p-value was 0.023.

**CONCLUSION**

Post-contrast T1 measurements controlled for dose and time showed the best accuracy and sensitivity when compared with derived values such as partition coefficient and ECV. Even after employing a correction for time based on a previously described analytical model,
**LL-CAS-TU3B • Congenital Cardiac Septal Defect in Adult: Role of Cardiac Computed Tomography in Preoperative Planning**

**Hyejoung Eom** MD (Presenter); Dong Hyun Yang MD; Joon-Won Kang MD; Tae-Hwan Lim MD, PhD

**PURPOSE**
To evaluate a role of cardiac computed tomography (CT) in preoperative planning of adult congenital cardiac septal defect.

**METHOD AND MATERIALS**
Fifty seven consecutive patients (47% male; mean age 46.9 years) who had preoperative cardiac CT and surgery were included (ASD n=46, VSD n=9, Both ASD and VSD n=2). For the evaluation of intracardiac structures, retrospective ECG-gated scan with ECG pulsing (30-80%) was done by using second generation dual source CT. The size and location of the defect were evaluated using multiplanar reconstruction images. The defects were categorized as follows: primum, secundum, sinus venosus and unroofed coronary sinus for ASD; perimembranous, muscular and subarterial for VSD. Accuracy of subtype classification was determined by using surgical findings as the reference standard. Maximum size of the defect on CT was correlated with surgical findings and limits of agreement were calculated (Bland-Altman method). Additional anatomic details detected on CT were described.

**RESULTS**
The number of secundum ASD and perimembranous VSD was 41 (72%) and 6 (11%), respectively. Detection of the defect on CT was available in all cases except for one patient with subarterial VSD (Only diastolic images were available in this patient) and subtype classification was correct in 55 patients (55/57, 96%). Echocardiography (ECHO) was able to detect the defects in all cases and subtype classification was correct in 54 patients (54/57, 95%). CT misclassified one patient; secundum ASD as sinus venosus ASD. ECHO misclassified three patients; muscular VSD with secundum ASD as perimembranous VSD, secundum ASD with sinus venosus ASD as multiple secundum ASDs and subarterial VSD as a fistulous tract between aortic sinus and right ventricle. All these patients were correctly diagnosed on CT. Maximum size of the defect on CT correlated well with surgical findings (r=0.79, p

**CONCLUSION**
Cardiac CT may have an incremental role in preoperative planning of adult congenital cardiac septal defect, particularly in patients with more complex anatomy.

**CLINICAL RELEVANCE/APPLICATION**
In adult patients with congenital cardiac septal defect, cardiac CT may be helpful in surgical planning by providing detailed septal anatomy and associated anomalies.

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**LL-CAS-TU4B • Diluted Contrast Material Injection Protocol for Coronary CT Angiography Using 256-slice Multi-detector CT to Uniform Intra-Coronary Enhancement**

**Naoto Kawaguchi** MD (Presenter); Teruhito Kido; Yuki Tanabe; Takuya Matsuda; Masashi Nakamura; Yoshiko Nishiyama MD; Tomoyuki Kido; Rami Yokoyama; Masao Miyagawa MD, PhD; Teruhito Mochizuki MD

**PURPOSE**
The purpose of this study was to propose and evaluate a new injection protocol using diluted contrast material (CM) injection to uniform intra-coronary enhancement (HU) in coronary CT angiography (CTA).

**METHOD AND MATERIALS**
Four scan protocols of different CM injection methods and tube voltages were compared in consecutive 200 patients with suspected coronary artery disease using a 256-slice multi-detector CT (retrospective ECG gated scan). In the diluted CM injection protocol (protocol A; 120kV, N=50 and protocol B; 100kV, N=50), the target luminal enhancement was set at 350 HU. From the time density curve of the diluted CM test scan (20%-diluted CM at 5ml/s, 10s injection), optimal concentration of CM in the real scan was calculated using the formula; A%=20%*(350 – base CT value) / (peak enhancement of the test scan – base CT value). Then the CM was administrated at the optimized scan timing, that was also decided by the diluted test scan. In the BW-adjusted protocol (protocol C; 120kV, N=50 and protocol D; 100kV, N=50), only scan timing was decided by the test scan. Then, CM of 225 (protocol C) or 175 (protocol D) mg-iodine/kg was administrated at the optimized scan timing. The weight-rate index (Ew) was set to group A 0.06, groupB 0.07 and group C 0.08. The injection rate (IR) and injection volume (IV) of group A (4.4ml/s, 37.6ml) were calculated based on the formula, IR(ml/s)=Ew×W(Kg), IV(ml)=IR×[t(s)+t'(s)]. W, t and t' represented patients’ weight, the scan time that obtained after setting up the scan scope and the pre-scan time (3s). Scan parameters were as follows: slice acquisition,64×0.625 mm,120kVp, auto mAs. The ROI in proximal segment of left anterior descending (pLAD), proximal segment of left circumflex coronary artery (pLCX), proximal and distal segment of right coronary artery (pRCA, dRCA) should be as large as the vessel lumen and the obvious calcified or fibrous plaque was avoided. Kruskal-Wallis test was used for the difference of sex and other information (CT values included) were analysis by One-way ANOVA among three groups.

**RESULTS**
There was no significant difference of sex, age, BMI and heart rate among three groups. The IR and IV of group A (4.4ml/s, 37.6ml) were significantly lower than that of group B (4.9ml/s, 41.4ml) and C(5.2ml/s, 44.7ml) (ppp=0.042).

**CONCLUSION**
The injection protocol of contrast material in 64-detector row CT coronary angiography can be individually optimized based on the weight-rate index of 0.07.

**CLINICAL RELEVANCE/APPLICATION**
The injection volume of contrast material in 64-detector row CT coronary angiography can be decreased.
― Clinical risk factors and Framingham risk score (FRS) were also evaluated from all patients.

LL-CAS-TU6B • Influence of Vessel Enhancement on the Motion Correction Effect of SnapShotFreeze Technique in Coronary CT Angiography

Xiaoguang Yang (Presenter); Xiangying Du MD; Kuncheng Li MD; Peng-Yu Li; Qianwen Li

PURPOSE
SnapShotFreeze (SSF) is a recently introduced vendor-specific motion correction technique in coronary CTA, which is based on automatic recognition of the centerlines of enhanced coronary arteries and non-rigid registration algorithm. The purpose of this study is to investigate the influence of vessel enhancement on the motion correction effect of SSF in coronary CT angiography (CTA).

METHOD AND MATERIALS

RESULTS
Images reconstructed by SSF technique showed less motion artifact and better image quality both in group A and B (p < 0.05). Similarly, the SSF technique provided better motion correction with respect to the non-enhanced image (p = 0.001).

CONCLUSION
Better vessel enhancement ensures better motion correction by SSF in coronary CTA. Contrast enhancement should be noted when applying SSF technique for motion correction.

CLINICAL RELEVANCE/APPLICATION
SSF provides the opportunity for the use of CT scanners with relatively low rotation speed in higher heart rates.

LL-CAS-TU7B • CT-related Independent Predictors for Cardiac Events in Individuals without Significant Coronary Stenosis

Jiwoon Seo (Presenter); Eun Ju Chun; Sang Il Choi MD; Yeo Goon Kim MD; Jin Young Yoo MD

PURPOSE
Cardiac events may be occurred in individuals without significant coronary stenosis. Therefore, we aimed to evaluate the independent predictors for cardiac events in adults without significant coronary stenosis on coronary CT angiography (CCTA).

METHOD AND MATERIALS
From ESCORT study of 4,502 asymptomatic individuals who underwent self-referred coronary calcium score (CACS) and CCTA between 2006 and 2007, we enrolled 4,271 adults (2,525 males, 57±10 yrs) without significant coronary stenosis and assessed the major adverse cardiac event (MACE; cardiac death, nonfatal MI and unstable angina requiring hospitalization) and total cardiac event (TCE: MACE plus coronary revascularization later than 90 days after CCTA). CT images were analyzed in terms of stenosis degree, plaque composition (non-calcified, mixed, calcified and high-risk plaque), and location (proximal versus distal). High-risk plaque (HP) was defined as plaque density ≥ 11. Clinical risk factors and Framingham risk score (FRS) were also evaluated from all patients.

RESULTS
During a median of 55 months of follow-up, MACE occurred in 12 subjects (0.3%) and TCE occurred in 24 subjects (0.6%). In multivariate analysis, familial history of premature CAD (FHx_CAD) (hazard ratio [HR], 3.7; 95% confidence interval [CI], 21.0 to 13.7; p=0.048) and HP (HR 5.7, 95% CI 1.1 to 28.8, p=0.034) were independent predictors for MACE, while FHx_CAD (HR 4.3, 95% CI 1.7 to 11.0, p=0.002), HP (HR=4.1, 95% CI, 1.2 to 13.8, p=0.023) and non-calcified plaque (NCP) (HR 4.8, 95% CI 1.4 to 17.1, p=0.014) were independent predictors for TCE. However, FRS and CACS were not independent predictors for MACE or TCE. Importantly, the absence of plaque by CCTA was associated with excellent outcome (0.05%).

CONCLUSION
FHx_CAD and plaque composition (HP and NCP) were independent predictors for cardiac event in asymptomatic individuals without significant coronary stenosis. CCTA might be useful for risk stratification for cardiac events regardless of significant coronary stenosis.

CLINICAL RELEVANCE/APPLICATION
Although in adults without significant coronary stenosis, CCTA findings may be useful to provide the plaque composition as predictors for cardiac events.

LL-CAE-TU8B • Radiologic Review of Acquired Pulmonary Vein Stenosis- A Potential Missed Diagnosis

Mauricio S Galizia MD; Rahul D Renapurkar MD; Michael A Bolen MD; Joseph T Azok MD; Charles T Lau MD; Ahmed El-Sherief MD (Presenter)

PURPOSE/AIM
- Review pulmonary vein embryology and anatomy
- Review primary and secondary imaging findings in acquired pulmonary vein stenosis
- Review the treatment options for acquired pulmonary vein stenosis and the role of imaging in pre and post-procedural assessment

CONTENT ORGANIZATION
- Pulmonary Vein Embryology
- Variation of Pulmonary Vein Branching Pattern
- Acquired Pulmonary Vein Stenosis
- Etiology
- Post Radiofrequency Ablation
- Extrinsic Compression
- Neoplastic (Lung Cancer, Lymphoma)
- Non-neoplastic (Fibrosing mediastinitis, Bronchogenic cyst)
- Primary Imaging Findings (US/CT/MR/Angio)
- Secondary Imaging Findings (CT)
- Waxing and Waning pulmonary edema or hemorrhage
- Lung volume loss
- Mixing artifact in the stenosed pulmonary vein
- Non-opacification of distal pulmonary veins -Treatment of Pulmonary Vein Stenosis
- Treatment options
- Surgical
- Transcatheter interventions
- Balloon Angioplasty
- Stent Implantation
- Role of imaging in pre-procedural planning and post-procedural evaluation (CT and MRI)

SUMMARY
From this exhibit, the attendee will be able to:
- Identify various etiologies of acquired pulmonary vein stenosis
- Indentify primary and secondary imaging findings in acquired pulmonary vein stenosis
- Understand the role of imaging in pre and post-therapy evaluation of acquired pulmonary vein stenosis

Chest - Tuesday Posters and Exhibits (12:45pm - 1:15pm)

Tuesday, 12:45 PM - 01:15 PM • Lakeside Learning Center
All subjects were male, with a mean age of 56.5±5.4 years (range from 50 to 69). The symptomatic group included more current smoking, 15 percentile point of lung density, and forced expiratory volume in first second as percentage of predicted. The association between CB symptoms and AWT and WA% was analyzed using multiple linear regression adjusted for age, body mass index, bronchi in different pulmonary lobes. Differences in airway wall measurements between groups were assessed by t-testing. The 1.0, Fraunhofer MEVIS, Bremen, Germany). AW T and WA% were measured for airways with a luminal diameter =5mm in five different 16-row multi-detector computed tomography (CT) modality (Sensation 16, Siemens, Forchheim, Germany) was utilized with a low-dose with CB symptoms (cough, mucus, dyspnea and wheezing) and 50 heavy smokers without CB symptoms were randomly selected. A This study was performed in the Dutch-Belgian Randomized Lung Cancer Screening Trial (acronym: NELSON trial). Fifty heavy smokers

METHOD AND MATERIALS
PhD; Marjolein A Heuvelmans

PURPOSE
Chronic bronchitis (CB) is usually caused by smoking and characterized by airway wall remodeling, commonly in large airways. The purpose is to determine differences in airway wall thickness (AW T) and wall area percentage (WA%) between subjects with and without CB symptoms.

METHOD AND MATERIALS
This study was performed in the Dutch-Belgian Randomized Lung Cancer Screening Trial (acronym: NELSON trial). Fifty heavy smokers with CB symptoms (cough, mucus, dyspnea and wheezing) and 50 heavy smokers without CB symptoms were randomly selected. A 16-row multi-detector computed tomography (CT) modality (Sensation 16, Siemens, Forchheim, Germany) was utilized with a low-dose acquisition protocol. The thin slice CT images were evaluated using a dedicated software tool for airway wall remodeling, commonly in large airways. The purpose is to determine differences in airway wall thickness (AWT) and wall area percentage (WA%) between subjects with and without CB symptoms.

RESULT
All subjects were male, with a mean age of 56.5±5.4 years (range from 50 to 69). The symptomatic group included more current smokers than the control group and had a significantly smaller Perc15, indicating more emphysema (P = 0.05).
CONCLUSION
Patients with symptoms of chronic bronchitis have thicker airway walls in airways with 5 to 10mm in luminal diameter, but not in airways with a larger diameter.

CLINICAL RELEVANCE/APPLICATION
In lung cancer screening trials, most persons are smokers, with high prevalence of CB. The airway wall thickening of this patient group can be assessed without additional radiation exposure and cost.

LL-CHS-TU4B • MRI-based Morphological and Functional Scoring of Chronic Obstructive Pulmonary Disease at 1.5 Tesla
Bertram Jobst MD (Presenter); Oliver Sediaczeck MD; Angela Anjorin; Hans-Ulrich Kauczor MD *; Sebastian Ley MD; Jurgen Biederer MD; Mark O Wielopetz

PURPOSE
In times of increasing therapeutic options in chronic obstructive pulmonary disease (COPD), novel non-invasive endpoints are necessary for repeated therapy monitoring. Since MRI allows for radiation-free regional morphological and functional assessment of the lung, it was the aim of this study to develop and validate a morpho-functional MR-based scoring system for COPD patients.

METHOD AND MATERIALS
20 COPD patients (GOLD-I-IV) underwent lung MRI with a protocol dedicated to morphology, respiratory mechanics and lung perfusion. Image data were independently reviewed by 3 chest radiologists with experience in lung MRI. The severity of bronchial disease, small airway disease, nodules, consolidations, parenchymal defects suggestive of emphysema, and perfusion defects were rated with a 3-point scale in a lobe-based approach (max. score 97). In addition, the extent of tracheomalacia, pulmonary trunk ectasia, right ventricular overload, and respiratory motion impairment was assessed. We compared score values in mild (GOLDII) vs. severe (GOLDDIII-IV) COPD.

RESULTS

CONCLUSION
The proposed semiquantitative morpho-functional MRI scoring system is capable of reporting a wide range of COPD-relevant findings with excellent interobserver-reproducibility.

CLINICAL RELEVANCE/APPLICATION
MRI allows for radiation-free assessment of regional changes in lung morphology and function. The proposed score may serve as a new biomarker for interventional trials.

LL-CHS-TU5B • Evaluation of Chronic Graft Dysfunction after Lung Transplantation Using T1 Mapping Magnetic Resonance Imaging
Julius Renne MD (Presenter); Jens Gottlieb; Peer Lauermann; Jan Hinrichs; Sajoscha A Sorrentino MD; Christian Schoenfeld; Marcel Gutberlet DiplPhys; Peter M Jakob PhD; Tobias Welte MD; Frank K Wacker MD *; Jens Vogel-Claussn MD

PURPOSE
Bronchiolitis obliterans syndrome (BOS) is the main cause of chronic graft dysfunction after lung transplantation. Early detection of graft dysfunction is crucial for an effective treatment. However, currently available diagnostic methods have only limited evidence for the detection of graft dysfunction. Purpose of this study was to evaluate if oxygen-enhanced T1-mapping magnetic resonance imaging may be useful to detect BOS.

METHOD AND MATERIALS
After written informed consent 55 patients with double lung transplants were included in this study. 8 patients had to be excluded because of acute pulmonary infections. MRI scans were performed on a 1.5T scanner using an inversion recovery snapshot fast low-angle shot (FLASH) sequence for T1 relaxation mapping while breathing room air and 100% oxygen. A minimum of 6 coronal slices (15mm slice thickness with 5mm gap) covering both lungs were acquired. After manual lung segmentation the mean T1 value and the coefficient of variation were calculated for each patient. BOS stages were determined using pulmonary function test. Statistical analysis was performed using non-parametric Kruskal-Wallis test, Mann-Whitney test and Spearman's correlation.

RESULTS

CONCLUSION
While T1 values did not correlate with the severity of BOS, the variation of T1 values expressed by the coefficient of variation increased with progression of BOS. Furthermore, the coefficient of variation showed an inverse correlation with the ratio of FEV1 / best FEV1 after transplant.

CLINICAL RELEVANCE/APPLICATION
T1 mapping MRI may serve as a future biomarker in early detection of chronic graft dysfunction.

LL-CHS-TU6B • Intra- and Inter-reader Variability of Pulmonary Nodule Classification according to the Fleischner Guidelines: Clinical Consequences
Sarah J Van Riel MD (Presenter); Eva M Van Rikxoort PhD; Colin Jacobs MSc *; Steven Schalekamp MD *; Mathias Prokop MD, PhD *; Bram Van Ginneken PhD; Pim A De Jong MD, PhD; Ernst T Scholten MD; Hester Gietema MD; Cornelia M Schaefer-Prokop MD *

PURPOSE
Recently published recommendations by the Fleischner Society differentiate between non-solid and part-solid nodules. For the latter follow up or invasive diagnostic procedures are recommended depending on the size of the solid core. For solid nodules, different recommendations apply. We evaluated inter- and intra-reader variability of nodule classification and the impact on patient management.

METHOD AND MATERIALS
20 part-solid, 10 non-solid and 10 solid nodular lesions were randomly selected from the NELSON screening trial. Data had been acquired using a low dose (16x0.75mm, 120-140 kVp, 30 mAs) protocol. Complete CTs were shown with axial and coronal projections with 1mm section thickness. Readers could interactively scroll through the scans, use magnification, windowing and manual calibre measurements as warranted. Four readers of varying experience were asked to classify the lesions as solid (1), part-solid with a core > 5mm and < 5mm, respectively (2 and 3), or as non-solid (4). All readings were done twice in six sessions, in which all permutations of nodules and section thicknesses were presented in different random orders. Inter- and intra-reader agreement were calculated using Cohen's kappa statistics. To evaluate possible consequences on patient management, the number of differences between assigned scores of 1 or 2 (invasive diagnosis) and scores of 3 or 4 (follow up) were calculated. All results stated are averaged over all reading sessions.

RESULTS
Inter-reader agreement was low with mean kappa of 0.33 (range 0.02-0.58). Intra-reader agreement was moderate with mean kappa
0.54 (range 0.31-0.72). Patient management would have differed in 27% caused by interreader disagreement, and would have changed in 8% caused by intrareader variability. 28% of all nodules were uniformly classified over all reading sessions. Of these, 18% were classified as solid and 73% as non-solid.

CONCLUSION
Inter- and intra-reader agreement are low and moderate for the classification of pulmonary nodules according to Fleischner criteria if pure visual analysis is used. This may affect patient management.

CLINICAL RELEVANCE/APPLICATION
Variability in nodule classification may have consequences on patient management; use of digital analysis tools appears to be necessary to improve classification.

Emergency Radiology - Tuesday Posters and Exhibits (12:45pm - 1:15pm)

Tuesday, 12:45 PM - 01:15 PM • Lakeside Learning Center

LL-ERS-TUB • AMA PRA Category 1 Credit™:0.5

LL-ERS-TU1B • Incidental Atherosclerosis on Abdominal/Pelvic CT of Young Patients and Its Association with Risk Factors of Cardiovascular Disease and Diabetes

Steven Peti MD (Presenter) ; David S Sarkany MD ; Michael Coords MD ; David J Krausz MD ; Adam M Bernheim MD ; Nima Jadidi MD ; Adam Hodes ; Bernard Goldwasser MD ; Amrita K Arneja MD

PURPOSE
The objective of this study was to examine the significance of incidental vascular calcifications found on abdominal computed tomography imaging in young patients, when compared to serum parameters of dyslipidemia and diagnoses of diabetes.

METHOD AND MATERIALS
A retrospective study reviewing incidental atherosclerosis on CT imaging of the abdomen/pelvis in 269 young patients, between the ages of 25 and 50, was performed. Patients were classified into mild, moderate, and severe groups based on calcium load. Clinical histories were reviewed. A control group of 678 patients without atherosclerotic calcification was used for comparison.

RESULTS
Using an analysis of variance, a significant difference was found between level of severity of atherosclerotic disease (mild = 112 patients, moderate = 73 patients, and severe = 84 patients) and LDL (p = 0.008) and total cholesterol (p = 0.01). The mean LDL levels of patients classified as having severe atherosclerotic disease was 129 +/- 48 versus 108 +/- 46 in the mild category (p = 0.003). The mean total cholesterol levels of patients classified as having severe atherosclerotic disease was 193 +/- 212 versus 164 +/- 166 in the mild category (p = 0.001). When compared to the control group, diabetes mellitus was significantly more prevalent among each group of patients with atherosclerotic calcification (6% versus 23%, 32%, 29% for mild, moderate, severe groups respectively). Patients with any atherosclerotic disease had significantly higher triglyceride levels (mean 136 versus 174, p = 0.003)

CONCLUSION
The incidental finding of atherosclerotic calcification on abdominal CT in young patients demonstrated the degree of severity of calcifications is correlated with higher levels of LDL and total cholesterol. In addition, just the presence of incidental atherosclerotic calcification is correlated with higher prevalence of diabetes and elevated triglyceride levels.

CLINICAL RELEVANCE/APPLICATION
The above correlations suggest the need for the radiologist to alert the referring clinician to the fact that their patient may have risk factors of cardiovascular disease and/or diabetes.

LL-ERS-TU2B • Reading Trauma: Inter-observer Variability and Discrepancy between Residents and Attendees in Reading Whole Body CT in Major Trauma

Charlie Sayer MBBS,FRCR ; Tharsi Sarvananthan MBBS, MRCS (Presenter) ; Sananda Haldar MBBS ; Ahmed Daghir MRCP, FRCR

PURPOSE
To assess the reliability of primary reporting of trauma CT by radiology residents and its affect on patient safety.

METHOD AND MATERIALS
As part of a large retrospective cohort analysis of a UK major trauma centre’s experience of whole body split bolus CT scanning the discrepancy rate between the provisional out-of-hours resident report and the subsequent senior (consultant/attending) radiologist report was analysed. A 3 point scoring system was devised where: 1 = No discrepancy; 2 = Minor discrepancy (no impact on emergency patient management); and 3 = Major discrepancy (change in emergency management with implications for patient safety). Discrepancies were subsequently analysed for trends in order to aid future learning.

RESULTS
Over a 9 month period 177 whole body trauma CT scans were performed following polytrauma according to the institution protocol. In our preliminary study 53.8% of patients had sustained major injury on CT (defined as an ISS score >15) and 25.0% were negative for any injury. 33% (n = 59) of scans were provisionally reported by a resident on call and subsequently second read by a senior radiologist. Of these 74.6% (n = 44) resulted in no discrepancy and 23.7% (n = 14) in a minor discrepancy. There were no major discrepancies. In the cases of minor discrepancies 100% where the result of a ‘missed’ finding rather than ‘overcalls’: Most frequently (64.3% n = 9) this was a vertebral fracture not requiring surgical management; in 14.3% (n = 2) a minor liver laceration was missed; other discrepancies included an inferior pubic ramus fracture, an incidental femoral non-ossifying fibroma and a small retroperitoneal haematoma managed conservatively. Images of these missed injuries are reviewed in this presentation.

CONCLUSION
The provisional reading of polytrauma CT out-of-hours by radiology residents is safe. There were no major discrepancies between residents and senior radiologists. The incidence of minor discrepancies was low (23.7%) and in no case did this have an impact on the patient’s management.

CLINICAL RELEVANCE/APPLICATION
Out-of-hours resident reporting of whole body CT for multitrauma is safe and results in a low incidence of discrepancies with no significant impact on patient management.

LL-ERS-TU3B • CT of the Cervical Spine in Trauma Patients: Evaluation of Ordering Practices

Steven R Kussman MD (Presenter) ; Powne Tu MD, PhD ; Fonda Chan MD ; Akifumi Fujita MD ; Nadja Kadom MD ; Osamu Sakai MD, PhD *

PURPOSE
To analyze the results of cervical spine (C-spine) CTs in the trauma setting based on patient demographics and presence of a concurrently ordered head CT.
METHOD AND MATERIALS
The IRB approved this HIPAA-compliant retrospective study. Informed consent was waived. The study period was 1/1/2011 – 3/1/2012. A review of all C-spine CTs ordered from the Emergency Department at a level 1 trauma center for trauma was performed. Patient age, gender, ordering physician, and findings were recorded. Note was also made if the C-spine CT was ordered concurrently with a head CT. 345 C-spine CTs ordered with a head CT (combined group) and 346 C-spine CTs ordered individually (alone group) were analyzed. Cases were considered positive if there was a C-spine fracture or questionable traumatic findings confirmed by subsequent MRI.

RESULTS
The overall rate of positive C-spine findings was 3.8% in the combined group and 3.2% in the alone group (p=0.52). The most common indication for the combined study was “falls” (51.1%), while the most common indication for the alone group was “motor vehicle collision (MVC)” (59.5%). Of all cases with the indication “MVC”, the positive rate was a 12.5% in the combined group and 1.5% in the alone group (p=0.015). Of all cases with the indication “falls”, the positive rate was 1.1% in the combined group and 9.9% in the alone group (p=0.11). The average age of the combined group was 51.3 and the average age in the alone group was 40.3 (p

CONCLUSION
The overall rate of positive c-spine findings in the combined and alone groups were similar. However, trends emerged based on study indication, with a statistically significant increase in positive c-spine findings for “MVC” when a combined study was ordered. This could be due to more serious accidents leading to a more comprehensive order. Trends in the other direction were noted in those studies for “falls”, with more positive findings in the C-spine alone group. In these cases, perhaps the combined studies were ordered in those intoxicated or unable to give proper history, while c-spine alone patients were able to explain focal symptoms.

CLINICAL RELEVANCE/APPLICATION
ER physicians may be able to better tailor their ordering practices based on the mechanism of injury to maximize injury detection while minimizing radiation exposure.

LL-ERS-TU5B • Current Concepts in the Imaging of Traumatic Dental Injury (TDI): Much More than a â€œBroken Toothâ€?

Ashley A Tuttle MD (Presenter); Steven A Brown DMD; Glenn A Tung MD

PURPOSE/AIM
TBI is common but frequently overlooked or incorrectly described by radiologists. In a busy level I trauma center, a dental consultation for TBI occurs daily. This electronic exhibit will raise awareness of dental trauma by reviewing basic dental anatomy, discussing the spectrum of TBI and focusing on radiologic findings that most impact management decisions.

CONTENT ORGANIZATION
We review normal dental anatomy, methods of dental imaging in the emergency department and common mechanisms of TBI. Types of crown, crown-root and root fractures, and the spectrum of periodontal injuries, including luxations and avulsion, will be discussed. Examples of these injuries will be demonstrated on panorex radiography and computed tomography. We will describe the treatment of TBI and specify dental imaging signs that critically influence management.

SUMMARY
After viewing this exhibit, radiologists will have a heightened awareness of TBI: They will understand dental anatomy, the spectrum of TBI and critical signs on dental imaging that will enable them to provide more detailed and pertinent information in their reports.

Gastrointestinal - Tuesday Posters and Exhibits (12:45pm - 1:15pm)
Tuesday, 12:45 PM - 01:15 PM • Lakeside Learning Center

LL-GIS-TUB • AMA PRA Category 1 Credit™: 0.5

LL-GIE-TU10B • Ultrasound-guided Percutaneous Core Biopsy of Pancreatic Tumor: Tips and Tricks to Ensure Safe and Effective Biopsy

Suk Hee Heo MD (Presenter); Jin Woong Kim MD; Sang Soo Shin MD; Sung Mo Kim; Yong-Yeon Jeong MD; Heoung-Keun Kang MD

PURPOSE/AIM
To review the ultrasound-guided percutaneous core biopsy (USPCB) of pancreatic tumor including indications, approach routes, tips of needle handling, contraindications, and potential complications, with emphasis on how to decide safe needle pathway using video clips and illustrations.

CONTENT ORGANIZATION
A. General overview of USPCB
1. Indications
2. Contraindications
3. Patient preparation before biopsy
B. How to decide approach route according to the location of pancreatic tumors: explanation with various clinical cases using video clips and illustrations
1. Proper planning of percutaneous needle approach route
   a. Transomental approach
   b. Transgastric approach
   c. Transenteric approach
   d. Transhepatic approach
   e. Transsplenic approach
   f. Transrenal approach
2. Technical tips and tricks for safe and effective USPCB
   a. How to effectively handle a biopsy needle under the ultrasound
   b. What to know in order to avoid potential complications
C. Summary

SUMMARY
USPCB of pancreatic tumor cannot be easily performed and usually requires experienced radiologists. However, it could be a safe and feasible method with a full understanding of the proper methodology. We will review the USPCB with various cases using video clips and illustrations about proper approach route and technical tips to ensure safe biopsy.

LL-GIE-TU11B • Complications of Radiofrequency Ablation for Liver Tumors: An Update on Management and Long-term Outcomes

Jihye Min MD (Presenter) ; Hyo Keun Lim MD ; Min Woo Lee ; Young-Sun Kim ; Dongil Choi ; Hyunchul Rhim MD, PhD

PURPOSE/AIM
The aim of the this exhibit is
1. To describe the imaging features and management of various complications associated with radiofrequency ablation (RFA)
2. To review the risk factors potentially affecting RFA-induced complications
3. To determine the impact of RFA-induced complications on the long term outcomes of RFA.

CONTENT ORGANIZATION
Although RFA is considered to be a safe and effective technique for treating liver tumors, various complications can happen when inadequately performed. We have performed more than 6,000 RFA procedures for treating liver tumors during the recent 14 years period and encountered diverse procedure-related complications. We divided RFA-induced complications into five types: hemorrhage, hepatic vascular injuries, biliary injuries, extrahepatic organ injuries and tumor progression.

SUMMARY
The major teaching points of this exhibit are
1. Because an early and accurate diagnosis of complications is mandatory for proper management, radiologists should be familiar with the imaging features, as well as management strategies of RFA-induced complications.
2. Thorough understanding of risk factors for developing RFA-induced complications may be beneficial in preventing potential complications.
3. Physicians who perform RFA should be aware of the impact of RFA-induced complications on the long term therapeutic outcomes of RFA.

LL-GIE1241-TUB • Rapid kWp-Switching Single-Source Dual-Energy CT: Practical Technology and Techniques

Lincoln L Berland MD (Presenter) * ; David N Bolus MD ; Mark E Lockhart MD ; Desiree E Morgan MD * ; John V Thomas MD, MRCP ; Therese M Weber MD ; Michael V Yester PhD

PURPOSE/AIM
Dual energy CT technology remains confusing, and the two current commercial versions differ substantially. This exhibit will be a practical guide for radiologists to the principles of single source rapid kWp-switching dual energy CT (RSDE) and its current and prospective clinical applications.

CONTENT ORGANIZATION
Principles of technology and techniques will be illustrated, including how rapid kWp-switching, using projection space, leads to two types of image series: 40-140 keV simulated image series (101 keV versions of the same image series) and material decomposition basis-pair image series. Basis pairs may be constructed from a variety of pair choices, the most common being water-iodine. The value and limitations of mg/cc material content analysis will be discussed. Analysis tools will be described, including scatterplots, spectral curves, color filters and contrast-to-noise curves. The use of these tools will be illustrated with several clinical applications, such as renal and post-ablation liver masses, renal calculi, pancreatic and adrenal masses and metal artifact reduction techniques.

SUMMARY
Rapid kWp-switching dual energy CT may be optimized after achieving familiarity with the basic principles of technology and the tools for clinical analysis. This exhibit will establish the basis for radiologists to use RSDE in daily practice.

LL-GIE-TU12B • Hypervascular Liver Lesions Revisited: MR Imaging Characteristics and Differentiating Features from Hepatocellular Carcinoma

Anne Gill MD (Presenter) ; Courtney A Coursey MD * ; Burcu Saka MD ; Volkan Adsay ; Pardeep K Mittal MD

PURPOSE/AIM
• To review the MR appearance of more common hypervascular liver lesions: hemangioma, focal nodular hyperplasia, arterio-portal shunt, transient hepatic intensity difference (THID), hepatocellular carcinoma (HCC), hypervascular metastases, adenoma, hepatic arteriovenous malformation, and nodular regenerative hyperplasia.
• To review the MR appearance of less common hypervascular liver lesions: fibrolamellar HCC, SVC obstruction, Peliosis Hepatis, and hepatic angiosarcoma.
• To correlate the MR imaging appearance of hypervascular liver lesions with histopathology specimens.

CONTENT ORGANIZATION
• Review the current MR imaging technique and contrast protocols for focal hepatic lesions.
• Discussion of the differential diagnosis of hypervascular liver lesions and the appearance on various MRI sequences.
• Review the histopathologic features of each lesion and correlate the histopathology with the imaging appearance.

SUMMARY
Hypervascular liver lesions encompass a wide variety of diagnoses and a spectrum of imaging features on MRI. Recognition and accurate diagnoses of these lesions is of utmost importance for radiologists. Correlation of imaging findings with histopathology helps clarify and explain the lesion’s appearance on various MR sequences.

LL-GIE-TU7B • Diffusion Imaging of Pancreatic Disease: Pearls Every Resident Must Know

Rammohan Vadapalli MD (Presenter) ; Abhijit Roychowdhury MD ; Abhinav Siriam S Vadapalli ; Krishna Mohan Pottal MD ; Manoj Ranjan MD ; Raghavendra Itgampalli ; Jagath S Weerakkody Dipl Phys, DMD
Preoperative Prediction Factors for Conversion of Laparoscopic to Open Cholecystectomy

Dae K Na (Presenter) ; Heon-Ju Kwon MD ; Mi Sung Kim MD ; Hae Won Park MD

PURPOSE
To determine predictive preoperative factors for conversion in patients undergoing conversion from laparoscopic to open cholecystectomy for benign gallbladder disease.

METHOD AND MATERIALS
This retrospective study was approved by our institutional review board, and informed consent was waived. We included 908 patients underwent laparoscopic cholecystectomy from January 2010 to January 2012. In consensus, two radiologists retrospectively evaluated preoperative CT parameters; anatomic variation of gallbladder, thickened gallbladder wall, enhancement of gallbladder wall, mucosal hemorrhage, or delayed gastric emptying. Late complications include band erosion, band slippage or prolapse, port malfunction, leakage at the port site tubing or band, pouch or esophageal dilatation, and esophagitis.

RESULTS
Conversion to open cholecystectomy was performed in 47 (5.1%) of 908 patients. In univariate analysis, anatomic variation of gallbladder (Odds Ratio [OR], 22.6; 95% confidence intervals [CI], 6.7 – 76.7), mucosal disruption of gallbladder (OR, 9.4; 95% CI, 4.4 – 20.1), perforation of gallbladder (OR, 5.6; 95% CI, 1.2 – 25.9), pericholecystic fluid or abscess (OR, 22.7; 95% CI, 6.7 – 76.7), pericholecystic hepatic parenchymal hyperemia (OR, 3.3; 95% CI, 1.7 – 6.6), severe atherosclerosis (OR, 14.4; 95% CI, 5.6 – 36.8) and stone in the cystic duct (OR, 15.8; 95% CI, 2.6 – 95.8) were able to predict for conversion. In multivariate analysis, anatomic variation of gallbladder (adjusted OR, 66.1; 95% CI, 1.5 – 2908.9) and pericholecystic fluid or abscess (OR, 11.5; 95% CI, 2.9 – 46.1) were defined as independent prediction factors.

CONCLUSION
On preoperative CT images, anatomic variation of gallbladder and pericholecystic fluid/abscess are associated with conversion from laparoscopic to open cholecystectomy. Recognition for these predictive factors for conversion could improve preoperative patient counseling and establish proper surgical planning.

CLINICAL RELEVANCE/APPLICATION
Recognition for predictive factors for conversion on preoperative CT images could improve preoperative patient counseling and establish proper surgical planning.
LL-GIS-TU2B • Optimization of Acquisition Interval in Abdominal CT Perfusion Measurement

Tomonori Kanda ; Takeshi Yoshikawa MD (Presenter) * ; Keitaro Sofue ; Yoshiharu Ohno MD, PhD * ; Yasaki Fujisawa MS * ; Hisano Koyama MD ; Mizuho Nishio MD * ; Noriyuki Negi RT ; Tohru Murakami ; Naoki Kanata MD ; Kazuro Sugimura MD, PhD *

PURPOSE
To optimize acquisition interval in upper abdominal CT perfusion measurement

METHOD AND MATERIALS
Seventy seven patients (male: 46, female: 21, mean: 67.5 yrs) underwent upper abdominal CT perfusion (CTP). Scans were conducted 7 to 120 secs after administration of contrast medium and 25-ml saline chaser. The patients were randomly divided into two groups; group 1 (data set A, every 2seconds during first 30 secs, total 22 scans) and 2 (B, every 3seconds, 17 scans). Third set was made from group 1 data (C, every 4 secs, 13 scans). Demographic features of the groups and CTDIvol (mGy) and DLP (mGy.cm) for CTP were recorded.

Hepatic arterial and portal perfusion (HAP and HPP, ml/min/100ml), arterial perfusion fraction (APF, %), mean transit time (MTT, sec), and distribution volume (DV, ml/100ml) were calculated using dual-input maximum slope (dMS), deconvolution (dDC), and compartment model (dCM) methods using the same ROIs on a prototype software. Arterial perfusions (AP), MTTs, and DVs in the pancreas, spleen, and gastric wall were calculated using single-input MS, DC, and CM (sMS, sDC, SCM) methods.

RESULTS
There was no significant difference in demographic features. CTDIvol (70.3 and 54.4, p

CONCLUSION
Although longer acquisition interval protocol has the benefit of lower radiation dose, equal to or less than every 3-second interval is recommended in upper abdominal CT perfusion.

CLINICAL RELEVANCE/APPLICATION
Although longer acquisition interval protocol enjoys the benefit of lower radiation dose, equal to or less than every 3-second interval is recommended in upper abdominal CT perfusion.

LL-GIS-TU3B • Preoperative N Staging of Early Gastric Cancer: Gross and Microscopic Determinants of Multidetector Computed Tomography Findings in pN0 Patients

Jung-Hyun Kang (Presenter) ; Jeong-Sik Yu MD ; Jae-Joon Chung MD ; Joo Hee Kim ; Eun-Suk Cho ; Ki Whang Kim MD

PURPOSE
To identify determinants of lymph node metastases on preoperative multidetector computed tomography (MDCT) in early gastric cancer patients with pN0 disease.

METHOD AND MATERIALS
For 199 patients with early gastric cancer in the pT1pN0 category, the largest perigastric lymph node on preoperative MDCT in each patient was categorized based on cutoffs for eight different parameters (short and long diameter 4 mm, 6 mm, or 8 mm; mean attenuation 100 HU; short-to-long diameter ratio 0.7) and correlated with the size, gross type, depth of invasion, and microscopic type of the primary lesions by chi-square test and multiple logistic regression analysis.

RESULTS
When the primary lesion was larger than 3 cm, the lymph nodes were larger for four parameters (short diameter or long diameter, 4 mm or 6 mm; p

CONCLUSION
Benign regional lymph node enlargement is more frequent in early gastric cancer patients with a primary lesion of larger size or poor microscopic differentiation, and less frequent in patients with gross type IIb disease.

CLINICAL RELEVANCE/APPLICATION
We hope that increased knowledge of factors that induce benign perigastric lymph node enlargement in early gastric cancer will lead to more accurate staging of lymph nodes in pre-operative CT scans.

LL-GIS-TU4B • Diffusion-weighted MR Imaging: Usefulness for Differentiating Intrapancreatic Accessory Spleen and Small Hypervascular Neuroendocrine Tumor of the Pancreas

Nieun Seo MD (Presenter) ; Jin Hee Kim MD ; Bo-Kyeong Kang MD ; Jae Ho Byun MD ; Seung Soo Lee MD ; Hyoung Jung Kim MD ; So Yeon Kim MD

PURPOSE
To investigate the usefulness of diffusion-weighted MR imaging (DWI) and measurement of apparent diffusion coefficient (ADC) value for differentiating intrapancreatic accessory spleen (IPAS) from small hypervascular neuroendocrine tumor (NET) of the pancreas.

METHOD AND MATERIALS
Twenty-five patients with IPAS, diagnosed by surgery (n=3), biopsy (n=2), scintigraphy (n=1), or typical imaging features (n=19) and 31 patients with small (<3cm) hypervascular NET of the pancreas, diagnosed by surgery (n=28) or biopsy (n=3) underwent both contrast-enhanced MRI (CE-MRI) and DWI. A ‘hypervascular’ NET was defined as a lesion that appeared hyperintense to the normal pancreatic parenchyma in the arterial phase of CE-MRI. The visually assessed signal intensity of the pancreatic lesions compared with the spleen on DWI (b-value of 1000 sec/mm²) was more frequently observed in IPAS than in NET (92% vs. 63%, p<0.001) and ADC values were compared between IPAS and NET group. For 25 IPASs and 13 NETs in the pancreatic tail, two blinded radiologists independently reviewed two MR image sets (CE-MRI alone vs. combined CE-MRI and DWI) and rated their confidence in differentiating between the two conditions using a five-point scale for each image set. The diagnostic performances of two MR image sets were compared using ROC analysis and McNemar test.

RESULTS
The isointensity of the pancreatic lesions compared with the spleen on DWI was more frequently observed in IPAS than in NET (92% vs. 12.9%, P=0.001) and ADC values were compared between IPAS and NET group. For 25 IPASs and 13 NETs in the pancreatic tail, two blinded radiologists independently reviewed two MR image sets (CE-MRI alone vs. combined CE-MRI and DWI) and rated their confidence in differentiating between the two conditions using a five-point scale for each image set. The diagnostic performances of two MR image sets were compared using ROC analysis and McNemar test.

CONCLUSION
Visual assessment of DWI and ADC quantification were useful in differentiating IPAS from small hypervascular NET of the pancreas. The diagnostic performance of combined CE-MRI and DWI was superior to that of CE-MRI alone for differentiating the two conditions.

CLINICAL RELEVANCE/APPLICATION
The use of DWI in combination with conventional CE-MRI may help to minimize unnecessary invasive procedures in patients with IPAS and to avoid misdiagnosing patients with NET as having IPAS.

LL-GIS-TU5B • The Value of Spectral HU Curve in Evaluating Histodifferentiation of Gastric Cancer: A Pilot Study

Lihong Chen (Presenter) ; Qing Duan ; Yunjing Xue MD
RESULTS
There were 32 moderate differentiated and 35 poor differentiated adenocarcinoma confirmed pathologically in our research (well differentiated adenocarcinoma was excluded for only 2 cases). The absolute mean slope rates of moderate differentiated adenocarcinoma were lower than those of poor differentiated adenocarcinoma. They were 1.11±0.39 vs 1.20±0.62 in AP and 1.67±0.41 vs 2.14±0.54 in VP and 1.57±0.46 vs 2.02±0.53 in PP, respectively. There were significant difference of mean slope rates between moderate differentiated and poor differentiated adenocarcinoma (all of them P<0.05). Meanwhile monochromatic CT values measured on every single energy level of moderate differentiated adenocarcinoma were lower than those of poor differentiated adenocarcinoma. Significant difference (all of them P<0.05) was found in VP.

CONCLUSION
The spectral HU curve could be used to differentiate moderate differentiated adenocarcinoma from poor differentiated adenocarcinoma and was helpful to evaluate the differentiation-state of gastric cancers.

CLINICAL RELEVANCE/APPLICATION
Differential diagnosis of differentiation degree for gastric carcinoma is important for survival prognosis and helpful for framing treatment scheme.

LL-GIS-TU6B • Measuring Liver Fat Content after Alcohol Intoxication Using Dual Energy CT (DECT) in a Rat Animal Model

Wolfgang Kromen (Presenter) ; Huedayi Korkusuz MD ; Bahram Raschidi ; Thomas J Vogl MD, PhD

PURPOSE
Quantitative evaluation of liver fat content provoked by alcohol intoxication using dual energy CT (DECT) determined attenuation in correlation to the biochemically measured liver fat content in a rat model.

METHOD AND MATERIALS
RESULTS

CONCLUSION
Dual energy CT (DECT) allows for an excellent biochemically proven non-invasive quantification of liver fat content in a rat model of an alcohol intoxication induced fatty liver.

CLINICAL RELEVANCE/APPLICATION
Dual energy CT is an excellent tool for quantifying the liver fat content. This might i.e. play an important role in predicting the quality of the (fatty) donor organ in split liver transplantations.

Genitourinary/Uroradiology - Tuesday Posters and Exhibits (12:45pm - 1:15pm)
Tuesday, 12:45 PM - 01:15 PM • Lakeside Learning Center

LL-GUS-TUB • AMA PRA Category 1 Credit ™:0.5

LL-GUS-TU1B • Clinical Application of High-pitch Excretory Phase Images during Dual-source CT Urography with Photon Detector

Hao Sun MD (Presenter) ; Huadan Xue MD ; Zhengyu Jin MD ; Xuan Wang MD ; Yu Chen MD ; Yonglan He MD

PURPOSE
To retrospectively evaluate the clinical feasibility of high-pitch excretory phase images during dual-source CT urography with photon detector.

METHOD AND MATERIALS
RESULTS

CONCLUSION
High-pitch low-tube-voltage during excretory phase dual-source CT urography with photon detector is feasible, with acceptable image noise and lower radiation dose.

CLINICAL RELEVANCE/APPLICATION
High-pitch low-tube-voltage mode scanning protocol is clinically applicable in excretory phase imaging acquisition of dual-source CT urography with photon detector.

LL-GUS-TU2B • Female Pelvic Endometriosis: 3D T2-weighted Imaging at 3T MRI - Image Quality and Lesion Detection in Comparison with 2D T2-weighted Imaging

Nienke L Hansen MD (Presenter) ; Junko Takahama MD ; Megumi Takewa MD ; Nagaaki Marugami ; Aki Takahashi MD ; Christiane K Kuhl MD * ; Kimihiko Kichikawa MD

PURPOSE
To clarify the utility of 3D T2-weighted images at 3T-MRI to diagnose female pelvic endometriosis in comparison with conventional 2D T2-weighted images.

METHOD AND MATERIALS
RESULTS

CONCLUSION
To assess the clinical application of gemstone spectral CT imaging in evaluating the different differentiation-state of gastric cancers quantitatively based on the basis of spectral HU curve.

METHOD AND MATERIALS
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The spectral HU curve could be used to differentiate moderate differentiated adenocarcinoma from poor differentiated adenocarcinoma and was helpful to evaluate the differentiation-state of gastric cancers.

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METHOD AND MATERIALS
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CONCLUSION
To assess the clinical application of gemstone spectral CT imaging in evaluating the different differentiation-state of gastric cancers quantitatively based on the basis of spectral HU curve.

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RESULTS

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The spectral HU curve could be used to differentiate moderate differentiated adenocarcinoma from poor differentiated adenocarcinoma and was helpful to evaluate the differentiation-state of gastric cancers.

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RESULTS

CONCLUSION
High-pitch low-tube-voltage during excretory phase dual-source CT urography with photon detector is feasible, with acceptable image noise and lower radiation dose.

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High-pitch low-tube-voltage mode scanning protocol is clinically applicable in excretory phase imaging acquisition of dual-source CT urography with photon detector.

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PURPOSE
To clarify the utility of 3D T2-weighted images at 3T-MRI to diagnose female pelvic endometriosis in comparison with conventional 2D T2-weighted images.

METHOD AND MATERIALS
RESULTS

CONCLUSION
To assess the clinical application of gemstone spectral CT imaging in evaluating the different differentiation-state of gastric cancers quantitatively based on the basis of spectral HU curve.

METHOD AND MATERIALS
RESULTS

CONCLUSION
The spectral HU curve could be used to differentiate moderate differentiated adenocarcinoma from poor differentiated adenocarcinoma and was helpful to evaluate the differentiation-state of gastric cancers.

CLINICAL RELEVANCE/APPLICATION
Differential diagnosis of differentiation degree for gastric carcinoma is important for survival prognosis and helpful for framing treatment scheme.
RESULTS
Images obtained with the 3D sequence had a significantly greater CNR for adenomyosis (2D 0.32 vs. 3D 0.42; p=0.035) and rectosigmoid lesions (0.31 vs. 0.40; p=0.025). No difference between 2D and 3D imaging was found in CNR for ovarian lesions (2D 0.50 vs. 3D 0.46; p=0.15). Interreader agreement was better in 3D compared to 2D for adenomyosis (kappa value 2D 0.32 vs. 3D 0.65) and for rectosigmoid lesions (0.47 vs. 0.70); and equal for ovarian lesions (0.53 vs. 0.55). General Image Quality was rated equally excellent in both 2D and 3D (average 4.5 of 5; p=0.5). No significant differences between 2D and 3D images were found regarding sensitivity and specificity (p=0.06-0.9).

CONCLUSION
In comparison with conventional 2D T2-weighted sequence of the female pelvis, 3D T2-weighted images had better conspicuity and better interreader agreement for adenomyosis and rectosigmoid lesions. Image quality and accuracy were equal in both 2D and 3D images.

CLINICAL RELEVANCE/APPLICATION
For clinical pelvic imaging of endometriosis at 3T MRI, 3D T2-weighted image has advantages over the conventional 2D image and can be allowed as substitute for conventional multi-plane 2D scanning.

LL-GUS-TU3B • Polyhydramnios and Fetal Congenital Malformations; Secrets of 4D Ultrasound

Nadia F El Ameen MD (Presenter) ; Adel S Mhosen MD ; Ahmad Kotb MD, MSC ; Nashwa Adel MSC

PURPOSE
The aim of our study was to assess the role of 4Dimension ultrasonography in diagnosis of fetal congenital anomalies in patients with polyhydramnios.

METHOD AND MATERIALS
In a prospective study, a total of 150 patients (age range from 25 – 40ys) with polyhydramnios were collected. All patients referred from Obstetrics and Gynecology department from a time interval between January 2011 and June 2012. Patients were included after meeting the inclusion criteria which depends on the clinical examination, obstetric history of the patient and 2D ultrasound examination.

RESULTS
4D ultrasound examination was positive in 96 (64%) out of 150 patients and negative in 54 (36%) who presented with polyhydramnios and suspected to have fetal congenital anomalies. They showed variable fetal congenital anomalies including CNS anomalies in 22 patients (14.7%), skeletal dysplasia in 20 patients (13.3%), renal anomalies in 18 (12%) patients, GIT anomalies in 12 patients (8%), cystic hygroma in 10 patients (6.7%), meningocele in 8 patients (5.3%) and cleft lip in 6 patients (4%). 2D examination showed much less sensitivity in detection of cleft lip anomalies and skeletal dysplasia, where only 2 cleft lip were diagnosed among the 6 detected by 4D and 12 patients with skeletal dysplasia only diagnosed among the 20 detected by 4D and all confirmed after delivery.

CONCLUSION
4D ultrasonographic evaluation in patients with polyhydramnios reduce the false negative diagnosis of congenital fetal malformations that occurs in 2D ultrasonography examination.

CLINICAL RELEVANCE/APPLICATION
4D ultrasonographic evaluations in patients with polyhydramnios increase the detectability of congenital fetal malformations.

LL-GUS-TU4B • Detection Rate for Prostate Cancer Using MRI-Ultrasound Fusion in a Biopsy-Naïve Population

Daniel J Margolis MD (Presenter) * ; Steven S Raman MD ; Edward K Chang ; Fred Dorey PhD ; Jiaoti Huang ; Patricia Lieu ; Malu Macairan ; Shyam Natarajan ; Robert E Reiter MD ; Geoffrey Sonn ; Leonard S Marks MD *

PURPOSE
Compare the detection rate of MRI-ultrasound fusion targeted biopsies versus systematic biopsies in a biopsy naïve population.

METHOD AND MATERIALS
After IRB approval we retrospectively analyzed 127 consecutive men undergoing their first prostate biopsy. Subjects had a multiparametric MRI on a 3.0 T Siemens Magnetom Trio without endorectal coil, including axial 3D TSE T2 (Siemens SPACE, TR/TE 3800-5000/101 ETL 13-14 cm FOV, 256 x 256 matrix, 1.5 mm contiguous slices), diffusion-weighted imaging (echoplanar, TR/TE 3800-5040/101 ETL 13, 14 cm FOV, 256 x 256 matrix, 1.5 mm contiguous slices), and dynamic view-sharing T1 (Siemens TWIST, TR/TE 3.9/1.4 ms, 12° flip angle, 26 x 26 cm FOV, 160 x 160 matrix, 3.6 mm slices, 4.75 s/acquisition over 6 minutes with 15 s injection delay, image analysis using iCAD VersaVue), prior to MRI-ultrasound fusion targeted biopsy (Artemis, Ewing Imaging, Inc.) and systematic biopsy at the same setting. PSA, age, prostate volume, maximum Gleason score (GS), target location, and maximum cancer length were recorded. Three definitions of significant disease were used: >5 mm of GS 6 or any length GS>6 (SD1), any GS>7 (SD2), and >5 mm GS=7 (SD3), analyzed with McNemar’s test.

RESULTS
In 127 men (median age 57, interquartile range 56-59), 232 targets were identified (mean 1.8 per subject). All men had at least one target, although 51 (22%) were low suspicion. On average, 2.7 biopsies were taken per target. At least 10 systematic biopsies were taken from 117 (92%) subjects. The median PSA was 6 (IQR 4.3-8.6) ng/mL. Cancer was found in 74 (58%) men. Significant disease was found in 93 (42%) men using SD1, 47 (37%) using SD2, and 22 (17%) using SD3. Targeted and systematic classification was concordant in 29 (55%) of SD1, 25 (53%) of SD2, and 11 (50%) of SD3 (Table). In each case, targeted biopsy identified more men with significant cancer, but this did not reach significance (p=0.05 for all).

CONCLUSION
MRI-ultrasound fusion targeted biopsy identified nearly 1/3 more significant cancers than systematic biopsy in men undergoing their first prostate biopsy. However, not all significant cancers are found by MRI-ultrasound fusion targeted biopsy.

CLINICAL RELEVANCE/APPLICATION
In a biopsy-naïve population, nearly one third more significant and moderate-to-high grade disease was found on MRI-ultrasound fusion targeted prostate biopsies than on systematic biopsies alone.

LL-GUS-TUSB • Potential Role of Fetal MRI in Characterising Common CNS and Non-CNS Congenital Fetal Anomalies. Assessment of Diagnostic Accuracy of Fetal MRI in Comparison to Ultrasound and Its Impact on Management and Outcome of Pregnancy

Mukta D Mahajan MBBS (Presenter) ; Sonal Garg MBBS ; Ritu M Kakkar MBBS ; Rashmi S Badhe

PURPOSE
1. To compare the diagnostic yield of fetal MRI as compared to a Level III antenatal ultrasound in the assessment of CNS and non-CNS fetal anomalies. 2. To assess the role of MRI as a complementary diagnostic tool in the presence of equivocal or inconclusive sonographic data and to determine how this addition may affect the management of pregnancy.

METHOD AND MATERIALS
This was a pilot study where we prospectively examined 35 fetuses who had sonographically suspected congenital anomalies. MRI was done within 1 week following US examination. The gestational age range was 17–19 weeks. Ultrasound and MRI were compared and the contribution of MRI was evaluated in terms of three parameters-change in the diagnosis, change in the outcome of pregnancy (termination versus continuation) and change in the prognosis.

RESULTS
Multiparametric Prostate MRI: Is It Worth the Cost?

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PURPOSE
We performed an analysis on patients with trans-rectal (TRUS) prostate biopsies negative for malignancy to determine whether the use of a multiparametric (mp)-prostate MRI is associated with differences in cancer detection or increased costs as compared with not using a mp-prostate MRI.

METHOD AND MATERIALS
We reviewed our institution patient data base (2008-2010) and identified all patients who underwent a mp-prostate MRI and who had at least one negative TRUS prostate biopsy and persistently elevated PSA levels prior to mp-prostate MRI. We divided the patients into 3 different groups (1, 2 or 3 and more negative TRUS prostate biopsies before obtaining a mp-prostate MRI). We performed statistical analyses of cost data in patients undergoing multiple TRUS prostate biopsies compared to addition of mp-prostate MRI prior to TRUS biopsy.

RESULTS
Of 213 patients in all; the mp-prostate MRI overall sensitivity for predicting positive biopsies was 96.5%. At our institution, the cancer-detection rate at repeat TRUS prostate biopsy (without a mp-prostate MRI) ranges between 21%-33%. Mean total costs for patients in group 1, 2, and 3 or more negative TRUS prostate biopsies were $44,175, $99,400, $356,700 and $152,675, $197,400, $356,700 respectively (p < 0.001).

The cancer-detection rate at repeat TRUS prostate biopsy ranges between 21%-33%. Mean total costs for patients in group 1, 2, and 3 or more negative TRUS prostate biopsies were $44,175, $99,400, $356,700 and $152,675, $197,400, $356,700 respectively (p < 0.001).

1.1% to 34.3%). MRI added significant value in patients with ventriculomegaly and corpus callosum pathologies. Visualization of the spinal cord is also far superior with MRI as seen in a patient of hemivertebra with diastatotomyelia. MRI scored over Ultrasound in fetal lung volumetry for thoracic anomalies which was more accurate and hence more indicative of prognosis. MRI helped differentiate hydronephrotic obstructive pattern of multicystic dysplastic kidney from isolated hydronephrosis as seen on ultrasound in one case which changed the outcome of the pregnancy.

CONCLUSION
Our results demonstrate that fetal MR imaging can be used as a problem solving modality in characterizing fetal anomalies when US findings are inconclusive or equivocal. This is valuable when the ultrasound diagnosis will result in termination of the pregnancy and in making critical decisions for fetal management.

CLINICAL RELEVANCE/APPLICATION
In the face of increasing availability of sophisticated and expensive investigations, the actual clinical utility, performance and effectiveness of tests like Fetal MRI has been assessed.
analysis using 'evidence-based medicine' (ebm) techniques

ll-hps-tu2b • re-initiation of advanced diagnostic imaging requests following withdrawal or modification in a collaborative peer-to-peer consultative environment

jeffrey d robinson md (presenter) * ; daniel s hippe ms * ; mark d hiatt md, mba *

purpose
utilization management (um) oriented towards appropriateness results in withdrawal or modification of some requests for advanced diagnostic imaging (adi). the purpose of this study was to see how often these withdrawn or modified studies were re-requested on the same patient for the same indication within 60 days.

method and materials
all adi requests received by healthhelp between january 2011 and december 2012 were reviewed for instances in which a request for a study was withdrawn or modified and subsequently re-initiated within 60 days.

results
1,998,620 adi requests were included in the data set. of these, 34,227 (1.7%) exams were withdrawn 12 weeks or more before the end of the study period. 10,065 (29%) of the withdrawn requests were resubmitted within 12 weeks. an additional 7,928 (0.4%) were modified, of which 297 (4%) were resubmitted within 12 weeks. clinical errors resulted in 3,916 artifactual withdrawals, and 30 artifactual modifications, resulting in final resubmission rates of 18% and 3%, respectively.

conclusion
collaborative peer-to-peer consultation for ordering of adi results in 1.7% withdrawal and 0.4% modification of ordered exams. withdrawn exams have an 18% chance of being re-initiated and modified exam requests have a 3% chance of being resubmitted within 12 weeks of the original request.

clinical relevance/application
providers uncommonly re-request exams after collaborative peer-to-peer consultation results in change or withdrawal of the original request.

ll-hps-tu3b • nationwide medicare data show the end of growth in utilization rates of advanced imaging

david c levin md (presenter) * ; vijay m rao md ; laurence parker phd ; andrea j frangos mph

purpose
anecdotal reports from various sources have suggested that advanced imaging is no longer growing. our purpose was to determine the correctness of this perception by studying recent trends in utilization rates of ct, mri, and nuclear medicine, using a nationwide database.

method and materials
the medicare physician/supplier procedure summary master files for 2000-2011 were used. these files cover all medicare beneficiaries in traditional fee-for-service medicare (36.3 million in 2011). all cpt codes for ct, mri, and nuclear medicine (including pet) were selected except those for guidance for invasive procedures and for radiation therapy planning. procedure volumes in the 3 modalities were determined by tabulating global and professional component claims. utilization rates per 1000 beneficiaries were calculated and tracked from 2000 through 2011.

results
the ct utilization rate per 1000 rose from 325 in 2000 to a peak of 637 in 2009 (+96%). in 2010, for the first time, a small drop in the rate was seen, to 626. in 2011 a large drop to 500 occurred. this was mostly attributable to bundling of the codes for ct of the abdomen and pelvis. the nuclear medicine rate per 1000 rose from 193 in 2000 to a peak of 320 in 2006 (+66%). there was a gradual and slight decline over the next 3 years, to 303 in 2009. in 2010, there was a sharp decline to 135, which was primarily due to bundling of the codes for primary myocardial perfusion imaging and its 2 add-on codes for left ventricular wall motion and ejection fraction. a further decline to 128 occurred in 2011. the mri rate rose from 95 in 2000 to 185 in 2006 (+95%). the rate thereafter remained essentially flat, and was 184 in 2011. no code bundling occurred in mri.

conclusion
the rapid growth that was seen in use of advanced imaging in the early part of the last decade has stopped. sharp declines were seen in ct in 2011 and nuclear medicine in 2010, due primarily to code bundling. however, even before then, growth in those 2 modalities had halted. in mri, where no bundling occurred, growth stopped after 2006. the cause of the cessation of growth is multifactorial.

clinical relevance/application
not applicable.

ll-hps-tu4b • reliability of magnetic resonance enterography in classification of small bowel crohnâ€™s disease patterns: an analysis using â€œevidence-based medicineâ€ (ebm) techniques

david j murphy mbchb, mrcpi (presenter) ; david gibson ; sinead h mc-evoy mbchb, ffrrcsci ; anna e smyth mrcpi ; glen doherty ; dermot e malone md

purpose
magnetic resonance enterography (mere) has a growing role in imaging small bowel crohn’s disease (sbcd). certain sbcd phenotypes respond well to biologic therapy, others need surgery. we evaluated the mere signs that classify sbcd into acute inflammatory, fibrostenosing, perforating and quiescent subtypes.

method and materials
ebm methods were used to search the literature. a secondary literature search yielded no relevant returns. a primary literature search was performed using pubmed and google scholar. the pjo format was used linking mesh terms with the boolean operators and or: ((crohn disease or inflammatory bowel disease) and (small intestine or small bowel)) and (magnetic resonance imaging or mri) and (severity of illness index or fistula or abscess or inflammation or sub-classification or intestinal obstruction or stricture). the abstracts were reviewed and publications meeting inclusion criteria were chosen. studies were assigned an oxford centre for emb ‘level of evidence’, and the validity and strength of the best evidence was assessed using a radiology specific critical appraisal sheet. raw data was extracted for calculation of test properties and graphs of conditional probability were constructed.

results
36 abstracts were identified, 9 were relevant. statistical tests are reported as (sensitivity {95% ci}, specificity {95% ci}, positive and negative likelihood ratios). level 3 evidence showed mere performed well in identifying fibrostenosing (0.92 [1.0-0.81], 0.9 [1.0-0.80], 9.2, 0.09) and perforating sbcd (0.81 [1-0.62], 0.96 [1.91-0.91], 20, 0.2). in the differentiation of acute inflammatory and fibrostenotic sbcd, level 2 evidence identified 3 useful, weaker signs: bowel wall thickening (0.87 [0.98-.75]), 0.42 [0.76-.08], 1.5, 0.4), mural t2 high signal
CONCLUSION
MRE can reliably identify fibrostenotic and perforating SBCD, but has not been shown to reliably differentiate acute inflammatory from chronic fibrotic SBCD.

CLINICAL RELEVANCE/APPLICATION
MRE reliably identifies fibrostenotic and perforating CD but has difficulty separating acute inflammatory from chronic fibrotic CD. Further research into multi-parametric MR assessment is required.

**LL-HPS-TUSB • The Impact of the Economy on the Utilization of Advanced Diagnostic Imaging**

Mark D Hiatt MD, MBA (Presenter) ; Scott Edwards *

**PURPOSE**
In determining the impact of the economy on the utilization of advanced diagnostic imaging, the recent economic downturn of 2010 provided a natural laboratory. For most of 2010, the health insurance industry in the United States witnessed a utilization rate of healthcare services that was less than projected, which contributed in turn to better-than-expected financial results for most of the industry. Many companies in the industry have attributed at least part of the drop in utilization to the concurrent economic downturn and its impact on consumers’ health care spending. This study sought to define more precisely the effect of economic fluctuations on utilization.

**METHOD AND MATERIALS**
To determine the impact of the economic downturn on imaging utilization for the nearly 5 million subscribers to a national health insurance company in 2010, economic data provided by The Conference Board were used to forecast what utilization would have been had economic conditions been similar between the recessionary and pre-recessionary periods. These data took into account more than 20 American economic indicators (e.g., average prime rate, average duration of unemployment) to provide aggregate indices showing how the U.S. economy was performing on an adjusted basis over time. Linear regression analysis was performed using utilization rates for CT, MRI, and PET between January 1, 2006 and November 31, 2010 as the dependent variables and the described economic indicators as the independent variables.

**RESULTS**
Economic conditions had an approximately 2% impact upon utilization of advanced diagnostic imaging, with an R-squared of 0.19.

**CONCLUSION**
The recent economic downturn did not significantly impact the utilization of advanced diagnostic imaging.

**CLINICAL RELEVANCE/APPLICATION**
For future analyses, the Economic Adjustment Factor resulting from this study may be used to estimate the impact of economic fluctuations on imaging utilization.

**LL-INS-TUB • Development of a Database to Track Resident Dictation Volume and Automatically Tabulate ACGME Case and Procedure Logs across Multiple Hospitals at a Large Academic Program**

Thomas W Loehfelm MD, PhD (Presenter) ; Jesse Knighton ; Brent Little MD

**CONCLUSION**
Raw data covering resident dictations can be used to automatically generate data for ACGME reporting requirements with minimum administrative staff and resident burden, and allows for advanced analyses to better understand and optimize the resident experience.

**Background**
We developed a database to track resident dictations across multiple hospitals at a large academic institution in order to satisfy ACGME requirements that Diagnostic Radiology program directors participate in the ACGME Case Log System, and that residents meet minimum numbers of specific case types. With access to raw data, we can generate advanced reports to quantitatively analyze the resident experience in a way that facilitates program improvements and optimizes resident education.

**Evaluation**
We identified data fields required to meet ACGME requirements and worked with RIS contacts at multiple hospitals to design queries. At a minimum, we required: 1) a unique identifier for each study, such as the accession number; 2) resident identifier; 3) plain-text study description (e.g. “CT Head w/o”); and 4) dictation timestamp. We also obtained a hospital identifier, since our residents cover at least 6 different hospitals, and the verifying attending radiologist, for use in advanced analyses. We retrieved data from the past 5+ years and thus built a comprehensive dataset covering all current residents and fellows trained in-house.

**Discussion**
We can now produce accurate Case and Procedure Logs for any current or former resident at the push of a button, no longer relying on 60+ residents to each manually track such information, or administrative staff to decipher and transcribe those logs. We have designed advanced reports to quantitatively analyze the resident experience to assess the variable experience of residents within and across training years. We believe that these and similar analyses facilitated by this database will enable data-driven program improvements to optimize resident education.

**LL-INS-TU2B • Development of a Novel Partial Volume Brain Tissue Segmentation Method Based on Diffusion Tensor MR Imaging Data Using Multi-tensor Model**

Seiji Kumazawa PhD (Presenter) ; Takashi Yoshiura MD, PhD ; Hiroshi Honda MD ; Fukai Toyofuku PhD

**CONCLUSION**
Our proposed PV brain tissue segmentation method improved accuracy in estimating tissue types and segmentation of brain tissue on DT-MRI data over the conventional method.

**Background**
To study the diffusion properties of cerebral gray matter (GM) and white matter (WM) separately in neurological diseases, brain tissue segmentation methods based on diffusion tensor MRI (DT-MRI) data have been proposed. However, in these methods, WM voxels in fiber crossing regions might be misclassified as GM region because of low fractional anisotropy (FA) values due to the partial volume (PV) effect of the DT. Our purpose was to develop a new brain tissue segmentation method for DT-MRI data in which effect of the PV averaging is taken into account by using a multi-tensor model in WM crossing regions.
Laterality
LL-INE-TU5B • LL-INS-TU4B • LL-INS-TU3B

In this article, we introduce the development of an automated detection and correction software algorithm by using Macro program, and additional software would be useful for the next generation PACS. With dedicated software, the discrepancy of the examination name and error could be detected, and this left sides in the radiologic report. This tends to occur more frequently in busy radiology departments, especially with a huge amount of studies, radiologists should select the correct exam and typewrite. However, a radiologist could make errors in the laterality of right and left sides in the radiologic report. Among a list of right/left or both sides of typographical errors in radiologic reports as the number of radiologic examinations increase.

Computer has transformed the radiologic reading workflow. The radiologic reading workflow has come to a new era of computer-based radiology. Along with the expectations for improvement of accuracy of interpretation, radiologists should be aware of the impact of ARG on DCEUS quantification parameters. More specifically rise time (RT), mean transit time (MTT), in agreement with other published results.

Evaluation

Our method consisted of 3 steps. First, initial segmentation was performed using a fuzzy c-means clustering. Second, for the GM voxels adjacent to WM region, we estimated the DTs based on the multi-tensor model. Finally, based on the 5 DT parameters (3 eigenvalues, apparent diffusion coefficient and FA), the PV fractions of WM, GM, and cerebrospinal fluid (CSF) were estimated in each voxel using a maximum a posteriori probability principle. We conducted a digital phantom experiment, in which the performance of our method was compared with that of a conventional method by means of the root mean square error (RMSE) and the volume overlap measure with the ground truth for each of 3 tissue types. In addition, the performance of the two methods was compared by visual evaluation of human DT-MRI data obtained from 5 healthy subjects.

Discussion

In the digital phantom experiment, the conventional method and our method yielded similar RMSE for GM and CSF, while RMSE for WM in our method was smaller than that in the conventional method. The volume overlap measures in our method were more than 0.8 in all three tissue types, and were greater than those in the conventional method. In visual evaluation of human data, the WM/GM/CSF regions obtained by our method better agreed with those depicted in the structural image than those obtained by the conventional method.

LL-INS-TU3B • 3D Visualization of Laparoscopic Images by Automatic Registration of 3D CT/MRI Model

Kai-Che Liu (Presenter) ; Atul Kumar ; Lihsun Chen ; Yen-Yu Wang ; Hurng-Sheng Wu ; Min Ho Huang ; Soler Luc

Purpose

Current work presents a method to create a stereo image of the monocular laparoscope video image by incorporating into them the depth information from 3D CT model. A pre-operative CT scan of the abdomen is indicated in many conditions, therefore, the presented method would be very useful in such cases where surgeons would be helped by the stereoscopic view of the organs during laparoscopic surgery.

Method and Materials

A 3D shape from the laparoscope image, using shape from shading algorithm, is generated and registered to the 3D CT model of the patient to identify correspondence between the image pixels and the 3D points of the CT model. Thereafter, the camera position is tracked in the ‘real’ world (reference frame of the laparoscope) and the ‘virtual’ world (reference frame of the 3D CT model). The depth information of the scene, in the 2D laparoscope image, with respect to the camera location in the ‘virtual’ world is combined to the 2D image to synthesize the left and the right images of stereo image.

Results

Data Collection: Four patients participated in the study where abdominal CT scan images were acquired. For the same patients the laparoscopy surgery videos were recorded. The CT images were segmented semi-automatically for the abdominal organs, by a trained resident. A customized software with a combination of VTK and OpenCV, in C++, was made for the visualization of the segmented images 3D virtual model, the calculation of the depth map and display of the stereo image on the 3D monitor. The result of the depth map was investigated for the correlation with the depth obtained from the latest shape from shading algorithm. The correlation coefficient between the depth maps (for selected regions) were found to be within the range of 0.70 to 0.95 (P < 0.05).

Conclusion

A method for stereo image synthesis from the conventional laparoscope image is presented. The major advantage of using our method is that it can use any volume image data such as CT or MRI and such images are commonly acquired for many pre-operative planning of abdominal surgery.

Clinical Relevance/Application

An improved version of the current method will be easily applicable and useful for most of the conventional laparoscope systems for minimally invasive surgery based on CT or MRI data.

LL-INS-TU4B • Automatic Respiratory Gating for the Quantification of Perfusion of Liver Metastasis with DCEUS

Damianos Christofides MSc ; Edward Leen MD, FRCR * ; Michalakis A Averkiou PhD (Presenter) *

Conclusion

ARG significantly improves the quantification of perfusion with DCEUS; this improvement has a large impact on the quantification parameters. The impact is especially large in the case of amplitude dependent parameters (PI, AUC) compared to time parameters (RT, MTT), in agreement with other published results.

Background

One of the major challenges in quantitative analysis of the perfusion of liver metastasis with dynamic contrast enhanced ultrasound (DCEUS) is motion due to respiration. Respiratory motion introduces errors in quantitative DCEUS perfusion analysis due to the movement of the lesion within and outside the region-of-interest. A novel automated respiratory gating (ARG) technique has been developed and clinically validated. The impact of ARG on DCEUS quantification parameters is investigated and presented.

Evaluation

Time intensity curves (TIC) from liver metastasis were extracted from 25 patients and were fitted on a lognormal indicator dilution model. The coefficient of determination (R²) value of the fit of the model to the TIC data was calculated with and without the use of ARG, in order to evaluate whether ARG improves quantification. Also the respiratory amplitude (RA), for each non-ARG-processed TIC, was calculated using a frequency domain analysis that takes into account the fact that the range of respiration frequencies is between 0.1 and 0.5Hz.

The impact of ARG on DCEUS quantification parameters was also evaluated. More specifically rise time (RT), mean transit time (MTT), area under the curve (AUC) and peak intensity (PI) of the model were calculated for each case with and without ARG.

Discussion

A one tailed paired t-test with unequal variances at a significance level of 0.01 was conducted between ARG-processed and non-ARG-processed R² values from the fit of the model to the data. T-test p-values indicated that the R² increased significantly (p<0.05) increased across the range of RA, in contrast with the R² without using ARG that had a strong linear dependency on RA. Large differences were found between the quantification parameters for RT (34±32%, mean± standard deviation), MTT (39±75%), AUC (78±72%) and PI (55±56%).

LL-INE-TU5B • Automatic Detection and Correction the Errors of Laterality in the Radiologic Reports: A Way to Minimize Errors of Laterality

Young Han Lee MD (Presenter) ; Eun Hae Park ; Sungjun Kim MD ; Ho-Taek Song MD ; Jin-Suck Suh MD

Purpose

The computer has transformed the radiologic reading workflow. The radiologic reading workflow has come to a new era of computer-based radiology. Along with the expectations for improvement of accuracy of interpretation, radiologists should be aware of the typographical errors in radiologic examinations. The typographical errors of the right and left sides of the extremities are not infrequent during the interpretation of radiographs. With the introduction of PACS, more radiologists have started to typewrite their radiologic interpretations. Among a list of right/left or both sides of studies, radiologists should select the correct exam and typewrite. However, a radiologist could make errors in the laterality of right and left sides in the radiologic report. This tends to occur more frequently in busy radiology departments, especially with a huge amount of radiologic burden.

We think this possible error could be minimized with additional software for Picture Archiving and Communicating System (PACS) and Electronic Medical Record (EMR). With dedicated software, the discrepancy of the examination name and error could be detected, and this additional software would be useful for the next generation PACS.

In this article, we introduce the development of an automated detection and correction software algorithm by using Macro program, and
illustrate its practical usages in the radiology reading work flow. From a viewpoint of long term investment, the next generation of PACS or EMR might be expected to include this additional or further advanced function for a better radiologic reading environment.

METHODS
1. Hardware and software
The PACS software was Centricity® Radiology RA1000 (GE Healthcare, Barrington, IL). The EMR software was designed in authors’ institution. Macro program AutoHotkey was used to design error detection and correction. This development tool is downloadable from the official webpage (http://www.autohotkey.com).

2. Flowchart
The software was performed according to the flowchart illustrated in Fig. 1. The first step is real-time automatic discrepancy detection of the laterality between radiologic examination name and radiologic report. In our software, one cycle per 0.5 second was used, and this time can be reduced or increased by the PACS workstation performance. The second step is conditioned discrepancy correction. This second conditioned step is done if Yes button is pressed. If there is no laterality or discrepancy, nothing is done, and the radiologic reading workflow is based on the conventional flow. For studies of both laterality (e.g. Knee AP Lt/Rt ), we added an additional code for bypass.

3. Accuracy evaluation
The accuracy of detection was evaluated from 300 consequently listed radiologic examinations on one day. Randomly sorted intended discrepancies and concordance of lateralities were input in the radiologic reporting system, and the detection and correction were counted in the radiologic reporting system. The confidence intervals of accuracies were calculated.

CONCLUSION
Automated detection and correction software was designed and ran well by using open-source Macro software. This method can be easily adapted for any PACS and EMR, and is expected to be included in the next generation PACS or EMR for a better radiologic reading environment.

LL-INE3175-TUB ● A Radiology Patient Portal with Personalized Guidelines for Non-small Cell Lung Cancer
Mary McNamara (Presenter) ; Corey W Arnold ; Denise R Aberle MD ; Alex A Bui MS, PhD

Background
An ongoing issue has been how best to provide patients with an understanding of their imaging. One solution has been the implementation of patient portals, which provide access to medical record information alongside extra supporting and explanatory content. However, term definitions and supporting information may be patient-specific. In this imaging informatics project, we examine the provision of supporting consumer content for non-small cell lung cancer (NSCLC) and surrounding radiologic studies.

Evaluation
We conducted a survey of preferences for patient portals with 50 lung cancer patients. Guided by these responses, we developed a framework that links concepts from a patient’s personalized problem list to medical guideline content available via MedlinePlus’ website. The interface consists of a problem list, radiology images, medical record data, and supporting content organized in several information orientations. A natural language processing module drives interface instantiation by identifying concepts in pathology, oncology, radiology, and laboratory documents. These concepts are then linked to MedlinePlus consumer content via their concept unique identifiers (CUIs). This content is made available to the patient within the portal via hypertext links. Concepts in the problem list are also linked to key slice radiological images that feature the region of interest (ROI).

Discussion
Patients in our survey responded positively to the idea of accessing radiology content; and rated diagnosis problem lists, radiology report content and imaging as important in helping them to understand their medical record. In response to these results, our visualization pairs relevant guidelines to medical record content and images to explain patient-specific disease presentations. This eliminates the need for patients to search consumer health websites to determine what content is applicable to their personal health situation.

CONCLUSION
Our framework utilizes patient preferences to design an interface that links NSCLC patients’ imaging and reports to supporting MedlinePlus information. This linkage allows patients to focus on consumer health content relevant to their personal health.

LL-INE3214-TUB ● Interactive Gesture Control of Radiologic Imaging Studies at Multiple Institutions Using the Leap Motion Controller
Thomas J O’Neill MD (Presenter) ; Ryan Moffitt * ; Rebecca Wright MD ; Bryan J Foley MD ; Eliot L Siegel MD *

Background
The Leap Motion Controller is a novel motion control human interface device which operates in intimate proximity with high precision and high tracking frame rate allowing for fine, touchless three-dimensional motion controlled computer interaction. Radiologists and other people who regularly interact with medical imaging studies may benefit from using this device for image manipulation by improving their efficiency and interacting in a more natural way, thereby reducing physical strain and fatigue from repetitive use. Gesture control and natural human-computer interaction is becoming more prevalent and often the expected means of computer control and naturally should follow in radiology/medical imaging.

Evaluation
We will demonstrate our experiences implementing the Leap motion controller for manipulation of three-dimensional and cross-sectional imaging at multiple institutions.

Discussion
As human-computer interactions become more diverse and more advanced, radiologists stand to benefit from more natural image manipulation and computer control. Change from the canonical keyboard-mouse model is imminent and may allow for a more efficient workflow and more ergonomic working environment. We will demonstrate the Leap motion control on various systems including Sectra PACS and TeraRecon.

CONCLUSION
We will demonstrate the use of the Leap motion control device in a real-world radiology environment for interactive manipulation of three-dimensional and cross-sectional medical imaging.

LL-INE3216-TUB ● A Customizable Cloud-based Integrated Dictaphone and Mouse Device for iOS
Brian C Goss MD (Presenter) ; Brian J Bartholmai MD ; Patricio C Fajnwaks MD

Background
Newer radiology dictaphones incorporate computer mouse functions. However, combining a simple and reliable device (the mouse) with a complex and reliable, high maintenance device (the dictaphone) raises important downtime and upgrade issues for the PACS administrator. We present a driverless, iOS-based dictation/mouse device with a USB interface that can be upgraded remotely and store user preferences in the cloud. This device requires no more maintenance on the PACS workstation than a standard keyboard or computer mouse. Furthermore, the device supports dynamic report creation software that can be customized for each dictating radiologist and/or each exam type.

Evaluation
The device consists of 4 components:
- an open source iOS transcription and report creation app
The device requires a PACS workstation with a USB port and a dictation enabled iOS device with a 30 pin dock connector. No driver installation required.

Discussion

Dictation enabled iOS devices coupled with a USB mouse/keyboard emulator allows dictation to occur independently of the PACS workstation. This reduces PACS maintenance and allows for context-aware report-creation apps that can be customized to the radiologist and/or exam. Touch pad gestures such as pinch-to-zoom or tilt-to-scroll can be adapted to any PACS and can be similarly customized. Dictaphone upgrades and user preference can be controlled remotely from the cloud without affecting the workstation. Many other features are possible, including two-factor authentication.

CONCLUSION

Open source hardware and software combined with widely available iOS devices offers a unique opportunity for improving radiologist efficiency. We present this new paradigm for radiology dictaphones and input devices that removes PACS workstation from the maintenance loop, compartmentalizes software functions, and allows new types of report-creation software with increased customization, context-awareness, and security.

LL-INE3173-TUB • Variability of Yield for Ordering Imaging Studies between Physicians

Tashfeen Ekram MD (Presenter) ; Rajan Jain MD * ; Daniel L Rubin MD,MS *

Background

Clinical guidelines such as the ACR Appropriateness Criteria can aid clinicians in ordering the most appropriate radiologic studies. However, it has been shown that such clinical guidelines may not be followed up to 24% of the time. The effect of not consistently following such guidelines on the yield of imaging has not been reported. Our goal was to establish the degree of variation in the yield of imaging among different referring clinicians.

Evaluation

We obtained the last 100 head CT reports ordered by each of six different referring physicians (total of 600 radiology reports) from the emergency department of a single institution. A report was identified as “negative” if the impression contained or expressed the equivalent of “No acute intracranial abnormality.” Reports were classified as “positive” if the impression indicated acute intracranial hemorrhage, acute ischemia, or new mass, mass effect, fracture, or hydrocephalus. Reports that were not clearly positive or negative were classified as “indeterminate.”

Discussion

We found the rate of positive imaging exams varied among the referring physicians from between 2% and 8%, suggesting there is a difference in ordering habits among these physicians. Indeterminate reports ranged from 1% to 5% while negative reports ranged from 90% to 96%.

CONCLUSION

We have found that the rate of positive imaging studies among referring physicians varies between 4%-7% while the negative rate ranges from 90% to 96% This result may be helpful as a benchmark of baseline performance to be improved through quality improvement tools and education initiatives. We also present our vision of how this information can be presented back to clinicians as a quality assessment tool to improve compliance with appropriateness guidelines.
LL-MKS-TU4B • Does the Radiological Skeletal Survey Still Have a Place in the Staging of Multiple Myeloma?

Surekha N Reddy MBChB, MRCS (Presenter); Fergus J Perks MBChB; Simon H Jackson MBChB

PURPOSE
To determine if the radiological skeletal survey (SS) remains an adequate imaging technique for the evaluation of patients with multiple myeloma (MM) in an era where magnetic resonance imaging (MRI) is being increasingly used for initial staging.

METHOD AND MATERIALS
All skeletal surveys performed regionally during a 3 year period (January 2009 to December 2011) were reviewed. Additional imaging (MR / CT) performed within 12 months of the SS mainly for alternate purposes were also evaluated. A retrospective review of prospectively collected clinical data was then performed for correlation.

RESULTS
419 SS were requested and 358 were performed for possible MM. 203 of 358 patients (56.7%); median age 72 years; were diagnosed with MM on clinical parameters and 69 patients with monoclonal gammopathy of undetermined significance (MGUS). 47 % (96 of 203) SS were positive in patients with MM and in 7% of those with MGUS.

Positive SS findings in those with MM were confirmed with further imaging in 72% (50 of 96). 51% of negative SS were also confirmed with further imaging. 7.9% (16 of 203) MM patients with negative SS were found to have cortical bone and bone marrow changes on further imaging (median period of 3 months; range 2 weeks to 7 months). 11 patients without MM were reported as having a positive SS. In this study the sensitivity and specificity of SS in MM was 85.7% and 87.9% respectively with a positive predictive value of 89.7% and a negative predictive value of 83.3%.

51% (49 of 96) had changes on SS involving the axial skeleton only; 37.5% (36 of 96) the appendicular skeleton and both in 11.5%.

CONCLUSION
Skeletal survey remains a useful imaging modality for initial staging in MM. Replacing SS with MR in countries where MR resources are more limited would not necessarily be of benefit. Due to the older population and high mortality rate the radiation doses associated with SS are of less clinical concern.

CLINICAL RELEVANCE/APPLICATION
The skeletal survey is a useful imaging modality for the initial staging of multiple myeloma, particularly in countries where MR resources are limited.

LL-MKS-TU3B • Role of MRI on Spread Route of Metastasis in the Spine of Lung Cancer

Qiang Ma (Presenter); Wen He; Daqing Ma MD; Eruh Jin MD

PURPOSE
To study whether the pattern of metastasis distribution in the spine of lung cancer and other kind of tumors are different and evaluate the role of MRI on metastasis in the spine.

METHOD AND MATERIALS
50 patients, who had biopsy-proven primary tumors and MRI examination of the spine entered the study, and 10 age-matched healthy controls entered the study. Each vertebral body was divided into 2 parts(27 cells)in the magnetic resonance images: the central and posterior cells in the midsagittal view were defined as central, and the other cells were defined as peripheral. The primary tumor was assigned to either lung cancer group (21 cases) or other tumor group(29 cases, 9 with breast cancer, 4 with prostate cancer, 2 with bladder cancer et al) based on Batson’s proposed mode of spread. The average number of lesions of every involved vertebral body in the central and peripheral regions was calculated.

RESULTS
MRI plays an important role in distinguishing spread route of metastasis in the spine in patients with lung cancer or other tumors. Arterial route may be important in the mechanism by which lung cancer spread to the vertebral body. Other kind of tumors may spread to vertebral body by vein.

CLINICAL RELEVANCE/APPLICATION
MRI plays an important role in distinguishing spread route of metastasis in the spine in patients with lung cancer or other tumors.

LL-MKS-TU2B • Correlation of gagCEST MRI in Cartilage with dGEMRIC

Wenbo Wei (Presenter); Guang Jia PhD; David Flanigan MD; Ajit M Chaudhari PhD; Metin N Gurcan PhD; Michael V Knopp MD, PhD; Robert Siston

PURPOSE
Glycosaminoglycan chemical exchange-dependent saturation transfer (gagCEST) MRI is a molecular MRI methodology which assesses the endogenous GAG concentration. Until now few studies include quantitative comparison of gagCEST with reference methods. This study assesses the correlation between gagCEST MRI and delayed gadolinium-enhanced MRI of cartilage (dGEMRIC) in determining cartilage GAG concentration.

METHOD AND MATERIALS
Eight volunteers with no previous knee diseases were recruited. Sagittal MR images were obtained using an 8-channel knee coil with a 3T MRI system (Achieva, Philips). D2GEMRIC were obtained at pre- and post-contrast periods using FFE sequences and 0.2mmol/kg of contrast agent (Gd-DTPA 2-) was injected intravenously. To help the contrast diffusion, subjects walked stairs for 10 mins and were seated for 90 mins. MR parameters were TR/TE=6/3ms, resolution=0.5x0.5x4mm3, flip angles=4, 8, 12, 16, 20°, NSA=2. gagCEST images was acquired using a FFE sequence: TR/TE=11,000/84ms, TSE factor=72, resolution=1.5x1.5x4mm3, NSA=2. The saturation pulse frequencies were from 2.5 to -2.5ppm with an interval of 0. 25ppm. The pulse length was 2s and power was 1.27T. A B0 map was acquired for B0 correction. The procedure time per subject was around 3hrs. Cartilage ROIs were examined. GAG contents and MTRasym(1ppm) were calculated based on dGEMRIC T1 results and gagCEST.

RESULTS
The average T1 value was 1052ms±56ms and 689ms±76ms at pre- and post- contrast injection, respectively. The average contrast in cartilage was 0.11mM±0.03mM. The average GAG concentration was 47.4mM±19.7mM and MTRasym(1ppm) was 2.4±1.6%. The GAG concentrations and MTRasym(1ppm) values have a good correlation (r=0.86) (Fig. 1a). Data was separated into two groups with GAG concentrations higher and lower than 40mM/kg. For the group with low GAG concentration, the fit line is almost flat. For the group with high GAG concentration, the MTRasym(1ppm) increases linearly with the GAG concentration with a good correlation (r=0.88) (Fig. 1b).

CONCLUSION
gagCEST MRI was shown to correlate well with dGEMRIC at higher GAG concentration cartilage. However, at lower GAG concentration level, gagCEST becomes less sensitive and dGEMRIC has better sensitivity in differentiating various GAG levels.
**YIELD OF CT GUIDED JOINT SYNOVIAL/CAPSULE BIOPSY FOLLOWING DRY ASPIRATION FOR THE DIAGNOSIS OF INFECTION**

**Ambrose J Huang** MD (Presenter) ; **Frank J Simeone** MD ; **Connie Y Chang** MD ; **Susan V Kattapuram** MD

### PURPOSE

to determine the yield of CT guided joint synovium/capsule biopsy following a dry aspiration for diagnosing infection.

### METHOD AND MATERIALS

From 10/1/2010-9/30/2012, 11 patients underwent CT guided core biopsy of the joint synovium/capsule for further evaluation following a dry aspiration. There were 8 total hip arthroplasties, 1 hip status post total hip arthroplasty removal, 1 total knee arthroplasty, and 1 native knee. A spring-loaded biopsy needle was used in all cases, and core samples were submitted to Microbiology for analysis and compared to clinical follow-up data. Patients were considered to be infected clinically if a) definitive cultures obtained during subsequent total hip arthroplasty revision and additional clinical findings were negative for infection (false positive). The patient with Peptostreptococcus micros was treated with vancomycin and cefepime (true positive). The patient with Staphylococcus lugdudensis underwent total hip arthroplasty revision, and definitive cultures acquired at surgery revealed Staphylococcus lugdudensis (true positive). One patient with a negative biopsy underwent total knee arthroplasty removal, and definitive cultures acquired at surgery revealed Staphylococcus lugdudensis, for which treatment with linezolid was begun (false negative). The sensitivity, specificity, positive predictive value, and negative predictive value of synovial/capsular biopsy compared to clinical follow up were 67%, 88%, 67%, and 88%, respectively.

### CONCLUSION

CT guided joint synovium/capsule biopsy may be of benefit in diagnosing infection when conventional joint aspiration yields no fluid.

### CLINICAL RELEVANCE/APPLICATION

CT guided joint synovium/capsule biopsy may be of benefit in diagnosing infection when conventional joint aspiration yields no fluid.
** LL-MKE-TU8B • A Multimodality Imaging Overview of Acute Syndesmotic Ankle Injury in Soccer Players  
Nabil Jomaah MD (Presenter); Cristiano Eirale; Pieter D’hooghe MD; Frank W Roemer MD*; Michel D. Crema MD*; Emad Almusa DO

** PURPOSE/AIM **  
To provide a pictorial overview of the ankle syndesmotic injury in soccer players with multimodality imaging including radiography, ultrasound and MRI.

** CONTENT ORGANIZATION **  
Describe the normal anatomy of the syndesmosis. Recognize pitfalls and normal variants of the anterior and posterior syndesmotic ligaments. Present the biomechanical background of syndesmotic injury. Illustrate the imaging findings of ankle syndesmotic injury and associated findings.

** SUMMARY **  
Syndesmotic injuries are the second most common ankle injury after lateral ligament injury and are encountered in 10% to 20% of all ankle sprains. Isolated syndesmosis injuries are often diagnosed as lateral ankle sprains however; they are more disabling than lateral ankle sprains and need a longer recovery period for athletes. Syndesmotic injury may not be routinely recognized on radiographs, but additional radiography under stress may reveal an unstable grade III syndesmosis sprain with surgical implication. Ultrasound can consistently depict anterior inferior tibiofibular ligament disruption; however it is less reliable in the assessment of the interosseous and the posterior inferior tibiofibular ligaments. MR imaging is highly accurate for the diagnosis of tibiofibular syndesmotic injuries and in characterizing associated pathology.

** LL-MKE1107-TUB • Ultrasound Visualization of Plantar Plate Injury  
Michael E Stone MD (Presenter); Marnix T Van Holsbeeck MD*; Deepa Bhatt DPM; Joshua Rhodenizer DPM

** PURPOSE/AIM **  
The purpose of this exhibit is:
1. To review the anatomy of the lesser MTP joint.
2. To review the clinical significance of plantar plate injury.
3. To discuss the ultrasound appearance of plantar plate tear.
4. To discuss the utility of ultrasound as a primary method of diagnosing plantar plate tear.

** CONTENT ORGANIZATION **  
1. Anatomy of the lesser MTP joint  
2. Clinical significance of plantar plate injury  
3. Ultrasound findings in plantar plate tear and correlation with cadaver dissection.  
4. Diagnostic utility of ultrasound in comparison to MRI  
5. Sample Cases  
6. Future Directions

** SUMMARY **  
The main teaching points of this exhibit are:
1. The plantar plate is a fibrocartilage structure supporting the lesser MTP joints.
2. Injury to the plantar plate is a common cause of persistent pain and digital deformity.
3. Plantar plate tear typically appears as a hypoechoic or heterogeneous defect in the homogenous substance of the plate.
4. Ultrasound is a sensitive modality of diagnosing plantar plate injury.

** Multisystem/Special Interest - Tuesday Posters and Exhibits (12:45-1:15pm) **  
Tuesday, 12:45 PM - 01:15 PM • Lakeside Learning Center

** LL-MSE-TU6B • Impact of Anti-Angiogenic Agents in the Radiology Reading Room: Lessons Learnt Over a Decade  
Alexandra Fairchild MD (Presenter); Sreeharsha Tirumani MBBS, MD; Stephanie A Howard MD; Katherine M Krajewski MD*; Atul B Shinagare MD; Nikhil H Ramaiya MD

** PURPOSE/AIM **  
Anti-angiogenic agents are novel molecular targeted therapies (MTT) that have been game changers in personalized cancer care in the past decade. This exhibit will familiarize the radiologist with the evolution of anti-angiogenic agents, imaging appearance of treatment response, and the unique spectrum of toxicities associated with them.

** CONTENT ORGANIZATION **  
• History of anti-angiogenic agents - from the first FDA approval (bevacizumab) to their wide spread expansion in cancer therapy.  
• Discussion of cancers which have been impacted most by the emergence of anti-angiogenic agents (colorectal cancer, renal cell carcinoma, gastrointestinal stromal tumor).  
• Evolution of alternative treatment response criteria like Choi criteria, Morphology, Attenuation, Size, Structure (MASS) criteria, modified Response Evaluation Criteria in Solid Tumors (mRECIST).  
• Discussion of unique spectrum of drug-specific and class-specific toxicities.

** SUMMARY **  
The exponential growth of anti-angiogenic agents in cancer therapy necessitates the radiologist to understand the mechanism, unusual response patterns, and toxicities associated with them.

** Neuroradiology/Head and Neck - Tuesday Posters and Exhibits (1:00pm - 1:30pm) **  
Tuesday, 12:45 PM - 01:15 PM • Lakeside Learning Center

** LL-NRS-TUB • AMA PRA Category 1 Credit ™:0.5  
LL-NRE-TU10B • Putting Humpty Dumpty Back Together: A Review of the CT Imaging Appearance of Various Materials Commonly Utilized in Craniofacial Fracture Repair  
Aaron B Wickley MD*; Michael J Reiter MD (Presenter); Ryan B Schwope MD; Jonathan Kini; Gerald E York MD; Jared
RESULTS

Two MCI-C and 3 MCI-NC patients and 5 HCs were excluded because the results of DTI analyses were ineligible due to substantial motion or eddy-current artifacts. In the PhC, FA values were significantly lower for patients with AD (left, p = 0.004; right, p = 0.037) and MCI-Cs (left, p = 0.005; right, p = 0.030) than HCs. In contrast, FA values in the PoC were significantly lower only in AD as compared with those in HCs (right, p = 0.043). No significant differences were observed between MCI-NCs and HCs in the PhC and PoC.

CONCLUSION

We found that the FA values for the PhC significantly decreased both in AD patients and in MCI-C patients and that these changes were more evident than those for the PoC, suggesting that microstructural alterations in the PhC precede those in the PoC. High-resolution DTI analysis of the PhC may be effective in predicting whether patients with MCI will convert to AD.

CLINICAL RELEVANCE/APPLICATION

High-resolution DTI analysis can detect subtle FA changes in the PhC even in patients with MCI and may help predict conversion of MCI to AD.

LL-NRE-TU11B • Current CNS Radiation Treatment Modalities: What Every Radiologist Should Know

Ruth Eliahou MD (Presenter); Michelle Alonso-Basanta MD,PhD; Zelig Tochner MD; Nicholas G Zaorsky MD; Alexander C Mamourian MD

PURPOSE/AIM

The purpose of this exhibit is to present current advances in radiation therapy techniques used for the treatment primary and secondary brain tumors

CONTENT ORGANIZATION

• Current available modalities of radiotherapy for brain neoplasms, focusing on 3D conformal, Intensity-Modulated Radiation Therapy (IMRT), Image Guided Radiation Therapy (IGRT), Rapid Arc Radiotherapy, Proton Beam therapy (particle beam), Stereotactic Radiosurgery (SRS) with either Gamma and Cyber Knife.

• Describing the principle, clinical uses, advantages and disadvantages and major complications of these modalities.

• Demonstrative cases.

• Summary

SUMMARY

1. Latest advances in radiotherapy for brain tumors utilize imaging techniques to increase precision and to deliver high doses of radiation while sparing healthy brain tissue.

2. SRS provides a single dose of targeted high dose radiation for clinical entities that previously required surgery for example trigeminal neuralgia, vestibular schwannoma and small arteriovenous malformations.

3. Proton beam therapy is a highly targeted radiation modality that is becoming more widely available and early results show a potential decrease in acute and long term side effects for variety of neoplasms in children and adults including gliomas, medulloblastomas and meningiomas.

LL-NRS-TU1B • High-resolution Diffusion Tensor Imaging of the Parahippocampal Cingulum and Posterior Cingulum Bundles in Patients with Mild Cognitive Impairment and Alzheimerâ€™s Disease

Kenji Ito PhD (Presenter); Makoto Sasaki MD *; Junko Takahashi MD; Fumio Yamashita PhD; Satomi Higuchi; Jonathan Goodwin; Ikuko Uwano PhD; Taisuke Harada

PURPOSE

To investigate alterations in the fractional anisotropy (FA) values of the parahippocampal cingulum bundle (PhC) and posterior cingulum bundle (PoC) in patients with mild cognitive impairment (MCI) or Alzheimer’s disease (AD) by using high-resolution quantitative diffusion-tensor imaging (DTI) analysis.

METHOD AND MATERIALS

RESULTS

From August 2011 till September 2012, we enrolled patients with PD-intact cognition (PD-IC, n=10), PD-mild cognitive impairment (PD-MCI, n=15), PD with dementia (PDD, n=11), and healthy control subjects (n=15). Fractional anisotropy (FA) maps of patient groups were compared with each other and that of control subjects by using tract-based spatial statistics (TBSS) where age and education were included as covariates in analysis of covariance.

RESULTS

The Pattern of White Matter Alteration in Patients with Parkinsonâ€™s Disease according to Cognitive Status

Na-Young Shin MD; Injoong Kim (Presenter); Yoon Seong Choi MD; Kyung-Eun Kim MD; Sung Soo Ahn MD; Jinna Kim MD; Seung-Koo Lee MD, PhD

PURPOSE

To assess the pattern of white matter alteration in patients with Parkinson’s disease (PD) according to cognitive status by using diffusion tensor imaging.

METHOD AND MATERIALS

To assess the pattern of white matter alteration in patients with Parkinson’s disease (PD) according to cognitive status by using diffusion tensor imaging.

METHOD AND MATERIALS

From August 2011 till September 2012, we enrolled patients with PD-intact cognition (PD-IC, n=10), PD-mild cognitive impairment (PD-MCI, n=15), PD with dementia (PDD, n=11), and healthy control subjects (n=15). Fractional anisotropy (FA) maps of patient groups were compared with each other and that of control subjects by using tract-based spatial statistics (TBSS) where age and education were included as covariates in analysis of covariance.

RESULTS
Compared with control subjects, FA values were significantly decreased in many major tracts in patients with PD-MCI and PDD as follows: corpus callosum, superior longitudinal fasciculus, anterior corona radiata, anterior limb of internal capsule, external capsule, posterior thalamic radiation, cingulum, and inferior longitudinal fasciculus. Compared with patients with PD-IC, there were significantly decreased FA values in the body of corpus callosum in patients with PDD. There were not significantly decreased FA values in patients with PD-IC compared with control subjects. PDD patients with shorter disease duration before dementia.

CONCLUSION
These data suggest that white matter damage in patients with PD exhibits a greater extent with increasing levels of cognitive impairment. In addition, white matter alteration responsible for PDD may differ according to disease duration of PD.

CLINICAL RELEVANCE/APPLICATION
Evaluation of fractional anisotrophy using TBSS can improve understanding of extension of white matter alteration in patients with PD according to cognitive status.

LL-NRS-TU4B • Diagnosing Intracranial Aneurysms with MR Angiography: Systematic Review and Meta-analysis
Anna M Sailer MD, MBA (Presenter) ; Bart A Wagemans MD ; Patty Nelemans ; Rick De Graaf MD, PhD ; Wim Van Zwam MD

PURPOSE
To evaluate the sensitivity and specificity of magnetic resonance angiography (MRA) in the diagnosis of ruptured and unruptured intracranial aneurysms.

METHOD AND MATERIALS
A systematic search was performed on four electronic databases including Pubmed and Embase on relevant papers that were published from January 1998 until February 2013. Inclusion criteria were met by twelve studies that compared MR angiography to digital subtraction angiography (DSA) and/or intraoperative findings as reference standard. Two independent reviewers evaluated the methodological quality of the studies. Heterogeneity was tested and risk for publication bias was visually assessed. Data from eligible studies were extracted and used to construct 2 x 2 contingency tables on a per aneurysm level. Pooled estimates of sensitivity and specificity were calculated for all studies and subgroups of studies.

RESULTS
Included studies were of high methodological quality. There was no evidence of publication bias. Most studies were performed using time-of-flight MRA technique. Among the 1092 patients assessed, 882 aneurysms were present. Heterogeneity concerning sensitivity and specificity were moderate to high. Pooled sensitivity of MRA was 96% (95% CI: 91%, 99%), pooled specificity was 90% (95% CI: 82%, 95%). False negative and false positive aneurysms detected on MRA were mainly located at the skull base and middle cerebral artery. Studies that evaluated only ruptured aneurysms did not report different sensitivity and specificity than studies evaluating both ruptured and unruptured aneurysms.

CONCLUSION
Studies on diagnostic performance of magnetic resonance angiography show high sensitivity with a large variation in specificity in detection of intracranial aneurysms. Diagnostic performance of MRA has increased significantly since the last meta-analysis of White and Wardlaw in 2000, but still is inferior to CTA.

CLINICAL RELEVANCE/APPLICATION
In suspicion of intracranial aneurysms, MRA may play a role as primary diagnostic test in a screening setting or if CTA is contraindicated.

LL-NRS-TU5B • Spectral CT for Improving Image Quality of Cerebral Artery CT Angiography after Metal Coils or Clips Treatment
Jia Yulin MD (Presenter) ; Xiao Xigang MD ; Li Chao ; Fan Jinyu ; Zhu Kai ; Sun Yuanyuan

PURPOSE
To investigate the effect of spectral CT for metal artifacts reduction in cerebral artery CT angiography (CTA) after metal coils or clips treatment.

METHOD AND MATERIALS
17 patients after metal coils or clips treatment underwent clinically indicated cerebral artery CTA in our hospital. All patients provided their written informed consent. The examination was performed using a single tube and fast kVp-switching technique between 80 and 140 kVp. The data were reconstructed into 3 image groups: quality check images (QC) with 140kVp data set only, monochromatic image sets in the range of 40-140 keV with the interval of 5 keV (MONO), and monochromatic images with metal artifacts reduction software (MARS). CT attenuation value of cerebral artery, contrast-to-noise ratio (CNR), signal-to-noise ratio (SNR) and subjective score of all images were measured. All data from the 3 groups (QC, MONO and MARS) were compared.

RESULTS
5 of 17 patients were detected with metal clips and the other 12 patients were with metal coils. Moreover, 1 patient had two metal coils and another patient had two metal clips. CT attenuation value of cerebral artery decreased as the photon energy increased from 40 to 140 keV in MONO and MARS groups. The average energy levels of 63 keV and 61keV were found to provide the best CNR for displaying the cerebral arteries in the monochromatic image sets of MONO and MARS groups, respectively. And CNR and SNR values of the two sets were all higher than those of group QC (P=0.78, 0.42, and 0.56, respectively).

CONCLUSION
The monochromatic images in the range of 60-80 keV could reduce the artifacts and improve image quality of cerebral artery after metal coils or clips treatment, and 63 keV and 61keV of MONO and MARS may provide best CNR for displaying the cerebral arteries.

CLINICAL RELEVANCE/APPLICATION
Spectral CT with GSI and MARS can reduce the artifacts from metal coils or clips in cerebral artery and improve image quality, so that, the evaluation of treatment can be accomplished.

LL-NRS-TU6B • Cerebral Gliomas: Monoexponential, Biexponential, Stretched-exponential Models of DWI and Diffusion Kurtosis Imaging in Grading
Yan Bai (Presenter) ; Meiyun Wang MD, PhD ; Dalpeng Shi MD ; Jinyuan Zhou PhD

PURPOSE
Previous studies commonly used quantitative ADC obtained from monoexponential fit to grade gliomas. However, contradictory findings have been reported in different studies. The biexponential and stretched-exponential models of DWI and diffusion kurtosis imaging (DKI) could offer additional information. The purpose of our study was to compare the values of the 3 different models of DWI and DKI in grading gliomas.

METHOD AND MATERIALS
RESULTS
ADCstandard, f, DDC, FA, MD, Dr and Da had no significant difference whereas ADCfast, ADCslow, ?, MK, Kr and Ka had significant difference between high- and low-grade gliomas. ADCfast, ADCslow, ?, MK, Kr and Ka values that were normalized to the values in the contralateral NAWM had significant difference. AUC was highest for ? (0.995) during testing to discriminate between high- and low-grade gliomas, followed by ADCfast(0.965), normalized ?(0.958), normalized ADCfast (0.947), MK(0.865), Kr(0.847), ADCslow (0.826) and ka(0.813).

CONCLUSION
These data suggest that white matter damage in patients with PD exhibits a greater extent with increasing levels of cognitive impairment. In addition, white matter alteration responsible for PDD may differ according to disease duration of PD.
The biexponential and stretched-exponential models of DWI and DKI are useful tools in grading cerebral gliomas.

CLINICAL RELEVANCE/APPLICATION
The noninvasive techniques of DWI and DKI are recommended to grade gliomas.

LL-NRE-TU7B • Structural Imaging, Spectroscopy and Diffusion Tensor Imaging in Amyotrophic Lateral Sclerosis (ALS): Current Insights into Degenerative Motor Neuron Disease in the Brain

Jose Maria Garcia Santos MD, PhD (Presenter); Carlos Vazquez MD; Alberto Inuggi; Miguel Blanquer; Paqui Iniesta; Joaquin Gomez Espuch; Salvador Martinez; Jose Maria Moraleda

PURPOSE/AIM
- To remember the pathophysiology of ALS
- To review the conventional structural imaging findings of ALS
- To learn about single voxel MR spectroscopy and DTI changes related to ALS
- To be aware about the possible effects of treatment based on single voxel MR spectroscopy

CONTENT ORGANIZATION
- Pathophysiology of ALS
- Review of brain conventional MRI of ALS
- Discuss brain DTI (fractional anisotropy and main diffusivity) changes related to disease
- Show brain single voxel MR spectroscopy changes in ALS
- Correlate DTI and single voxel MR spectroscopy (fractional anisotropy and main diffusivity) changes in ALS
- Show future directions related to treatments

SUMMARY
The major teaching points of this exhibit are:
- Conventional MRI findings involving the motor cortex and the corticospinal tract only appear in a reduced number of patients.
- DTI changes (lower fractional anisotropy; higher mean diffusivity) in the brain go far beyond the corticospinal tract.
- Single voxel MR spectroscopy and DTI parameters change depending on disease progression or upper motor neuron scores.
- Single voxel MR spectroscopy and DTI data are related in ALS and support the future benefits of clinical multiparametric analysis.
- Single voxel MR spectroscopy and DTI might show the effect of specific ALS treatments on disease progression.

LL-NRE-TU8B • Congenital Ossicular Anomalies: An Imaging Review

Behroze Vachha MD, PhD (Presenter); Mary N Tenenbaum MD; Caroline D Robson MBChB*; Gul Moonis MD

PURPOSE/AIM
A comprehensive review of the imaging findings of congenital ossicular lesions associated with major and minor congenital ear malformations. Discussion of the classification schemas of congenital ossicular anomalies.

CONTENT ORGANIZATION
Congenital anomalies of the ear are generally classified as major or minor malformations, depending on the presence of a normal external auditory canal and tympanic membrane. Major malformations of the ear (e.g. Congenital Aural Atresia) tend to have more severe ossicular abnormalities. Minor malformations include isolated ossicular dysplasias (fixations, fusions or defects of the ossicular chain and malformations of the oval and round window). We will review embryology of the ossicles and MDCT features of the following congenital ossicular anomalies: 1) Congenital Aural Atresia; 2) Bony bars: Including malleus and incus bars. 3) Oval Window Atresia: These lesions typically demonstrate an aberrant course of the tympanic segment of the facial nerve canal, often overlying or coursing inferior to an atretic oval window, and the stapes is often dysplastic and may not contact the atretic oval window

SUMMARY
Imaging plays an important role in the evaluation of congenital ossicular anomalies. Familiarity with the imaging patterns of major and minor ear anomalies can optimize diagnosis and management.

LL-NRE-TU9B • Assessing Glioblastoma Response to Therapy: A Diverse and Rapidly Evolving Field

Daniel S Chow MD (Presenter); Velelin Miloushev MD, PhD; William Win MD; Bryan A Lanzman MD; Akash D Shah MD; Angela Lignelli MD; Christopher G Filippi MD

PURPOSE/AIM
Glioblastoma multiforme (GBM) is an invasive and highly aggressive tumor. Currently, varying imaging metrics are employed to provide risk stratifications, treatment guidance, and prognostic information. Therefore, it is important for the radiologist to have a firm understanding of different imaging approaches, limitations, and varying definitions in response. Additionally, it is important to be familiar with new investigative tools given the rapid growth and development of technology and treatment in GBM.

CONTENT ORGANIZATION
1. Epidemiology of GBM.
2. Current approaches and limitations of current neuroimaging metrics in GBM assessment
   a. Unidimensional Techniques (RECIST)
   b. Bidimensional Techniques (MacDonald)
   c. Response Assessment in Neuro-Oncology (RANO) Criteria
3. Specific challenges encountered in GBM assessment
   a. Post-surgical cavity
   b. Pseudoprogression
   c. Pseudoresponse
4. Developing neuroimaging techniques in GBM assessment
   a. Automated volumetric contouring assessment
   b. Morphologic assessment
   c. Diffusion imaging
   d. BOLD fMRI
   e. Spectroscopy

SUMMARY
The various neuroimaging techniques used in assessing GBM response to therapy is continually expanding and evolving. It is important for radiologists to be 1) familiar with differing techniques and their limitations and 2) aware of those in development.
LL-OBETUB

Physics - Tuesday Posters and Exhibits (12:45pm - 1:15pm)

Tuesday, 12:45 PM - 01:15 PM • Lakeside Learning Center

LL-PHS-TUB • AMA PRA Category 1 Credit ™:0.5

LL-PHE-TUB10B • New Generation Coronary and Aortic CT Scanners: What the Radiologist Needs to Know

Anand Narayan MD, PhD (Presenter) ; Pamela T Johnson MD * ; Mahadevappa Mahesh MS, PhD * ; Elliot K Fishman MD *

Stefan L Zimmerman MD

PURPOSE/AIM
State of the art MDCT technology to evaluate coronary arteries and the aorta include high pitch CT scanners and wide area detectors. These two technologies use different strategies to capture a fast moving heart in a single rotation or a single heart beat. The aim of this exhibit is to review the physics underlying these new CT scanners and familiarize readers with information necessary to guide scanner selection and protocol optimization to best take advantage of these new systems.

CONTENT ORGANIZATION
1. Introduction
   • Review of relevant basic CT physics
   • Technological challenges in evaluating coronaries and aorta
2. Next generation CT scanners- review of scanner hardware and physics
   • High pitch CT scanners
   • Wide area detector scanners
   • Dual energy CT
3. Relative advantages and disadvantages of next generation scanners
   • Temporal and spatial resolution optimization
   • Dynamic perfusion imaging
   • Radiation dose reduction
   • Dual energy cardiovascular applications
4. Imaging protocols

SUMMARY
After reviewing this exhibit, readers will gain an understanding of the principles behind the newest generation CT technology for evaluating the coronary arteries and the aorta, the advantages and disadvantages of these technologies, as well as protocol optimization to maximize utility of these new scanners.

LL-PHS-TUB1B • Development of Cranial MRI-Phantom for Assessing Perfusion, Diffusion, and Fluctuation

Tomohiro Chigusa ; Tosiaki Miyati PhD ; Naoki Ohno MS ; Hikari Usui ; Shinnosuke Hiratsuka (Presenter) ; Hirohito Kan ; Toshifumi Gabata MD ; Osamu Matsui MD

PURPOSE
To clarify relations and mechanisms among blood-perfusion, water-diffusion, water-fluctuation, and biomechanics of the intracranial tissue, we developed an original cranial phantom for magnetic resonance imaging (MRI).

METHOD AND MATERIALS
The new cranial phantom consisted of a high-density polypropylene filter (filtration accuracy of 0.5 µm, apparent diffusion coefficient [ADC] of 1.3 x10⁻³ mm²/s) with intra- and extra-filter spaces, and a capacitor space, which were filled with water at 17 degrees centigrade. These correspond to a brain parenchyma, artery and vein, and cerebrospinal fluid space, respectively. Then, volume loading was periodically applied to the cranial phantom by a pulsation flow (simulated cerebral blood flow) pump. Under these conditions, on a 3.0-T MRI, we determined the regional phantom flow and the ADC change (water-fluctuation) in the pulsation period using pseudocolor continuous arterial spin labeling and ECG-triggered multi-phase single-shot diffusion echo planer imaging with multi-b (16 points), respectively. Moreover, we compared those values with trans-cranial phantom flow obtained with phase contrast cine MRI and actual pressure wave in the phantom.

RESULTS
The ADC change during the pulsation period in the filter was synchronized with the trans-cranial phantom flow and actual pressure wave in the phantom, indicating water-fluctuation are affected by biomechanical properties. The regional phantom flow agreed with the trans-cranial phantom flow and the ADC change. Moreover, ADC calculated with lower b-values (0 to 160 s/mm²) depended on the regional phantom flow.

CONCLUSION
Our original phantom makes it possible to clarify relations and mechanisms among blood-perfusion, water-diffusion, water-fluctuation, and biomechanics of the intracranial tissue interact in diverse ways.

CLINICAL RELEVANCE/APPLICATION
Our original phantom makes it possible to clarify relations and mechanisms among blood-perfusion, water-diffusion and fluctuation, and biomechanics of the intracranial tissue.

LL-PHS-TUB2B • Improvement of CAD Scheme for Detection of Silent Lacunar Infarcts on MR Images by Using Template Matching on Eigen Space

Yoshikazu Uchiyama (Presenter) ; Chisako Muramatsu PhD ; Takeshi Hara PhD ; Junji Shiraishi * ; Hiroshi Fujita PhD

PURPOSE
The detection of asymptomatic lacunar infarcts is important because their presence indicate an increased risk of severe cerebral infarction. However accurate identification of lacunar infarcts on MR images is often hard for radiologists because of the difficulty in distinguishing lacunar infarcts and enlarged perivascular spaces. Therefore, we have been developing CAD schemes for the detection of lacunar infarcts. Our previous method was applied to 132 patient cases and the sensitivity of 96.8% with 0.71 FP per slice was obtained. However, further reduction of FPs was remained as an issue to be solved for the clinical application. The purpose of this study is to improve our CAD scheme for detection of lacunar infarcts by use of a template matching technique on eigen space.

METHOD AND MATERIALS
Our database consisted of T1- and T2-weighted images obtained from 132 patients, which included 93 lacunar infarcts. The images were acquired on a 1.5 T MR scanner. Using our previous method, almost all lacunar infarcts were detected accurately. However, 753 FPs were obtained. For reduction of these FPs, we employed template matching technique. Although the conventional template matching is useful acquired on a 1.5 T MR scanner. Using our previous method, almost all lacunar infarcts were detected accurately. However, 753 FPs were...
Digital tomosynthesis (DTS) is able to crudely separate the overlapping anatomical structures on chest radiography. However, the resolution in the posterior-anterior (PA) view is quite limited due to the nature of DTS. Furthermore, the spillover of high-contrast objects from off-fulcrum planes generates artifacts. We demonstrate that by applying a dual-view DTS on chest imaging, the spatial resolution in the PA direction is improved and the artifacts are alleviated.

METHOD AND MATERIALS

We obtained 37 clinical transverse breast MR scans from Shanghai Cancer Hospital in China. All images were fat-suppressed T1-weighted MR acquired with an Aurora 1.5-T MR scanner. The image size was 512x512x256 and the resolution in x, y, z axis was 0.7031 mm after linear interpolation in z axis. Sixteen breasts in 8 cases were manually delineated by a physicist and confirmed by a radiologist for objective evaluation of three-dimensional (3-D) segmentation method. We first developed techniques to determine a bounding box for a breast and to extract the major part of the breast by use of a 3-D spiral scanning method and dynamic programming. A small portion of the breast around the pectoral muscle was not included in the initial segmentation result. We then further developed a technique to delineate the chest wall and to add the missing small portion of the breast back to the major portion. A sectional dynamic programming method was designed in each 2-D slice of a 3-D MR scan to trace the upper and/or lower boundaries of the chest wall. Our method also took advantages of the continuity of chest wall across adjacent slices. The performance level of the whole breast segmentation method was subjectively observed by human readers, and was evaluated by objective indices of Dice overlap measure and volume agreement.

RESULTS

By subjective observation of the 37 cases, we found that the proposed method obtained good segmentation of the whole breasts. By comparing with the manually delineated region of 16 breasts in 8 cases, an overlap index of 90.5% ± 2.6% (mean ± SD), and a volume agreement of 96.2% ± 3.5% were achieved, respectively.

CONCLUSION

The fully automated method for accurate segmentation of the whole breast would be useful for developing CAD systems for risk assessment and early diagnosis of breast cancer in MRI.

CLINICAL RELEVANCE/APPLICATION

Our CAD scheme could help the radiologists to quantitatively analyze breast cancer risk and to improve the accuracy and efficiency of breast cancer diagnosis.

LL-PHS-TU3B Fully Automated Segmentation of Whole Breast in MR Images Using Dynamic Programming

Luan Jiang PhD ; Yanyun Lian ; Yajia Gu MD ; Xiaoxin Hu ; Qiang Li PhD (Presenter) *

PURPOSE

We are developing a computer-aided diagnostic (CAD) scheme for breast cancer diagnosis, risk assessment, and density analysis in magnetic resonance (MR) image. This study is to develop a key technique in the CAD for accurate segmentation of the whole breast.

METHOD AND MATERIALS

We proposed a dual-view DTS technique in which projection images are acquired in two orthogonal views and reconstructed using an iterative method. We acquired cone beam CT images of an anthropomorphic chest phantom with 300 projections and an angular step size of 1.2°. The experiment was carried out using 120kVp, 40mA continuous mode x-ray, with source-to-detector distance of 180cm. The flat panel detector had a pixel size of 0.2mm. The dual-view DTS images were extracted from the CBCT images with different angular ranges and step sizes to investigate the effects of these parameters. We extracted the DTS data with the angular ranges of 30° and 60°.
RESULTS
The dual-view DTS images were fairly accurate in depicting the shape and dimensions of the anatomy in the fulcrum, especially for the sagittal views. The RMSD values calculated on different regions demonstrated the improvement of the image quality in dual-view DTS over single-view DTS. The thick slice thickness was greatly reduced for dual-view DTS. Our results also demonstrated that the RMSD and thick slice thickness with 60° angular range was better than with 30° angular range, and the a smaller angular range resulted better quality images.

CONCLUSION
With a similar number of projections, dual-view DTS can render more accurate 3D images than single-view DTS does. This work was supported in part by research grants CA124585 and CA138502 from NIH-NCI.

CLINICAL RELEVANCE/APPLICATION
The applying of dual-view DTS technique provides better image quality and spatial resolution in chest imaging.

LL-PHS-TU6B • ICRP103 Effective Dose vs DLP vs SSDE: Which Is a More Clinically Useful and Sensitive Tool for Identifying Radiation Dose Outliers?

Priyanka Prakash MD (Presenter); William W Boonn MD *; Tessa S Cook MD, PhD

PURPOSE
Comparing the ability of ICRP 103 effective dose (ED), dose-length product (DLP) and size-specific dose estimate (SSDE) to identify patients scanned with above-expected radiation dose.

METHOD AND MATERIALS
Abdominopelvic CTS from July 2012 to March 2013 performed on 64-slice (Sensation 64, Siemens) scanners were reviewed. All scans were acquired using standard departmental protocol with tube current modulation. Parameters (mean mAs, kVp, scan length, effective patient diameter) and dose metrics (CTDVol, ED, SSDE, DLP, organ doses) for these scans were extracted using commercial software (Exposure, Version 1). All patients who underwent the CT scan with doses = or = 2 standard deviations (SD) beyond the mean DLP, ED and SSDE were identified and assessed. The mid slice effective diameter was also manually calculated using vA*Lat (where AP=anteroposterior diameter and Lat=transverse diameter) for a subset of patients.

RESULTS
1685 exams were included in the study. The mean DLP, ED and SSDE for these studies were 734.7±338.5mGy-cm, 13.2±6.4mGy-cm and 15.6±3.8mGy-Gy. The scans with dose = 2 SD [DLP 1411.6 (35; 6m, 29F); ED 25.9 (29; 12M, 17F); and SSDE 23.1 (47; 7M, 40 F)] or = 2 SD [DLP 57.8 (none); ED 0.5 (none); and SSDE 8 (4; 1M, 3 F)] were identified. The effective diameter for the subset of patients with dose = 2 SD of mean SSDE was statistically similar to the automated values (p=0.34). The 4 patients with = 2 SD of mean SSDE were very small patients. For dose = 2 SD, DLP (12/29) and ED (11/35) mostly identified patients with repeat series while the SSDE mostly identified patients scanned with arms by the side (24/47) or off centering (17/47) as the cause of high radiation dose. The organ specific ED for liver and urinary bladder demonstrated best correlation with ED (0.99, 0.98) followed by DLP (0.95, 0.97). SSDE showed the least correlation (0.86, 0.86) which dropped as the SSDE increased (for = 2 SD, correlation dropped to 0.26 and 0.32 for liver and bladder organ dose respectively).

CONCLUSION
SSDE identified the largest number of patients with above-average radiation dose and is a more sensitive indicator of patient positioning and attenuation in the field of view. DLP and ED are more sensitive indicators of scan length.

CLINICAL RELEVANCE/APPLICATION
SSDE, DLP and ED are influenced by different scanning parameters, and should be used appropriately to study the influence of a particular parameter.

LL-PHS-TU7B • A Novel Implementation of X-ray Differential Phase Contrast CT Imaging without Talbot-Lauter Interferometer: Principles and In Vivo Animal Studies

Ke Li MS (Presenter); Stephen T Brunner BS; Yongshuai Ge; John W Garrett MS *; Guang-Hong Chen PhD *

PURPOSE
The recently proposed method to achieve X-ray differential phase contrast CT (DPC-CT) imaging using a gratings Talbot-Lau interferometer has not had success in achieving in vivo DPC-CT scans. A novel method is proposed to achieve DPC-CT imaging without grating interferometer and used for in vivo imaging.

METHOD AND MATERIALS
A calibration phantom (12.7 cm diameter) containing several insertions with known electron density was scanned using a 64-slice Discovery CT 750HD scanner to obtain electron density imaging of the phantom. The same phantom was scanned using a tabletop DPC-CT data acquisition system with grating interferometer to obtain DPC-CT imaging. The DPC-CT image values were calibrated to generate the corresponding electron density imaging. The calibration coefficients (at the effective energy of 28 keV) obtained from the two methods has a coefficient of determination of 0.998. The slope of the regression was used to calibrate the electron density imaging from animal experiments to generate DPC-CT imaging in vivo.

RESULTS
DPC-CT image values measured from grating based DPC-CT system and the proposed method are given as the following pairs: Polymethyl methacrylate (3.32e-7, 3.33e-7); Polytetrafluoroethylene (5.49e-7, 5.19e-7); Polyoxymethylene (3.94e-7, 3.91e-7); Gammex Adipose (2.72e-7, 2.74e-7); Gammex Liver (3.15e-7, 3.13e-7). Linear regression of the DPC-CT image values obtained from the two methods has a coefficient of determination of 0.998. The slope of the regression was used to calibrate the electron density imaging from animal experiments to generate DPC-CT imaging in vivo.

CONCLUSION
DPC-CT imaging can be achieved in vivo from a clinical dual energy CT scanner with high accuracy and at any target X-ray beam energy.

CLINICAL RELEVANCE/APPLICATION
DPC-CT images generated from DECT may provide immediate new diagnostic information for soft tissues without the complication of modifying hardware. This may open up a new venue for cancer detection.

LL-PHS-TU8B • Diffusion Kurtosis in the Vertebral Bone Marrow

Tomohiro Noda (Presenter); Tosiaki Miyati PhD; Naoki Ohno MS; Harumasa Kasai MSc; Nobuyuki Arai MS; Risa Yorimitsu; Makoto Kawano; Yuta Shibamoto MD, PhD

PURPOSE
To assess the structure of cancellous tissue in the vertebral bone marrow, we analyzed the restricted diffusion using diffusion kurtosis.

METHOD AND MATERIALS
On a 1.5 T MRI, single-shot diffusion echo planar imaging was used with b values of 0, 20, 120, 500, 1200 and 2200 s/mm², and a
sensitivity encoding technique. Apparent diffusion kurtosis ($K_{app}$) and apparent diffusion coefficient ($D_{app}$) were calculated from diffusion kurtosis analysis based on non-Gaussian diffusion theory. $K_{app}$ and $D_{app}$ were determined in the lumbar vertebral body of seven normal subjects, and then compared with the bone mineral density (BMD) obtained with dual-energy X-ray absorptiometry (DXA). Moreover, fat fraction (FF) of the bone marrow was measured with spectral presaturation with inversion recovery in the same subject.

RESULTS
A strong positive correlation was found between $K_{app}$ and BMD in the vertebral bone marrow ($R^2=0.76$, $P_{app}$ and $FF$ in this region, showing the dependence on trabecular architecture. However, there was no significant correlation between $D_{app}$ and BMD, indicating the greater utility of the $K_{app}$ than that of the $D_{app}$.

CONCLUSION
Water-restricted diffusion analysis with diffusion kurtosis makes it possible to obtain more detailed information on the structure of cancellous tissue and the bone metabolism.

CLINICAL RELEVANCE/APPLICATION
Diffusion kurtosis analysis increases the amount of bone metabolic information, and may be useful for assessing bone aging, early degeneration in the cancellous tissue and diagnosis of osteoporosis.

LL-PHS-TU9B ● Material Decomposition of Dual-energy Computed-tomography Data Using Polar Coordinates

Lukas Havla (Presenter) ; Michael Peller DPhil ; Konstantin Nikolaou MD * ; Maximilian F Reiser MD ; Olaf Dietrich PhD

CONCLUSION
The transformation of DECT attenuation data into polar coordinates exhibits the potential to improve tissue visualization and material decomposition.

Background
Dual-energy computed-tomography (DECT) allows for patient examination with two different x-ray spectra at the same time. Thereby, independent data on material-specific attenuation properties are obtained. The separate evaluation of both datasets can be difficult and non-conclusive; particularly, for DECT data with contrast media enhancement, material decomposition in the relevant scale of ±200 HU is challenging due to similar attenuation coefficients of calcium and iodine. We hypothesize that the transformation of dual-energy data into polar coordinates can ease analysis and help to distinguish between concentration and kind of matter.

Evaluation
Given two corresponding DECT images, first, the attenuation values ($\rho(U1), \rho(U2)$) in Hounsfield units (HU) of both energies ($U1, U2$) are displayed as scatter plot in Cartesian coordinates for all voxels $i$. Then, the polar coordinate transformation is applied; i.e., the distance, $r_i$, of every data point ($\rho(U1), \rho(U2)$) to the coordinate origin and the angle, $F_i$, to the abscissa is calculated. Depending on the examined tissues and/or materials, different characteristic polar angles can be observed in the spectrum-like scatter plot of ($r_i, F_i$). For example, typical polar angles for fat, calcium, and iodine-based contrast agent are $-125^\circ$, $62^\circ$, and $71^\circ$, respectively. Alternatively, it is possible to display the parameter map $F(x,y)$ ($x,y$: coordinates in image space) which allows assessing the spatial distribution of specific materials in an image with preserved anatomic and morphologic structure and details.

Discussion
The advantage of our method is the possibility to display the energy dependence of the attenuation coefficient in a function of a single variable (polar angle $F$) which contains the additional relevant information on material attenuation. Material decomposition becomes possible by selecting only data corresponding to certain polar angles.
“This course was extremely helpful for me. As this was my first radiation oncology rotation this course gave me a very strong foundation in the field.”

“This course was very important in helping me become more comfortable with my decision to go forward with radiation oncology as a career.”

“I [think] a course like this would have made my first rotation much smoother.”

“Excellent course, I wish my home institution had a similar one.”

LL-ROS-TU3B • Role of External Beam Radiotherapy in Patients with Thyroid Cancer: One Center Experience
Sule Karaman ; Rabia Nergiz Dagoglu (Presenter) ; Seden Kucucuk MD ; Rasim Meral ; Ahmet Karadeniz ; Ethem N Oral

LL-ROS-TU4B • Predictors of Academic Career Selection in Radiation Oncology: A National Survey of Radiation Oncology Residency Programs
Sanjay Anjea BS (Presenter)

ABSTRACT
Purpose:
Changing dynamics of the US healthcare system coupled with the increasing demand for radiation therapy services has placed increased pressure on radiation oncology departments to maintain large clinical volumes often at the expense of the academic mission of their residency programs. The effect of these changes on resident career choice is unknown. The purpose of this study was to identify trends in academic career choice among radiation oncology residents and possible program qualities that may influence resident career choices.

Methods:
A survey was sent to 83 radiation oncology residency program directors within the United States regarding residency graduates between the years 2001 and 2010. The survey contained 295 questions regarding the number of residents who pursued an academic position following graduation, research time during residency, and number of residents per class. Additionally, hospital data regarding the largest hospital for each residency program was obtained through publically available data from the U.S. News and World Report. A multivariate logistic regression model was built to test predictors of resident career choice.

Results:
Of the 83 radiation oncology programs contacted, 15 (18.0%) completed the survey representing approximately 26% of radiation oncology residency graduates from 2001-2011. Of the 306 residency graduates a total of 144 (47%) of residents initially chose academic careers following graduation. 45% of male graduates and 49% of female graduates initially chose academics. The percentage of residency graduates who pursued academics increased slightly over the period of the study (35% in 2001 vs. 48.5% in 2011). Residents from programs with more research months during residency (OR 1.02, p=.041), more residents per class (1.35, p=.005), and an affiliation with an NIH-Cancer Center (OR 1.39, p=.036) were more likely to pursue academic careers. Conversely, residents who trained at hospitals with larger clinical volumes (as measured by number of discharges) were less likely to pursue academic careers following graduation (OR .98, p=.005).

Conclusions:
Over the last decade there has been a relative increase in the proportion of radiation oncology residents who have chosen academic careers following graduation. Although unrelated to gender, the choice to pursue academic radiation oncology is perhaps related to protected research time, exposure to an NIH Cancer Center, and manageable clinical volume that is divided among a large residency class. The radiation oncology community must be vigilant to promote aspects of residency programs that best train both academic and community radiation oncologists.

LL-ROS-TUSB • Expanding Oncologic Education in the United States: The Role of the Radiation Oncologist
Malcolm Matte (Presenter) ; Evangelia Katsoulakis

ABSTRACT
Purpose/Objective(s): Cancer is the most common cause of mortality in the United States, and for most human cancers, the extent of disease at diagnosis is the most important predictor of survival. As such, primary care physicians play a crucial role in cancer outcomes, for their role in early diagnosis, prevention, screening, and support during treatment. Unfortunately, the majority of US medical students going into primary care will never do a clinical rotation in oncology. In addition, because of the multidisciplinary nature of cancer care, a cohesive oncologic education during the clinical years is uncommon at most medical schools. Radiation Oncologists are in a unique position to take ownership of teaching the basic principles of clinical oncology to medical students, since they treat the entire spectrum of malignancies and collaborate with the entire spectrum of Oncologists. The goal of this project was to develop an Oncology curriculum at our institution, starting with a dedicated lecture on the basics of clinical oncology for third year medical students. In this study, we have evaluated the utility of that lecture to them.

Materials/Methods: An interactive 60 minute lecture was given by a Radiation Oncology resident to third year medical students during their internal medicine rotation. Over the course of the year all students would have attended once. Topics covered included an overview of cancer pathophysiology, natural history, diagnosis, imaging, staging, management with chemotherapy, radiation and surgery, clinical trial design, oncologic emergencies, and palliative care. An emphasis was placed throughout the session on the most common malignancies in the United States. Afterwards, students were emailed an electronic survey using SurveyMonkey. Descriptive statistics are reported below.

Results: To date, three lectures have been given to a total of 54 students, and 16 completed the survey (response rate 30%). Prior to attending the lecture, on average, respondents had completed 6.7 months of rotations and had received a total of 1.9 hours of dedicated oncology teaching during their rotations. 100% of respondents would like to have more oncology education during their clinical years, and 93% believe that every medical student should see a lecture of this type. After attending the session, 86% felt more competent interacting with Oncologists, and 71% felt more competent caring for cancer patients.

Conclusions: While the sample size so far is small, our findings suggest that a greater emphasis on clinical oncology education would be welcomed by most medical students. Future directions will include expanding to other medical schools, teaching more than a single lecture, and also including residents in primary care specialties in addition to medical students.

LL-ROS-TU6B • IMRT with MR Guidance for Prostate Cancer-A Dynamic Therapeutic Approach with Screening Implications
Joseph M Baisden MD,PhD (Presenter) ; Dana O Olson MD

PURPOSE
This study highlights the usefulness of magnetic resonance imaging (MR) in the treatment of prostate cancer with implications for screening. MR was used for planning prostate cancer radiation treatment and to evaluate the value of periodic limited MR during the course of therapy. This was evaluated in the community clinic setting.

METHOD AND MATERIALS
Planning CT images were acquired and individual treatment plans were performed for localized prostate cancer patients. MR images were acquired at 1.5 T at the community hospital. T2-weighted axial images were fused for planning purposes, and a second plan was generated using the fused images. Patients were treated with IMRT with daily CT image guidance using helical tomotherapy to a total dose of 81 Gy. Periodic limited MR imaging, including T2, diffusion and STIR were acquired twice weekly to evaluate the dynamic MR response to therapy.
RESULTS
Rectal doses were decreased significantly for the patients treated with fused-MR planning, compared to plans generated with CT data only. Discrepancies in prostate volume and associated Planning Target Volume (PTV) were variable, highlighting the advantage of MR over CT in delineated prostate anatomy. There was a 29.3% decrease in mean prostate volume with MR compared to CT. Regarding rectal dose, the V80, V70, V60 and V50 were decreased by 82.6, 65.9, 54.7 and 43.7%, respectively. Similar improvements were seen in dose to the bladder and penile bulb. Patients tolerated the treatments with no Grade 3 or higher acute toxicities. The MR imaging during the course of therapy demonstrated changes including a general decrease in MR prostate spatial frequency and mild gland enlargement.

CONCLUSION
Fusion of MR for planning purposes results in significant sparing of normal organs for prostate cancer IGRT/IMRT in the community setting. Patients tolerated 81 Gy with side effect profiles consistent with other reports. Further dose escalation is being pursued. Periodic limited MR imaging may be useful for ongoing therapy guidance and the changes noted may provide a useful approach to using this technology as an effective screening tool.

CLINICAL RELEVANCE/APPLICATION
MR serves a valuable role in prostate cancer therapy, both guidance and outcome assessment. MR allows more accurate radiation targeting and normal organ sparing, permitting safe dose escalation.

**LL-ROS-TU7B • Breast Cancer and Bone Metastases: MR Imaging of Axial Skeleton Metastases for Predicting Skeletal Related Events**

Christian B Van Der Pol MD (Presenter) ; Mark E Schweitzer MD ; Gina A Di Primio MD ; Marcos L Sampaio MD ; Ania Z Kielar MD ; Mark Clemons ; Tinghua Zhang ; Arash Jaberi MD

PURPOSE
Bone metastases from breast cancer are associated with significant morbidity and mortality. Skeletal related events (SREs) are defined as radiation/surgery to bone, pathologic fractures, malignant spinal cord compression and hypercalcemia. We hypothesized that certain skeleton MRI characteristics were associated with developing an SRE.

METHOD AND MATERIALS
Over a 3-year period, 250 unselected patients were identified with skeletal metastases on axial skeleton MRI, histologically proven breast cancer and no other malignancy. Two radiologists reviewed each study independently. Patients were divided into 3 groups: 1) metastatic marrow replacement, 2) > 20 skeletal metastases, and 3) = 20 metastases. Marrows were divided into 7 subregions (cervical, thoracic, lumbo-sacral spine, pelvis, proximal femurs, sternum and shoulder girdles). The number of regions with metastases was summed. Presence of a pathologic fracture was documented. Charts were reviewed for the subsequent development of SREs. Logistic regression was applied to determine the odds ratio (OR) for developing an SRE, with 95% CI and p-values.

RESULTS
176/250 (70%) patients developed an SRE. Presence of a prior pathologic fracture demonstrated the strongest association with developing an SRE; OR 2.506 (1.112-5.648, p=0.03). Marrow replacement and > 20 metastases were associated with developing an SRE compared with = 20 metastases; OR 2.048 (1.019-4.118) and 2.176 (1.086-4.361), respectively (p=0.03). A higher sum of involved skeletal regions was associated with developing an SRE; OR 1.251 (1.081-1.448, p=0.003). Metastases involving predominantly the axial skeleton, increasing metastases quantity, metastases T1 signal and signal uniformity were not statistically associated with SREs. Increased metastatic involvement of the proximal femur showed a trend for shorter time to hip fracture (Figure).

CONCLUSION
Several characteristics of axial skeleton metastatic disease on MRI are associated with developing SREs. These include presence of a pathologic fracture, marrow replacing process, > 20 skeletal metastases, and more skeletal regions of involvement. These findings require prospective confirmation.

CLINICAL RELEVANCE/APPLICATION
Features of bone metastases on axial skeleton MRI may be of utility for predicting development of skeletal related events in patients with breast cancer.

**Vascular/Interventional - Tuesday Posters and Exhibits (12:45pm - 1:15pm)**

**LL-Vis-TUB • AMA PRA Category 1 Credit™: 0.5**

**LL-Vis-TU1B • Stop-flow Foam Sclerotherapy (SFFS) of Symptomatic High Flow Female Varicocele**

Roberto Gandini MD, PhD ; Daniel Konda (Presenter) ; Valerio Da Ros ; Daniele Morosetti MD ; Sergio Abrignani ; Marcello Chiocchi MD ; Giovanni Simonetti MD

PURPOSE
To assess the efficacy of Stop-Flow Foam Sclerotherapy (SFFS) in high flow pelvic varicocele using 3% sodium-tetrade cyl-sulphate (STS) foam.

METHOD AND MATERIALS
A retrospective study was conducted in 26 patients (mean age: 37.3 years; range: 23-46) with pelvic congestion syndrome (PCS) with high outflow venous collaterals treated by SFFS between June 2005 and June 2011 at our Department. Full approval and waiver of informed consent for our study was obtained by our institutional review board. PCS was diagnosed by physical and transvaginal color-Doppler US, while high outflow venous collaterals were detected at selective ovarian venography. According to the type of varicocele (non-cross-pelvic, cross-pelvic), the type of outflow (low- or high outflow) and their drainage (ovarian vein etc.), we created a new phlebographic classification of pelvic varicoceles. SFFS was performed by injection of 3% STS foam into the pelvic varices while performing balloon-occlusion of the major venous vessels to which the high outflow venous collaterals were tributary. Follow-up was performed at 1, 3, 6 and 12 months by physical and transvaginal color-Doppler US examination and by a questionnaire-based assessment of pain.

RESULTS
The technical success rate was 100%. After the injection of 3% STS foam, all patients presented a colic-like pain with spontaneous resolution after 5 minutes. Mean fluoroscopy time was 17.0 ± 3.49 minutes. During follow-up, no recurrences of PCS were detected. A significant improvement of symptoms (Student’s t test P)

CONCLUSION
SFFS is a safe and effective procedure. Differently from other techniques, SFFS aims at the direct sclerotisation of pelvic varices rather than at the occlusion of outflow vessels. The procedure allows precise identification of all outflow vessels and, by temporary balloon-occlusion of the major venous vessels to which they are tributary, enables the stagnation of STS foam within the varices leading to their complete sclerotisation. SFFS does not require the positioning of foreign bodies (e.g. coils, plugs) and requires the administration of only small amounts of sclerosing agent. SFFS should be considered as an alternative to other endovascular and surgical options.

CLINICAL RELEVANCE/APPLICATION
This minimally invasive procedure is performed under local anaesthesia in a day hospital setting and is associated to a significant reduction of symptoms and low recurrence rates.
LL-VIS-TU2B • Non-small-Cell Lung Cancer Patients with Hemoptysis and Predictive Factors for False Negative Diagnosis

Younggyung Shin (Presenter) ; Gyoo Sik Jung MD ; Hee Kang MD

PURPOSE
To evaluate diagnostic yields of percutaneous transluminal forceps biopsy in patients suspected of having a malignant biliary obstruction and evaluate predictive factors for false negative diagnosis.

METHOD AND MATERIALS
Two hundred forty three consecutive patients (151 men and 92 women; mean age, 61 years) with obstructive jaundice underwent transluminal forceps biopsy during or after percutaneous transhepatic biliary drainage. The lesions involved the common bile duct (n = 97), common hepatic duct (n = 60), hilum (n = 47), ampullary segment of the common bile duct (n = 29), right or left intrahepatic bile duct (n = 10). In each patient, three to five specimens (mean, 3.4 specimens) were taken from the lesion with 5.4-F biopsy forceps. The final diagnosis for each patient was confirmed with pathologic findings at surgery, additional histocytologic data, or clinical and radiologic follow-up. Multivariate logistic regression analysis was used to identify risk factors associated with false negative diagnosis.

RESULTS
177 of 243 biopsies resulted in correct diagnoses of malignancy. 17 biopsy diagnoses proved to be true-negative. There were 49 false-negative diagnoses and no false-positive diagnoses. The diagnostic performance of transluminal forceps biopsy in malignant biliary obstructions was as follows: sensitivity, 77.4%; specificity, 100%; and accuracy, 79%. Ampullary segment of common bile duct (odds ratio 4.355 95% CI 1.651-11.490, p=0.003) and non-mucosal tumor (odds ratio 2.386 95% CI 1.216-4.585, p=0.011) were the significant risk factor for false negative diagnosis. No major complications related to the biopsy procedures occurred.

CONCLUSION
Percutaneous transluminal forceps biopsy provides relatively high accuracy in the diagnosis of malignant biliary obstructions. The predictive factors for false negative biopsy were biopsy site and tumor origin.

CLINICAL RELEVANCE/APPLICATION
Percutaneous transluminal forceps biopsy provides high accuracy in the diagnosis of malignant biliary obstructions.

LL-VIS-TU3B • Immediate and Late Outcomes of Bronchial and Systemic Artery Embolization for Palliative Treatment of Non-small-Cell Lung Cancer Patients with Hemoptysis

Masahiro Tanabe MD (Presenter) ; Takeshi Fujita MD ; Kazuko Moritani ; Naofumi Matsunaga MD, PhD ; Tsuneo Matsumoto MD

PURPOSE
The aim of this study was to evaluate immediate outcomes, late outcomes, and safety of bronchial and systemic artery embolization (BAE) for palliative treatment in a group of patients with advanced non-small-cell lung cancer (NSCLC) with hemoptysis.

METHOD AND MATERIALS
Between March 2009 and November 2012, BAE using gelatin sponge particles was performed in 28 consecutive patients with NSCLC. Sixteen patients had adenocarcinoma and 12 had squamous cell carcinoma. Three patients were classified as clinical stage IIB, five were stage IIIA, 14 were stage IIIB, and six were stage IV, respectively. Hemoptysis was defined as follows: acute massive bleeding greater than 300 mL within 24 h (n = 8), moderate bleeding of 100-300 mL within 24 h (n = 12), and slight bleeding less than 100 mL within 24 h (n = 8). A retrospective analysis of technical, immediate, and late success rates was performed. Complications were also evaluated.

RESULTS
The technical success rate was 96%. Immediate clinical success within 24 h after BAE was achieved in 22 (81%) of 27 patients who underwent embolization. Hemoptysis was observed in 27 patients after BAE. A small amount of hemoptysis recurred within 14 days of embolization in two patients. Both immediate and late clinical success rates were achieved in 20 of 27 patients (74%). There were no major complications requiring further management, and eight (30%) minor complications occurred.

CONCLUSION
BAE with gelatin sponge particles can provide good management of hemoptysis as a palliative treatment in patients with advanced NSCLC.

CLINICAL RELEVANCE/APPLICATION
BAE with gelatin sponge particles is a safe and effective palliative treatment for hemoptysis in patients with advanced non-small-cell lung cancer for maintenance of quality of life.

LL-VIS-TU4B • Renal Cryoablation: A New Paradigm for Nearly any Tumor Location

Hussein D Aoun MD (Presenter) ; Peter J Littrup MD * ; Barbara A Adam MSN ; Evan N Fletcher MS, BA ; Mark J Krycia BS

PURPOSE
To assess technical feasibility, efficacy and complication rates of CT guided percutaneous renal mass cryoablation in a large series on long term follow up.

METHOD AND MATERIALS
CT and/or CT-US fluoroscopic-guided percutaneous cryoablations were performed in 247 procedures on 262 tumors (210 RCC, 45 metastasis, 6 oncocytomas and 1 angiomylolipoma) in 214 patients noting tumor size and location. Thirty-seven patients had multiple renal tumors ablated. Follow-up CT or MRI was utilized to assess efficacy and evaluate for local recurrences or new multicentric tumors. Hydrodissection with normal saline/contrast (60:1) solution was performed to protect adjacent vital structures such as bowel, ureter or pancreas. Complications followed the grading system of the National Institutes of Health, Common Terminology of Complications and Adverse Events (CTCAE 4.0).

RESULTS
All the procedures were performed under conscious sedation and were virtually painless during and after the procedure. Average tumor and ablation size was 3cm and 5cm, respectively, with the largest 10.4cm. Hydrodissection was performed in 73 procedures. Major complication (only grade 3) rate attributable to the procedure was 2.4% (6/247). Of the major complications, 3 (3/5) were related to hemorrhage requiring transfusion (Grade 3). A ureteral strictures prior to ureteral stent placement for central tumors and bowel injury prior to protective hydrodissection techniques were observed early on in our experience. Median follow-up was 1.8 years with 72 patients having > 3 year follow-up and 36 patients having > 5 year follow-up. Local recurrence rate was 2% (6/262), with 4 technical failures and 2 tract recurrences. Of the local recurrences, 4 were re-ablated (2 tract and 2 technical) without residual disease on follow-up for a secondary efficacy of 99%.

CONCLUSION
Renal cryoablation has established low complication and local recurrence rates which do not appear to be significantly affected by tumor size or central location. CT guided percutaneous cryotherapy is a low cost and low morbidity alternative for patients with complex renal tumors.

CLINICAL RELEVANCE/APPLICATION
The rising cost of health care mandates consideration of renal cryoablation as a cost effective treatment option, justified by comparable low recurrence and complication rates for any renal location.
Type II endoleaks (T2EL) are common complications following EVAR. Persistent T2EL are potentially associated with late aneurysm rupture. Although embolization procedures are frequently used to treat persistent T2EL, there is a paucity of literature on its outcomes. This study aims to evaluate the effectiveness of embolization of T2EL and whether the embolization agent, approach to embolization, or endoleak configuration has an impact on its efficacy.

A retrospective review of patients who underwent EVAR and subsequent T2EL embolization between 2003 and 2012 was performed. Embolization was performed via direct sac puncture or a transarterial approach with the goal of obliterating both the endoleak sac and feeding vessels. Embolization agents used include cyanoacrylate glue only (43%), glue and coils (31%), coils only (18%), and other agents (8%). Aneurysm volume was measured before and after embolization. Technical success, freedom from sac expansion and the incidence of recurrent T2EL were documented. Comparisons were made between the outcomes using different embolization agents, approach to embolization, and T2EL configurations.

A total of 29 patients (median age 76 years) underwent 42 embolization procedures. The median duration from EVAR to embolization was 16 months (95% CI 10-24 months), and the median follow-up was 11 months (95% CI 7-22 months). Immediate technical success of embolization was 91%. Freedom from aneurysm sac expansion was achieved in 96%, and freedom from T2EL (no enhancement of the aneurysm sac) was accomplished in 71%. There were no ruptured aneurysms during the follow-up period. No statistically significant differences were found in the outcomes between different embolic agents, the approach for embolization or the configuration of the endoleak.

Embolization of T2EL with cyanoacrylate glue is effective for the prevention of aneurysm sac growth in mid-term follow-up. The results are similar regardless of the embolization approach, the addition of coils or the T2EL configuration. Further studies are needed to determine the long-term outcomes in this group of patients.

Persistent T2EL are associated with serious adverse outcomes, thus evaluation of the efficacy of existing treatments is needed to optimize outcome in this group of patients.

**LL-VIS-TU6B • Nuts and Bolts of Microwave Ablation**

**Meghan G Lubner** MD (Presenter); **Timothy J Ziemlewicz** MD; **J. Louis Hinshaw** MD *; **Fred T Lee** MD *; **Christopher L Brace** PhD *; **Marci Center**

**PURPOSE/AIM**

- Review advantages/limitations of microwave ablation (MWA).
- Discuss applications of gas cooled MWA and available antennas.
- Use case-based review to illustrate patient selection, antenna placement, intra procedural imaging, technical efficacy and complications of microwave ablation in the lung, liver, kidney, adrenal and retroperitoneum.

**CONTENT ORGANIZATION**

- Introduction
- Potential advantages and limitations of MWA
- Review of available antennas: advantages/limitations, applications.
- Multi-organ (liver, kidney, lung, retroperitoneum) clinical case based pictorial review illustrating patient selection, intra procedural monitoring, technical efficacy, complications, follow up.
- Summary

**SUMMARY**

- Use of MWA enables rapid generation of very high temperatures, which can lead to decreased treatment time and decreased susceptibility to heat sink effects and high tissue resistance.
- Gas cooled MWA allows for treatment at high powers with a relatively small gauge antenna.
- MWA can be readily and effectively applied in the lung, liver, kidney, retroperitoneum.
- A conventional triaxial microwave antenna is able to generate relatively large, long ablation zones for treatment of larger tumors, whereas a modified triaxial antenna can produce a short, round ablation zone for treatment of tumors adjacent to vulnerable structures.

**LL-VIE-TU76 • Renal Denervation- What the Interventional Radiologist Needs to Know**

**Ken Courtney** (Presenter); **Umer Salati** MD; **Hong Kuan Kok** MBBCh, MRCPI; **Davinia Ryan** MBBCh, MRCPI; **Pradeep Govenor**; **William C Torreggiani** MBBCh

**PURPOSE/AIM**

The goal of this exhibit is to review the key radiological findings required prior to renal denervation as well as highlighting findings that contraindicate or potentially complicate successful renal denervation.

**CONTENT ORGANIZATION**

Cases undergoing CT angiography prior to renal denervation will be presented. Renal denervation is an endovascular procedure generally carried out by either interventional radiologists or interventional cardiologists and its success is largely determined by the ability to screen and select the correct patients on CT angiography. In this exhibit, we select cases and demonstrate the key findings that require specific assessment such as renal artery size, uniformity and branching pattern. Examples of contraindications such as early secondary renal artery take off as well as asymmetrical tapering which are a contraindication to renal denervation are demonstrated.

**SUMMARY**

CT angiography prior to renal denervation is becoming a more common examination which will undoubtedly grow rapidly in the coming years. In this abstract we show the key radiological features which require assessment by the reporting radiologist.

**LL-VIE1302-TUB • The Use of Contrast-enhanced Ultrasound (CEUS) in Vascular Diseases**

**Sasan Partovi** BS *; **Markus Aschwanden** MD; **Fabian Rengier** MD (Presenter); **Deniz Bilecen** MD, PhD; **Daniel Staub** MD

**PURPOSE/AIM**

Contrast-enhanced ultrasound (CEUS) is a novel imaging technique enabling patient studies at the bedside without any radiation exposure. The purpose of this educational exhibit is to demonstrate potential applications of contrast-enhanced ultrasound of vascular diseases.

**CONTENT ORGANIZATION**

- Introduction in contrast-enhanced ultrasound:
  a. Technical considerations including equipment
  b. Available and approved contrast agents for patient studies
  - CEUS in carotid artery diseases:
MSAS33B • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

Process Engineering to Optimize Work Flow Processes in Radiology: A Case Study Approach (Sponsored by the Associated Sciences Consortium) (An Interactive Session)

Tuesday, 01:30 PM - 03:00 PM • S105AB

Kris Meltzer MD (Presenter) * ; Habib Tannir MD (Presenter)

LEARNING OBJECTIVES
1) How to produce patient education videos. 2) How to deploy them in a patient care setting. 3) How to measure the impact on patient satisfaction.

MSAS33A ● Improving Patient Experience Through Technology

Carolyn C Meltzer MD (Presenter) * ; Habib Tannir MS (Presenter)

LEARNING OBJECTIVES
1) Gain an understanding of the Production Preparation Process, its basic elements and tools. 2) Explore a successful Imaging Center Case Study. 3) Review the benefits, challenges and lessons learned by LandM.

ABSTRACT
The focus of this session will be on the successful design of Lawrence and Memorial Hospital’s new Imaging Center. Given the massive capital investment required in healthcare facility construction, hospitals must develop innovative approaches to contain costs while also maintaining organizational and project goals. Over the next 5 years LandM Hospital is embarking on a number of strategic initiatives that are geared toward growth, updating the physical plant, improving our inpatient/outpatient care models, implementing electronic health records, and preserving the overall financial health of the organization. Many of these initiatives require the re-design of existing facilities or the building of new facilities. While the need for capital increases, access to capital continues to become more of a challenge. In order for LandM to achieve its strategic goals within planned timelines and budgets, the hospital has integrated the Production Preparation Process (3P) into the design phase of new and renovation facility projects. The 3P methodology incorporates Lean principles and demands interdepartmental collaboration and transparency at the earliest stages of the design phase. The focus is on rapidly designing or retrofitting facilities, services, and care models that support, and are not in contradiction with, Lean concepts of efficiency, optimal flow, and waste reduction. The overall goal is to implement a high-quality design process that is scalable in size and scope, while ensuring project managers meet timeline requirements at the lowest possible cost. Our key objectives are to create an ideal patient experience, integrate best-practice standards in process and clinical care, maximize space utilization to accommodate current and future volumes, and gain efficiencies in the 7 flows of medicine.
MSES33 • Pediatric Airway Emergencies

Jonathan O Swanson MD (Presenter)

LEARNING OBJECTIVES
1) Identify the radiographic appearance of common causes of stridor and wheezing in the pediatric population. 2) List common radiographic approaches to evaluate pediatric foreign body aspiration. 3) Define radiographic-apparent causes of chest pain in the pediatric population.

MSES33B • Imaging of Osteomyelitis in Children

Diego Jaramillo MD, MPH (Presenter)

LEARNING OBJECTIVES
1) Recognize that there have been epidemiological changes with significant implications for imaging of musculoskeletal infections in children, particularly with Staphylococcal infections increasingly presenting with subperiosteal and soft tissue abscesses, multifocal disease and deep venous thrombosis. 2) Recognize the imaging findings in pediatric osteomyelitis and the important differential diagnostic considerations. 3) Be aware of the contribution of the different imaging modalities in the evaluation of pediatric musculoskeletal infections. 4) Be familiar with imaging algorithms for the different types and scenarios of children with musculoskeletal infections.

ABSTRACT
Acute hematogenous osteomyelitis is the most common musculoskeletal infection in children. More than half of osteomyelitis affect children below five years of age with 70% involvement of the lower extremities. During the past few years, the incidence of methicillin-resistant Staphylococcus aureus (MRSA) has increased and now accounts for nearly 30% of the cases in children. Multifocal infections, subperiosteal and soft tissue abscess, and deep venous thrombosis are now very prevalent. Hematogenous osteomyelitis usually arises in the metaphysis of long bones or the metaphyseal equivalents of the flat and round bones. Metaphyseal-equivalents are areas adjacent to cartilage that have similar vascularity to that of the metaphyses of long bones. Plain radiographs are primarily used to exclude other pathologies. Ultrasound is important in the detection of subperiosteal and soft tissue abscess. MRI has become the predominant modality for evaluation of osteomyelitis. Gadolinium-enhanced imaging is important in the evaluation of spinal osteomyelitis to exclude epidural and paraspinal collections, in pelvic osteomyelitis to diagnose the abscesses which are prevalent in this infection, and in epiphyseal cartilage infections which may only be visible after contrast administration. Otherwise, contrast material is mainly helpful in increasing the confidence of a diagnosis of a drainable collection. CT scanning is not used routinely but may help in complex cases of chronic osteomyelitis. PET/CT is useful in determining whether a chronic infection is active. The role of bone scintigraphy has declined as evaluation of extra-skeletal findings has become more important, but it is still useful in younger children where the focus of infection is not clinically localizable and in patients who cannot be sedated for MRI.

MSES33C • Cardiac CT in Children Beyond the Coronaries: Why, How, and When?

Catherine M Owens MD (Presenter)

LEARNING OBJECTIVES
1) To understand the role of Cardiac CT in children, with particular emphasis on the conditions where CT has a synergistic role e.g. when there is important associated tracheobronchial and pulmonary parenchymal pathology. 2) To illustrate specific conditions where CT has a major role in diagnosis and follow up. 3) To describe the techniques for acquisition of cardiothoracic CT images which are 'fit for purpose' and acquired at low radiation dose. 4) To discuss the various types of acquisition and compare image quality versus effective radiation dose.

ABSTRACT

Quality Improvement: Strategies for Improving Patient Safety: Root Cause Analysis

Tuesday, 01:30 PM - 03:00 PM • S406B

Co-Director
Jonathan B Kruskal, MD, PhD *
Co-Director
James V Rawson, MD
Moderator
James V Rawson, MD

LEARNING OBJECTIVES
1) Understand the role of the root cause analysis in process improvement. 2) Learn techniques to improve patient safety.

MSQI33A • Root Cause Analysis - Getting to the Root(s) of Your Problem

Sumir S Patel MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

MSQI33B • A Mock Root Cause Analysis

James V Rawson MD (Presenter) ; Sumir S Patel MD (Presenter) ; Norman B Thomson MD (Presenter) ; Layne Mitchell RT (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

MSQI33C • Using Lessons Learned to Improve Patient Safety

Norman B Thomson MD (Presenter) ; Layne Mitchell RT (Presenter)
Tuesday Plenary Session

Tuesday, 01:30 PM • Arie Crown Theater

PS30  •  CME : CME credit is not available for this session.
To receive credit, relinquish attendance voucher at end of session.

Presiding
Sarah S Donaldson , MD , Palo Alto, CA
President, Radiological Society of North America

Presentation of the Gold Medal of the Radiological Society of North America

Theresa C McLeod , MD , Boston, MA
Harvey L Neiman , MD , Reston, VA
J. Frank Wilson , MD , Milwaukee, WI

Introduction by
Sarah S Donaldson , MD , Palo Alto, CA

Special Lecture: Mobilizing Human Potential

Condoleezza Rice, PhD , Stanford, CA

Introduction by
Sarah S Donaldson , MD , Palo Alto, CA

Interventional Oncology Series: Lung

Tuesday, 01:30 PM - 06:00 PM • S405AB

VSIO31 • AMA PRA Category 1 Credit ™:4.25 • ARRT Category A+ Credit:5
Moderator
Alison R Gillams , MBChB *

LEARNING OBJECTIVES
1) To learn the latest results of ablation in primary and secondary lung tumours. 2) To understand how to use the different ablation technologies (RF, MW and cryotherapy). 3) To learn optimal patient selection for lung ablation. 4) To understand the imaging appearances following ablation. 5) To know how to diagnose and manage possible complications following ablation.

VSIO31-01 • Primary Lung Cancer

Robert D Suh MD (Presenter)

LEARNING OBJECTIVES
1) Discuss long term outcomes of image-guided ablation for early stage lung cancer. 2) Discuss local control rates of image-guided ablation for early stage lung cancer. 3) Understand the factors in image-guided ablation influencing survival and local control. 4) Understand treatment options and relative outcomes of image-guided ablation compared to alternative therapies for early stage lung cancer.

ABSTRACT
Thermal ablation is a safe therapeutic and effective option to provide local control for 1° lung malignancies. Thermal ablation confers survival benefits in carefully selected patients: RF ablation with encouraging mid- and long-term results. Microwave and cryoablation remain promising techniques, requiring future studies for validation.

VSIO31-02 • Colorectal Lung Metastases

Stephen B Solomon MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO31-03 • Sarcoma and Other Non-CR Lung Metastases

Jean Palussiere MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO31-04 • Irreversible Electroporation of Lung Metastases: Initial Experience

Thierry J De Baere MD (Presenter) * ; Julien Joskin ; Antoine Hakime MD ; Geoffroy Farouil ; Lambros C Tselikas MD ; Frederic Deschamps

PURPOSE
Because recurrence rate of lung RFA has been reported higher when tumor are in contact with large vessels we used Irreversible Electroporation (IRE) used to treat such located lung metastases and reported herein our initial experience

METHOD AND MATERIALS

RESULTS

CONCLUSION
IRE is well tolerated, induces a rapid decrease in size of the treated tumor but tumor regrowth is frequent within the first year of follow-up.

CLINICAL RELEVANCE/APPLICATION
IRE of lung metastases, although inducing rapid decrease of the tumor size does not prevent later growth of the tumor. Consequently, the technique must be improved before routine clinical use.

VSIO31-05 • What Does SBRT Contribute to the Management of Primary or Metastatic Lung Cancer?
LEARNING OBJECTIVES
1) Understand the different approaches and techniques for thorough cryoablation of lung tumors (e.g., the "1-2 Rule"), emphasizing

1) Identify the different approaches and techniques for thorough cryoablation of lung tumors (e.g., the "1-2 Rule"), emphasizing

LEARNING OBJECTIVES
1) Underline case-base information. 2) Identify treatment strategies. 3) Evaluate thoracic interventional procedures.

VSIO31-07 • Interpretation of Follow-up Imaging
William H Moore MD (Presenter) *

LEARNING OBJECTIVES
1) Understand the findings on follow-up imaging that are characteristic of post-ablation zones. 2) Identify the findings on follow-up imaging that are characteristic of recurrence. 3) Compare the post-ablation imaging findings between RFA, Microwave, Cryoablation and Nanoknife.

ABSTRACT

VSIO31-08 • Why, When and How I Perform RF Ablation of Lung Tumours
Jo-Anne O Shepard MD (Presenter) *

LEARNING OBJECTIVES
1) Understand multidisciplinary patient selection and describe the indications and contraindications to RFA of the lung. 2) Outline the RFA procedure including sedation, appropriate approach and positioning, equipment setup and treatment and follow-up protocols.

VSIO31-09 • Why, When and How I Perform MW Ablation of Lung Tumours
Thomas J Vogl MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Identify indications for MWA of lung tumors. 2) Identify procedure-related risk factors. 3) Learn about tips and tricks.

ABSTRACT

1) Identify indications for MWA of lung tumors. 2) Identify procedure-related risk factors. 3) Learn about tips and tricks.

Thermal ablation techniques have increasingly expanded their role in minimal invasive destruction of tumor tissue beyond the liver, especially in the lung. Both primary and secondary lung cancers are currently of interest among thermal ablation techniques such as laser therapy, radiofrequency ablation, and others. With its introduction microwave ablation (MWA) has rapidly gained its role as a precise, excellently controllable ablation technique. In the following course different techniques of MWA of lung cancers will be presented. This includes techniques on the access, protocols for the ablation and preventive management of complications. Special focus is directed towards the daily management of risk factors at our institute in Frankfurt based on the up-to-date experience.

In the second part the indications for thermal ablation among other technologies such as radiooncology, surgery and systemic chemo-immunotherapy will be presented.

In summary, MWA of neoplastic diseases of the lung rapidly gains acceptance and provides excellent treatment results with a low rate of complications and side effects. Its current role among an armamentarium of other treatment techniques has to be searched for, documented, consolidated and expanded.

VSIO31-10 • Evaluation of a Combined Protocol of Microwave Ablation (MWA) and Transpulmonary Chemoembolization (TPCE) versus MWA Only Protocol: Treatment of Primary and Secondary Nonresectable Lung Tumors
Thomas J Vogl MD, PhD (Presenter); Thomas Dauda BS; Stefan Zangos MD; Emmanuel C Mbaliiske MD; Nour-Eldin A Nour-Eldin MD, MSc

PURPOSE

To evaluate tumor response with volumetric assessment of tumor sizes after treating nonresectable primary and secondary lung tumors with transpulmonary chemoembolization (TPCE) combined with microwave ablation (MWA) versus MWA only protocol in palliative intention.

METHOD AND MATERIALS
Between 2007 and 2012, 23 patients (10 males, 13 females; average, 61.2 years; range, 29-83) suffering from unresectable primary (n=3) and secondary lung tumors (n=20) were treated with TPCE (average, 4.3 sessions) followed by MWA. Another 13 patients (8 males, 5 females; average, 60.2 years; range, 28-83) suffering from unresectable primary (n=2) and secondary lung tumors (n=11) were only treated with MWA. Patients treated with a combined therapy suffered from primary lung tumors (n=3) and metastases of different origins such as colorectal carcinomas (n=6), breast cancer (n=5), urothel carcinoma (n=3), and others (n=6). Patients treated only with MWA suffered from primary lung tumors (n=2) and metastases of different origins such as colorectal carcinomas (n=6), and others (n=5). Follow-up was between 4 months and 3.7 years for primary and secondary lung tumors.

RESULTS
All patients tolerated the combined treatment and the MWA only well and without adverse effects. The rate of spontaneously resolving pneumothoraces was 5.3% in the combined protocol and 4.1% in the MWA only protocol. According to the retrospective study data, in the combined treatment protocol complete response was documented in 30.4% (n=7) of lesions, while in 21.7% (n=5) stable disease was documented and in another 47.8% (n=11) a progressive disease situation. In the group of patients treated only with MWA (n=13), complete response was documented in 38.5% (n=5), stable disease in 7.7% (n=1) and progress in 53.8% (n=7).

CONCLUSION
According to the first evaluated data the additional use of TPCE results in a slight improvement of the local response rate and a reduction of the rate of progression. Further prospective studies are, however, necessary.

CLINICAL RELEVANCE/APPLICATION
Transpulmonary chemoembolization (TPCE) and microwave ablation (MWA) are relevant palliative treatment options in patients with primary and secondary nonresectable lung tumors

VSIO31-11 • Why, When and How I Perform Cryoablation of Lung Tumours
Peter J Litttrup MD (Presenter) *

LEARNING OBJECTIVES
1) Understand the different approaches and techniques for thorough cryoablation of lung tumors (e.g., the "1-2 Rule"), emphasizing
unique benefits for chest wall, pleural-based, central and para-esophageal locations. 2) Understand techniques to minimize morbidity, assessing tumor location and approach. 3) Identify major imaging follow-up criteria for ablation success and any early failures. 4) Describe the overall cost-efficacy trade-offs for cryo vs. heat-based renal ablations vs. stereotactic body radiation therapy, in relation to tumor location, complications and recurrence rates.

ABSTRACT
Cryoablation of lung tumors offers a lower pain alternative than heat-based modalities, especially for pleural and/or chest wall locations. Central locations near major bronchi locations also have low rates of pneumothorax or broncho-pleural fistulas, while paraesophageal locations are readily protected by esophageal warming balloons. Major cryoablation benefits include its excellent visualization of ablation zone extent, low procedure pain and flexible hydrodissection of chest wall ablation sites near skin. CT-guidance is the cryoablation guidance modality of choice due to circumferential visualization and ready availability. MR-guidance has little clinical benefit or cost-efﬁcacy. For safety, cases will be considered for choosing the most avascular approach, extent of peri-bronchial contact and chest wall involvement. Imaging outcomes of complications and their avoidance will be shown. For optimal efficacy, tumor size in relation to number and size of cryoprobes emphasize the “1-2 Rule” of at least 1 cryoprobe per cm of tumor diameter and no further than 1 cm from tumor margin, as well as cryoabroyce spacing of

**VSIO31-12 • Thoracic Cryoablation: A Major Benefit for More Central and Chest Wall Locations?**

**Peter J Littrup** MD (Presenter) *; **Hussein D Aoun** MD; **Barbara A Adam** MSN; **Evan N Fletcher** MS, BA; **Mark J Krycia** BS

**PURPOSE**
To assess recurrence factors for percutaneous thoracic cryoablation. Tumor and ablation size, complications, location and vessel proximity were assessed for patients with primary thoracic and metastatic tumors.

**METHOD AND MATERIALS**
CT and/or CT-US fluoroscopic-guided percutaneous cryoablation was used in 222 procedures on 283 tumors (75 primary, 208 metastatic tumors) in 133 patients, noting tumor and ablation volumes, location, abutting vessels >3mm, recurrences, complications, and tumor type. Primary thoracic included all lung cancer types (n=70) and pleural tumors (n=5). Complications were graded by the National Institutes of Health, Common Terminology of Complications and Adverse Events (CTCAE). Hydrodissection and esophageal warming balloon were used for tissue separation as needed (20 and 9 respectively). A minimum of 2 cryoprobes were used on all patients and for larger tumors, tumor diameter plus one was used for probe number.

**RESULTS**
All patients required only conscious sedation. Overall tumor and ablation median size was 2.2cm and 4.2cm, respectively. Major complication rates were signiﬁcantly lower in tumors = 3 cm as opposed to =3cm, 1.5% (2/134) vs. 11.8% (9/76) (p<0.05). CT guided percutaneous cryoablation in the lung provides a low morbidity alternative for complex patients, particularly for pleural/ chest wall and more central tumors. Complication rates are signiﬁcantly lower for tumors >3 cm. CT guided cryoablation is a safe and efﬁcacious option for central and chest wall locations.

**CONCLUSION**
CT guided percutaneous cryoablation offers a lower pain alternative than heat-based modalities, especially for pleural and chest wall locations. For safety, cases will be considered for choosing the most avascular approach, extent of peri-bronchial contact and chest wall involvement. Imaging outcomes of complications and their avoidance will be shown. For optimal efﬁcacy, tumor size in relation to number and size of cryoprobes emphasize the “1-2 Rule” of at least 1 cryoprobe per cm of tumor diameter and no further than 1 cm from tumor margin, as well as cryoabroyce spacing of

**VSIO31-13 • Complications of Lung Ablation, Preventing Them and When They Occur - Their Management**

**Kamran Ahrar** MD (Presenter)

**LEARNING OBJECTIVES**
1) List potential complications of lung tumor ablation. 2) Outline steps to avoid potential complications. 3) Outline steps to manage complications.

**VSIO31-14 • Evaluating Cryoablation of Metastatic Lung/Pleura Tumors in Patients - Safety and Efficacy (ECLIPSE)**

**David A Woodrum** MD, PhD (Presenter); **Thierry Debaere**; **Fereidoun G Abtin** MD; **Peter J Littrup** MD *; **Frederic Deschamps**; **Robert D Suh** MD; **Hussein D Aoun** MD; **Matthew R Callstrom** MD, PhD *

**PURPOSE**
To evaluate safety and preliminary efﬁcacy of CT guided lung cryoablation for lung metastases =3.5cm in patients with pulmonary metastatic disease.

**METHOD AND MATERIALS**
Forty patients (24 males,16 females; mean age 63 years) were enrolled in a prospective single arm study to evaluate CT guided lung cryoablation(Gallil Medical,Arden Hills, MN) for patients with lung metastases. Inclusion criteria were up to 3 unilaterally or a maximum of 5 metastases bilaterally. Patients were followed with serial CT imaging at 1 week, 3, 6, and 12 months. The primary endpoint for the study is local tumor control assessed by a modiﬁed RECIST. Complications were assessed using the CTCAE 4.0

**RESULTS**
A total of 62 tumors (40 patients) underwent 48 cryoablation procedures. The mean tumor size was 1.4 cm (range 0.3 to 3.2 cm), and 80% (n=32) of patients had unilateral disease. Sedation was general (67%; n=32), conscious/sedation in 31% (n=15), and 2% regional sedation (n=1). Treatment time ranged from 32-272 minutes (mean=101). Nine chest tubes (18%) were placed for pneumothorax but removed in 1 day or less. We did not encounter major hemorrhage to the lung or the pleura. At 3 months, 28 patients (75%) followed up with 100% response rate deﬁned as either stable disease, partial response, or complete response. At 6 months, 15 patients (38%) followed up with a 95% response rate due to one patient having a local failure.

**CONCLUSION**
Cryoablation of metastatic lung tumors =3.5 cm appears to be a safe. Our preliminary results demonstrate promising local tumor control within the lung.

**CLINICAL RELEVANCE/APPLICATION**
CT guided lung cryoablation demonstrates safety and preliminary efﬁcacy in treating metastatic lung disease.

**VSIO31-15 • Percutaneous Cryoablation in Management of Recurrent Mesothelioma after Surgical Pleurectomy and Decortication: Efficacy and Predictors of Local Recurrence**

**Fereidoun G Abtin** MD (Presenter); **Jesse K Sandberg** MD; **Robert D Suh** MD; **William Hsu** PhD; **James Sayre** PhD; **Robert Cameron** MD

**PURPOSE**
Percutaneous cryoablation (PCT) is an ablative technique, used to manage recurrent mesothelioma in patients following surgical lung sparing decortication and pleurectomy. The purpose of this study was to evaluate the efﬁcacy and clinical and ablation variables that are predictive of tumor recurrence following PCT.

**METHOD AND MATERIALS**
IRB obtained. From a database containing surgical and radiological information, patients with recurrent mesothelioma following lung
spare pleurectomy and decortication with at least one PCT were identified. Patients were followed after PCT using CT and PET/CT scans for at least 6 months. Clinical variables included: stage at diagnosis, chemotherapy, radiation, recurrence time lag following surgery, and number of lesions at time of recurrence presentation. PCT variables included: size of the lesion, edge of ice ball beyond the tumor, number of probes, size of probes, number of cryo cycles, maximum and total freeze and thaw time. A stepwise multiple logistic regression model was used to assess predictors of local recurrence after ablation; local recurrence determined by increased regional metabolic activity or increased size of post ablation zone.

RESULTS

17 patients were identified who underwent a total of 75 outpatient cryoablations (range of 1-25). Lesions measured a mean of 37 mm (range 14-113) by 22.0 mm (range 12-55) in diameter. At 6 months 68/75 (90.7%) ablations showed no recurrence. No major, but minor complications including hematoma, small pneumothorax and hemoptysis in one patient each and erythema in 3 chest wall subcutaneous lesions (5/75 =6.6%). Late complications in 4/75 (5.3%) ablations. Considering the clinical and ablation variables, iceball beyond tumor edge less than 6.52 mm detected on CT scan during ablation was the only statistically significant predictor of recurrence (p = 0.02). PCT can be used for management of recurrent mesothelioma following surgery with low recurrence rate of 9.3%, and limited early complications of 6.6%. When performing PCT, at least 6.52 mm of the edge of iceball is needed to extend beyond the edge of tumor to limit local recurrence.

CLINICAL RELEVANCE/APPLICATION

Percutaneous Cryoablation can be used in local control of recurrent mesothelioma after surgery with low recurrence rate and limited early complications.

VSIO31-16 • Can a Biopsy Performed after Lung Radiofrequency Ablation Be Contributive?

Lambros C Tselikas MD (Presenter) ; Julien Adam ; Frederic Deschamps ; Geoffroy Farouil ; Julien Joskin ; Christophe Terilitehue ; Antoine Hakime MD ; Thierry J De Baere MD *

PURPOSE

To evaluate the effectiveness of a biopsy performed after lung radiofrequency ablation (RFA).

METHOD AND MATERIALS

Institutional review board approval was obtained. Eighteen patients with lung tumors, including 72% of metastases (14/18) (8 colorectal, 1 renal, 1 parathyroid, 1 melanoma, 1 osteosarcoma, 1 cholangiocarcinoma and 1 breast cancer) and 23% of primary lung cancers (1 epidermoid and 3 adenocarcinomas) were treated with lung RFA. A biopsy was performed immediately after RFA. The biopsy was obtained through the canula used to insert the RFA probe without need for additional puncture. Pathological results including diagnostic of malignancy and morphological characteristics of tumor have been analyzed. Effectiveness was defined by ability to obtain a diagnosis of malignancy. The ability to diagnose tumor subtype, and primitive tumor location (if applicable) was determined. Procedures characteristics, recurrences and complications were also registered.

RESULTS

Mean tumor size was 17.9mm (SD: 1.5mm) at CT immediately before RFA. 89% (16/18) of biopsies were able to diagnose malignancy. Cancer subtype and origin for malignant tumors was determined in 72% (13/18) of tumors. During one-year follow-up, 1 tumor demonstrated local progression (5.5%), 5 patients presented distant lung disease progression (33%) and 11 were lung disease free (61%). Thirteen complications occurred (72%), including 5 pneumothoraxes requiring chest tube placement (27%), and 7 minor pneumothoraxes without treatment (34%), and 1 intrapulmonary hemorrhage (5%) not requiring any specific treatment. No fatal complication occurred.

CONCLUSION

A biopsy performed after RFA of lung tumor can confirm malignancy in close to 90% of cases. This diagnosis is obtained without the need for additional puncture. Such post RFA biopsy avoids the need for immediately pre-RFA biopsy, which are at risk of alveolar hemorrhage, then blurring the tumor for subsequent targeting with RFA.

CLINICAL RELEVANCE/APPLICATION

Biopsy performed after RFA through the guiding canula has a high success rate, limits the number of transthoracic punctures, and preserves the best puncture path for RFA probe placement in lung tumor.

VSIO31-17 • IR Tumour Board

William H Moore MD (Presenter) * ; Jo-Anne O Shepard MD (Presenter) * ; Thomas J Vogl MD, PhD (Presenter) ; Peter J Littrup MD (Presenter) ; Kamran Ahrar MD (Presenter)

LEARNING OBJECTIVES

1) Understand case-based information. 2) Identify treatment strategies. 3) Evaluate interventional procedures.
5) Integrating 'CT dose screens' from legacy systems into RDSR. 6) Pre-scan dose pop-ups on the CT console defined by the MITA Dose Check standard. 7) Recent AAPM guidance on their use. 8) Learn how to specify the above features when purchasing and integrating Radiology Systems. 9) Learn about components of a dose management program such as protocol optimization. 10) Participation in the ACR Dose Registry, and reporting requirements such as California SB-1237.

Decoding the Alphabet Soup (IHE®, MIRC®, RadLex®, Reporting): Whirlwind Tour of RSNA Informatics Projects

Tuesday, 02:30 PM - 04:00 PM • S501ABC

John Eng, MD
David S Mendelson, MD *
Krishna Juluru, MD
Daniel L Rubin, MD, MS *
Charles E Kahn, MD, MS *

LEARNING OBJECTIVES
1) Articulate the main objectives of each of the RSNA-sponsored informatics projects. 2) Identify the practical problems being addressed by each project. 3) Understand the relationships between these informatics projects.

ABSTRACT
The RSNA is a longstanding leader in developing and promoting informatics tools and technologies for the practicing radiologist. In this refresher course, leaders of four of RSNA’s most important informatics projects will introduce their respective projects, discuss the latest work, and describe what these projects mean to the practicing radiologist. MIRC is a set of free software tools for managing radiology teaching files and clinical imaging trials. RadLex is a unified system of radiology terminology that allows standardized description and indexing of many kinds of radiology information for diverse applications. The Reporting project creates and maintains a collection of best-practice radiology report templates. IHE is an organization that promotes standardized communication between all types of health information systems such as PACS.

URL’s

Creating, Storing, and Sharing Teaching Files Using RSNA’s MIRC®: A Hands On Course

Tuesday, 02:30 PM - 04:00 PM • S401AB

Mary R Wyers, MD
Frederick E Weiss, MD

LEARNING OBJECTIVES
1) Learn how easy it is to install the new and improved RSNA teaching file software with the one-click installer. 2) Learn how to create, organize, and share teaching files, create conference documents and save interesting cases for yourself, your group or your department.

ABSTRACT
BOOST: Gastrointestinal-Case-based Review (An Interactive Session)

Tuesday, 03:00 PM - 04:15 PM • S103AB

Fergus V Coakley, MD
Bruce G Haffty, MD
Theodore S Hong, MD
Lawrence Blaszkowsky, MD

LEARNING OBJECTIVES
1) Understand critical clinical issues that govern therapy of tumors in the anorectal region. 2) Understand how imaging techniques, including MRI, PET-CT and CT, provide useful information for deciding therapy of anorectal tumors. 3) Identify common sites of recurrence for anorectal tumors and recognize the imaging appearances of these recurrences.

ABSTRACT
BOOST: Breast-Case-based Review (An Interactive Session)

Tuesday, 03:00 PM - 04:15 PM • S103CD

Fergus V Coakley, MD
Bruce G Haffty, MD
Sharad Goyal, MD
Liane E Philpotts, MD *
Brigid Killelea, MD

LEARNING OBJECTIVES
1) To present diagnostic imaging, radiation oncology and surgical issues in the workup and selection of breast cancer patients being considered for breast cancer treatment, focusing on nodal management issues. 2) To understand the surgical approach in the primary and neoadjuvant setting in patients being considered for sentinel node biopsy or axillary dissection, and how this effects the radiotherapy approach. 3) To improve knowledge and understanding of appropriate imaging evaluation of the regional lymphatics in these various clinical scenarios. 4) To apply these principles in the surgical, imaging, and radiotherapeutic management of several practical cases of patients being considered for breast cancer treatment, focusing on the regional nodal evaluation and management.

ABSTRACT
Regional nodal evaluation and management is undergoing rapid change due to implementation of neoadjuvant systemic therapy and sentinel node sampling, and evolving evidence regarding the benefit of regional nodal irradiation. There remain controversies regarding the appropriate management of patients, imaging issues, surgical issues and radiotherapeutic approach in the evaluation and management of the regional lymphatics, both in the primary treatment of breast cancer, in the neoadjuvant therapy setting, and in the setting of loco-regional recurrence. In this panel a surgeon, diagnostic radiologist and radiation oncologist will discuss several cases being considered for regional nodal evaluation and management. Appropriate workup, surgical approach and radiation approach for each case will be discussed. The panelists will present the most recent information on controversies in the surgery, diagnostic imaging and radiation therapy in managing the regional lymphatics in patients with breast cancer.

**Breast Imaging (Screening and Density)**

Tuesday, 03:00 PM - 04:00 PM  •  Arie Crown Theater

**SSJ01-01 • Patient Awareness of Breast Density and Interest in Supplemental Screening Tests for Women with Dense Breasts among Women at a County Hospital Compared to Women at an Outpatient Radiology Clinic of an Academic Medical Center**

Jennifer Trinh MD; Long Trinh MD (Presenter); Kevin K Lee MD; Haatal B Dave MD, MS; Kei Hanafusa MD; Jafi A Lipson MD

**Purpose**: We compared patient awareness of breast density and interest in supplemental screening tests for women with dense breasts among women obtaining screening mammograms at a county hospital compared to at an outpatient radiology clinic of an academic medical center.

**Method and Materials**: Over a three month period, a nine question survey was given to 153 women at a county hospital prior to their screening mammogram appointments. Surveys were available in English, Spanish, and Vietnamese. Women were asked if they were aware of their breast density. They were then informed about the decreased sensitivity of mammography in dense breast and the association between dense breasts and cancer risk. They were asked about their interest in and willingness to pay for additional screening tests such as whole breast ultrasound and contrast enhanced spectral mammography if they had dense breast. The Student’s test (two tailed) was used to compare the survey results with the responses obtained from a similar survey conducted at an outpatient radiology clinic.

**Results**: 5% of women (6 out of 132) were aware of their breast density compared to 24% (25 out of 105) at the outpatient radiology clinic (p<0.0005). Both populations have an interest in knowing their breast density and in additional screening studies despite false positives. However, women receiving care at the county hospital are less willing to incur out-of-pocket expenses in contrast to their counterparts at the outpatient radiology clinic. This study demonstrates the potential disparity in healthcare if supplemental screening tests are not covered by insurance.

**Clinical Relevance/Application**: Five states require radiologists to inform patients of their breast density. With the exception of one state, coverage for additional screening tests remains a medical and political debate.

**SSJ01-02 • The Relationship of Breast Density in Mammography and Magnetic Resonance (MR) Imaging in Women at High Risk for Developing Breast Cancer and Women with Breast Cancer**

Freyja Schnabel MD; Jennifer Chun MPH; Marissa L Albert MD, MSc (Presenter); Jiyon Lee MD; Shira Schwartz; Linda Moy MD

**Purpose**: Mammographic breast density (BD) is associated with a 4 to 6-fold increased risk for developing breast cancer. Background parenchymal enhancement (BPE) in MRI has also been correlated with breast cancer risk. The purpose of our study was to evaluate the relationship between BD, BPE, and FGT (assessment of fibroglandular tissue with contiguous MR images) in women with breast cancer (BC) and at high risk (HR) for developing breast cancer.

**Method and Materials**: From January 2010 to February 2013, 475 women enrolled in our longitudinal databases and underwent mammography and MRI at our institution. Variables included age, BD, BPE, FGT, family history of breast cancer (FHBC), BRCA status, atypical hyperplasia (AH), and lobular carcinoma in situ (LCIS). BD was defined by ACR classifications 1-4. FGT was assessed on a similar scale. BPE was categorized as minimal, mild, moderate, or marked. Statistical analyses included Pearson’s Chi Square, Fisher’s Exact Tests, and logistic regression.

**Results**: A total of 403 (85%) women had BC and 72 (15%) were at high risk for developing BC. In the HR group, the etiology of breast cancer risk (FHBC, BRCA status, AH, and/or LCIS) had no relationship to BD, FGT, and BPE. In the BC group, there was also no relationship between background risk factors with BD, FGT, and BPE. However, when we compared the HR and BC groups, we found that BD (p=0.0005), BPE (p=0.04), and FGT (p=0.04) were all increased in women with breast cancer when compared with high risk women. This suggests that women with dense breasts and increased BPE and FGT may be at an increased risk of developing breast cancer. The odds ratios in our analysis may give a sense of the magnitude of risk that may be useful in improving quantitative breast cancer risk assessment models.

**Clinical Relevance/Application**: As BD, BPE, and FGT may be associated with breast cancer, our study supports the need to include them as risk factors in developing better quantitative and individualized risk assessment models.

**SSJ01-03 • Younger Women with Breast Cancer Show Highest Risk from Increased Density Together with Abnormal Density Regression with Age**

Nicholas M Perry MD (Presenter); Stephen W Duffy; Sue E Milner BSC; Kefah Mokbel MD; Katja Pinker-Domenig MD

**Purpose**: To assess whether the link between quantitatively measured breast density and associated cancer risk differs between younger and older women, and if so, could this relate to differing patterns of density regression with age in breast cancer patients compared to healthy controls.

**Method and Materials**: This study included 282 histopathologically verified breast cancer cases (age range 30-83) and 317 healthy controls matched by date of birth, age at diagnosis, and race. The Student’s t-test was used to compare the means of the two groups. The Student’s t-test (two tailed) was used to compare the survey results with the responses obtained from a similar survey conducted at an outpatient radiology clinic.
RESULTS
Breast cancer patients showed higher mammographic density than controls up to the age of 50. Healthy controls demonstrated a significant decline in log % density with age following a linear pattern resulting in the equation: \[ \text{log(density)} = 3.6926 - 0.0126 \times \text{age} \]. In breast cancer patients there was a significant departure from linearity, and a term in the square of age was required, as follows: \[ \text{log(density)} = 5.6531 - 0.0822 \times \text{age} + 0.0006 \times \text{age}^2 \]. Both the coefficient for age and that for the square of age were highly significant (p<0.01).

CONCLUSION
The data suggest that automated volumetric breast density measurement is predictive of breast cancer risk in younger women from the age of 30 and that the risk of breast cancer may be related to an altered pattern of density regression with age.

CLINICAL RELEVANCE/APPLICATION
Younger women are at highest risk of density-associated breast cancer and early estimation of density may be useful in offering enhanced screening to some.

SSJ01-04 • Correlation of Breast Cancer Incidence with Breast Density as Assessed by an Automated Assessment Tool in the TOMMY Trial
Fiona J Gilbert MD (Presenter); Oliver Morrish; Richard Black MS; Lorraine Tucker; Paula Willsher; Stephen W Duffy

PURPOSE
To assess the relationship of breast density and breast cancer in a UK screening population.

METHOD AND MATERIAL
Women recalled to assessment following routine National Health Service breast screening and women attending family history screening were recruited into the UK tomosynthesis trial – TOMMY Trial (A comparison of Tomosynthesis with digital Mammography). Volumetric breast density (Vbd) was measured from the 2D full field digital mammography (FFDM) images of both breasts using an automated assessment tool (Quantra, Hologic Inc.). The relationship between breast density, age (in 10 year age bands) and cancer incidence was assessed. Pathology reports were used to confirm cancer cases.

RESULTS
Volumetric breast density (Vbd) of 5,713 women aged 34-85 was examined. Density ranged from 1% – 47% with mean Vbd of 11.21% across the cohort. The mean Vbd decreased with each increasing decade: 30-39: 21.42%; 40-49: 13.57%; 50-59: 11.09%; 60-69: 9.34%; 70-79: 8.87%; 80-89: 8.66%. The table shows the percentage of women with cancer in each age band/density category (cancers/total cases). Using logistic regression, for all age groups, there was a significant trend in increasing probability of cancer with increasing density, after adjusting for age (p=0.004). The age adjusted odds ratio for density 17-47 relative to 1-6 was 1.72 (95% CI 1.20-2.45). The trend did not differ significantly by age.

Analysis of data for the 40-49 FH screen cases and the 50-69 assessment cases show that there is a trend for cancer risk with increased breast density.

CONCLUSION
Breast density decreases with age as reported in the literature. Breast density is related to cancer incidence in the ages 40-69 year olds using this automated breast density technique, consistent with the findings of other studies using different density measures. However the FH sample is small with few cancers and the assessment cohort may not be representative of population breast density. Further work needs to be undertaken in terms of establishing which Quantra values should be used to define breast density.

CLINICAL RELEVANCE/APPLICATION
This automated breast density tool analysing 2D digital mammograms demonstrates a relationship with cancer risk.

SSJ01-05 • The Complementary Roles of Breast Density and Parenchymal Texture in Breast Cancer Risk Assessment: A Case-Control Study with Digital Mammography
Brad M Keller PhD (Presenter); Jinbo Chen PhD; Yan Wang MSc, PhD; Yuanjie Zheng; James C Gee PhD; Emily F Conant MD *; Despina Kontos PhD

PURPOSE
Mammographic percent density (PD%) is a strong risk factor for breast cancer. We investigate if quantitative measures of parenchymal texture, which capture the local appearance and structure of breast tissue, can provide complementary information to PD% for breast cancer risk assessment.

METHOD AND MATERIAL
Contralateral, mammotome breast images from 106 women with unilateral invasive breast cancer and 318 age and side-matched controls were retrospectively analyzed. Breast PD% and a total of 24 parenchymal texture features, including histogram statistics (11), run-length (3), gray-level co-occurrence (7) and structure features (3) were extracted using validated software. Established risk factors for each woman's family history of breast cancer, ethnicity, age at menarche, parity, and number of biopsies were available via archived questionnaire. A logistic regression model with feature selection comprised of texture features adjusted for PD% and standard risk predictors was compared to a model with only standard risk factors and PD% as input variables. Area under the curve (AUC) of the receiver operating characteristic (ROC) was used to evaluate model performance. DeLong's test was used to compare the two models.

RESULTS
Standard risk factors and PD% alone have an AUC of 0.64 (p=0.01). Measures of breast parenchymal texture provide statistically significant, complementary information regarding a woman's risk for breast cancer, after adjusting for standard risk factors and breast PD%, potentially leading to improvements in breast cancer risk estimation.

CLINICAL RELEVANCE/APPLICATION
Breast cancer risk assessment may be improved by using measures of local parenchymal tissue texture and structure, in addition to breast density and standard demographic and reproductive risk factors.

SSJ01-06 • Non-invasive Optical Assessment of Breast Density and Identification of High-risk Subjects
Paola Taroni PhD (Presenter); Giovanna Quarto PhD; Antonio Pifferi PhD; Rinaldo Cubeddu; Francesca Ieva; Anna Maria Pagoni; Francesca Abbate MD; Nicola Balestreri; Serena Ganino; Simona Menna; Enrico Cassano

PURPOSE
Breast density is a strong independent risk factor for breast cancer. Optical techniques have been used to visualize the use of ionizing radiation. The ability to non-invasively identify high-risk women could allow earlier design of personalized screening pathways and preventive interventions.

Optical techniques can provide functional and structural information on tissue in absolutely non-invasive way. We exploited time domain diffuse optical spectroscopy to assess both tissue composition in terms of key constituents and scattering parameters that are related to breast cancer risk.
METHOD AND MATERIALS
Time domain multi-wavelength (635-1060 nm) optical mammography was performed on 147 subjects. Average breast tissue composition (water, lipid, collagen, oxy- and deoxyhemoglobin) and scattering parameters (amplitude and slope) were estimated using the diffusion approximation to the radiative transfer theory to model photon propagation in tissue.

Mammographic density was classified through BI-RADS categories.

To develop a procedure for the identification of high-risk women, the mammographic density was dichotomized, comparing subjects in BI-RADS categories 1 to 3 to subjects in category 4, and applying regression logistic analysis to the optically derived parameters.

RESULTS
An increase in BI-RADS category corresponds to increasing amounts of optically estimated water and collagen content, while lipid content decreases. A gradual increase is also observed in scattering amplitude and slope. Such observations are consistent with known differences in composition and microscopic structure between fatty and fibroglandular (dense) tissue.

The best regression logistic model for the risk probability resulted to depend on collagen content and scattering parameters. It provides a total misclassification error of 12.3%, corresponding to a simple kappa of 0.84, which compares favorably with the reproducibility of BI-RADS measures even intra-radiologist.

CONCLUSION
An optical tool was developed to assess non-invasively breast density, and provided promising initial results for the identification of high-risk subjects.

CLINICAL RELEVANCE/APPLICATION
The optical estimate of breast density is non-invasive, feasible in clinical practice, and could allow the design of more effective screening and preventive paths for high-risk subjects.

SSJ02-01 • Breast Imaging Keynote Speaker: Breast CT

John M Boone PhD (Presenter) *

PURPOSE
Breast CT is an emerging technology that will likely have a role to play in clinical breast imaging in the next few years. This RSNA Integrating Science and Practice (ISP) scientific session is the first to be dedicated exclusively to breast CT per se, and this reflects the advancements in breast CT technology as well as the growing catalog of widespread research imaging with prototype breast CT systems. In this introduction, a brief review of breast CT technology will be discussed to familiarize the audience with the capabilities and limitations of these systems.

SSJ02-02 • Is Contrast Enhanced Dedicated Breast Computed Tomography Superior to Digital Breast Tomosynthesis and Digital Mammography in the Evaluation of BI-RADS 4 and 5 Breast Lesions?

Shadi Aminololama-Shakeri MD (Presenter) ; Anita Nosratieh ; Karen K Lindfors MD * ; John M Boone PhD *

PURPOSE
To compare the conspicuity of BIRADS 4 and 5 lesions on digital breast tomosynthesis (DBT), contrast enhanced breast CT (CEbCT) and digital mammography (DM).

METHOD AND MATERIALS
105 patients with 103 BIRADS 4 or 5 lesions were prospectively enrolled in our IRB-approved study. Patients had DM & DBT (14), DM & CEbCT (45), or DM, DBT & CEbCT (44). All lesions were biopsied. Patients received 100 ml of IV iodixanol 320 at a rate of 3 ml/s for CEbCT. 2 experienced radiologists independently assigned a conspicuity score (CS) of 0-10 for each biopsied lesion (0=not seen, 10=excellent conspicuity). Results are shown as mean CS+/-SD. Significant differences among conspicuity of lesions on DM, DBT & CEbCT. 2 experienced radiologists independently assigned a conspicuity score (CS) of 0-10 for each biopsied lesion (0=not seen, 10=excellent conspicuity). Results are shown as mean CS+/-SD. Significant differences among conspicuity of lesions on DM, DBT & CEbCT (p<0.05).

RESULTS
Of 103 breast lesions, 58 (56%) were malignant and 45 (44%) were benign. 27 (47%) of the malignant lesions were masses and 31 (53%) were calcifications. Of 45 benign lesions, 18 (40%) were masses and 27 (60%) were calcifications. Malignant masses were significantly more conspicuous on CEbCT than on DBT or DM (9.7+/-.5 vs 7.0+/-.3, p<0.05). Breast masses were less conspicuous on CEbCT than on DBT or DM (7.9+/-.5 vs 5.0+/-.2, p<0.05). Malignant lesions were more conspicuous on CEbCT than DBT & DM. While these results favor CEbCT for detection of malignant masses in comparison to the other 2 modalities, the latter observation underscores the potential of decreasing false positive evaluations.

CONCLUSION
CEbCT and DBT are promising new techniques for detection of breast lesions. We show that CEbCT and DBT are similar to DM in detection of malignant calcifications and benign masses. But malignant masses are more conspicuous and benign calcifications are less conspicuous on CEbCT than DBT & DM. While these results favor CEbCT for detection of malignant masses in comparison to the other 2 modalities, the latter observation underscores the potential of decreasing false positive evaluations.

CLINICAL RELEVANCE/APPLICATION
The optical estimate of breast density is non-invasive, feasible in clinical practice, and could allow the design of more effective screening and preventive paths for high-risk subjects.

SSJ02-03 • Is Lesion Depiction on Contrast Enhanced Dedicated Breast Computed Tomography Affected by Contrast Timing?

Shadi Aminololama-Shakeri MD (Presenter) ; Peymon Gazi MS ; Karen K Lindfors MD * ; John M Boone PhD *

PURPOSE
Patients undergoing contrast enhanced dedicated breast computed tomography (CEbCT) have sequential imaging of both breasts following an intravenous injection of iodine based contrast material. This sequential scanning protocol with one breast imaged at a slightly more delayed time post contrast than the contralateral side has raised questions regarding lesion depiction. The goal of this study was to measure lesion depiction as a function of time after contrast injection.

METHOD AND MATERIALS
90 consecutive patients with BIRADS 4 or 5 lesions were prospectively enrolled. All patients had CEbCT after IV injection of 100 ml of iodixanol 320 at a rate of 3 ml/s, followed by core biopsy. Two experienced radiologists independently reviewed each study and assigned a conspicuity score (CS) of 0-10 for each biopsied lesion (0=not seen, 10=excellent conspicuity). A subset of patients (50) also had iodixanol 320 at a rate of 3 ml/s, followed by core biopsy. Two experienced radiologists independently reviewed each study and assigned a conspicuity score (CS) of 0-10 for each biopsied lesion (0=not seen, 10=excellent conspicuity). Results are shown as mean CS+/-SD. Significant differences among conspicuity of lesions in early versus late delay
Breast lesions were equally conspicuous in the early and late contrast delay time groups with CS of 7.3 +/- 3.2, n=39 and 7.1 +/- 3.7, n=39 respectively. Background parenchymal enhancement categories were equally distributed with early and delayed contrast times. 83% (34/41) of breasts imaged at the early contrast time showed minimal/mild and 17% (7/41) showed moderate/ marked background parenchymal enhancement. 78% (7/9) of the breasts imaged at the late contrast delay time showed minimal/mild and 22% (2/7) showed moderate/ marked background parenchymal enhancement.

CONCLUSION
There is no correlation between conspicuity scores of BIRADS 4 and 5 breast lesions and contrast timing on CEBCT. Contrast time does not correlate with background parenchymal enhancement and does not affect conspicuity of breast lesions on CEBCT.

CLINICAL RELEVANCE/APPLICATION
CEbct lesion depiction is not contrast time dependent.

SSJ02-04 • Dedicated High-resolution Breast CT Can Outperform Digital Mammography and Breast Tomosynthesis at Equivalent Dose Levels

Willi A Kalender PhD (Presenter) *; Daniel Kolditz PhD *; Ann-Christin Roessler MSc; Christian Steiding MSc *; Evelyn Wenkel MD; Ruediger Schultz-Wendtland

PURPOSE
There is general consensus that computed tomography (CT) can provide good soft-tissue discrimination and dynamic contrast-enhanced studies of the breast, but with insufficient spatial resolution and dose values exceeding the limits set for screening examinations. We re-evaluated if this assumption still holds true for an innovative high-resolution breast CT (bCT) system.

METHOD AND MATERIALS
We compared the performance of a bCT prototype (CT Imaging GmbH, Erlangen, Germany) to two clinical systems of two different manufacturers for each digital mammography (DM) and breast tomosynthesis (BT) with respect to detectability of the structures presented by the American College of Radiology (ACR) accreditation phantom. bCT examines one breast at a time with the patient lying prone on the patient bed without exposing the body trunk. The prototype employs a new cadmium telluride detector with 100 µm pixel size, single photon counting electronics and close to 100% detection efficiency [Kalender WA et al. Eur Radiol 2012; 22(1):1-8]. The tests focused on the question if fibers down to 0.75 mm, masses down to 0.50 mm, and specks down to 0.24 mm were clearly distinguished as recommended by the ACR. Tests were also performed to determine image quality and dose. We did not add overlaying structures, which would be potentially confounding the ACR structures for DM and BT.

RESULTS
Acceptance testing for all 5 systems confirmed that they met the requirements for screening mammography; the bCT system provided better than 100 µm spatial resolution at average glandular dose levels below 5 mGy. Measurements of the ACR phantom revealed the following: DM and BT showed fibers, masses and specks as required; bCT went beyond this and revealed even the finest structures presented in the ACR phantom, i.e. fibers of 0.4 mm, masses of 0.25 mm and specks of 0.16 mm.

CONCLUSION
Fully 3D high-resolution breast CT showed performance superior to DM and BT, even in the benevolent situation with no confounding structures superimposed. Smaller structures may have to be introduced in test phantoms to provide adequate tests for finer details.

CLINICAL RELEVANCE/APPLICATION
High-resolution breast CT appears to offer potential for superposition-free fully 3D imaging of the breast at improved detail resolution and dose levels accepted for screening procedures.

SSJ02-05 • Cone Beam Breast Computed Tomography’s Ability to Detect Mammographically Occult Lesions

Posy J Seifert DO (Presenter); Andrea L Arieno BS; Renee Morgan RT

PURPOSE
To review lesions that were mammographically occult and imaged with cone beam breast Computed Tomography (CT) with or without contrast.

METHOD AND MATERIALS
From June 2008 to December 2012, 411 subjects were prospectively enrolled in 2 IRB approved studies; all had non contrast CT (NCCT) and 69 had contrast enhanced CT (CECT). 27 lesions in 25 subjects were considered to be mammographically occult at diagnostic work-up and are the basis of this study; all had NCCT and 18 also had CECT. Data recorded included subject demographics, method of detection, lesion characteristics, core biopsy pathology and open surgical pathology when applicable.

RESULTS
25 subjects with 27 lesions were determined to be mammographically occult but detected by diagnostic work-up; all were masses. Of the 27 lesions, 19 were detected by breast CT. Average lesion size at diagnostic work-up was 1.5cm (range 0.3 to 4cm). Average lesion size on breast CT was 1.4cm (range 0.3 to 4.5cm). Overall, 10 lesions were biopsy-proven malignant; 9 invasive and 1 non-invasive. Sixteen lesions were biopsy-proven benign and 1 atypical. Eight lesions were mammographically occult and also CT occult, but found on ultrasound. One was biopsy proven invasive ductal carcinoma, one was atypical and 6 were biopsy proven benign.

CONCLUSION
In this small study, breast CT (NCCT and CECT) showed value in detecting mammographically occult lesions. CT detected 19 lesions that were not detected by mammography and additionally was able to detect one new lesion not detected on any other imaging. Out of all cancers in this cohort, only one was not seen by CT. This study showed that CT has the potential to have high sensitivity for the detection of breast lesions.

CLINICAL RELEVANCE/APPLICATION
Breast CT is a new imaging technology that may have a role in the detection of breast disease. In this small study cohort, breast CT demonstrated the ability to detect mammographically occult lesions.

SSJ02-06 • Clinical Application and Analysis of Contrast-enhanced Cone-beam Breast CT (CE-CBBCT) in Differentiating Benign and Malignant Breast Lesions

Peng Han MD, MBBS (Presenter); Zhao Xiang Ye

PURPOSE
To evaluate the contrast enhancement and the optimal enhancement timing for contrast-enhanced cone-beam breast computed tomography (CE-CBBCT) in differentiating benign and malignant breast lesions.

METHOD AND MATERIALS
Twenty-one subjects were enrolled under an Institutional Review Board (IRB) approved study protocol in Tianjin Cancer Hospital, China,
CARDIAC FUNCTION

Tomography Angiography (CTA) in Three Consecutive Cardiac Cycles: Association with Intracoronary Mean Contrast Effect and SSJ03-02

SSJ03-01 • Optimization of Contrast Injection Protocol for Tube Potential during Cardiovascular Computed Tomography

Yajuan Wang PhD (Presenter) *; Anjali Kottha; Corey Kemper PhD *; John F Kalafut PhD *; Sandra S Halliburton PhD *

PURPOSE

X-ray tube potential affects iodine attenuation on CT images but is rarely considered in contrast protocol planning. This study investigated modification of a commercial contrast injection algorithm (P3T®, Bayer Radiology) to account for tube potential at cardiovascular CTA.

METHOD AND MATERIALS

59 patients referred for evaluation pre- or post- endovascular stent graft repair were imaged (Definition FLASH, Siemens). Prospectively ECG-triggered helical techniques were used with a tube potential of 100 (n=34) or 120 kV (n=25), depending on patient size. Patient weight, timing bolus characteristics, and scan time were inputs to the contrast protocol algorithm. Average attenuation and noise (standard deviation of attenuation) from 6 circular regions of interest (ROI) placed along the length of the aorta were computed and compared using a Student’s t test. A pharmacokinetic model (ACES, Bayer Radiology) was used to simulate aortic attenuation at 100kV and investigate the potential to achieve a desired enhancement (350HU) at contrast volume reductions of 20, 30 and 40%.

RESULTS

Both cohorts had similar age, M/F ratios, scan duration and scan length. 100kV cohort had lower body mass index (24.8±3.4 vs. 29.4±3.1 kg/m²), total contrast volume (93±19 vs 106±6 ml) and size-specific dose estimates (2.9±0.9 vs 4.4±1.2 mGy). Average aortic attenuation was 27% higher at 100kV (482±96 HU vs 381±62 HU) and image noise was slightly greater (36±6 vs. 30±4 HU).

Simulated aortic attenuation using recommended contrast protocols matched measurements at 100kV validating ACES for this application. A 30% contrast volume reduction at 100 kV yielded simulated aortic attenuation closest to measured attenuation at 120kV (362±101 vs. 381±62 HU; P=0.44) and to the target attenuation.

CONCLUSION

This study demonstrated that P3T® algorithm yielded higher attenuation in cardiovascular CT patients scanned at 100 vs 120 kV. Simulation results suggest contrast protocol optimization for tube potential could allow a 30% contrast reduction. Additional studies are needed to validate simulation results in vivo.

CLINICAL RELEVANCE/APPLICATION

Contrast injection protocols can be optimized for tube potential permitting use of less contrast in some patients to achieve the desired blood enhancement.

SSJ03-02 • Transluminal Attenuation Gradient in Normal Coronary Arteries with 320-row Prospectively ECG-gated Computed Tomography Angiography (CTA) in Three Consecutive Cardiac Cycles: Association with Intracoronary Mean Contrast Effect and Cardiac Functions

Yukihiro Nagatani MD (Presenter) ; Masashi Takahashi MD; Norihisa Nitta MD; Noritoshi Ushio RT; Hiroshi Sakai; Takashi Yamamoto; Hideji Otani MD; Kazumasa Kobashi; Jyousei Ueda; Kiyoshi Murata MD

PURPOSE

To compare both mean contrast effect (MCE) and transluminal attenuation gradient (TAG) among three consecutive cardiac cycles (CC) and evaluate their relations to cardiac functions and body habitus indices in respective three normal coronary arteries (NCA).

METHOD AND MATERIALS

Study group consisted of 40 patients with NCA who underwent both 320-row ECG-gated CTA and trans-thoracic echocardiography within 1 month of each other. They were classified into 20 patients in group-A (prospectively ECG-gated CTA in the three consecutive CC) and 20 patients in Group-B (retrospectively ECG-gated CTA: r-CTA). Each patient received 240mg/kg body weight of a non-ionic contrast medium in 10-sec, and data acquisition was started when both a threshold of 250 Hounsfield Unit (HU) in left atrium and that of 80 HU in descending aorta was reached. In group-A, image data were reconstructed at each CC. Both TAG and MCE were calculated as linear regression coefficient between luminal attenuation and axial distance based on multiple measurements with even 10-mm intervals, and as average of CT attenuation value in all the measurements, respectively. Pearson’s correlation coefficients between TAG and some cardiac functional indices were obtained in each CC and r-CTA. Both TAG and MCE were compared among three consecutive CC using Friedman and Wilcoxon signed-rank test in group-A, and between each CC and r-CTA using Man-Whitney U test.

RESULTS

In all the 3 NCA, MCE at the 3rd CC was higher than MCE at the 1st CC. In right coronary artery (RCA), TAG at the 3rd CC (-1.6±5.3) was larger than that at r-CTA (-6.7±3.6) (p=0.01). In left circumflex artery (LCX), TAG was larger at the 3rd CC (-14.9±16.4) than at the 2nd CC (-18.5±14.2) (p=0.041). In RCA, MCE at every CC correlated with body mass index. In left anterior descending artery, MCE at the 3rd CC and TAG at the 1st CC correlated with body surface area (r=0.658 and 0.634, respectively). In LCX, TAG at the 3rd CC correlated with ejection fraction (r=0.526).

CONCLUSION

Increase in MCE at the 3rd CC could have potentiality to approximate TAG to 0-level in RCA and LCX regardless of considerable influence of body surface area and ejection fraction.
SSJ03-03 • Oral Use of Gadobenate Dimeglumine for Visualization of Oesophagus during MRA in Patients Candidated to Catheter Ablation

Alessandro Rapellino MD ; Riccardo Faletti (Presenter) ; Angela Grasso MD ; Camilla Bogetti MD ; Chiara Perazzini MD ; Annelis Dominguez MD ; Paolo Fonio ; Giovanni Gandini MD

PURPOSE
Atrio-oesophageal fistula was first reported as a fatal complication of surgical endocardial and percutaneous endocardial radiofrequency ablation for atrial fibrillation, with an incidence after catheter ablation between 0.03% and 0.5%. Cardiac magnetic resonance angiography (MRA) was usually performed to obtain pre-procedural 3D images, used to create an electro-anatomical map guiding step-by-step ablation strategy of AF. Our purpose was to assess oesophagus anatomy during MRA due to obtain a ‘real-time’ visualization of the oesophageal position during RFCA.

METHOD AND MATERIALS
In 35 consecutive patients a MRA sequence, was performed in axial plane 24 hours before catheter ablation using intravenous gadobenate dimeglumine contrast media and oral administration for oesophagus intensification of 2.5ml gadobenate dimeglumine contrast media mixed with approximately 50 mg thickened water gel, while they were on scanning table immediately before MRA breath-old sequence acquisition.

RESULTS
Oesophagus visualization was obtained in all patients and well merged, as left atrium and pulmonary veins, during percutaneous endocardial radiofrequency ablation, successfully creating an electro-anatomical map. All patients well tolerate the study protocol and any immediately or late complication was observed after oral contrast agent administration. MRA acquisition time with double contrast agent administration did not show any significance difference from conventional MRA.

CONCLUSION
In our experience oesophagus visualization with gadobentetate dimeglumine oral administration MRA is a feasibly imaging technique for integration of oesophagus anatomy images into the electroanatomical map preventing oesophageal injuries during AF ablation without patients undesirable side effects and without increasing significatively cost and examination time.

CLINICAL RELEVANCE/APPLICATION
Oesophagus visualization in electro-anatomical map during RFCA procedure is an important help to avoid fatal complication as atrio-oesophageal fistula.

SSJ03-04 • Gadofosveset versus Gadobenate for Steady-state 3D Contrast-Enhanced MRA (SS CE-MRA) Evaluation of the Thoracic Aorta: Is a Blood Pool Agent Required?

Vikram Bamra MD (Presenter) ; Jeffrey H Maki MD, PhD * ; Dinesh Kumar MBBS

PURPOSE
Compare the image quality (SNR and vessel edge sharpness) of gadobenate (MultiHance, Bracco) vs. gadofosveset (Ablavar, Lantheus) for steady state, ECG-triggered 3D CE-MRA evaluation of the thoracic vasculature. Gadofosveset is a blood pool contrast agent with extended intravascular retention and high R1 relaxivity designed for MRA. These properties allow for steady-state (equilibrium phase) high resolution ECG-gated MR angiograms. The objective was to determine whether similar imaging could be performed with the high relaxivity extracellular agent gadobenate.

METHOD AND MATERIALS
No significant difference noted in mean SNR (15.5 vs. 15.2) or image sharpness (2.4 vs. 2.1 mm) for gadofosveset vs. gadobenate (both p > 0.05). Vessel sharpness trended better with gadobenate, with a trend also toward more blurring and less SNR in the ascending aorta that may be due to greater flow and motion.

CONCLUSION
Steady-state ECG-triggered thoracic CE-MRA performed in the early equilibrium period (within 5 min) with a high relaxivity contrast agent is equivalent to that with a blood pool agent.

CLINICAL RELEVANCE/APPLICATION
Gadofosveset and gadobenate provide similar image quality for thoracic SS CE-MRA when gadobenate SS MRA is started relatively quickly after contrast. Therefore the additional cost of gadofosveset might not be justified for routine thoracic MRA studies.

SSJ03-05 • A Pilot Study of Optimized Injection Rate of Contrast Media(CM) on Image Quality of Coronary CT Angiography(CCTA)

Shujing Yu MD (Presenter) ; Lianli Zhao ; Yanfeng Xu MD ; Jing Zheng MD ; Li Zhang MD ; Zhi Wang MD

PURPOSE
The higher the injection rate of CM, the more danger for the patients who had heart disease and needed CCTA. In this study, the optimized injection rate will be found for different patients with different Body Weight Index (BMI) for using Dynamic Volume CT (DVCT) angiography.

METHOD AND MATERIALS
We enrolled 252 patients, aged between 30 and 70, with normal heart and lung functions and all the subjects were scanned using DVCT(Aquilion ONE, Toshiba, 16cm detector). The heart rate of all the subjects was controlled below 65 beats per minutes, which guaranteed the data acquisition within one heart beat. Of these, patients were assigned to 2 groups: A, BMI>24, scanned using 120kV with 350ml CM. Each group was divided into six sub-groups by giving 370 or 350 mg I/ml of CM (65ml) at the rate of 4, 5 or 6 ml/s. The three coronary trunks were divided into 15 segments. The objective and subjective methods were used for evaluating the image quality for each of the 15 segments. For the subjective method, signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) of each segment were calculated and compared between groups. For the subjective one, two experienced radiologists evaluated the image quality by 4-point (1=bad, 2=good, 3=very good, 4=perfect).

RESULTS
The injection rate had no significant effect on the image quality of coronary artery for both Group A and B (p>0.05). The image quality of Group B was significantly higher than that of Group A (p<0.05). Different injection rate had no effect on image quality, that means we can try to use lower injection rate, such as 4ml/s for CCTA. This should be further tested in a large cohort of subjects.

CLINICAL RELEVANCE/APPLICATION
This study confirmed that lower injection rate will generate similar image quality with the higher ones. This conclusion will have very good benefit for patients.
SSJ03-06  Quantification of Iodine Concentration at Various Heart Rates by Using Cardiac Gemstone Spectral Imaging: An In Vitro Validation

Zhang Zhang (Presenter); Ningnanan Zhang PhD; Chun-Shui Yu; Dong Li MD; Jing Yu; Wenjia Zhang; Jiaojiao Li; Qingqing Lu; Huiting Liu; Qian Cui; Tielian Yu

PURPOSE
CT attenuation values from the traditional polychromatic X-ray imaging (TPXI) are variable due to X-ray absorptivity varying on different energies. It is so hard to make accurate diagnoses only based on the CT attenuation values, which cannot distinguish the different tissues or materials, such as iodine and calcium in coronary plaques. Material decomposition, which derived from gemstone spectral imaging (GSI), may allow us to measure the relative value for certain material. The purpose of the current study was to validate the iodine concentration quantification, and to discuss the relationship between the CT attenuation value and iodine concentration at different heart rates by using cardiac GSI.

METHOD AND MATERIALS
A polypropylene phantom (Quantitative Standard Pulsating Phantom QSP-1, Fuyo Corporation) with eight test tubes (in which iodine concentrations of solution were 50, 40, 30, 20, 15, 10, 5, 1 mg/ml) underwent TPXI and cardiac GSI on a single-source dual-energy spectral CT (Discovery CT750 HD CT FREEdom Edition scanner, GE Healthcare, Milwaukee, WI, USA) at various simulated pulsating rates (0, 40, 50, 60, 70bpm). All the spectral imaging data were analyzed with GSI viewer to reconstruct the virtual monochromatic spectral (VMS) images. The CT attenuation values of both TPXI and VMS were measured for each data set. The iodine concentration was measured on the water- suppressed image (iodine-water as the basic substances)

RESULTS
The correlation coefficients between the CT attenuation value and known iodine concentration were improved by the VMS (r2=0.999749, 0.999977 on stationary condition, 0.999664, 0.999585, 0.999912, 0.998731, 0.997761, 0.996838, 0.995368, 0.993482 on 40~140 keV with interval of 10 keV) comparing to TPXI (r2=0.997364, 0.997052, 0.996878, 0.996385 on 80,100,120, and 140 kVp). From the Bland–Altman analysis, the mean differences between the measured and the known iodine concentration were 2.5±3.5 on stationary condition, 2.3±3.0, 1.7±2.9, 2.7±4.0, 2.5±3.8 at 40~70bpm with 5mm amplitude; and 2.0±3.0, 2.7±4.0, 2.0±3.0, 2.3±3.6 at 40~70bpm with 10mm amplitude, respectively.

CONCLUSION
Comparing to TPXI, VMS can produce better correlation coefficients between the CT attenuation values and iodine concentrations. And the iodine concentration could be accurately quantified from the iodine-water basic substances imaging.

CLINICAL RELEVANCE/APPLICATION
The cardiac GSI may provide an accurate coronary artery assessment for the clinicians.

Cardiac (Contrast 1)

Tuesday, 03:00 PM - 04:00 PM • SS02AB

SSJ04 • AMA PRA Category 1 Credit™: 1 • ARRT Category A+ Credit: 1

Moderator
Bernd J Wintersperger, MD *
Moderator
E. Kent Yucel, MD
Moderator
Sririn Tridandapani, PhD, MD

SSJ04-01  Effect of Reduced X-ray Tube Voltage, Low Iodine Concentration Contrast Medium and Iterative Reconstruction on Image Quality and Radiation Dose at Coronary CT Angiography: A Prospective Multicenter Study

Wei-Hua Yin (Presenter); Bin Lu MD; U. Joseph Schoepf MD *; Zhi-Hui Hou MD; Zhi-Qiang Wang; Yang Gao; Fang-Fang Yu; Hui-Li Cao

PURPOSE
To explore the effect of reduced (100 kVp) x-ray tube voltage, low iodine concentration (270 mgI/ml) contrast medium and iterative image reconstruction on image quality and radiation dose at coronary CT angiography (cCTA).

METHOD AND MATERIALS
With IRB approval, 123 consecutive symptomatic patients with suspected coronary artery disease were randomly assigned to one of two dual-source cCTA protocols: 120kVp, 370mgI/ml iopromide and filtered back projection reconstruction (n=62; 26 women; 54.1±9.5 years); or 100kVp, 270mgI/ml iodixanol and sinogram affirmed iterative reconstruction (n=61; 24 women; 55.5±10.4 years). Other scan parameters and the contrast injection protocol were held constant. Attenuation in the ascending aorta and coronary arteries along with image noise were measured. Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) were calculated. Image quality was scored on a four-point scale. Effective dose was calculated based on volume CT dose index and dose length product. Data were compared using Student’s t-test and x2 test.

RESULTS
All patient scans were successfully completed. There were no significant differences in patient body mass index (24.9kg/m2±3.4 vs 25.0kg/m2±2.9; p=0.800), contrast volume (68.4 ml±3.4 vs 68.5ml±6.2; p=0.880) and image quality scores (3.5±0.6 vs 3.4±0.6; p=0.265) between groups. Differences in mean attenuation between 100kVp (401.4HU±72.3) and 120kVp (403.0HU±78.1) protocols were not statistically significant (p=0.909). This was also true for image noise (17.3HU±3.7 vs 17.3HU±3.2; p=0.988), SNR (24.3±7.1 vs 23.9±5.9; p=0.710), and CNR (41.4±17.9 vs 36.2±20.0; p=0.136). Mean iodine dose was 27% lower with the 100kVp protocol than with 120kVp (25.3g±1.2 vs 18.5g±1.7; p<0.001). Continuous reduction in radiation exposure and iodine load associated with cCTA should enhance the safety and clinical acceptance of this test.

CONCLUSION
Use of low x-ray tube voltage and iterative image reconstruction allows decreasing the iodine load and effective radiation dose at cCTA while image quality is maintained.

CLINICAL RELEVANCE/APPLICATION
Continuous reduction in radiation exposure and iodine load associated with cCTA should enhance the safety and clinical acceptance of this test.

SSJ04-02  CT Coronary Angiography: Effect of Iodine CONCetration on Vascular Attenuation: The CT-CON Multicentric Study Preliminary Results

Marco Rengo MD (Presenter); Anoeshka S Dharampal MD; Marco Das MD *; Marc C Kock MD; Andre Niezen; Fiek Van Tilborg; Damiano Caruso MD; Koen Nieman MD; Gabriel P Krestin MD, PhD *

PURPOSE
To explore the relative impacts of iodine concentration versus iodine delivery rate on intra-coronary attenuation. To describe the effect of iodine concentration on contrast bolus characteristics.
Patients in Routine Clinical Settings

100 patients with stable and low heart rates of (METHOD AND MATERIALS)

kilovoltage (kVp) with adaptive statistical iterative reconstruction (ASiR) in coronary computed tomography angiography (CCTA).

To evaluate the feasibility of reducing both contrast and radiation doses using lower concentration contrast agent and a lower peak kilovoltage (kVp) with adaptive statistical iterative reconstruction (ASiR) in coronary computed tomography angiography (CCTA).

SSJ04-03 • Postmarketing Surveillance Study with Iodixanol (VISIPAQUE®) 270/320 mgI/mL Injection in 20,185 Chinese Patients in Routine Clinical Settings

Bin Lu MD (Presenter); Ya-Wei Xu; Wei-Hua Yin; Zhi-Hui Hou MD; Yang Gao; Fang-Fang Yu; Bu-Chun Zhang; Lei Hou

PURPOSE

This study was to investigate the incidence and nature of immediate and delayed adverse drug reactions (ADRs) as well as patient discomfort in patients using iodixanol.

METHOD AND MATERIALS

A multicenter, open-label, prospective, observational study was conducted at 95 centers in China from June 2011 to October 2012. Demographics, medical conditions, details of the diagnostic procedure, contrast agent administration and ADR data were collected using a standardized case report form. Patients were asked to report immediate (occurring within one hour of administration of iodixanol) or delayed (occurring from 1 hour up to 7 days after administration of iodixanol) adverse reactions. Discomfort was rated by patients on a scale of from 0 to 10 for pain, heat, and coldness (score 0 = no discomfort; 1–3 = mild; 4–7 = moderate; 8–10 = severe); individual scores were combined into a composite score (0–30). The incidence of ADR was summarized and discomfort score was converted to no, mild, moderate or severe discomfort and summarized.

RESULTS

A total of 20,185 patients were enrolled. The mean age of this group was 60.4 years. Overall incidence of ADRs were 1.52% (307/20,185 patients), of which 0.58% was immediate, and 0.97% was delayed onset. Five patients experienced both immediate and delayed ADR. The most common immediate ADRs were nausea, vomiting, and other gastrointestinal disorders with an incidence of 0.22% (45/20,185 patients). The most common delayed ADRs were rash, pruritus, mucocutaneous rash and other skin and subcutaneous tissue disorders with a total incidence of 0.68% (138/20,185 patients). Serious ADRs occurred in two patients (0.01%). There were 73.3% (14,791/20,185) of patients in this study had no pain after injection of iodixanol, and 21.5% (4,338) reported a composite score of 1–3 (mild discomfort), 5.2% of 4–15 (moderate discomfort), 2 reported over 15 (severe discomfort).

CONCLUSION

There were no unexpected serious ADRs were observed. Patients’ discomforts during administration were mild or absent. The results of this postmarketing surveillance study indicated that iodixanol was a safe contrast agent in Chinese population.

CLINICAL RELEVANCE/APPLICATION

Iodinated radiographic contrast media are considered as safe diagnostic drugs with a low incidence of adverse drug reactions.

SSJ04-04 • A Prospective Study of Low Concentration of Contrast Medium in Coronary CT Angiography with Low kVp Technique

Xu Li (Presenter); Liren Zhang MD; Yanping Liu; Dongsheng Xu

PURPOSE

To prospectively investigate the utility of low tube voltage to reduce contrast medium dose in coronary CT angiography (CCTA).

METHOD AND MATERIALS

90 consecutive patients (BMI < 28, 52 men, 38 women; mean age: 53.0±8.39 years) with low heart rates were randomly divided to two groups. Group A (n=46) underwent conventional CCTA with 120 kVp and normal contrast medium (Omnipaque, 350 mgI/ml) dose at 0.8 ml/kg on a LightSpeed VCT scanner, group B underwent modified CCTA with low kVp and low contrast medium (Visipaque, 270 mgI/ml) dose at 0.8 ml/kg (n=44) on a Discovery CT 750 HD scanner. FBP image and 30% ASiR-FBP images were reconstructed for group A and B respectively. The CT value and SD value of aortic root (AO), left main coronary artery (LM), left anterior descending artery (LAD), left circumflex (LCX), and right coronary artery (RCA) were measured. Two radiologists assessed all images with 4-point scale. Data were analyzed using student T-test and Wilcoxon rank sum test by SPSS 13.0 statistical analysis software.

RESULTS

Both the mean ages and BMIs of two groups (age, 53.0±8.39 vs 55.8±8.47, P=0.12; BMI, 24.4±2.93 vs 24.1±1.71, P=0.58) had no significant difference. The mean ED in group B (0.87±0.22 mSv) was reduced by 44.9% than that in group A (1.58±0.46 mSv). The mean enhancement of three main coronary arteries were similar between two groups (LAD, 394.59±64.98 vs 390.69±59.87; LCX 370.5±58.23 vs 374.77±57.4; RCA 408.75±66.44 vs 412.79±52.62, each P>0.05). The SD values of three main coronary arteries in group A were lower than in group B (LAD, 24.67±7.05 vs 31.39±8.35; LCX, 28.52±7.33 vs 36.31±10.58; RCA 24.76±6.88 vs 38.14±7.77; both P<0.05).

CONCLUSION

Both the mean ages and BMIs of two groups had no significant difference. The mean ED in group B was reduced by 44.9% than that in group A. The enhancement of three main coronary arteries were similar between two groups. The SD values of three main coronary arteries in group A were lower than in group B.

CLINICAL RELEVANCE/APPLICATION

Low concentration of contrast medium reduce 44.9% radiation dose and provide compatible enhancement and image quality than conventional CCTA.

SSJ04-05 • Initial Experience of Contrast Agent Dose Reduction with Low Tube Voltage and Adaptive Statistical Iterative Reconstruction (ASiR) in Coronary Computed Tomography Angiography

Hao Zhang (Presenter); Tong Zhang MD; Bao-Zhong Shen

PURPOSE

To evaluate the feasibility of reducing both contrast and radiation doses using lower concentration contrast agent and a lower peak kilovoltage (kVp) with adaptive statistical iterative reconstruction (ASiR) in coronary computed tomography angiography (CCTA).

METHOD AND MATERIALS

100 patients with stable and low heart rates of (METHOD AND MATERIALS)
RESULTS
The mean CNR values for the 4 coronary arteries were 13.4±3.2 in group A and 13.1±3.2 in group B, with no difference (P > 0.05). There was also no difference between the two groups in image quality score (3.53±0.58 vs. 3.48±0.59, p > 0.05). On the other hand, Contrast dose was reduced by 33% in group B, and effective radiation dose was about 43% lower with the 80kVp protocol (1.8±0.7mSv) than with the 120kVp (4.21±1.20mSv).

CONCLUSION
33% contrast and 43% radiation dose reduction can be achieved by using 270mgI/ml concentration contrast agent and 80kVp tube voltage with 50%ASiR in CCTA without image quality deterioration.

CLINICAL RELEVANCE/APPLICATION
This coronary CTA method is suitable for patients with renal dysfunction, and can reduce the contrast-induced nephropathy and the potential carcinogenic of risk of coronary CTA.

SSJ04-06 • Novel Connecting Tube for Saline Chaser in Contrast-enhanced CT: The Effect of Spiral Flow of Saline on Contrast Enhancement

Masafumi Kidoh; Takeshi Nakaura MD (Presenter); Kazuo Awai MD *; Koji Yuba *; Kazunori Harada; Yasuyuki Yamashita MD *; Takayuki Kobayashi MS; Young-Kwang Park; Takanobu Yagi

PURPOSE
We developed a new connecting tube for the saline chaser, which generates a spiral flow of saline. The purpose of this study was to evaluate the effect of a newly developed connecting tube on aortic and hepatic contrast enhancement during hepatic-arterial and portal venous phase (HAP, PVP) Computed Tomography.

METHOD AND MATERIALS

RESULTS

CONCLUSION
Our study demonstrated that the new connecting tube increased the effect of saline chaser and significantly improved aortic contrast enhancement during HAP.

CLINICAL RELEVANCE/APPLICATION
The new connecting tube increases the effect of saline chaser. The new connecting tube may further reduce the volume of contrast material without a subsequent decrease in arterial attenuation in CTA.

Cardiac (CV Outcomes and Risk Assessment)

Tuesday, 03:00 PM - 04:00 PM • S504AB

SSJ05 • Prognostic Value of Coronary CT Angiography (CCTA) for the Prediction of Major Cardiovascular Events - 'Warranty Time' after a Normal (No Visible Plaque) CCTA

Hugo M Marques MD (Presenter); Antonio Ferreira; Rosana G Santos MD; Cecilia I Leal; Nuno Cardim MD; Vasco V Mascarenhas MD; Adaligisa Guerra MD; Pedro A Goncalves MD; Pedro Araujo Goncalves

PURPOSE
Coronary CT angiography is now an established method for the evaluation of patients with suspected coronary disease. The time without major cardiac events after a normal (no visible plaque) CCTA is still to be completely accessed and is of particularly importance since it may impact on the downstream use of other tests. The purpose of this study was to evaluate the mid/long term prognostic value of a normal CCTA.

METHOD AND MATERIALS
From a prospective registry of consecutive 2062 patients that underwent CCTA (dual-source 64s) from February 2007 to December 2010, we excluded all with previous revascularization and/or those undergoing the study for suspected acute coronary syndrome. The presence of coronary plaque and the severity of stenosis (< 50% vs > or = 50%) was assessed. The final study population was followed-up (telephone interviews and/or clinical records) for the occurrence of major adverse events (all cause mortality, myocardial infarction or revascularization> 90 days after CCTA). The information from 1352 was obtained (89% completion rate).

RESULTS
623 patients (46%) had a normal CCTA (without visible plaque), 514 (38%) had plaque with 50% stenosis) There were no events on patients with a normal CCTA within the first 2,5years of follow up.

CONCLUSION
CCTA provides important and durable prognostic information. There were no events on patients with a normal CCTA (no plaque visualized) within the first 2,5years of follow up.

CLINICAL RELEVANCE/APPLICATION
The time without major cardiac events after a normal (no visible plaque) CCTA is still to be completely accessed and is of particularly importance since it may impact on the downstream use of other tests.

SSJ05-02 • Predictors of Recurrent Stroke in Patients with Ischemic Stroke: Comparison Study between Transesophageal Echocardiography and Cardiac Computed Tomography

Kye Ho Lee MD (Presenter); Jin Hur MD; Young Jin Kim MD; Hye-Jeong Lee MD; Yoo Jin Hong MD; Byoung Wook Choi MD

PURPOSE
Determinants of stroke recurrence after ischemic stroke using cardiac computed tomography (CCT) is not well established. We investigated the CCT findings predictive of recurrent stroke in ischemic stroke patients and determined the incremental risk stratification benefit of CCT findings as compared to transesophageal echocardiography (TEE) in ischemic stroke patients.

METHOD AND MATERIALS
Among 465 consecutive patients, 374 ischemic stroke patients (67.9% were male with a mean age of 63.1 years) who underwent TEE and CCT were prospectively enrolled in this study. TEE and CCT images were assessed for cardioembolic sources including thrombus, tumor,
spontaneous echo contrast (SEC), valvular vegetations, septal abnormality, and aortic plaque. The primary end-point was recurrence of stroke. We assessed prognostic factors with Cox univariate and multivariate analysis. Time-dependent receiver operating characteristic (ROC) curve method was used and integrated area under the curve (IAUC) was calculated to compare the predictive prognosis between CT and TEE parameters.

RESULTS
During the median follow-up period of 239 days, there were a total of 24 recurrent stroke. CT parameters of plaque thickness (HR: 1.178, 95% CI: 1.015-1.366, p = 0.031) and complexity of plaque (HR: 5.304, 95% CI: 2.264-12.425, p = 0.001) were significant predictors of recurrent stroke. In addition, CT parameter of aortic plaque had risk-predictive advantages compared to TEE parameters.

CONCLUSION
Cardiac CT can be used to assess cardioembolic sources and also determine risk of recurrent stroke in stroke patients.

SSJ05-03 • Incremental Prognostic Value of Whole-body MRI beyond Cardiac MRI for the Occurrence of Cardiovascular Events in Patient with Diabetes Mellitus

Christopher Maroules MD, MPH (Presenter); Amit Khera MD, MSc; Colby Ayers MS; Akshay Goel BS; Ronald M Peshock MD; Kevin S King MD

PURPOSE
Cardiac magnetic resonance imaging (MRI), especially late-gadolinium enhancement, has been shown to provide valuable prognostic information in patients with diabetes. However, diabetes mellitus is a systemic disease affecting all micro- and macrovascular territories. Thus, we studied the incremental prognostic value of whole-body (WB) MRI beyond cardiac findings in a cohort of subjects with diabetes.

METHOD AND MATERIALS
This prospective cohort study enrolled 65 diabetic patients (type 1 and 2), who underwent a comprehensive, contrast-enhanced WB-MRI protocol (1.5/3 T), including dedicated brain, cardiac, arterial (carotid, abdominal, pelvic, and peripheral arteries) sequences at baseline. Follow-up was performed after five years by phone interview by an independent investigator and endpoints were verified. The primary endpoint was occurrence of a MACE, defined as fatal cardiovascular event, non-fatal myocardial infarction, stroke, coronary revascularization, or heart failure (NYHA = III). Beyond cardiac findings (function, enhancement), MRI was assessed for the presence of atherosclerotic vessel changes, and chronic ischemic cortical changes. Kaplan-Meier-Survival and Cox-regression analysis was performed to determine independent associations.

RESULTS
Follow-up was completed in 60 subjects (92%, 62.8±13 years, 48% female) with a median follow-up period of 70 months. At the end of the follow-up, 14 (23%) patients experienced MACE. While a normal whole-body MRI excluded MACE over the follow-up period (0%), any detectable ischemic/atherosclerotic changes on WB-MRI (prevalence: 66%) conferred a cumulative event-rate of 15% at 2 years, 31% at 5 years and 40% at 7 years. While cardiac MR findings conferred a high independent risk for events (OR: 5.52, 95%-CI: 0.87-42.9, 15% (2/14) subjects without cardiac finding developed MACE. Among these, all subjects had findings on WB-MRI (14/14, 100%). Also, the AUC increased significantly to 0.904 (95%CI: 0.84-0.97; p=0.01) when adding the WB-MRI findings to the model that contained the cardiac MR findings.

CONCLUSION
Systemic assessment of subclinical disease burden by WB-MRI may provide incremental prognostic information beyond cardiac MR findings in patients with diabetes mellitus.

CLINICAL RELEVANCE/APPLICATION
Assessment of atherosclerotic/ischemic changes on whole-body MRI may enhance current risk stratification schemes in patients with diabetes mellitus, including findings on cardiac MRI.

SSJ05-04 • Aortic Stiffness by MRI Is Predictive of Cardiovascular Events and Mortality among Subjects with Metabolic Syndrome

Christopher Maroules MD (Presenter); Amit Khera MD, MSc; Colby Ayers MS; Akshay Goel BS; Ronald M Peshock MD; Kevin S King MD

PURPOSE
To determine the predictive value of aortic stiffness by MRI for future cardiovascular events and mortality among subjects with metabolic syndrome.

METHOD AND MATERIALS
The study consisted of 790 participants with metabolic syndrome from the Dallas Heart Study who underwent aortic MRI at 1.5 Tesla. Aortic stiffness was assessed by ascending aortic compliance (AC) and aortic arch pulse wave velocity (PWV) using phase-contrast velocity-encoded MRI. Participants were monitored for cardiovascular death, non-fatal cardiac events, and non-fatal extra-cardiac vascular events over 7.8±1.5 years. Cox proportional hazards regression was used to assess for independent associations of aortic stiffness and cardiovascular events.

RESULTS
A total of 75 participants (9.5%) experienced a cardiovascular event and 17 participants (2.2%) succumbed to cardiovascular death during the surveillance period. AC was independently associated with increased risk for composite cardiovascular events (HR 1.41 per 1SD increase, p=0.04). Compared with participants in the highest quartile AC (most compliant), those in the lowest quartile AC (least compliant) were 3.5-fold more likely to experience a composite event (p=0.03). PWV was not independently associated with composite events after multivariate adjustment (HR 1.16 per 1SD increase, p=0.09). Both AC and PWV were independently associated with increased risk for cardiovascular death (HR 2.27 per 1SD increase, p=0.02; and HR 1.46 per 1SD increase, p=0.004, respectively). Similarly, both AC and PWV were independently associated with increased risk for nonfatal extra-cardiac vascular events (HR 2.08 per 1SD increase, p=0.02; and HR 1.33 per 1SD increase, p=0.02, respectively).

CONCLUSION
Among subjects with metabolic syndrome, MRI measures of aortic stiffness are independently predictive of future cardiovascular events and mortality.

CLINICAL RELEVANCE/APPLICATION
Among patients with metabolic syndrome, the presence of a stiffer aorta on MRI indicates increased risk for death and future adverse cardiovascular events.

SSJ05-05 • Cardiovascular Risk Associated with Non-obstructive Coronary Artery Disease on CCTA Stratified by Sex Among Stable Individuals: Results from an International Multicenter Study of 18,158 Patients

Jonathan A Leipsic MD (Presenter); Gilat Grunau PhD; Carolyn Taylor MD; Cameron J Hague MD; Leslee Shaw PhD; James Min MD; Gudrun Feuchtner MD; Ricardo C Cury MD; Matthew J Budoff MD; Stephan Achenbach MD

PURPOSE
Coronary artery disease (CAD) detected by coronary computed tomographic angiography (CCTA) has been shown to predict death and major adverse cardiac events (MACE) in men and women. To date, potential difference in gender-based prognostic utility of non-obstructive CAD identified on CCTA for myocardial infarction and death has not been adequately examined.
METHOD AND MATERIALS
From an international multicenter observational cohort study of 27,725 individuals consecutively undergoing CCTA from 12 centers, we identified 18,158 patients without known CAD with normal CCTA or non-obstructive disease (defined as

RESULTS
At a 2.3 + 1.1-year follow-up, MACE occurred in 251 patients (0.6% annual event rate). Women were more likely to be dyslipidemic, hypertensive, diabetic and have a family history of CAD (p

CONCLUSION
Non-obstructive CAD on CCTA confers similar risk of death and myocardial infarction in men and women when matched for underlying cardiovascular risk. The absence of plaque is associated with a similarly low event rate in men and women.

CLINICAL RELEVANCE/APPLICATION
Our data confirms similar risk of non-obstructive CAD on CCTA between men and women helping to better understand CAD related sex differences.

SSJ05-06 • Cardiac Mortality and Morbidity in Breast Cancer Survivors after Radiation Therapy - Is Coronary Atherosclerosis the Culprit?

Paul Apfaltrer MD (Presenter) ; U. Joseph Schoepf MD * ; James R Spears BS ; Lothar P Rilz ; Stefan O Schoenberg MD, PhD * ; Rozemarjn Vliegenthart MD, PhD ; Garrett W Rowe BS ; Aleksander Krazinski ; Andrew D McQuiston BS

PURPOSE
Breast cancer survivors after radiation therapy (RT) have increased rates of cardiac morbidity and mortality. We sought to investigate whether accelerated coronary artery disease (CAD) is to blame by comparing coronary calcium scores (CCS) in breast cancer survivors with and without RT.

METHOD AND MATERIALS
334 women with history of breast cancer were included. 67 patients underwent chest CT studies =6 months after the start of RT (RT-group), while 239 patients had a CT scan either prior to or without undergoing RT (noRT). Indications for performing CT studies varied, and involved contrast enhanced acquisitions. Coronary calcium was quantified by applying a threshold-based automated algorithm using a dedicated workstation. Statistical analysis included the Fisher's exact test, Wilcoxon-Mann-Whitney Test, and the Siegel-Tukey Test. Cox regression analysis was performed to evaluate the risk of a positive CCS, adjusted for time between diagnosis/RT and CT imaging.

RESULTS
Mean age at diagnosis for the noRT group was 57.1±11.9 years, versus 58.4±12.9 years for the RT group (p>0.05). The groups showed no significant differences in race, smoking history, laterality of breast cancer, or cancer stage. Median interval between diagnosis/RT and CT image acquisition was 119 (25th, 75th percentile: 50, 238) days for the noRT group and 449 (211, 979) days for the RT group (p<0.05). The median CCS for both groups was 0 (25th, 75th percentile: 0, 4; p>0.05). When adjusting for the time between diagnosis/RT and CT, RT patients had a significantly lower risk of a positive CCS compared to noRT patients, with a hazard ratio of 0.54 (95% confidence interval, 0.32-0.93, p

CONCLUSION
Breast cancer survivors after RT are not more likely to show coronary calcifications on subsequent CT imaging. Our preliminary results thus do not support radiation-induced accelerated CAD as an explanation for higher rates of heart disease in this group. However, suboptimal CT technique for evaluation of CCS along with a limited patient population may have influenced our results.

CLINICAL RELEVANCE/APPLICATION
The search for a culprit should be widened to include other potential causes of higher heart disease rates in breast cancer survivors after RT.

Chest (Digital Imaging)

Tuesday, 03:00 PM - 04:00 PM • S404CD

SSJ06 • AMA PRA Category 1 Credit ™:1 • ARRT Category A+ Credit:1

Moderator
Heber Macmahon , MD *

Moderator
Sudhakar N Pipavath , MD *

SSJ06-01 • Multi-institution Evaluation of Digital Tomosynthesis, Dual-energy Radiography, and Conventional Chest Radiography for Detection and Actionability of Pulmonary Nodules

James T Dobkins PhD (Presenter) * ; H. Page McAdams MD * ; John M Sabol PhD * ; Dev P Chakraborty PhD ; Ella A Kazerooni MD ; Gautham P Reddy MD ; Jenny Vikgren MD, PhD *

PURPOSE
Measure sensitivity and specificity of digital tomosynthesis (DT), dual-energy radiography (DE), and conventional radiography (CXR), alone and in combination, for detection of pulmonary nodules and for determining actionability in an international, multi-institution, multi-reader study.

METHOD AND MATERIALS
This IRB-approved, HIPAA-compliant study enrolled 158 subjects (115 positive, 43 negative for CT-confirmed pulmonary nodules) at four tertiary care institutions. Subjects were imaged by chest CT, CXR (PA and lateral), DE, and DT on a flat-panel imaging device (VolumeRAD, GE Healthcare, Chalfont St. Giles, UK). Three experienced thoracic radiologists confirmed presence and location of nodule(s) by CT and determined their actionability using Fleishner Society guidelines. Five general radiologists, using free-response methodology and scoring on a 5-point likelihood scale, marked nodules and then determined actionability using CXR alone, CXR plus DE, DT alone, and DT plus DE (2193 total markings). Overall sensitivity, specificity, and JAFROC figure-of-merit (FOM; overall measure of observer performance) for various nodule size categories were determined using CT data as the reference standard.

RESULTS
516 nodules (344 of 3-5 mm, 130 of >5-8 mm, and 42 of >8-20 mm) were identified by CT. Overall detection sensitivity was 3.8%, 5.7%, 13.5%, and 13.4% for CXR, CXR+DE, DT, and DT+DE, respectively, for all nodules (3-20 mm; n=516); and 9.0%, 13.5%, 27.8%, and 28.1%, respectively, for nodules >5 mm: n=172. On a per-subject basis, sensitivity and specificity for actionability was 41.3% (75.0%) for CXR, 50.4% (69.4%) for CXR+DE, 60.6% (78.4%) for DT, and 52.6% (80.3%) for DT+DE. On a per-nodule basis (diam > 5 mm), JAFROC FOM was 0.453, 0.446, 0.575, and 0.573 for CXR, CXR+DE, DT, DT+DE, respectively; DT FOM was significantly better than CXR (p

CONCLUSION
DT outperformed CXR for lung nodule detection and for determination of actionability using Fleishner Society criteria. The addition of DE improved determination of actionability when paired with CXR but not when paired with DT.

CLINICAL RELEVANCE/APPLICATION
DT shows significantly improved clinical performance over CXR for pulmonary nodule detection and is recommended for imaging nodules
SSJ06-02 • Comparative Study between Mobile Computed Radiography and Mobile Flat-panel Radiography with and without Anti-scatter Grid for Bedside Chest Radiography: Impact on Image Quality

Thomas Lehnert MD (Presenter); Nagy N Naguib MSc; Josef Matthias Kerl MD*; Ralf W Bauer MD*; Maya C Larson; Thorsten Burkhard MD; Boris Schulz MD; Thomas J Vogl MD, PhD

PURPOSE
To evaluate the effect of an anti-scatter grid on perceived image quality in adult bedside chest radiographs using both a mobile digital radiography (DR) system and a conventional computed radiography (CR) system.

METHOD AND MATERIALS
We included 103 intensive-care patients (mean age: 66.4 years). Patients received bedside chest radiographs using four acquisition techniques (CR and DR with and without grid). Image quality was evaluated independently by four radiologists using a 9-point visibility scale. Evaluated were: lung parenchyma, soft tissues, thoracic spine, foreign bodies and overall image quality. Inter-observer agreement and differences between systems were tested using inter-class correlation test. Mean scores were compared by analysis of variance (ANOVA) followed by post-hoc pairwise testing (Tukey test) in case of multiple group comparison and by student’s t-test in case of single group comparison (p < 0.05 = significant).

RESULTS
The image quality of the DR images with a grid was significantly higher than that obtained without a grid (p<0.05).

CONCLUSION
The use of an anti-scatter grid significantly improved the image quality of bedside DR radiographs. A similar effect was seen with CR radiographs but only for lung parenchyma, soft tissue and overall image quality. Mobile DR outperformed CR in all structures.

SSJ06-03 • Impact of Digital Scatter Correction on the Image Quality of Bedside Chest Radiographs

Sarah Poetter-Lang (Presenter); Helmut Prosch; Daniela Kienzl; Barbara J Fueger MD; Michael Weber; Cornelia M Schaefer-Prokop MD*; Martin Uffmann MD

PURPOSE
The use of an anti-scatter grid for bedside chest radiographs in intensive care unit patients yields improved image quality at the cost of increased patient dose, higher demands on the acquisition technique and a heavier cassette weight. The aim of our study was to evaluate the impact on image quality of a newly developed processing method that allows for digital correction of scattered radiation.

METHOD AND MATERIALS
On consecutive days, 51 intensive care unit patients received clinically indicated bedside chest radiographs (MobileDiagnost wDR, Philips, Hamburg) with an anti-scatter grid (method A), and without an anti-scatter grid, but at a 1.6-fold reduced radiation dose (method B). The reduced-dose images were processed using scatter correction software (method C). Four readers evaluated the 153 images independently, in random order, scoring the visibility of five image quality features on a 10-point scale from 1 (very bad) to 10 (excellent), and with 4 indicating the minimum requirement for diagnostically acceptable image quality. Mobile DR outperformed CR in all structures.

RESULTS
For all imaging features, quality was rated significantly different (p<0.05).

CONCLUSION
The scatter correction algorithm yielded significantly higher image quality for bedside chest radiographs compared to non-corrected images, but were inferior to grid images. The scatter-corrected images were comparable to grid images based on a threshold chosen to determine potentially diagnostically relevant differences.

CLINICAL RELEVANCE/APPLICATION
Scatter correction applied to bedside chest radiographs may obviate the need for anti-scatter grids, and therefore, enables a substantial radiation dose reduction.

SSJ06-04 • Yield of Screening Chest Radiography for a Positive PPD Test in New York City

Grace C Lo MD (Presenter); Michael A Kadoch MD; Vivian Bishay MD; Thomas J Ward MD; Matthew D Cham MD; Adam Jacobi MD

PURPOSE
The Centers for Disease Control recommends that individuals with a positive PPD test undergo chest radiography to exclude a diagnosis of tuberculosis (TB). There are more reported cases of TB in New York City (NYC) each year than in any other city in the country. The purpose of this study was to review the prevalence of radiographic abnormalities of TB on chest x-rays (CXR) performed for a positive PPD in a single, urban tertiary medical center in NYC.

METHOD AND MATERIALS
In a single, urban tertiary medical center in NYC, we reviewed 904 consecutive bedside chest radiographs for a positive PPD test. The prevalence of radiographic abnormalities of TB, the amount of downstream testing generated, and the results of sputum cultures, when available, were recorded.

RESULTS
Of the 904 cases reviewed (676 females, 228 males, mean age 34.74), not a single case of confirmed active TB was identified. Active TB could not be excluded based on CXR alone in 4 patients (0.4%), but all sputum cultures that were obtained in these individuals were negative. Granulomas were present in 26 patients (2.9%). No cavitory lesions were identified. A single case of lung cancer was identified (0.1%). Follow-up exams were recommended in 30 patients (3.3%), which included 15 CT scans (1.7%), 11 radiographs (1.2%), 2 echocardiograms (0.2%), 1 ultrasound (0.1%), and 1 mammogram (0.1%).

CONCLUSION
Despite the fact that there are more reported cases of TB in NYC than in any other city in the country, universal screening of asymptomatic PPD positive patients with chest radiography is still a low-yield study for the detection of active TB. It also generates a significant amount of downstream testing. These exams may also represent an unnecessary source of radiation exposure.

CLINICAL RELEVANCE/APPLICATION
Screening chest radiography among asymptomatic PPD patients appears to be a low-yield study for the detection of active TB. Therefore, it may be time to reconsider this universal recommendation.


Takehiko Abe MD (Presenter); Norihisa Motohashi MD, PhD; Yuka Sasaki; Tomomichi Izuka; Naoko Koyanagi; Atsuko Kurosaki MD; Sumiya Nagatsuka MS; Hideo Ogata; Shoji Kudoh MD, PhD

PURPOSE
To evaluate the effect of an anti-scatter grid on perceived image quality in adult bedside chest radiographs using both a mobile digital radiography (DR) system and a conventional computed radiography (CR) system.
**Emergency Radiology (Brain Emergencies)**

**SSJ06-06 • Performance of a Next Generation Computer-aided Detection Algorithm for the Detection of Overlooked Lung Cancers on Chest Radiographs**

**Calen Frolkis** BA (Presenter) ; **Robert C Gilkeson** MD *

**PURPOSE**

This retrospective study sought to evaluate a next generation CAD algorithm on the detection of previously overlooked lung cancer on prior chest radiographs.

**METHOD AND MATERIALS**

Institutional Review Board approval was granted for this retrospective study. Patient consent was not necessary given the retrospective nature of the data collection. Retrospective review of 606 patients presented within the last year at our institutions thoracic tumor board was performed. Clinical reports from cross-sectional imaging, pathology and prior chest radiographs were analyzed. Of this cohort, analysis revealed 41 patients whose lung cancer was inititally overlooked on a chest radiograph. A board certified chest radiologist with 15 years experience confirmed that this overlooked lesion corresponded to the site of the malignant lesion. A subtlety rating from 1-10 (1 + very subtle) was assigned to each radiograph. Anatomic distribution of nodules was recorded. All 41 images were analyzed by a next generation CAD algorithm for lung cancer detection (OnGuard 5.2 Riverain Medical). The time lapse between index CXR and eventual clinical diagnosis was recorded.

**RESULTS**

Overlooked lung nodules were found in 41 patients (age range 44-91yrs, average: 69yrs; 23 women, 18 men) on 41 chest radiographs. Subtlety ratings ranged from 1-9, mean of 2.39, mode of 2. Overlooked lesions were distributed in the upper lobes, 41.4% in the Right upper lobe, and 19.5% in the Left upper lobe. The time interval between the index CXR and diagnosis ranged from 1 day to 8yrs, with an average interval of 577 days (1.5yrs). The CAD algorithm detected 28 of 41 of these lesions (sensitivity 67%). Location of the lesions detected by CAD were right upper lobe and apex (13, 31.7%), and left upper lobe and apex (8, 19.5%).

The most common pathologic diagnosis in our cohort was Adenocarcinoma (24, 58.5%), Squamous cell carcinoma (14, 34.1%), and metastatic lesions (3, 7%). There was a false positive average of 0.75 per image in this cohort. The majority of false positive marks were located in the upper lobes, often overlying bony structures, and pleural surfaces.

**CONCLUSION**

When compared to the prior literature, this CAD algorithm demonstrates marked improvement in performance in the radiologic evaluation of subtle lung cancer.

**CLINICAL RELEVANCE/APPLICATION**

Our study suggests that adoption of a next generation CAD system has the potential to improve time to diagnosis in patients with lung cancer.

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**SSJ07 • AMA PRA Category 1 Credit™: 1 • ARRT Category A+ Credit: 1**

**Antoniola Averna** MD (Presenter) ; **Niv Khorrami** ; **Savvas Nicolaou** MD ; **Luck J Louis** MD ; **Ana-Maria Bilawich** MD ; **Sharon Gershony** MD

**PURPOSE**

To determine whether DECT head generated monoenergetic data sets reduces petrous apex beam hardening artifact and improves assessment of gray- white differentiation in the ED.

**METHOD AND MATERIALS**

A total of 20 consecutive DECT head studies were scanned on the 128-slice dual source scanner in the ED. Protocol included the following parameters, 64 by 0.6mm collimation reconstructed to, 3mm, axial slices at 100 kv and 140kv Sn. The 3mm 20 D34 axial DECT scans...
were uploaded in the monoenergetic dual energy class on the multimodality workplace and ME energy levels from 40 to 190 keV in 4 keV increments were analyzed through the cerebrum. Noise was calculated by using the standard deviation of 4 regions of interest measuring 10mm(sq) within the pons, external capsule, head of the caudate, and gray white interface. The weighted mixed data DECT 3 mm axial images simulating a 120 kvp exam were analyzed on the MMWP as well using identical ROI size and anatomic distribution from the same patients. Signal to noise ratio was compared between the monoenergetic and weighted polychromatic data sets. Subjective image quality and diagnostic confidence using a 3-point Likert scale was performed between the two data sets by two ER radiologists one with 12 and one with 5 years of experience.

RESULTS
A Mann-Whitney U test was used to compare the SNR between the monoenergetic and polychromatic DECT weighted data sets and maximal optimal values were appreciated at 68keV and at the 108 keV monoenergetic levels resulting in a U value of 1 (< 0.01). Similar statistical analysis of the supratentorial brain yielded a U value of 0 (p < 0.01). The two radiologists reported superior grey –white matter differentiation and a greater reduction of beam hardening artifacts on the monoenergetic images as compared to routine weighted 120 kvp axial scans.

CONCLUSION
Monoenergetic generated scans from DECT heads at 68 keV and 108 keV improved the assessment of the posterior fossa and grey -white matter differentiation.

CLINICAL RELEVANCE/APPLICATION
Acute Stroke evaluation with Monoenergetic images obtained from DECT heads has the potential in improving the detection of acute brain infarcts.

SSJ07-02 • Non-contrast Head CT with 3rd Generation Integrated Circuit CT Detector: Subjective Improvement in Grey-white Matter Differentiation in the Acute Setting
Patrick McLaughlin FFRRCSI (Presenter) ; Graeme J McNeil MRCP, FFRRCSI ; Shamir Rai BSC ; Taryn L Reddy FRANZCR ; Teresa Liang MD, Bsc ; Nivmand Khorrarni-Arani MBBS, BSc ; John R Mayo MD * ; Hugue A Ouellette MD ; Savvas Nicolaou MD

PURPOSE
Accurate and reliable differentiation between cerebral grey and white matter structures demands both high contrast and spatial resolution from a CT system. Recently 3rd generation CT detectors, which employ integrated (IC) rather than discrete (DC) electronic circuits, have been introduced into clinical practice. Phantom studies demonstrate reduced electronic noise and increased spatial resolution but the clinical benefits of IC detectors for head CT have yet to be evaluated.

METHOD AND MATERIALS
853 consecutive patients underwent non-contrast helical Head CT over a 28 day period in the ED using a dual source 128-slice CT system with IC detectors (Stellar; Siemens Healthcare, Forchheim, Germany). 77 patients who were previously imaged using the same CT system and protocol (120kV, ref mAs 350, 128x0.6 mm) with DC detectors were included in this retrospective intra-individual study. Subjective analysis of differentiation and superficial grey and white matter differentiation (GWD) was independently performed by 1 general and 1 subspeciality neuroradiologist using a semi-objective 5 point scoring scheme at a standardized window width, level and slice thickness (W=48, L=40HU, 3mm). Objective analysis of noise was also performed for all datasets.

RESULTS

CONCLUSION
The use of integrated 3rd generation CT detectors results in improved subjective grey and white matter differentiation in the frontal, parietal and insular regions on helical CT head examinations.

CLINICAL RELEVANCE/APPLICATION
The use of integrated 3rd generation CT detectors results in improved subjective grey and white matter differentiation in the frontal, parietal and insular regions on helical CT head examinations.

SSJ07-03 • Whole-brain 320-detector Row Dynamic Volume CT Perfusion Performed on Hyperacute Ischemic Stroke Patients within 4.5 hours Improves Diagnostic Sensitivity and Accuracy
Zhu-Ren Luo (Presenter) ; Xiong-Jie Zhuang ; Rong-Zhou Zhang ; Bao-Zhong Shen

PURPOSE
To determine if use of whole-brain CT perfusion (CTP) with an extended range covering the entire brain could improve diagnostic sensitivity and accuracy relative to non-contrast CT (NCCT) for patients presenting with stroke symptoms.

METHOD AND MATERIALS
A total of 30 patients presenting to our emergency department with symptoms of ischemic stroke within 4.5 h of the event were included in the study. All were subject to whole-brain Perfusion CT, which includes NCCT, and were then immediately evaluated by diffusion-weighted MRI or DWI. The NCCT and CTP were evaluated by two physicians for evidence of acute infarct and vascular territory, if present. CTP covered the whole brain (16 cm coverage); low relative cerebral blood volume (CBV) in a region of low cerebral blood flow (CBF) or elevated time to peak (TTP) was the operational definition for ischemia or infarct. A third physician rated the DWI for acute infarct and vascular territory, if present. Sensitivity, specificity, and negative and positive predictive values were calculated. Statistical analysis was performed using an exact McNemar test and generalized by estimating equations from a binary logistic regression model to assess the difference in detection rates between modalities. A two-sided P value < 0.05 was considered significant.

RESULTS
Of the 30 patients evaluated, NCCT revealed two (6.7%) acute infarcts without false positives. CTP revealed 28 (93.3%) acute infarcts with one false positive. Of the two infarcts missed on CTP, one was a small cortical infarct, whereas the other was a lacunar type infarct (< 10 mm in size). CTP was significantly more sensitive (93.3% vs. 6.7%, P < 0.05), accurate (76.0% vs. 52.0%, P < 0.05), and had a better negative predictive value (93.5% vs. 51.7%, P < 0.05) than NCCT.

CONCLUSION
A 320-slice CT allows completing dynamic visualization of entire brain and enables calculation of whole-organ perfusion maps. Whole-brain CTP improved sensitivity and accuracy relative to NCCT in this cohort of 30 patients with symptoms of hyperacute stroke evaluated within 4.5 hours of the event.

CLINICAL RELEVANCE/APPLICATION
320-slice CT can enable calculation of whole-brain perfusion maps and improve sensitivity and accuracy for diagnosing hyperacute stroke.

SSJ07-04 • Improvement of Image Quality (IQ) with Model Based Iterative Reconstruction (MBIR) Algorithm in Cranial CT (CCT) in Trauma Patients
Susan Notohamiprodjo MD (Presenter) ; Zsuzsanna Deak MD ; Fabian Mueck ; Felix Meurer ; Maximilian F Reiser MD ; Stefan Wirth MD *

PURPOSE
CCT is a frequently needed examination in emergency medicine. Compared to the current clinical standard of image reconstruction Adaptive Statistical Iterative Reconstruction (ASIR), MBIR is a more advanced algorithm promising improved spatial resolution and reduced image noise.
The aim of the study was to compare the effects of MBIR in CCT imaging to ASIR on identical dose levels.

METHOD AND MATERIALS
Raw data sets of anonymized 100 trauma patients receiving CCT according to the institutional standard protocol (120 kV, 260 mAs, 20 mm detector collimation; 0.984 pitch) were reconstructed with ASIR and MBIR, multiplanar reformations of 2.5 mm axial, coronar and sagittal slices were calculated. Two radiologists blinded to the reconstruction independently rated IQ by the depiction of different parenchymal structures and the effect streak artifacts of photon starvation using a semi-quantitative scale (0: non-diagnostic, 1: impaired, 2: sufficient, 3: good, 4: excellent). Mean attenuation value (MAV; [HU]) and standard deviation (SD; [HU]) were measured for liquor space (LS) and white matter (WM) supratentorial (ST) and in the posterior fossa (PF). Data were analyzed using ICC, Mann-Whitney-U and ANOVA testing.

RESULTS
MBIR significantly decreased streak artifacts in PF (p < 0.05) in univariate analysis, logit regression and receiver operator characteristic curve. We also used logistic regression to determine which of the 14 clinical items included in either guideline, in independently predicts CICF. Since NOC is applied only for GCS-15 impaired, 2: sufficient, 3: good, 4: excellent). Mean attenuation value (MAV; [HU]) and standard deviation (SD; [HU]) were measured for liquor space (LS) and white matter (WM) supratentorial (ST) and in the posterior fossa (PF). Data were analyzed using ICC, Mann-Whitney-U and ANOVA testing.

CONCLUSION
MBIR significantly improves IQ and could represent an effective method to decrease radiation dose of CCT imaging, which is one of the most important causes for increase of public radiation exposure.

SSJ07-05 • Acute Intracranial Hemorrhage in Computed Tomography - Benefits of Sinogram-affirmed Iterative Reconstruction Techniques

Boris Bodelle MD (Presenter); Boris Schulz MD; Firas Al-Butmeh; Thomas Lehner MD; Julian L Wichmann MD; Claudia Freiessen; Ralf W Bauer MD *; Josef Matthias Kerl MD *; Thomas J Vogl MD, PhD

PURPOSE
To compare image quality (IQ) and intracranial hemorrhage (ICH) in brain computed tomography (CT) with sinogram-affirmed iterative reconstruction (SAFIRE) and filtered-back-projection (FBP) reconstruction techniques at standard and low dose tube current levels.

METHOD AND MATERIALS
The study was approved by the IRB. 54 patients (mean age 64 ± 20 years) in group 1 and 40 patients in group 2 (mean age 57 ± 23 years) received CT in two different tube current–time products (group 1: 340 mAs; group 2: 260 mAs) in a multi-detector CT. Images were reconstructed with FBP and five different iterative strengths (S1-5) and were ranked (5-point scale) by two radiologists for IQ and ICH in a blinded manner. Image noise (IN), signal-to-noise ratio (SNR), dose-length product (DLP, mGycm) and mean effective dose (mSv) were calculated.

RESULTS
FBP at standard 340 mAs and S1 at 260 mAs showed no statistical significance (p < 0.05) for subjective rating. IN was higher (p < 0.05) in group 2. SNR increased with higher strength of SAFIRE in both groups. There was predominantly no significant difference in SNR between FBP and S1. Highest SNR was achieved with S5. Best score for subjective rating of IQ/ICH was achieved with S3/S4-5. Patients were exposed to a significantly lower dose in group 2 (mean: 744 mGycm/1.71 mSv) than group 1 (mean: 1045 mGycm/2.40 mSv, p < 0.05) in univariate analysis, logit regression and receiver operator characteristic curve. We also used logistic regression to determine which of the 14 clinical items included in either guideline, in independently predicts CICF. Since NOC is applied only for GCS-15 impaired, 2: sufficient, 3: good, 4: excellent). Mean attenuation value (MAV; [HU]) and standard deviation (SD; [HU]) were measured for liquor space (LS) and white matter (WM) supratentorial (ST) and in the posterior fossa (PF). Data were analyzed using ICC, Mann-Whitney-U and ANOVA testing.

CONCLUSION
SAFIRE provides better IQ and visualization of ICH in brain CT. Dose reduction by almost one-third is possible without significant loss in diagnostic quality.

CLINICAL RELEVANCE/APPLICATION
Sinogram-affirmed iterative reconstruction technique provides better image quality and visualization of intracranial hemorrhage in brain CT with almost one-third dose reduction compared with FBP.

SSJ07-06 • Screening CT in Mild Traumatic Brain Injury: Comparison of Two Mostly Used Clinical Guidelines in a Tertiary Referral Hospital in Northeastern Japan

Daddy Mata Mbemba MD, PhD (Presenter); Shunji Mugikura MD, PhD; Atsuhiko Nakagawa; Takaki Murata MD; Li Li MD, PhD; Kei Takase; Teiji Tominaga; Shigeki Kushimoto PhD; Shoki Takahashi MD

PURPOSE
To avoid unnecessary CT, Canadian CT Head Rule (CCHR) and New Orleans Criteria (NOC), each containing 7 clinical items, are widely-used guidelines to indicate screening CT in mild traumatic brain injury (TBI). We aimed to compare the two guidelines in predicting Clinically Important CT Findings (CICF), by introducing two scoring systems.

METHOD AND MATERIALS
Consecutive 142 mild TBI (Glasgow coma scale (GCS):13-15) patients (age: 17-88 years), who underwent CT examination indicated by either CCHR or NOC, were included. We introduced two 8-graded (0 to 7) scores and assigned them to each patient, Canadian score from CCHR and New Orleans score from NOC: a patient's score represented a sum of the number of positive items, each of which was rated +1 if present. Two neuroradiologists reviewed screening CT for CICF. In all the GCS13-15 patients, we examined whether both scores were related to CICF by univariate analysis, logit regression and receiver operator characteristic curve. We also used logistic regression to determine which of the 14 clinical items included in either guideline, independently predicts CICF. Since NOC is applied only for GCS-15 patients, we additionally compared two scoring systems only in GCS-15 group (n=67).

RESULTS
Of 142 mild TBI patients, 49 patients (34.5%) showed CICF. In GCS 13-15 group, both scores showed a significant relationship to CICF (P< 0.05) in univariate analysis. However, in multivariate analyses, only Canadian score was a predictor of CICF (P=0.0130) yielding a better performance (AUC=0.69) than New Orleans score (AUC=0.63). In addition, among all 14 clinical items included in either guidelines, the item of GCS

Conclusion
In mild TBI, CCHR was a better predictor of CICF in a tertiary referral hospital in northeastern Japan. Our results are consistent with a big-scale western-study.

CLINICAL RELEVANCE/APPLICATION
In mild TBI, selective use of CT decreases unnecessary irradiation, but improper selection can lead to missing life-threatening lesions. Our study encourages the use of CCHR for efficient CT scanning.
SSJ08-01 • Detection of Hepatocellular Carcinoma with Rapid Switching Dual Energy Spectral MDCT (DECT)

Rupan Sanyal MD (Presenter) ; John V Thomas MD, MRCP ; Laureen F Alexander MD ; Mark D Little MD ; David N Bolus MD ; Desiree E Morgan MD *

PURPOSE
Evaluate increased conspicuity of hyperenhancing hepatocellular carcinoma (HCC) using lower viewing keV and iodine material decomposition images.

METHOD AND MATERIALS
IRB approved/HIPAA compliant retrospective study of consecutive cirrhotic outpatients with HCC evaluated with rapidly switching DECT at outpatient facility of tertiary care where 120 liver transplants are performed each year. Variables evaluated on independent dual energy workstation included iodine concentrations (x100 mcg/cc), Hounsfield units (HU) at 70 and 52 keV, and image noise; absolute contrast difference between tumoral and nontumoral liver (abHU), iodine difference, and conspicuity (abHU or iodine difference/image noise) were calculated and compared using t test and ANOVA.

RESULTS
47 subjects (18 females) had 86 tumors, median size 2.2 cm. Mean tumor HU at 52keV was statistically different than at 70 keV (99.0 HU and 161.3 HU, respectively, p

CONCLUSION
HCC conspicuity is best on iodine material decomposition images. HCCs are better visualized at lower viewing energy using rapid switching DECT compared to routine 70 keV images simulating routine PACS viewing.

CLINICAL RELEVANCE/APPLICATION
Iodine material decomposition images and lower viewing energies are recommended for enhanced detection hyperenhancing hepatocellular carcinoma using rapid switching dual energy MDCT.

SSJ08-02 • Quantitative Correlation between Liver Fat and Biopsy Score Using Multi-material Decomposition and Fast-kV Switching Dual-energy CT

Masayuki Kudo PhD, RT (Presenter) ; Tomoko Hyodo MD ; Takamichi Murakami MD, PhD * ; Peter Lamb * ; Paulo R Mendonca PhD * ; Masanobu Uemura

PURPOSE
The purpose of this study was to investigate the correlation between liver fat volume percentage (LFV%), obtained using a method based on multi-material decomposition (MMD) and histopathologic biopsy score in patients with nonalcoholic fatty liver disease (NAFLD) and alcoholic steatohepatitis.

METHOD AND MATERIALS
This study included 31 patients who underwent non-contrast (NC) and contrast-enhanced (CE) CT of the upper abdomen with dual energy CT (DECT) within 4 weeks prior to liver biopsy. The scan parameters employed for this study were 80/140kVp, 630mA, 0.6 sec/rot, 5mmTH, and helical mode. For CE studies, a non-ionic contrast agent was used and imaging was performed at the arterial, portal venous, and equilibrium phases. LFV% maps were generated from DECT data using MMD. For NC and CE exams, the measured LFV% was the average of 3 regions-of-interest (ROIs) that were placed in the hepatic parenchyma of the LFV% maps corresponding to the planned biopsy site. LFV% measurements were correlated with histopathologic grade of steatosis by the NAFLD activity (NAS) score. Differences in the mean LFV% for NC and CE data were tested by two-factor analysis of variance (ANOVA) with post hoc Tukey-Kramer test. Spearman rank correlations were calculated between NC LFV% and NAS steatosis score.

RESULTS
NAS steatosis scores were 0 in 4 patients, 1 in 15 patients, 2 in 12 patients and 3 in 0 patients. The mean LFV% of each NAS steatosis score group was 1.2%, 6.0% and 15.2%, respectively. Two-factor ANOVA results showed a statistically significant difference in LFV% by NAS score (P

CONCLUSION
MMD-based LFV%, from both NC-CT and CE-CT data, shows statistically significant correlation to histopathologic biopsy grade, implying MMD can be used to accurately LFV% in the liver. Due to the agreement between LFV% across all phases of imaging (NC and CE), MMD can potentially obviate the need for the NC acquisition in DECT imaging of patients with fatty liver disease, which can lead to a significant reduction of radiation dose to patients.

CLINICAL RELEVANCE/APPLICATION
MMD-based method of LFV using fast-kv switching DECT enables accurate, non-invasive, and rapid measurement of LFV%. MMD may reduce total radiation dose by obviating the need for a NC-CT acquisition.

SSJ08-03 • Spectral CT Imaging in Differential Diagnosis of Pancreatic Ductal Adenocarcinoma and Mass Forming Pancreatitis

Xiao Zhu Lin MD (Presenter) ; Su Zhang ; Chao Li ; Xueqin Xu ; Kemin Chen MD, PhD ; Fuhua Yan

PURPOSE
The objective of this study is to investigate the spectral CT imaging features of pancreatic ductal adenocarcinoma (PDAC) and mass forming pancreatitis (MFP) and to assess its value in differential diagnosis between them.

METHOD AND MATERIALS
The institutional ethics committee approved this retrospective study with waiver of informed consent. A total of 129 stones (gallbladder, bile duct ) and calcifications of liver found in 110 patients were examined with single-energy nonenhanced CT and dual-source dual-energy CT in the portal venous phase (100kVp and 140 kVp) . Virtual nonenhanced (VNE) images were generated from the portal venous phase dual-energy CT data sets by using commercially available software (Syngo, Dual Energy Liver VNC; Siemens Healthcare). The CT numbers for the stone, liver, and bile; stone size; and image noise were assessed for each image set. The conspicuity and size of the stones, image quality of the VNE images as a replacement for true nonenhanced (TNE) images were assessed.

SSJ08-04 • Detection of Stones and Calcifications in the Hepatobiliary System on Virtual Nonenhanced Dual-energy CT

Da-Ming Zhang MD (Presenter) ; Xuan Wang MD ; Huadan Xue MD ; Hao Sun MD ; Yu Chen MD ; Zhengyu Jin MD

PURPOSE
To retrospectively determine the features of stones and calcifications in hepatobiliary system after virtual elimination of contrast medium at dual-energy computed tomography (CT).

METHOD AND MATERIALS
The institutional ethics committee approved this retrospective study with waiver of informed consent. A total of 129 stones (gallbladder, bile duct ) and calcifications of liver found in 110 patients were examined with single-energy nonenhanced CT and dual-source dual-energy CT in the portal venous phase (100kVp and 140 kVp) . Virtual nonenhanced (VNE) images were generated from the portal venous phase dual-energy CT data sets by using commercially available software (Syngo, Dual Energy Liver VNC; Siemens Healthcare). The CT numbers for the stone, liver, and bile; stone size; and image noise were assessed for each image set. The conspicuity and size of the stones, image quality of the VNE images as a replacement for true nonenhanced (TNE) images were assessed.
A total of 61 imaging studies were evaluated (33 CT, 28 MRI). Three independent and blinded observers (O1 – O3) were asked to review 43 patients with 46 distinct pancreatic lesions, which were histologically confirmed to be IPMNs, were included in this retrospective study.

**METHOD AND MATERIALS**

The purpose of this study was to investigate the diagnostic predictability of the histologic entity of IPMN based on objective imaging criteria, such as the Sendai criteria and observer confidence.

**RESULTS**

After virtual elimination of contrast medium, the CT value and CNR of the lesions decreased, the size stayed the same. The lesions which attenuation greater than 229.2HU and size larger than 0.15 cm² can be detected with good reliability.

**CONCLUSION**

The derived monochromatic images from DEsCT could improve the accuracy of T and N staging in rectal cancer. nIC and dnIC values between metastatic and non-metastatic lymph nodes in AP and PP (dnIC) were also significantly different (P=0.02, P=0.01).

**CLINICAL RELEVANCE/APPLICATION**

Dual-source DECT may provide additional information for the differential diagnosis of liver lesions without interrupting CT scanning workflow or adding radiation dose.

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**SSJ08-05 • Differentiating Liver Lesion Types by DECT keV Spectrum**

**Xiaohui Qi** MD; **Gaofeng Shi** MD; **Qi Wang** BSc (Presenter); **Runze Wu**

**PURPOSE**

To investigate the possibility of using dual-energy CT keV spectrum to differentiate hepatic carcinoma (HCC), liver metastasis, hemangioma and cysts.

**METHOD AND MATERIALS**

Eighty-one patients with liver diseases were enrolled. The dual-energy CT was performed at the portal venous phase with tube voltage 100/Sn140 kV, tube current 230/178 mAs, collimation 32 * 0.6 mm, slice thick 5 mm, reconstruction interval 5 mm. After the injection 90 ml contrast agent at flow rate of 3 ml/s, arterial and venous phase images were acquired at 30 and 70 s delay. The venous phase keV images were calculated on a commercial workstation using the images of high and low kVp. The region of interest was carefully placed on the lesions to measure the CT value for 40 – 110 keV. The surrogate slope of keV spectrum was calculated by difference of CT value at 40 and 110 keV divided by 70. After grouped by lesion types, the slopes were compared between HCC, metastatic lesion, hemangioma and cyst.

**RESULTS**

The slope of DECT keV spectrum had the potential to differentiate HCC/hemangioma, metastasis and cyst.

**CONCLUSION**

The derived monochromatic images from DEsCT could improve the accuracy of T and N staging in rectal cancer. nIC and dnIC values between metastatic and non-metastatic lymph nodes in AP and PP (dnIC) were also significantly different (P=0.02, P=0.01).

**CLINICAL RELEVANCE/APPLICATION**

Dual-source DECT may provide additional information for the differential diagnosis of liver lesions without interrupting CT scanning workflow or adding radiation dose.

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**SSJ08-06 • Evaluation of Dual Energy Spectral CT Imaging in Rectal Cancer**

**Huanhuan Liu** (Presenter); **Huan Zhang**; **Lei Shi** MD; **Lifang Pang** MD; **Zilai Pan** MD; **Fuhua Yan**

**PURPOSE**

To investigate the value of dual energy spectral CT (DEsCT) in preoperative TN-staging and differentiating histological grading of rectal cancer.

**METHOD AND MATERIALS**

56 patients with primary rectal cancer proved by pathology underwent plain scan and dual-phase pelvic enhanced scans (arterial phase (AP) and portal venous phase (PP)) with DEsCT mode. The reconstructed images, including the conventional polychromatic images, monochromatic image sets with photon energy from 40 to 140keV and material-decomposition images, were reformatted and analyzed. The accuracies for TN staging between the conventional polychromatic and monochromatic images were compared. Iodine concentrations (IC) in the lesions and lymph nodes were measured on iodine-based material-decomposition images, and were normalized to external iliac artery to obtain the normalized IC (nIC). The nIC values at AP and PP and the difference of nIC (dnIC) between AP and PP for the primary lesions of different histological grading and the metastatic and non-metastatic lymph nodes were analyzed. Results were correlated with pathological findings.

**RESULTS**

The accuracies for T, N staging were (89.3%, 80.9%) and (82.1%, 71.4%) for rectal cancer on 70 keV monochromatic images and conventional 120kVp images, respectively. The improvement of the accuracy in T and N staging with 70 keV monochromatic images was statistically significant (P=0.04, P=0.03). For the primary lesions, significant differences existed for nIC in PP and dnIC(PP-AP) between different histological grades (P=0.03, P=0.02). The nIC values between metastatic and non-metastatic lymph nodes in AP and the changes between AP and PP (dnIC) were also significantly different (P=0.02, P=0.01).

**CONCLUSION**

The derived monochromatic images from DEsCT could improve the accuracy of T and N staging in rectal cancer. nIC and dnIC values may help to differentiate between primary rectal cancer with different histological grading, and between metastatic and non-metastatic lymph nodes.

**CLINICAL RELEVANCE/APPLICATION**

(dealing with dual energy spectral CT) 'DEsCT can improve the accuracy of TN staging and differentiate histological grading of rectal cancer and is recommended in the rectum preoperative staging.

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**Gastrointestinal (Pancreas Focal Lesions and Carcinoma)**

**Tuesday, 03:00 PM - 04:00 PM • E353C**

**SSJ09 • AMA PRA Category 1 Credit ™:1 • ARRT Category A+ Credit:1**

**Moderator**

**Fatih Akisik**, MD *

**SSJ09-01 • Objective Imaging Criteria for Intraductal Papillary Mucinous Neoplasms of the Pancreas - Diagnostic Predictability and Interobserver Confidence**

**Thula Walter** (Presenter); **Ingo Steffen**; **Lars H Stelter**; **Timm Denecke** MD; **Marcus Bahra** MD; **Bernd K Hamm** MD *; **Christian Grieser**

**PURPOSE**

The purpose of this study was to investigate the diagnostic predictability of the histologic entity of IPMN based on objective imaging criteria, such as the Sendai criteria and observer confidence.

**METHOD AND MATERIALS**

43 patients with 46 distinct pancreatic lesions, which were histologically confirmed to be IPMNs, were included in this retrospective study.
A total of 61 imaging studies were evaluated (33 CT, 28 MRI). Three independent and blinded observers (O1 – O3) were asked to review the imaging and predict malignancy based on existing imaging criteria (main duct > 10mm, mural nodules/solid components, size > 30mm) and to provide the diagnostic certainty of this prediction on a scale from 0 – 10 (0 = very likely benign, 10 = very likely malignant). Moreover, they were asked to rate the histologic entity; i.e. adenoma, borderline type, carcinoma in situ (CIS), invasive carcinoma (IPMC) or solid carcinoma (CA).

RESULTS
Of the 46 evaluated lesions, 29 were benign (IPMN Adenoma; 16; IPMN Borderline; 15) and 16 malignant (CIS; 12; IPMC; 4, solid CA; 8). Mural nodules and lesion size (>30 mm) were significant for malignant lesions (p=0.0069 and p=0.0076, respectively). The odds ratio (OR) for nodules was 6.50 (p = 0.0107), while the OR for size was 1.03 (p = 0.0485). Main duct involvement (MD >10mm) was not found to be a significant predictor of malignancy in our study population (p = 0.05). The accuracy (ACC) of differentiation between benign and malignant IPMN was 84 - 87% for CT and 87 - 90% for MRI for all three observers (interobserver agreement (IA): range, 79-94%, and 78-100%, respectively; p

CONCLUSION
The evaluated imaging criteria, especially in combination, are useful in the differentiation between benign and malignant IPMN, with limited accuracy for dysplasia early carcinomas.

CLINICAL RELEVANCE/APPLICATION
Radiologic imaging criteria are helpful but not sufficiently reliable in aiding clinical decision making in terms of surveillance, prophylactic or early pancreatic cancer surgery.

**SSJ09-02** • Intraductal Papillary Mucinous Neoplasm of the Pancreas: Evaluation of Unresectability with MR Only

Seongho Kim (Presenter); Jeong-Min Lee MD *; Eun Sun Lee MD, PhD; Jeehyun Baek MD; Joon Koo Han MD; Byung Ihn Choi MD, PhD *

PURPOSE
To evaluate MRI findings between benign vs malignant IPMNs and noninvasive vs invasive IPMNs. To evaluate MRI performances in differentiating between each other and to evaluate the accuracy for surgical resectability using only MR images with surgery and pathologic analysis as reference standards.

METHOD AND MATERIALS
Informed consent requirement was waived, and institutional review board approval was obtained. 93 patients with pathologically proved as IPMNs (benign, n = 51; high grade dysplasia, n = 17; invasive, n = 25), underwent MRI before the surgery. Qualitative and quantitative image analysis was performed. MRI performances of determining malignancy potential, invasiveness and unresectability were evaluated. Statistical analysis was performed with Fisher's exact test, Mann-Whitney U test, and ROC curves.

RESULTS
Intramural nodules were observed in 3 benign IPMNs, and 17 malignant IPMNs(P=.00007). Peripancreatic infiltration was observed in 1 benign IPMN, and 7 malignant IPMNs(P=.02). The mean diameter of MPD was 3.4mm and 8.7mm respectively in benign and malignant IPMNs(P=.0014). Intramural nodules were observed in 8 noninvasive IPMNs, and 12 invasive IPMNs(P=.0004). Peripancreatic infiltration was detected in 2 patients with noninvasive IPMNs, and 6 patients with invasive IPMNs(P=.004). The median diameter of MPD was 2mm in noninvasive IPMNs, and 6.4mm in invasive IPMNs(P=.05). MRI performance of determining malignancy potential and invasiveness was obtained by scoring ranging from 1 to 5 (1 as definitely benign or noninvasive, 5 as definitely malignant or invasive). AUC was 0.778 and 0.721, respectively. The unresectability was evaluated by scoring its possibility of resection ranging from 1 to 4 (1 as definitely resectable, 4 as definitely unresectable). AUC was 0.742 with sensitivity 12.5% and specificity 98.82% under the criterion value of >2(P=.01) with moderate agreement between two raters(K=.651).

CONCLUSION
MRI is helpful in differentiation of benign vs malignant IPMNs and noninvasive vs invasive IPMNs. However sensitivity of evaluating unresectability is significantly low.

CLINICAL RELEVANCE/APPLICATION
MR is helpful to rule out benign IPMNs which are not needed resection, but it is limited evaluating unresectable malignant IPMNs, and is not recommended evaluating unresectability with only the MR.

**SSJ09-03** • Pancreatic Cystic Lesions in Patients with Advanced Liver Disease

Simon Abramson MD (Presenter); Beatrice L Madrazo MD; Seth Scilor; Emmanuel Coronel; Paul Martin; Victor J Casillas MD; David Jativa

PURPOSE
Routine abdominal imaging frequently uncovers unsuspected masses. Recent studies report a prevalence of incidentally detected pancreatic cystic lesions (PCL) in the general population of 2.4% to 2.6% (De Jong 2010, Laffan 2008). We have observed increasing numbers of PCL in cirrhotic patients receiving routine abdominal imaging for hepatocellular carcinoma surveillance. The aim of this study is to establish PCL prevalence in patients with advanced liver disease.

METHOD AND MATERIALS
This was a cross-sectional study comparing three groups of cirrhotic patients: 1) “Clinic” (hepatology clinic patients, 2010-11), 2) “MRI” (consecutive patients with cirrhosis and abdominal MRI, 2009-11), and 3) “Transplant” (liver transplant recipients, 2010-11). Patients with cirrhosis and CT and MR imaging studies were included. For liver-transplanted patients, only pre-transplant images were considered. Key exclusions were age

RESULTS
Seven-hundred and twenty-three patients were screened and 585 were eligible (cirrhosis with CT or MR scans). From these 585 patients, 65 were excluded due to age, pancreatitis, and polycystic liver and/or kidney disease. Two-hundred and twenty-eight patients were in the Clinic group, 150 in the MRI group, and 142 in the Transplant group. Mean age was 59, 57, and 56 in the 3 groups, respectively. Male patients comprised 69%, 55%, and 75% of the 3 groups, respectively. Additionally, median MELD score and interquartile range in patients with cysts (n=43) was 15 (10-18) and without cysts (n=547) was 11 (9-15), p=.03. PCL prevalence in patients with non-alcoholic steatohepatitis (NASH) related cirrhosis was 1/64 (1.6%) compared to PCL prevalence of 42/456 (9.2%) in all other liver disease (p

CONCLUSION
Overall, there is a marked increase in PCL prevalence in our cirrhosis cohorts compared to the non-cirrhotic population.

CLINICAL RELEVANCE/APPLICATION
Prospective studies are needed to define pathogenesis and management of these incidental lesions in cirrhotic patients.

**SSJ09-04** • Solid Pseudopapillary Tumor (SPT) of Pancreas

Udaykamal H Barad MD (Presenter); Mark S Frank MD; Mark Tann MD; Temel Tirkes MD; Fatih Aksik MD *; Kumaresan Sandrasegaran MD *

PURPOSE
To describe imaging features of SPT in a Mid-West US population.

METHOD AND MATERIALS
A retrospective review radiology and pathology database revealed 26 cases of SPT with preoperative imaging. The images were analyzed for size of tumor, location, enhancement characteristics, internal component, local invasion and metastatic disease. Clinical database were used to determine tumor therapy and progression.

RESULTS
Most patients (25/26) were female. The mean age was 25.4 years (range: 8 to 53 years). Eleven patients (44%) were less than 20-years old at presentation. In these, the most common appearance was a thin-walled, cystic, noncalcified mass with internal hemorrhage (10/11). In the eight patients over 25 years, the tumor was a thick walled cystic mass (n=3) or completely solid mass (n=3). Calcification was only seen in two tumors. No metastases were seen. Following tumor resection, no recurrence was seen in any of the patients (n =24) with more than 12 months follow-up (range: 12 to 114 months).

CONCLUSION
SPT presents as a thin-walled cystic mass in younger (teenage) patients, while more solid or thick-walled appearance was seen in over 25 years, suggesting probable evolution of the appearance of tumor with age. Lesion calcification is rare. The prognosis following surgical excision of SPT is good.

CLINICAL RELEVANCE/APPLICATION
Unlike most other cystic pancreatic masses, SPT is usually associated with internal hemorrhage. In older patients, it may present as a solid enhancing mass, simulating a neuroendocrine tumor.

SSJ09-05 ● Pancreatic Adenocarcinoma: Comparison of Six MRI Sequences Including Diffusion-weighted Imaging for Tumor Conspicuity

Francois-Xavier Arnaud MD (Presenter) ; Laurence Legrand ; Elodie Sibilleau MD ; Isabelle Boulay-Coletta MD ; Samir Benadjoud ; Marc Zins MD

PURPOSE
To assess the best MR sequences among conventional, dynamic contrast-enhanced and diffusion-weighted imaging for pancreatic adenocarcinoma relative conspicuity.

METHOD AND MATERIALS
Our local institutional review board approved this retrospective study and waived the informed consent requirement. 55 consecutive patients with pathologically proven pancreatic adenocarcinoma who underwent MRI (1.5T, n=25 or 3T, n=30) were retrospectively included. Fat-suppressed (FS) T1-weighted gradient-echo (GRE), FS T2-weighted fast-recovery fast spin echo, 3D FS dynamic T1-weighted gadolinium-enhanced GRE during arterial, portal and delayed phases and diffusion-weighted imaging (DWI) with b values of 0 and 600 or 800 sec/mm2 were obtained. Apparent diffusion coefficient cartographies were generated. For each sequence, two gastrointestinal radiologists independently assessed the lesion’s signal intensity relative to non tumoral pancreas and the subjective visual conspicuity using a four-point rating scale (0 to 3). They designated the sequence with the best visual conspicuity. The study coordinator performed a quantitative analysis of the lesion conspicuity on each sequence, placing regions of interest for tumor-to-pancreas contrast (either proximal or distal non tumoral pancreas). Visual conspicuity scores and tumor-to-pancreas contrast ratios in each sequence were compared using paired Wilcoxon or t-tests. p-values were considered statistically significant at p 0.05.

RESULTS
92% of Pancreatic adenocarcinomas appeared hypointense on 3D FS T1 GRE arterial phase, which was the best sequence for tumor conspicuity (2.7), followed by portal phase (2.4) and DWI (2.2)/p.

CONCLUSION
3D T1 FS GRE arterial phase is the best sequence for pancreatic adenocarcinoma conspicuity. DWI is limited for clear delineation of pancreatic adenocarcinoma.

CLINICAL RELEVANCE/APPLICATION
Contrast-enhanced MRI is highly needed to improve pancreatic adenocarcinoma conspicuity.

SSJ09-06 ● CT-evaluation of Extrapancreatic Perineural Invasion in Patients with Resectable Cancer of Pancreatic Head

Ekaterina Kasatkina (Presenter) ; Vladimir Lyadov ; Igor Shrayner ; Svetlana Bogomazova ; Elena Mershina ; Valentin E Sinitsyn MD, PhD

PURPOSE
The aim of the study was to find whether multi-detector computed tomography (MDCT) is capable to detect extrapancreatic perineural invasion (EPI) in resectable adenocarcinoma of pancreatic head.

METHOD AND MATERIALS
Preoperative CT-series of 31 patients with resectable adenocarcinoma of pancreatic head were evaluated retrospectively. Extrapancreatic perineural invasion was identified as confluent tissue of similar attenuation to primary pancreatic cancer extending along neural plexuses pathways. Plexus Pancreaticus Capitalis II (PLX-II: the area along the inferioposterior pancreaticoduodenal artery (IPDA) and the jejunal trunk) was selected for analysis as this area is more susceptible for extrapancreatic invasion of pancreatic head cancer. Two patterns of perineural spread were established: confluent tumor spread (Pattern 1) and infiltration (Pattern 2) along known pathway or in retropancreatic adipose tissue.

RESULTS
All patients underwent Whipple procedure, histologically adenocarcinoma of pancreatic head was confirmed in all patients. Extrapancreatic perineural invasion was found in 25 patients (77.4%), 17 of them showed carcinoma invasion in pancreatic parenchyma. Extrapancreatic perineural invasion was more prominent in larger tumors. All 25 patients with positive PLX-II invasion were correctly diagnosed on preoperative CT-scans. Pattern 1 was found in 16 patients, Pattern 2 – in 9 patients. Two false-positive results were present in patients with Pattern 2 which was subtle infiltration of adjacent adipose tissue.

CONCLUSION
MDCT provides sufficient diagnostic information to detect PLX-II invasion on preoperative CT-series in patients with adenocarcinoma of the pancreatic head. Further research, follow-up and prospective studies are needed to confirm the accuracy of MDCT in detecting EPI.

CLINICAL RELEVANCE/APPLICATION
Preoperative detection of EPI which is significant cause of positive surgical margin and tumor recurrence can influence clinical management of patient - choice to perform surgery or neoadjuvant therap
Thickening of the gastric wall is often seen in patients with Gadoxetic acid-enhanced MR cholangiography (Gadoxetic-MRC). The aim of this study is to evaluate the relationship between biliary excreted contrast media in the stomach and the presence of bile reflux gastritis.

METHOD AND MATERIALS
A total of 111 consecutive patients who underwent both Gadoxetic-MRC and upper gastrointestinal endoscopy from May 2009 to April 2012 were included in this study. Two radiologists performed a blinded review of Gadoxetic-MRC set images consisting of axial and coronal images obtained 60 minutes after IV injection of contrast media. Presence of contrast media in duodenum and stomach was recorded along with the extension grade of reflux if the contrast media was seen in stomach: grade 1, antrum; grade 2, body; and grade 3, fundus. Endoscopic images were reviewed by an expert gastroenterologist blinded to the result of Gadoxetic-MRC. Sydney classification of gastritis was used to categorize gastritis if present.

RESULTS
Among a total of 111 patients, contrast media was present in the stomach on 60 minutes delayed images in 39 patients. Of these 39 patients, 13 patients had bile reflux gastritis and 3 patients showed bile in the stomach without evidence of erythematous mucosal changes. Of the 72 patients who did not show contrast media in the stomach, none of them had bile reflux gastritis and 2 patients showed bile in the stomach without evidence of erythematous mucosal changes. Bile reflux gastritis was significantly more frequent in patients with contrast media in the stomach on Gadoxetic MRC (13/39, 33.3%) than those without (0/72, 0%) (p < 0.001). However, there was no significant difference between bile reflux gastritis and the extension grade of reflux (grade 1: 2/12, grade 2: 4/11, grade 3: 7/16) (p = 0.335).

CONCLUSION
About a third of patients with biliary excreted contrast media in stomach had bile reflux gastritis which was more significantly frequent compared to those without. Biliary excreted contrast media in stomach on Gadoxetic-MRC obtained at 60 minutes could be an indication of the presence of bile reflux gastritis.

CLINICAL RELEVANCE/APPLICATION
Biliary excreted contrast media in stomach on Gadoxetic-MRC obtained at 60 minutes could be an indication of the presence of bile reflux gastritis.

SSJ10-02 • A New Sandwich Sign of Borrmann Type 4 Gastric Cancer on Diffusion-weighted MRI: Radiological-histopathological Correlation
Lei Tang MD (Presenter) ; Xiao-Peng Zhang MD ; Ying-Shi Sun MD, PhD ; Zi-Yu Li ; Jia-Fu Ji ; Zhong-Wu Li ; Xiaoting Li

PURPOSE
To explore the histopathological basis of a new finding sandwich sign of Borrmann type 4 gastric cancer on diffusion-weighted MRI (DW-MRI).

METHOD AND MATERIALS
The abdominal DW-MRI was performed using SS-EPI sequence with b-factors of 0 and 1000 s/mm² on a 1.5T scanner, in patients with Borrmann type 4 gastric cancer. Radical gastrectomy was performed in one week after DW-MRI examination. Histopathological analysis of the resected specimens was performed by one pathologist and one radiologist together, with emphasis on the correlation of the DW-MRI signs and the histopathologic findings, by means of layer-to-layer comparison.

RESULTS
DW-MRI was performed on 30 patients with Borrmann type 4 gastric cancer. A three-layer sandwich sign that demonstrated high signal in the inner and outer layer and low signal in the intermediate layer was observed in 73.3% (22/30) of cases on DW-MRI. Through the comparison with pathological large sections, we found that the intermediate low signal on DW-MRI corresponded to the muscularis propria. Further enlargement of the pathological sections demonstrated that the cancer cells were interspersed in the intermuscular space, which cause the decreased restriction of water molecular movement and lower down the signal on DW-MRI; thereby create the three-layer sandwich sign.

CONCLUSION
DW-MRI can highlight the signs of Borrmann type 4 gastric cancer, which often present a characteristic three-layer sandwich sign. The uneven distribution of cancer cells in different layers of cancerous gastric wall maybe the histopathological basis of this unique sign.

CLINICAL RELEVANCE/APPLICATION
DW-MRI can be a useful method for the clinical evaluation of Borrmann type 4 gastric cancer.

SSJ10-03 • Preliminary Study of Spectral CT Imaging in the Differentiating Normal and Malignant Residual Stomach Wall Thickening
He Qing Wang MSc (Presenter) ; Ailian Liu MD ; Ye Ju ; Sheng Wang ; Shifeng Tian ; Longmin Zhang

PURPOSE
To investigate the value of spectral CT imaging in the differential diagnosis of normal and malignant residual stomach wall thickening.

METHOD AND MATERIALS
32 cases (pathological finding proved 11 cases of residual stomach cancer, long-term clinical follow-up confirmed 21 cases of Stomach normal postoperative change). Nine patients underwent the plain scan, 23 patients underwent both the plain scan and the dynamic examination. With dual-kVp spectral CT imaging, monochromatic images (40-140keV) and the iodine and water-based material decomposition images were reconstructed. CT values of 70 keV and effective iodine content (eIC) were measured. One-way analysis of variance was performed for analyzing the resulting parameters, and p

RESULTS
There was a statistically significant difference between malignant and normal gastric wall tissue in 40-140keV 101 monoenergetic images: arterial phase 40keV, 50keV, 60keV, 70keV, 80keV, effective monoenergetic spectrum value, material value based water and iodine and portal phase 40keV, 50keV, 60keV, 70keV,80keV, effective monoenergetic spectrum value, material value based iodine. Significant differences were seen in 40-140keV 101 monoenergetic images: arterial phase 40keV, 50keV monoenergetic spectrum value between malignant and normal gastric wall tissue.

CONCLUSION
CT Gemstone Spectral Imaging could provide additional imaging information that may improve the differentiation of the normal and malignant wall of the residual stomach. Spectral CT curve is expected to be a new non-invasive method to differentiate them.

CLINICAL RELEVANCE/APPLICATION
Using spectral CT multiple parameters might be a new noninvasive method to differentiate the normal and malignant residual stomach wall for the conventional polychromatic CT images.

SSJ10-04 • The Value of Diffusion-weighted MR Image in Diagnosing Metastatic Lymph Nodes in Patients with Gastric Cancer
Zhuping Zhou (Presenter) ; Jian He MD, PhD ; Song Liu ; Bin Zhu ; Zhou Z Ping ; Zhengyang Zhou

PURPOSE
To explore the characteristics of lymph nodes in patients with gastric cancer by diffusion weighted (DW) MR imaging, and investigate the value of apparent diffusion coefficient (ADC) and short axis measurement in diagnosing metastatic lymph nodes.

METHOD AND MATERIALS
This prospective study was approved by local ethics committee and the patient informed consent was obtained. Fifty-five patients (34 male, 18 female) with gastric cancer underwent preoperative DW MR imaging. All the detectable lymph nodes on DW images were divided into metastatic and non-metastatic groups with the reference of post-operative histopathological findings. The ADC values and short diameter of lymph nodes were measured and compared between the two groups. Diagnostic performance of ADC value and short diameter for diagnosing metastasis were compared by receiver characteristic curve (ROC) analysis.

RESULTS
ADC value from DW MR imaging is superior to short diameter measurement in diagnosing metastatic lymph nodes in patients with gastric cancer.

CLINICAL RELEVANCE/APPLICATION
DW imaging could be added into routine preoperative MR imaging of patients with gastric cancer to detect and diagnose lymph node metastasis.

SS110-05 • Preclinical Study on CT-optics Hybrid Lymphangiography for Stomach Sentinel Lymph Node Mapping, Labeling and Intra-operative Navigation in a Beagle Model
Hon Soul Kim MD, PhD (Presenter); Sang Kil Lee; Se Hoon Kim; Soo-Jeong Lim; Woo Jin Hyung MD; Joonseok Lim MD

PURPOSE
Multi-modality hybrid imaging of loco-regional lymphatic system would improve preoperative mapping and intra-operative navigation of the sentinel lymph nodes. We assumed that if a reliable method for sentinel lymph node labeling is available, the application of minimally invasive treatment for stomach cancer could be expanded.

METHOD AND MATERIALS
Animal experiments were approved by our institutional animal care and use committee. We developed a nano-scale iodine-indocyanine green oil emulsion that can be used for both CT and optical imaging. We endoscopically injected this hybrid contrast agent in the gastric submucosal compartment of 9 beagles. Serial preoperative CT scans were obtained. The degree of lymph node enhancement was qualitatively and quantitatively measured. Each beagle underwent either open laparotomy, laparoscopy-assisted surgery or robot(equipped with integrated infra-red optical camera)-assisted surgery. Specimen CT and near infra-red fluorescence imaging was performed.

RESULTS
Our lymphangiography method generated significant contrast effect for both CT and near infra-red range optical devices. Significant and persistent accumulation of the hybrid contrast signal was observed in the draining lymphatic system, which remained throughout the entire experiment (over 5 hours) achieving the effect of lymph node labeling. Preoperative CT provided information on anatomy oriented lymph node mapping. We were able to identify 40 lymph nodes showing enhancement on CT scan in 9 beagles. Optical imaging ensured high resolution visualization of both the draining lymph nodes and intervening lymphatic vessels. In addition, adopting intra-operative compatible optical devices (such as Robot-assisted surgery in this study) enabled real time high resolution imaging during surgery, and therefore considerably enhanced the sensitivity and confidence on sentinel lymph node assessment.

CONCLUSION
Our CT-optics based hybrid imaging is a feasible and effective method for lymphangiography, which can be used for preoperative mapping, labeling and intra-operative navigation of sentinel lymph nodes. We believe these advantages can be exploited to design minimally invasive treatment strategies with extended indications.

CLINICAL RELEVANCE/APPLICATION
Nano-scale iodine-indocyanine green oil emulsion based hybrid (CT and optical) lymphangiography can be used for sentinel lymph node assessment and non-invasive treatment of early gastric cancer.

SS110-06 • Diagnosis of Esophageal or Duodenal Invasion of Advanced Gastric Cancer: Comparison of CT and Endoscopy
Yoon Jin Lee MD (Presenter); Young Hoon Kim MD, PhD; Ji Hoon Park MD; Kyoung Ho Lee MD; Hye Seung Lee MD; Do Joong Park; Hyung-Ho Kim MD, PhD

PURPOSE
To retrospectively compare the accuracy of CT with that of endoscopy in the diagnosis of esophageal or duodenal invasion of advanced gastric cancer.

METHOD AND MATERIALS
Forty-five patients (26 men, 19 women; median age, 68 years; range, 40–82 years) who underwent gastrectomy and had pathologically confirmed advanced gastric cancer with esophageal or duodenal invasion were included. The preoperative reports of CT and endoscopic exams were compared for the diagnosis of esophageal or duodenal invasion. The longitudinal length of tumor invasion into the esophagus or duodenum was retrospectively measured on CT images and histopathological specimens under microscopy. Other histopathological data were also collected, including the invasion pattern (mucosal or submucosal spread), Borrmann type, and WHO histologic classification. The sensitivity of CT and endoscopy were calculated and histopathological data were evaluated for the association with false negative findings.

RESULTS
The overall diagnostic value of CT was significantly higher than that of endoscopy (66% [31/47] vs. 38% [18/47], P=.001). CT was significantly more accurate than endoscopy in diagnosing both esophageal invasion (71% [22/31] vs. 45% [14/31], P=.008) and duodenal invasion (56% [9/16] vs. 25% [4/16], P=.013). Longitudinal tumor invasion lengths showed strong correlation between CT (median, 9.4 mm; interquartile range, 5.0–12.8 mm) and histopathologic (median 6.5, interquartile range, 3.3–11.0) measurements (Spearman’s rho=0.86, P

CONCLUSION
CT is more accurate than endoscopy in the diagnosis of esophageal or duodenal invasion in patients with advanced gastric cancer.

CLINICAL RELEVANCE/APPLICATION
CT is more accurate than endoscopy for the prediction of esophageal or duodenal invasion, and may be more helpful for the decision of optimal longitudinal surgical extent.
Cesarean scar implantation pregnancies, if untreated, are at high risk for miscarriage and/or serious complications, including uterine placentation. In this study, the findings of intraplacental abnormal vascularity and protrusion of placenta into the internal os were good predictors of placental invasion. Intraplacental T2 dark bands, intraplacental abnormal vascularity, uterine bulging, total placental previa, partial placental previa and placental protrusion into internal os had moderate or better interobserver reliability. Using multivariable logistic regression analysis, we found that the findings of intraplacental abnormal vascularity (A) and placental protrusion into internal os (B) had significant odds ratios of an increased risk of placental invasion. (A: odds ratio, 82.7; 95% CI, 4.1 to 5942; p=0.002, B: odds ratio, 83.1; 95% CI, 3.61 to 6329; p=0.0047)

CONCLUSION
In this study, the findings of intraplacental abnormal vascularity and protrusion of placenta into the internal os were good predictors of placental invasion.

CLINICAL RELEVANCE/APPLICATION
This study showed that the presence of placental protrusion into internal os is a new useful MRI finding for the diagnosis of invasive placentation.
Improving the Clinical Utility and Consistency of Placental MRI Reports: Introduction of a Novel Placental MRI Grading Scale to Assign a Confidence Score in Diagnosing Abnormal Placental Implantation

Angela Trinh MD (Presenter) ; Jeanne M Horowitz MD ; Senta M Berggruen MD ; Helena Gabriel MD ; Adrienne Vargo MD ; Frank H Miller MD

PURPOSE
To assess feasibility of a novel MRI grading scale using major and minor imaging criteria to assign confidence in diagnosing abnormal placental implantation (API), and improve the accuracy, consistency, and clinical utility of placental MRI.

METHOD AND MATERIALS
Two board-certified radiologists blinded to all reports independently, retrospectively reviewed 20 randomized placental MRI exams (10 with API by surgery and/or pathology and 10 negative cases). Assessment was made for major and minor diagnostic criteria of API, based on MRI signs reported in literature. Major criteria included placental invasion outside the uterus, intraplacental bands, uterine bulging, very heterogeneous placenta, and bladder tenting. Minor criteria included mild/moderately heterogeneous placenta, tortuous flow voids, focal interruption of the myometrial wall and myometrial thinning. Confidence levels (CL) were assigned for the diagnosis of any level of API, including placental accreta, increta, and percreta. CL were: 90% confidence for cases with 2 or more major criteria, 75% confidence with either 1 major criterion or all 4 minor criteria, 50% confidence with 3 minor criteria, 25% confidence with 1-2 minor criteria and 10% confidence if no criteria met.

RESULTS
Between the two radiologists, there was complete agreement on 12 of 20 cases based on CL. 6 cases demonstrated a difference of only one CL. 2 cases demonstrated complete disagreement. When grouping the 90% and 75% CL into high suspicion and the 25% and 10% CL into low suspicion of API, the radiologists agreed on 18 of 20 cases. Of these 18 cases, 7 were high suspicion and 11 were low suspicion. The 7 high suspicion cases and 9 of the 11 low suspicion cases matched the surgical/pathology results. 2 of the 11 low suspicion cases were positive for placenta accreta. This resulted in a sensitivity of 0.7-0.89 and specificity of 0.91-1.0 for detection of API between the radiologists. Accuracy ranged from 0.85-0.91.

CONCLUSION
Utilizing major and minor imaging criteria on MRI to diagnose API can make placental MRI reporting more consistent and accurate and thus aid in surgical planning.

CLINICAL RELEVANCE/APPLICATION

Placental MR Imaging in Fetuses with Placental Insufficiency

Isabelle Thomassin-Nagara MD (Presenter) ; Marie-Claude Chevrier MD ; Lamia Jarbouri MD ; Audrey Morel MD ; Sophie Dechoux ; Marc J Bazot MD

PURPOSE
To retrospectively evaluate the accuracy of pelvic magnetic resonance (MR) imaging performed to characterize indeterminate sonographic adnexal masses during pregnancy and to test the accuracy and the reproducibility of the ADNEXMR score in this population.

METHOD AND MATERIALS
Institutional ethics committee approved the study and granted a waiver of informed consent. Our study population comprised 31 pregnant women (mean age : 32 (19-42) with a mean gestational age at the diagnosis of 16 weeks (16-26) who underwent MR imaging for characterization of indeterminate adnexal masses in our center. Two radiologists with 1 and 10 years experience retrospectively evaluated MR criteria for characterization of complex adnexal masses and ADNEXMR score was tested using ROC curve analysis and Kappa values. The reference standard was surgical pathology or at least a one-year imaging follow-up.

RESULTS
CONCLUSION
During pregnancy, MR imaging is an accurate tool to differentiate benign form malignant adnexal masses without any cancer missed. ADNEXMR score is as accurate and reproducible as in general population. Thus, our study suggests its potential to improve patient management. Larger multicenter prospective validation of the score is warranted.

CLINICAL RELEVANCE/APPLICATION
MR imaging is highly accurate to characterize adnexal masses during pregnancy and may be helpful to determine the risk with the patient to opt for the absence of surgery specifically until childbirth.

Placental MR Imaging in Fetuses with Placental Insufficiency

Twenty-five of the 50 pregnancies were categorized as having an insufficient placenta. The mean placental thicknesses with placental insufficiency were larger than that without placental insufficiency (p < 0.01). The mean placental areas and the mean placenta to amniotic fluid signal intensity ratio (SIR) with placental insufficiency were smaller than those without placental insufficiency (p < 0.01). There was no significant difference in placental volumes. The sensitivity, specificity, and accuracy were as follows; 76.0%, 80.0%, and 78.0% with globular appearances, 52.0%, 88.0%, and 70.0% with decreased FVs, and 82.0% with globular appearances plus decreased FVs. There is a significant difference in sensitivity between decreased FVs and globular appearances plus decreased FVs.

CONCLUSION
Placental insufficiency is associated with placental areas, placental thicknesses, and placenta to amniotic fluid SIR. Evaluating FVs on T2-weighted RARE images can be useful for detecting placental insufficiency, particularly in placentas without globular appearances on MRI.

ADNEXMR score is as accurate and reproducible as in general population. Thus, our study suggests its potential to improve patient management.
Comparison between Magnetic Resonance Hysterosalpingography Performed with 1.5 Tesla and 3 Tesla

Valentina Cicolla; Renato Argiro (Presenter); Daniele Guerrieri MD; Domiziana Santucci; Carlo De Felice MD

PURPOSE
The aim of this study was to compare results of magnetic resonance hysterosalpingography performed with 1.5 Tesla and with 3 Tesla (1.5 T MR-HSG and 3T MR-HSG) for the diagnostic workup of infertile women.

METHOD AND MATERIALS
We retrospectively analyzed 326 MR-HSG performed at our institution in a period of 30 months. The MR examination was performed with 1.5-T or 3-T MR unit. In both cases T2-weighted and fat-saturated T1-weighted images after intracavitary injection of normal sterile saline were obtained using routine clinical parameters to assess intracavitary and extracavitary abnormalities.

For the evaluation of tubal patency, fat-saturated T1-weighted gradient echo 3D dynamic sequences were acquired during the hand-injection of a small amount of a contrast solution consisting of gadolinium diluted in normal sterile saline. Contrast solution employed was reduced from 2 ml to 0.5 ml with 3T.

RESULTS
One hundred and ten MR-HSG were performed with 1.5 T and 216 with 3 T. Comparative analysis of examination show that intramural and ampullary portions of the tube were visualized in 75.3% of cases with 1.5 T and in 85.7% of cases with 3 T. Failure rate was 5.6% with 1.5 T and 2.5% with 3 T. Mean execution time was 25 min for 1.5T MR-HSG versus 18 min required for 3T MR-HSG. Gadolinium dose was reduced from 2 ml to 0.5 ml with 3T.
CONCLUSION
3T MR-HSG achieve a shorter execution time and a lower failure rate and offers a better visualization of the fallopian tubes compared to 1.5-T MR-HSG. Thanks to higher CNR, 3T allow gadolinium dose reduction an potential cost saving. 3T MR-HSG should be considered more accurate and faster single comprehensive examination to be employed in female infertility investigation.

CLINICAL RELEVANCE/APPLICATION
3T MR-HSG represent a faster and more accurate imaging approach compared to 1.5T MR-HSG in the diagnostic workup of female infertility.

SSJ12-04 • Improvement of 3T MR-HSG as ‘One-stop-Shop’ Imaging Approach to Female Infertility: Our Experience Over the Years
Valentina Cipolla (Presenter) ; Renato Argiro ; Daniele Guerrieri MD ; Domiziana Santucci ; Carlo De Felice MD

PURPOSE
To confirm the improvement over the years of 3 Tesla magnetic resonance imaging hysterosalpingography (3T MR-HSG), as single comprehensive imaging approach to female infertility.

METHOD AND MATERIALS
Two hundred and sixteen infertile women underwent 3T MR-HSG. After standard imaging of the pelvis, dynamic study was performed by acquiring T1- and T2-weighted 3D time-resolved imaging of contrast kinetics (TRICKS) sequences during manual injection of 4-5 ml of contrast solution consisting of gadolinium (0.5 ml) and normal saline (20 ml). This procedure was carried out 1, 2 or 3 times. Two radiologists independently analyzed images. Regarding tubal patency, possible diagnoses were: fast tubal patency; delayed tubal patency; asymmetrical tubal patency; loss of regular tubo-ovarian relationship; bilateral tubal occlusion.

RESULTS
3T MR-HSG was successfully completed in 97.5%, failure rate was 2.5%. Analysis of morphological sequences revealed extratubal-extracavitary abnormalities in 44.9%, while uterine cavity abnormalities were found in 25% of patients. Overall extratubal abnormalities were detected in 69.9% of cases. Dynamic sequences showed intramural and ampullary portions of the tube in 85.7% while diagnosis of tubal patency was made indirectly in the remaining 14.3%. Bilateral tubal patency was found in 62%, among which 34.5% presented fast and symmetrical bilateral tubal patency and regular tubo-ovarian relationship. Unilateral tubal patency was found in 25%, among which 14.6% presented fast unilateral tubal patency with regular tubo-ovarian relationship. Bilateral tubal occlusion was detected in 9.4%. Average examination time was 18 min.

CONCLUSION
Over the years 3T MR-HSG showed a sensitive improvement in diagnostic accuracy for extratubal abnormalities and tubal visualization, allowing the clear depiction of intratubal spillage of contrast media, despite the very small amount injected. Execution time and failure rate were also reduced. After a three years experience, we could affirm that 3T MR-HSG is a simple, fast, safe and well tolerated examination. 3T MR-HSG represents a comprehensive "one-stop-shop" examination and should be employed as first level imaging technique in female infertility investigation.

CLINICAL RELEVANCE/APPLICATION
3T MR-HSG represents a fast and accurate, comprehensive imaging examination for female infertility.

SSJ12-05 • Pearls and Pitfalls of Essure Microinsert Imaging: Does Abnormal Shape on U/S Predict Complications on HSG?
Wendaline M McEachern MD (Presenter) ; Ian Suchet ; John Thiel *

PURPOSE
We hypothesize that the shape of the Essure microinsert on ultrasound is able to predict complications evident on hysterosalpingogram (HSG), the accepted gold standard.

METHOD AND MATERIALS
From July 2, 2009 to July 2, 2012, 441 women at our institution received Essure microinsert placement for the purpose of permanent sterilization. 2D, 3D and 4D volume contrast imaging-coronal plane (VCI-C) transvaginal ultrasounds were performed three months after Essure microinsert placement. Those patients with complications identified on ultrasound, a non-diagnostic ultrasound or complications from the insertion procedure were referred for HSG. Patients with both HSG and ultrasound performed were retrospectively selected and anonymized. The ultrasounds were prospectively reviewed using previously archived 3D and 4D US volumes by a single, blinded radiologist. The shape of each Essure microinsert was described using a numeric grading system. This numeric descriptor was then independently analyzed images. Regarding tubal patency, possible diagnoses were: fast tubal patency; delayed tubal patency; asymmetrical tubal patency; loss of regular tubo-ovarian relationship; bilateral tubal occlusion.

RESULTS
The sensitivity of Essure microinsert shape on ultrasound in predicting complications, compared with standard HSG, was 94%, with a positive predictive value of 85%; specificity was 95%, with a negative predictive value of 98%.

CONCLUSION
Abnormal microinsert morphology is an excellent predictor of abnormality (sensitivity 94%). The positive predictive value of 85% results in slightly more individuals classified as "abnormal", but is safer for patients as it leads to appropriate referral for HSG and recommendation for interim secondary form of contraception.

CLINICAL RELEVANCE/APPLICATION
Ultrasound as a frontline modality for Essure microinsert assessment may contribute to a future FDA label change which mandates HSG post-insertion.

SSJ12-06 • Virtual Hysterosalpingography in 10000 Cases
Patricia M Carrascosa MD (Presenter) * ; Javier Vallejos MD ; Carlos Capunay MD ; Mariano Baronio ; Jorge M Carrascosa MD

PURPOSE
To illustrate the typical findings of V-HSG by MDCT in daily practice and the differential diagnosis with other pathologies.

METHOD AND MATERIALS
We evaluated the V-HSG studies of 10000 patients (mean age 35.4 ± 3.5 years) derived from our institution. Studies were performed using 64,128 and 256 multislice CT scanners. Scanning parameters were: On 64-row CT: slice thickness of 9 mm and a reconstruction interval of 0.45 mm, 120 kV and 100-250 mAs, with an average duration of each scan of 3.6 seconds. On 128 and 256-slice CT: slice thickness of 6 mm and a reconstruction interval of 3 mm, 80 kV and 100-150 mAs, with an average duration of each scan of 1.3 seconds.

For visualization of the internal genital organs 10-20 ml of a dilution of low-osmolality iodinated contrast was instilled into the uterine cavity. Images were analyzed using multiplanar reconstructions, 3D and virtual endoscopy. The duration of the CT scan, the radiation exposure and the degree of discomfort of the patients were documented.

RESULTS
Using 64-row CT scanners, the mean radiation dose was 0.9 mSv. Using 128 to 256-slice CT scanners the mean radiation dose was 0.3 mSv.

In the cervical region were identified parietal irregularities (26%), thickening of folds (10%), polyps (8%), diverticula (6%), stricture (6%) and adhesions (1%). At the level of the uterine cavity showed polyps (35%), submucous fibroids (9%) and adhesions (4%). In
addition changes were observed in the wall of the uterus: fibroids (15%), malformations (3,6%), adenomyosis (6%) and cesarean section (11%). 4% of the uterine tubes are not visualized completely. Unilateral hydrosalpinx was visualized (8%) and bilateral (1,5%). Patients reported no or mild discomfort in 85% of the cases.

CONCLUSION
The Virtual-HSG allowed a proper assessment of the internal genital organs, providing useful diagnostic information on infertility and other gynecological disorders. The technique is painless, well tolerated by patients with low doses of radiation. These advantages place this modality as a valid alternative algorithm study in patients with infertility

CLINICAL RELEVANCE/APPLICATION
CT Virtual Hysteroscopy provides a complete, minimally invasive evaluation of the female reproductive system. Low radiation doses are very important.

### ISP: Health Service, Policy and Research (Evidence, Guidelines and Outcomes)

**Tuesday, 03:00 PM - 04:00 PM • S102D**

**SSJ13 • AMA PRA Category 1 Credit ™:1 • ARRT Category A+ Credit:1**

**Moderator**

David C Levin, MD *

**Moderator**

Marta E Heilbrun, MD

**SSJ13-01 • Health Service, Policy and Research Keynote Speaker: The Effect of CPT Code Bundling on Imaging Reimbursement**

David C Levin MD (Presenter) *

**SSJ13-02 • Comparative Effectiveness of Contrast-enhanced CT versus Non-contrast Plus Contrast-enhanced CT in the Evaluation and Management of Patients with Hypervascular Liver Metastases: A Critically Appraised Topic**

Gelareh Sadigh MD (Presenter) ; Kimberly E Applegate MD, MS ; Deborah A Baumgarten MD, MPH

**PURPOSE**

To critically appraise literature to evaluate whether addition of abdominal non-enhanced (NE)CT to contrast-enhanced (CE)CT improves liver mass detection, characterization or patient management for initial staging or follow-up of patients with known breast, melanoma, neuroendocrine or thyroid cancer.

**METHOD AND MATERIALS**

A focused clinical question was constructed and the literature was searched using the patient, intervention, comparison, outcome (PICO) method comparing CECT vs. its combination with NECT for detection or characterization of liver metastases, the radiologists’ confidence level, and detection of significant incidental findings in patients with breast, melanoma, neuroendocrine or thyroid cancer. Retrieved articles were appraised and assigned a level of evidence based on the Oxford University Centre for Evidence-Based Medicine hierarchy of validity for diagnostic studies.

**RESULTS**

The retrieved diagnostic performance for different phases of CT for characterization of liver metastases showed sensitivity/specificity of 97%/76% for NECT, 97%/75% for arterial CT and 98%/76% for portal CT in patients with breast cancer (level 2 of evidence; reported in 1999); sensitivity of 90% (arterial and portal CT) vs. 100% (NECT, arterial and portal CT) in patients with melanoma (level 3 of evidence; reported in 1999); and sensitivity of 43% (portal CT) vs. 17% (NECT) in patients with neuroendocrine tumor (level 3 of evidence; reported in 2009). No primary study was found evaluating performance of CT phases in patients with thyroid cancer. Available evidence showed radiologists reported more conspicuous liver masses on CECT compared to NECT in patients with breast and neuroendocrine cancer; however, NECT was reported to add value to portal phase CT in 42% of patients with breast cancer.

**CONCLUSION**

NECT adds only a small incremental value to CECT for detection/characterization of liver metastases. Further, addition of NECT increases patient’s risk of exposure to radiation, and the time and cost of imaging interpretation. The role of adding NECT to CECT in confidence level of radiologists or characterization of significant incidental findings is less clear.

**CLINICAL RELEVANCE/APPLICATION**

A critical appraisal of literature shows addition of NECT to CECT for characterization of liver metastases in patients with breast, melanoma, neuroendocrine or thyroid cancer is of limited benefit.

**SSJ13-03 • Mobile Mammography Utilization Trends and Disparities Over a Decade at a Comprehensive Urban Cancer Center**

Sarah G Mizuguchi MD ; Elizabeth Riley MD * ; Laura E Barkley MD (Presenter) ; Lane M Roland MD ; Shesh N Rai PhD ; Jianmin Pan PhD ; Connie L Sorrell MPH ; Stacey M Crawford MD ; Laura Fry MBA

**PURPOSE**

Mobile mammography units (MMU) have become a model of community outreach. The purpose of this study is to assess the utilization of MMU in the largest county in Kentucky as it relates to race and insurance status.

**METHOD AND MATERIALS**

From January 2001 - December 2010, our MMU performed 21,858 screening mammograms. Demographic data was retrospectively reviewed to identity differences in screening utilization and return rates by race and insurance status. This data set was compared to existing census data for Jefferson County (JC) and Kentucky (KY). Descriptive statistics for patient age, race and insurance status were computed by entire cohort and within the subsets of cohorts. To study the patterns of frequency distributions, in-discrete variables were performed using Pearson Chi-square tests. For continuous variable range, a 95% confidence interval of mean was estimated. The comparison with a p-value < 0.05 was considered statistically significant.

**RESULTS**

Self reported Blacks (B) constitute 29% of the MMU utilization over the 10 year period. Whites (W) and Hispanics (H) represent 64% and 4%, respectively. Census data demographic reports are 19%, 74% and 3%, respectively. This discordance between demographic data of the MMU and the census data is statistically significant across all races (p<0.05). Census data demographic reports are 19%, 74% and 3%, respectively. This discordance between demographic data of the MMU and the census data is statistically significant across all races (p<0.05).

**CONCLUSION**

MMU captures minorities in greater density than JC and KY census data would predict. This data alone will help tailor future outreach and outcome initiatives to this specific patient population.

**CLINICAL RELEVANCE/APPLICATION**

Mobile mammography programs increase access to screening of disadvantaged populations. Understanding utilization by race and insurance has implications for funding, patterns of outreach and access.

**SSJ13-04 • Follow-up of Pulmonary Nodule Detected on Abdominal CT: Cost Implications for Adhering to Nationally Recommended Best-practice Guidelines**
Incidental pulmonary nodules are commonly identified on abdominal CT, which often require imaging follow-up, but cost implications for these recommendations are unknown. Our department has adopted a modified Fleischner guideline for use by abdominal radiologists, which is embedded into a point-of-care clinical decision support (CDS) tool for radiologists. We evaluated the cost implications when radiologists adhered to the guidelines using the CDS tool compared to recommendations made without use of the tool.

METHOD AND MATERIALS
The RIS was mined for abdominal CT reports from 1/1/12 – 10/22/12 describing a pulmonary nodule, which did not have prior abdominal/chest CT or concurrent chest CT. Inclusion criteria included solid, noncalcified, pulmonary nodule < 3 cm. The numbers of additional CT examinations recommended over 2 year f/u assuming no additional findings with and without the use of the CDS tool were compared. Without the tool, some recommendations varied from unnecessary additional imaging, insufficient imaging and appropriate imaging when compared to guidelines. CDS tool recommendations conformed to departmental guidelines.

RESULTS
Of 20,578 consecutive abdominal CT reports analyzed, 462 documented a pulmonary nodule. Manual review yielded 268 patients who met inclusion criteria. Without use of the CDS tool, imaging was recommended on 53% (143/268) which would have led to 409 f/u CTs over two years. Furthermore, excessive imaging was recommended for 23% (61/268) and insufficient imaging was recommended for 28% (74/268). Using the CDS tool would have recommended 592 f/u CT examinations in 190 patients (an additional 183 exams compared to without the CDS tool). Using MPFS payment for a non-contrast CT (71250 - $212.98), the total cost of recommended f/u without use of the tool would be $87,108.82 over two years. Recommendations conforming to departmental guidelines would have resulted in an increase of $38,975.35 for a total $126,084.16 in cost.

CONCLUSION
Compliance with nationally accepted best practice algorithms for follow-up of pulmonary nodules identified on abdominal CT leads to an increase in initial cost due to the greater number of imaging recommendations.

CLINICAL RELEVANCE/APPLICATION
Following departmental guidelines for pulmonary nodule workup would increase the short term cost. The effect on outcomes and long-term cost is not known.

SSJ13-05 • Breast Cancer Risk, Worry, and Anxiety: Effect on Patient Perceptions of False-positive Screening Results

Jessica Chubiz MS ; Janie M Lee MD (Presenter) * ; John S Swan MD ; Tina Motazed BS ; Elkan F Halpern PhD * ; G. Scott Gazelle MD, PhD * ; Karen Donelan DSC *

PURPOSE
To evaluate how women across the spectrum of breast cancer risk view breast cancer screening and its consequences, focusing on false-positive test results.

METHOD AND MATERIALS
From 7/1/11–12/31/12, women scheduled for breast cancer screening at an academic medical center were recruited to complete a survey online, by mail, or with assistance over the telephone. Using a scale ranging from 0 (equivalent to Dead) to 100 (Perfect Health), women rated their quality-of-life (QoL) for scenarios of breast cancer screening with mammography or MRI. Scenarios described the diagnostic testing period both before and after false-positive results were known. Breast cancer risk was calculated using Gail and BRCAPRO models, and categorized as low, intermediate, or high. Risk perception and breast cancer worry were also assessed. Trait anxiety was evaluated by the State Trait Anxiety Inventory (STAI). Univariate and multivariable linear regression was performed to identify predictors of QoL scores.

RESULTS
The response rate was 194/388 (50%). After excluding women with incomplete responses, 162 women at low (n=43, 26%), intermediate (n=66, 41%) and high risk (n=53, 33%) were included in the final analyses. Across all screening scenarios and risk levels, significant differences were seen in QoL scores while awaiting test results vs. when false-positive results were known (p < 0.05).

CONCLUSION
Regardless of risk level, women undergoing breast cancer screening have decreased QoL while awaiting biopsy results, which improves upon receipt of benign test results. Women with high anxiety levels have significantly decreased quality of life even after receipt of benign results at the end of diagnostic testing.

CLINICAL RELEVANCE/APPLICATION
Women with high baseline anxiety levels may obtain particular benefit from discussions regarding false-positive test results when selecting a breast cancer screening regimen.

SSJ13-06 • Appraisal of LI-RADS, AASLD and EASL-EORTC Guidelines for the Non-invasive Diagnosis of Hepatocellular Carcinoma in Patients with Liver Cirrhosis

Anne Carroll MBBCh (Presenter) ; Lisa P Lavelle MBBCh ; Eve O’Toole PhD ; Edmund Ronan Ryan MBBCh ; Dermot E Malone MD

PURPOSE
There are some differences between leading guidelines in their recommendations for the non-invasive diagnosis of Hepatocellular Carcinoma (HCC) in patients with liver cirrhosis. This study was performed to establish the relative validity of these guidelines using Evidence-Based Medicine (EBM) methodology.

METHOD AND MATERIALS
The American Association for the Study of Liver Disease (AASLD) 2010 guidelines, the European Association for the Study of the Liver and the European Association for Research and Treatment of Cancer (EASL-EORTC) 2011 joint guidelines and the American College of Radiology Liver Imaging Reporting and Data System (LI-RADS) v.2013.1 guidelines were appraised. To assess the methodological rigor and transparency used in developing the guidelines, the internationally recognized Appraisal of Guidelines for Research & Evaluation (AGREE) 2 Instrument was used. Each guideline was appraised under 6 different domains, followed by an overall assessment. The AGREE (74/268). The ideal algorithm using the CDS tool would have recommended 592 f/u CT examinations in 190 patients (an additional 183 exams compared to without the CDS tool). Using MPFS payment for a non-contrast CT (71250 - $212.98), the total cost of recommended f/u without use of the tool would be $87,108.82 over two years. Recommendations conforming to departmental guidelines would have resulted in an increase of $38,975.35 for a total $126,084.16 in cost.

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CLINICAL RELEVANCE/APPLICATION
Following departmental guidelines for pulmonary nodule workup would increase the short term cost. The effect on outcomes and long-term cost is not known.

SSJ13-05 • Breast Cancer Risk, Worry, and Anxiety: Effect on Patient Perceptions of False-positive Screening Results

Jessica Chubiz MS ; Janie M Lee MD (Presenter) * ; John S Swan MD ; Tina Motazed BS ; Elkan F Halpern PhD * ; G. Scott Gazelle MD, PhD * ; Karen Donelan DSC *

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CLINICAL RELEVANCE/APPLICATION
Women with high baseline anxiety levels may obtain particular benefit from discussions regarding false-positive test results when selecting a breast cancer screening regimen.

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Anne Carroll MBBCh (Presenter) ; Lisa P Lavelle MBBCh ; Eve O’Toole PhD ; Edmund Ronan Ryan MBBCh ; Dermot E Malone MD

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RESULTS
The Agree 2 scaled domain scores were calculated as follows: (obtained score – minimum possible score) / (maximum possible score – minimum possible score) x 100. The EASL-EORTC guidelines scored the highest at 83%. The AASLD guidelines scored 72% and the LI-RADS guidelines scored 50%. All 3 guidelines were recommended for use, but AASLD and LI-RADS guidelines would be improved by better referencing and better identification of the level of evidence behind the recommendations.

CONCLUSION
The methodological rigor and transparency of leading guidelines varies as described. If guidelines disagree, the EASL-EORTC 2011 guidelines have the highest validity by EBM criteria.

CLINICAL RELEVANCE/APPLICATION
EASL-EORTC 2011 are the highest quality current guidelines addressing the non-invasive diagnosis of HCC. They should be followed if
SSJ14-01 • Clinical Temporal Structured Query Language (ctSQL): A General Purpose Clinical Timeline Report Query System

Jaron Chong MD (Presenter)

CONCLUSION
We believe ctSQL extensions will offer a more expressive, accessible, and automated method for users to query for clinically significant events across a patient’s entire timeline.

Background
Traditional search applications utilize keyword and exact phrase matching to derive relevant search results. While very flexible in basic searches, clinical applications often require the consideration of not just the presence of concepts within a single document, but a series of events. This project describes the theoretical and practical implementation of syntax extensions to traditional boolean query operators to allow a search engine to implement clinical timeline searches.

Evaluation
Clinical Temporal Structured Query Language (ctSQL) is a syntax translation layer built upon existing PHP/SPHINX API's that converts a ctSQL query into a series of nested queries in SPHINX EXTENDED2 query format. Core concepts include (1) concept lists, (2) temporal operators, and (3) result chains. Concept lists are equivalent to traditional search queries and represent a series of keywords and boolean operators that can be matched to single full-text documents. Temporal queries represent chains of concept lists that have a particular event sequence specified using custom operator symbols that traverse multiple reports under a single patient identifier. Result chains are the natural consequence of ctSQL's emphasis on clinical timelines, with results returned as report chains instead of individual documents.

Discussion
Using this framework, more complex clinical queries can be resolved in an automated fashion delivering search results that can address more advanced clinical scenarios. We describe application examples involving (1) critical findings of pneumothorax and automated documentation of treatment (Closed Loop Pattern), (2) IVC filter insertion and retrieval (Closed Loop Pattern), and (3) lung nodule growth versus stability (Long-Term Timeline). Additionally, meta-information present within result chains allows for the straightforward calculation of quality-control metrics such as delays in management, follow-up, or disease progression.

SSJ14-02 • Taking the Hunting and Gathering Out of Radiology with Intelligent Personal Assistants

Mark A Flyer MD (Presenter); Jonathon Dreyer BS *

CONCLUSION
Virtual assistants will provide an intelligent layer between radiologists and their RIS or PACS. This will enable them to improve the quality of their reports while reducing the time it takes to create and deliver actionable information to the referring physician and, in turn, the patient.

Background
As the industry transitions from a traditional fee-for-service payment to value-based reimbursement, there is a risk that radiology will become marginalized. One emerging solution that aims to address this issue is an intelligent virtual assistant that can streamline the "hunting and gathering" of information for radiologists.

Evaluation
How can radiologists raise their visibility in the face of the integrated patient care cycle, underlining their importance and contribution to the goals of healthcare today? By leveraging virtual assistants to streamline tasks that involve time-intensive "hunting and gathering" of information, a virtual assistant is an embeddable piece of technology that actively listens and takes directives from a user—a radiologist or other clinical professional—and engages in conversational, human-like dialogs to fulfill specific requests. For example, virtual assistants can provide radiologists with more accurate, timely access to clinical guidelines and alert them to missing information in records. This presentation will discuss the wide ranging use cases and benefits associated with the integration of virtual assistants as part of the radiologists' workflow.

Discussion
As we've grown accustomed to the benefits and ease of use of voice-enabled personal assistants like Siri in our everyday lives ("Send text to my wife and let her know I'll be late for dinner"), we've also come to expect this same type of experience in our work lives. Nowhere is this type of virtual assistant technology—a solution that can streamline administrative tasks and aid in information retrieval—more critical than in the healthcare realm. Moreover, the ability to leverage a conversational user interface to make these interactions natural and human-like is critical as radiologists and clinicians alike face more complexity and increasing workloads as a result of ever-evolving state of healthcare.

SSJ14-03 • Implementation of a Pseudonymized Feedback System to Improve Individual Turnaround-times for Radiology Reports

Achim Escher (Presenter); Tobias Heye MD; Elmar M Merkle MD *

PURPOSE
To analyze turnaround-times for radiology reports as a key performance indicator (KPI) for referring physician's satisfaction and to implement a pseudonymized feedback system.

METHOD AND MATERIALS
The time period until a preliminary report was available for clinicians in the hospital information system and the time interval between preliminary to final reports were defined as report turn-around times. Calculation was based on data retrieved from the radiology information system (RIS) and a pseudonymized feedback system was developed and implemented. Hereby, an algorithm respecting complex schedules, including on-/off service times on nights and weekends providing a balanced assessment of turnaround times was used. The feedback system gives an overview of the average turnaround-times of the entire department, all sections (n =6) and each department member (n = 45) in a pseudonymized fashion. Each department member can locate himself/herself on pseudonymized graphs illustrating average turnaround-time of all department members by the identification code only provided to him/her.

The feedback system is composed of three different elements:

a) Monthly target-reporting stratified by sections presented in the department board-meeting to review the achievement of objectives.

b) Monthly benchmarking reports on the average turnaround-times stratified by the individual radiologist in a pseudonymized fashion.

c) The daily current workload for each section within the department was displayed as screen saver on all PACS workstations updated
every ten minutes.

RESULTS
Initial results comparing data from introduction of the feedback system in March 2013 with February 2013 showed an improvement in average turnaround-time by 11.4% for preliminary reports and by 8.5% for final reports. 70% of department members improved in their individual turnaround-times.

CONCLUSION
Initial results demonstrate that transparency, feedback and comparison of individual performances in relation to the pseudonymized peer group improve turnaround-times of radiology reports as an important KPI.

CLINICAL RELEVANCE/APPLICATION
Timely availability of radiology reports by improved turnaround-times expedites communication of relevant information to clinicians thus optimizing patient care.

SSJ14-04 • Trends in Inpatient Imaging Utilization Over the Last Decade

Atul B Shinagare MD (Presenter); Ivan Ip MD, MPH; Sarah K Abbott MD, MPH; Richard Hanson *; Steven E Seltzer MD *; Ramin Khorasani MD *

PURPOSE
We have previously reported inpatient imaging utilization trends at our institution from fiscal years (FY) 1984 through 2002. In this study, we assessed the trends in imaging utilization for inpatients from FY 2003 through 2012.

METHOD AND MATERIALS
In this institutional review board-approved, retrospective study performed at a 793-bed tertiary care academic institution, we reviewed imaging utilization in adult inpatients from October 1, 2002 through September 30, 2012 (FY 2003 through 2012) and recorded the gross number of imaging studies coded by modality (conventional [plain films and fluoroscopy], sonography, nuclear medicine [NM], CT, and MRI) and associated relative value units (RVUs). We used linear regression to assess trends in number of imaging studies and RVUs per case-mix-adjusted admissions (CMAA).

RESULTS
The total number of imaging studies as well as CT, NM and conventional studies adjusted for CMAA decreased (p=0.02, p=0.0006, p=0.0008 and p=0.001 respectively; Fig. 1); CT per CMAA increased until 2009 and then decreased through 2012. Utilization of ultrasound and MRI did not change significantly (p=0.15 and p=0.22, respectively). Unadjusted global RVUs increased until 2009 and then showed a slight decrease through 2012 (p=0.04), while RVUs per CMAA did not change significantly (p=0.18).

CONCLUSION
After decades of continued rise, imaging utilization for inpatients significantly decreased by most measures between 2009 and 2012. Future studies to evaluate the contribution of various factors to this decline, including efforts to reduce inappropriate use of imaging and concerns about potential harms of radiation exposure, may be helpful in optimizing imaging utilization and resource planning.

CLINICAL RELEVANCE/APPLICATION
Understanding the trends in imaging utilization is important to help optimize rational use of imaging as well as informed resource planning for healthcare institutions.

SSJ14-05 • The Commoditization of Healthcare Information Systems: Is the Time Now?

Nogah Haramati MD *; Anne C Krok (Presenter); Mony Weschler MSC, BSC; Gad Levy MD; Roni Zaharia *

PURPOSE
We assessed the advantages and disadvantages of at least partially commoditizing radiology healthcare information systems.

METHOD AND MATERIALS
Components included in the study: viewer, archive, worklist or workflow manager, 3D/volume rendering, CAD, decision support tools, integration/interoperability/data exchange engines or tools. Offerings of tools, as well as system components were analyzed from available products. Incorporation of additional functionalities deemed useful in practice but not available as part of an existing commercial “turn-key” PACS was included in this study.

RESULTS
Viewer: Majority of commercial systems have viewers that lack essential tools. Open market viewers exist that offer DICOM connectivity to existing archives. Archive: Vendor neutral DICOM archive (VNA) is the component that is most aggressively being marketed today. Many options exist in this space. Worklist or workflow manager: Rudimentary but not robust tools needed to create worklists exist as a commodity product. SEE Note A 3D/volume rendering: Advanced tools exist. Desktop integration into a viewer is variable. CAD: No consensus achieved within radiology regarding effectiveness and necessity of CAD tools. Availability and ease of incorporation of tools into an viewer is variable. Decision support tools: This area is one in which many of the needed tools are likely still lacking. SEE Note A. Integration/interoperability/data exchange engines or tools: Many vendors are demonstrating IHE XDS/XDSi capabilities at IHE connectathons. Ability to pull data in real-time from other clinical systems within an enterprise, even from the same vendor still lacking. NOTE A: Incorporating such tools into a commoditized system, rather than waiting for a vendor to incorporate these tools would likely result in a shorter time cycle from the research bench to the clinical workplace.

CONCLUSION
Viewer and archive commoditized products exist and rival those of commercial turnkey systems. Areas exist in which commoditized systems may be suitable to bring these functionalities to the desktop in a shorter time as compared to commercial vendor turnkey systems.

CLINICAL RELEVANCE/APPLICATION
Commoditized products are generally less expensive than complete systems. As healthcare organizations reach PACS end of life and look for a replacement, a commoditized alternative may offer higher funct

SSJ14-06 • The Evaluation of Academic Productivity Using Bibliometric Profiling

Nickalus R Khan BSc (Presenter); Asim F Choudhri MD

CONCLUSION
The analysis of academic productivity using bibliometric profiling is a robust way to delineate an individuals productivity. These indexes have use in academic medicine and may precede changes in academic rank or departmental rank. Understanding the calculation and use of these indices is paramount in the future of academic productivity evaluations.

Background
Bibliometrics is defined as the study of statistical and mathematical methods used to quantitatively analyze scientific literature. The application of bibliometrics in academic medicine is in its infancy. Recently there have been many new metrics introduced to evaluate academic productivity such as the h-index, contemporary h-index, m-quotient, g-index, e-index, Google’s i10, and more. Of these the h-index has gained the most attention. The authors describe the calculation, interpretation, and comparison of these bibliometric measures in academic medicine.

Evaluation
**Molecular Imaging (Neurosciences)**

**Tuesday, 03:00 PM - 04:00 PM • S504CD**

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**SS15 • AMA PRA Category 1 Credit ™: 1 • ARRT Category A+ Credit: 1**

**Moderator**

**Satoshi Minoshima, MD, PhD** *

**Moderator**

**Peter Herscovitch, MD**

**SSJ15-01 • Development and In Vivo Assessment of an Optimized EGFR Targeted PET Probe for Glioma Imaging**

**Eric Wehrenberg-Klee** MD (Presenter) ; **Navid Redjal** MD ; **Alicia Leece** ; **Pedram Heidari** MD ; **Nafize S Turker** PhD ; **Khalid Shah** PhD ; **Umar Mahmood** MD, PhD

**PURPOSE**

Distinguishing true progression of glioblastoma multiforme (GBM) from pseudoprogression after surgery with chemoradiation is quite challenging using current imaging techniques. EGFR is overexpressed on 40% of GBMs, and we hypothesized that targeted imaging could provide a novel mechanism for distinguishing recurrence from pseudoprogression in the large fraction of patients with confirmed baseline EGFR expression. We developed and preclinically tested a novel PET probe, 64Cu-DOTA-EGFR F(ab′)2, for direct tumor imaging based on EGFR expression, with optimized pharmacokinetics for clinically translatable PET imaging.

**METHOD AND MATERIALS**

An EGFR-specific imaging probe, 64Cu-DOTA-EGFR F(ab′)2 was developed with F(ab′)2 fragmentation and chelator conjugation of a humanized monoclonal antibody to EGFR. Probe affinity was assessed using Ga-67 labeling and saturation binding studies with EGFR positive A345 cells. For in vivo studies, GlI-36, an EGFR expressing GBM cell line transfected to express luciferase, was used. Nude (nu/nu) mice were injected intra-cranially with 5x10^4 GlI-36 cells. Prior to PET imaging, tumor growth was confirmed with bioluminescence. In vivo agent kinetics were established by imaging (n=3) mice at 4, 8, 16, and 22h after injection of 100 uCi of 64Cu-DOTA-EGFR F(ab′)2. Blocking studies were performed by injecting mice (n=3) with escalating doses of cetuximab 24h prior to agent administration.

**RESULTS**

**CONCLUSION**

Specific PET imaging of glioblastoma multiforme tumors that express EGFR is possible using the kinetically optimized novel PET imaging agent 64Cu-DOTA-EGFR F(ab′)2.

**CLINICAL RELEVANCE/APPLICATION**

A direct EGFR specific imaging agent for GBM tumors expressing EGFR may be able to confidently distinguish true progression from pseudoprogression, sparing patients the high surgical risks of biopsy.

**SSJ15-02 • EGFR MAb-bioconjugated Superparamagnetic Iron Oxide Nanoparticles as a Specific MRI Contrast Agent for Detection of Brain Glioma In Vivo**

**Wenzhen Zhu** MD, PhD (Presenter) ; **Shun Zhang** ; **Ketao Mu** PhD

**PURPOSE**

Superparamagnetic iron oxide nanoparticle (SPIONPs) delivery system has become a model system in which to study the target molecule-specific biodistribution, rapid excretion and undesired side-effects using in vivo small animal MRI. As a cellular transmembrane receptor, EGFR regulates important cellular processes and is linked to a poor prognosis in various human cancers. In this study, we developed a potentially valuable new targeted nanocarrier based on SPIO delivery system, EGFRmAb-bioconjugated nanoparticles—EGFRmAb-SPIONPs. The purpose of this study was to elucidate strategies for further improvement of this promising approach.

**METHOD AND MATERIALS**

EGFRmAb-SPIONPs were prepared and characterized. The preferential accumulation of the EGFRmAb-SPIONPs within gliomas and subsequent MRI contrast enhancement were demonstrated in vitro in C6 cells and in vivo in tumors of rat model. MRI scanning was performed using a 3.0T MRI scanner and a research coil insert designed specifically for imaging rats was used to MRI.

**RESULTS**

The average particle size of about 10.21 nm, hydrodynamic diameter of about 161.5 nm, saturation magnetization of 55 emu/g Fe and T2 relaxivity of 92.73 S-1mM-1 of the EGFRmAb-SPIOs suggested its applicability for MRI. MR T2WI of iron uptake in C6 cells treated with EGFRmAb-SPIONs were demonstrated in vitro in C6 cells and in vivo in tumors of rat model. MRI scanning was performed using a 3.0T MRI scanner and a research coil insert designed specifically for imaging rats was used to MRI.

**CONCLUSION**

EGFRmAb-SPIONPs could be specifically and efficiently uptaken by C6 glioma cells, and selectively improve the detection of tumor by MRI; it could produce the remarkable contrast change of brain glioma in vivo following intra-cardioid administration of EGFRmAb-SPIONPs.

**CLINICAL RELEVANCE/APPLICATION**

EGFRmAb-SPIONPs is suitable for use as negative MRI contrast agent, and had good biocompatibility and exhibited no toxicity, which was very important for the clinical application.

**SSJ15-03 • Imaging Biomarker Evaluation of Cytoskeletal Stabilization Therapy for Traumatic Brain Injury**

**Donna J Cross** PhD (Presenter) * ; **Rodney Ho** PhD * ; **Todd L Richards** PhD ; **Vasily L Yarnyk** PhD ; **Greg Garwin** ; **Pierre Mourad** ; **David Cook** ; **Satoshi Minoshima** MD, PhD *

**PURPOSE**

There are important differences among individuals using the three different currently available bibliometric databases. The interpretation of the h-index, g-index, m-quotient, and contemporary h-index can provide different perspectives into an individuals academic profile. There are large variations depending on which database is used and caution is advised when searching for individuals using Google Scholar or Web of Science.

**Discussion**

The h-index, g-index, m-quotient, and contemporary h-index are compared using Scopus, Web of Science, and Google Scholar. The differences between these databases are evaluated. The authors discuss the description of how to calculate these indexes and how to apply the indexes in the evaluation of academic productivity.
Multiple Sclerosis

**Methods and Materials**

Subjects, (C57BL6 mice, n=12, 10wks) had craniotomy plus controlled cortical impact (CCI) surgery under isoflurane anesthesia, (Leica Biosystems, Richmond, IL), followed by 200 ug/kg paclitaxel (n=6) or vehicle (n=6) applied to the brain injury site. Sham surgery (craniotomy no CCI) was performed on controls (n=3). At 2 days post surgery, subjects had gait assessment by CatWalk automated gait analysis (Noldus Information Tech, The Netherlands) followed by high-tesla MR imaging (14T MR Avance III Ultrafield, Bruker BioSpin, Billerica, MA). T1-weighted and quantitative T2 maps were obtained: MDEFT, FA:12°, TR:5000ms, TE:1.9ms, resolution 0.140x0.140x0.25mm3, 64 slices and, T2 map: TR=2000ms, 16 echoes, spacing:6.7ms, TE 1: 6.7ms, TE 2: 13.4ms, resolution 0.12x0.12x1.0mm3, 15 slices. Manual VOI analysis of lesion volume and volume of edema related to injury was performed.

**Results**

Lesion analysis on T2 and T1 images, blinded to therapeutic regimen, indicated 20% reduction in volume with paclitaxel treatment (9.96±2.3 versus 7.94±1.5mm3, p=0.05) and hyperintense voxels (edema) on quantitative T2 maps were reduced 26% (11.92±3.0 versus 8.6±2.2mm3, p=0.05). Paclitaxel resulted in improved gait (computer-recorded objective analysis) for maximum print area (0.38±0.09 versus 0.29±0.08cm2, p=0.05) and mean intensity (79.45±14.26 versus 66.38±5.52, p=0.05) over vehicle group.

**Conclusion**

The results indicate that administering drugs to stabilize axonal cytoskeleton following TBI improves outcome in neurological/gait assessment, also demonstrated as improvement on MR imaging biomarkers. This improvement appears to be mediated by reductions in size of lesion and corresponding post-injury edema. Evaluations of structural integrity on DTI and myelin degradation with magnetization transfer as well as western blot protein analysis are ongoing to better characterize the mechanisms of improved outcome after treatment.

**Clinical Relevance/Application**

This study provides evidence of the efficacy for microtubule-stabilizing drugs to improve outcome following traumatic brain injury and imaging assessment that can be translated to patient evaluation.

**SSJ15-04 • Dual-modality Imaging of Exogenous Endothelial Progenitor Cells in Ischemic Stroke Mouse**

**Ying Ying Bai (Presenter) ; Sheng Hong Ju MD, PhD**

**Purpose**

The objective was to noninvasively visualize the homing, migration and differentiation of exogenous EPCs in vivo using a dual-modality imaging probe, and to examine the effect of transplanted EPCs on the recovery of ischemic stroke.

**Method and Materials**

Bone-marrow derived EPCs were labeled with a multifunctional probe modified with gadolinium, Cy5.5 and rhodamine. EPCs(5×105) were transplanted via ipsilateral internal carotid artery into cortical ischemia mice induced by photothermalism. Magnetic Resonance(MR) and near-infrared(NIR) optical imaging were performed at different time points. The infarct areas were determined by T2WI-MR and bone-marrow derived EPCs were labeled with a multifunctional probe modified with gadolinium, Cy5.5 and rhodamine.

**Results**

After transplantation, the signal intensity enhancement was observed in stroke area on NIR imaging starting on day 1 and in perilesion region on MR imaging starting on day 3. The signal intensity reached their peak on day 5 in both imaging methods. Compared with unlabeled EPCs group, the fluorescent signal intensity had a remarkable increase from day 3 to 7(p<0.05).

**Conclusion**

Exogenous EPCs can be detected non-invasively on both MR and NIR imaging by using this probe. Transplanted EPCs could home to the ischemic-angiogenic region and promotes stroke recovery. The paracrine effects of EPCs in ischemia area may contribute to angiogenesis and neurogenesis.

**Clinical Relevance/Application**

EPCs treatment at 24 hours after the stroke onset when thrombolytic therapy doesn't work may promote the recovery of ischemic stroke patients.

**SSJ15-05 • Axonal Degeneration in Alzheimer Disease: Functional Investigation with Dynamic Manganese-enhanced MR Imaging**

**Christopher A Potter MD (Presenter) ; Nathalie M Martin BA ; Greg Garwin ; Yoshimi Anzai MD ; Satoshi Minoshima MD, PhD * ; Donna J Cross PhD **

**Purpose**

Axonal dysfunction is an early feature of Alzheimer disease (AD). Research implicates altered axonal transport as a possible cause. We hypothesize that the axonal transport rate in the olfactory tracts will decrease with age in triple transgenic AD mice.

**Method and Materials**

2 groups of triple transgenic AD model and wild-type mice were imaged on a 14T Bruker MR magnet at 1.5 months, prior to pathology and at 5 months of age, after synaptic dysfunction, A-beta plaque, neurofibrillary tangle formation and axonal degeneration. Unilateral intranasal injection of MnCl2 was administered. Mice were scanned dynamically using MDEFT (Modified Drive Equilibrium Fourier Transform) sequence for 45 min at 1 hour post MnCl2 (TR/TE:5000ms/1.9ms, resolution 0.140 x 0.140 x 0.25mm3) and again at 4 hours post for 80 min. Image processing was performed stereotactically in 3D atlas space (NEUROSTAT, UW Seattle) and pixel intensity normalized globally. VOI was used to measure average signal intensity change in the olfactory bulb. Uptake and rate of transport were estimated.

**Results**

Comparison with wild type mice, axonal transport significantly decreases in AD Tg mice as they age and develop known AD pathology. Although there is mild decrease in uptake and transport in aged WT mice, there is a significantly greater axonal transport decrease in AD Tg mice.

**Conclusion**

Investigation of axonal transport provides critical insights into pathogenesis of AD and facilitates new imaging developments that can be applied in the clinic.

**SSJ15-06 • Molecular Magnetic Resonance Immunoradiology Reveals Novel Effect of Interferon-Î' on Myeloid Cells in Murine Multiple Sclerosis**

**Benjamin Pulli MD (Presenter) ; Gregory R Wojtkiewicz MSc ; Lionel A Bure MD ; Muhammad Ali MBBS ; John Chen MD, PhD **

**Purpose**

Conventional contrast-enhanced MRI measures blood-brain-barrier breakdown, but not necessarily inflammation. We hypothesized that MPO-Gd (bis-SHT-DTPA-Gd), a molecular MRI probe sensitive and specific for the inflammatory enzyme myeloperoxidase (MPO), can...
detect therapeutic effects of Interferon-? (Ifn-?), a current first-line drug in MS and reveal changes in the immune response.

METHOD AND MATERIALS
Thirty-three female SJL mice were injected with proteolipid protein (PLP) to induce experimental autoimmune encephalomyelitis, a mouse model of MS, and treated with either Ifn-? (17g/day) or saline. To determine effects of Ifn-? on MPO, mice underwent MRI at 4.7T with MPO-Gd at the disease peak (day 12). Lesion volumes and CNR at 10 and 60 minutes post MPO-Gd injection were quantified. MPO activity assay and MPO secretion experiments were performed.

RESULTS
Disease severity was ameliorated with Ifn-? (p < 0.05; figure, D). Since Ifn-? is known to affect lymphocytes, we expected to see fewer lesions but not changes to MPO activity. Indeed, MPO-Gd enhanced MRI showed a smaller total (p < 0.05) and mean (p < 0.01) lesion volume with Ifn-? compared to saline (A+B). Surprisingly, while CNRs of lesions at 10 minutes post MPO-Gd injection, which mostly reflect edema, showed no benefit (p = 0.85), CNRs at 60 minutes post injection, which reflect MPO activity, were significantly lower with Ifn-? treatment (p < 0.01; A+B). Lesion-by-lesion quantification confirmed these findings (p = 0.06 for 10 minutes and p < 0.001 for 60 minutes post MPO-Gd injection; C). Brain homogenates from mice treated with Ifn-? had markedly reduced MPO activity (p < 0.01; E), validating the imaging findings. Myeloid cells showed less MPO secretion when incubated with Ifn-? (p < 0.05; F), but Ifn-? did not directly inhibit MPO activity (p = 0.93; G).

CONCLUSION
Our results revealed a new mechanism: Ifn-? directly acts on myeloid cells to decrease MPO secretion, contributing to the efficacy of this widely used drug. MPO-Gd enhanced MRI can detect inhibition of MPO secretion by Ifn-? non-invasively. This study also demonstrated the unique capability of molecular imaging to probe immunology in vivo.

CLINICAL RELEVANCE/APPLICATION
Upon translation, MPO-Gd molecular imaging could be used to monitor treatment efficacy of Ifn-? and similar drugs in MS patients.
RESULTS

avg HU within a region of interest (ROI) near hardware and for an ROI containing similar tissues on a slice without hardware.

metal-bone interface and overall quality. Accuracy of attenuation near hardware was quantified as the absolute difference (AD) between I-MRI and standard filtered back projection (FBP) in patients with shoulder arthroplasties (SA). Images were reconstructed on a standalone workstation with a smooth kernel (B30) and 0.6mm collimation, eff pitch 0.35-0.8). Images were reconstituted on a side by side comparison from best=1 to worst=4 for bone, soft tissue, functional and clinical outcome after SLAP repair.

CLINICAL RELEVANCE/APPLICATION

Indirect shoulder arthrography is a less invasive alternative to Direct shoulder arthrography with comparable sensitivity.

SSJ16-03 • Usefulness of Pre and Post MR Arthrogram Imaging of the Shoulder in Detection of Unstable Labral Tears

Thomas H Magee MD (Presenter)

PURPOSE

Shoulder surgeons commonly intervene on unstable labral tears (those tears that displace with patient movement). Surgeons can detect unstable tears at surgery. It is difficult to be certain a tear is unstable on a static MR image. We report the benefit of pre and post arthrogram MR imaging in detection of unstable labral tears.

METHOD AND MATERIALS

One hundred fifty consecutive conventional shoulder MR and MR arthrogram exams performed on the same patients were reviewed retrospectively by consensus reading of two musculoskeletal radiologists. Both conventional MR and MR arthrogram exams were performed on each patient on the same day. Labral tears were assessed. It was also determined if there was any difference in position of the labral tear comparing pre and post arthographic images. All patients went on to arthroscopy.

RESULTS

Of these one hundred fifty patients, ninety-four had SLAP (superior labral anterior to posterior) tears, fifty three had posterior labral tears and forty two had anterior labral tears on MR exam. All one hundred fifty patients went on to arthroscopy. All lesions described on MR were described on arthroscopy. Twenty three SLAP tears, sixteen posterior labral tears and seventeen anterior labral tears demonstrated a change in the position of the labral tear on pre versus post arthographic images. All of these labral tears were considered unstable by the surgeon and all of these patients had surgical tacking performed.

There were five SLAP tears, three anterior labral tears and four posterior labral tears seen on arthroscopy not seen on MR or MR arthrogram examination.

CONCLUSION

In this study, pre and post arthrogram MR imaging of the shoulder was useful in demonstrating unstable labral tears in twenty three patients with SLAP tears, sixteen patients with posterior labral tears and seventeen patients with anterior labral tears. This information was useful in surgical planning.

CLINICAL RELEVANCE/APPLICATION

Pre and post arthrogram MR imaging of the shoulder is useful in demonstrating unstable labral tears. This information is useful in pre surgical planning.

SSJ16-04 • Postoperative CT Arthographic Features of Superior Labral Anterior-to-Posterior Lesions: Correlation with Functional and Clinical Outcome

Bohwa Choi (Presenter) ; Na Ra Kim MD ; Sung Gyu Moon MD ; Jin-Young Park MD

PURPOSE

To assess the presence of a superior labral cleft on postoperative CT arthography after superior labral anterior to posterior lesion (SLAP) repair and to evaluate whether such superior labral clefts are correlated to functional and clinical outcome.

METHOD AND MATERIALS

Forty six patients (37 men, nine women; mean age, 35 years) were included and underwent CT arthography of the shoulder after arthroscopic SLAP repair. Two musculoskeletal radiologists reviewed CT arthographic images for the presence and size of a superior labral cleft defined as a detectable contrast material-filled focal discontinuity of the labrum within anchor fixation sites of the glenoid on an oblique coronal image. The extent, direction of curvature, and marginal irregularity of a superior labral cleft were assessed on axial, oblique coronal and oblique sagittal CT arthographic images. The functional and clinical outcome was evaluated by using the American Shoulder and Elbow Surgeons (ASES) scoring. The mean time interval between surgery and postoperative CT arthography was 16.9 months (range, 7 to 63 months).

RESULTS

The superior labral cleft was found in 52% (24 of 46). The mean width and depth of the superior labral cleft were 2.0mm ± 1.1 and 2.8mm ± 0.9. When present, the superior labral cleft extended posterior to the biceps anchor in 62.5% (15 of 24), was curved medially in 91.7% (22 of 24), and had a smooth margin 79.2% (19 of 24). No significant association was seen between the presence, width and depth of a superior labral cleft, and ASES score (P = .569, .633 and .067, respectively). The superior labral clefts were seen more commonly in long time interval between surgery and postoperative CT arthography (P = .018).

CONCLUSION

Shallow superior labral clefts can be frequently seen after arthroscopic SLAP repair at long-term follow-up. The presence of superior labral clefts do not necessarily correlate with functional and clinical outcome after SLAP repair.

CLINICAL RELEVANCE/APPLICATION

Shallow superior labral clefts can be frequently seen after SLAP repair. The presence of superior labral clefts do not necessarily correlate with functional and clinical outcome after SLAP repair.

SSJ16-05 • Novel CT Metal Artifact Reduction Prototype for Evaluation of Shoulder Arthroplasties

Naveen Subhas MD (Presenter) * ; Sahar Shiraj MD ; Andrew Primak PhD * ; Joshua M Polster MD ; Andreas Krauss PhD * ; Jean P Schils MD ; Joseph Iannotti *

PURPOSE

Iterative metal artifact reduction (IMAR) is a new sinogram inpainting technique to reduce CT metal artifact which adds high frequency data to improve visualization close to metal edges. Our purpose was to compare the image quality and accuracy of attenuation values near hardware of IMAR and standard filtered back projection (FBP) in patients with shoulder arthroplasties (SA).

METHOD AND MATERIALS

Eight patients (6 male, avg age 60) with 9 SAs were scanned on a FLASH CT (Siemens) with a standard protocol (140 kVp, 300 eff mAs, 0.6mm collimation, eff pitch 0.35-0.8). Images were reconstructed on a standalone workstation with a smooth kernel (B30) and 0.6mm slice thickness. 3 IMAR reconstructions with different amounts of high frequency data: IMAR (least), IMAR1.5 (more), IMAR2.5 (most) and FBP were ranked for image quality by 5 readers in a side by side comparison from best=1 to worst=4 for bone, soft tissue, metal-bone interface and overall quality. Accuracy of attenuation near hardware was quantified as the absolute difference (AD) between avg HU within a region of interest (ROI) near hardware and for an ROI containing similar tissues on a slice without hardware.

RESULTS

100%, with a positive predictive value of 94%, and a 0% false negative percentage.

CONCLUSION

Direct shoulder arthrography is currently as the gold standard imaging technique in the diagnosis of labral pathology. However, indirect shoulder arthrography is a less invasive alternative, which is extremely helpful in the young population. In this series, the sensitivity of I-MRI for detecting labral pathology was 94% (100% for the second reader) which is comparable to the historical range reported for D-MRI of 88-96%. It appears that I-MRI may be a reasonable and less invasive alternative to D-MRI in young patients.

CLINICAL RELEVANCE/APPLICATION

Indirect shoulder arthrography is a less invasive alternative to Direct shoulder arthrography with comparable sensitivity.
**Musculoskeletal (Cartilage, Arthritis)**

**Tuesday, 03:00 PM - 04:00 PM** • **E451B**

**SSJ16-06 • CT Metal Artifact Reduction in Internally Fixed Proximal Humeral Shaft Fractures: Comparison between Monoenergetic Extrapolation of Dual Energy and Iterative Artifact Reduction Algorithms**

Sebastian Winkloher MD (Presenter); Fabian Morsbach; Emanuel Benninger MD; Stefan Rahm MD; Steffen Ross MD; Bernhard Jost MD; Christian Spross MD; Paul Stolzmann MD; Michael J Thali MD; Hatem Alkadhi MD; Roman Guggenberger

**PURPOSE**

To assess the value of monoenergetic extrapolations from dual-energy computed tomography (DECT) and standard filtered back projections (FBP) from single-energy computed tomography (SECT) compared to a new iterative frequency split-normalized (IFS) metal artifact reconstruction (MAR) algorithm for artifact reduction in internally fixed humeral fractures.

**METHOD AND MATERIALS**

In this cadaveric study, artifacts in seven internally fixed humeral fractures of five subjects were examined with SECT and DECT. Postprocessing included routinely used FBP algorithm, a new IFS-MAR algorithm, and monoenergetic extrapolation of DECT images. Image analysis included quantitative assessment of image artifacts (HU measurements) as well as evaluation of image quality and osteosynthesis material and visualization of screw position in FBP, IFS-MAR, and DECT using a five-point Likert scale.

**RESULTS**

HU values of streak artifacts were significantly (P < .05) different between FBP (115.7±222.4) and IFS-MAR (68.7±106.3), and between FBP and monoenergetic DECT (10.1±146.1). Between IFS-MAR and DECT no significant differences were detected (P = .30). Artifact scores in IFS-MAR and DECT were significantly lower than those in FBP (P < .05). No significant differences were seen between IFS-MAR and DECT (P = .10). Visualization scores of osteosynthesis material differed significantly (P < .05) between FBP (2.9) and IFS-MAR (2.3) and between DECT (2.6; P < .05), whereas no significant differences were seen between IFS-MAR and DECT in 11 cases, with a subjectively better visualization in DECT.

**CONCLUSION**

IFS-MAR algorithm in SECT as well as monoenergetic extrapolations from DECT allow for an improved image quality, a reduction of artifacts and better assessment of screw-position compared to standard FBP in SECT.

**CLINICAL RELEVANCE/APPLICATION**

Both, dual-energy CT and a newly applied iterative frequency split-normalized metal artifact reconstruction algorithm for CT are promising techniques for metal artifact reduction in internally fixed fractures.

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**SSJ17-01 • Quantitative Magnetic Resonance Imaging (MRI) Evaluation of Cartilage Repair Tissue after Microfracture in Rabbit Knee Joint Osteochondritis Dissecans (OCD) Models: Correlation with Histological Examination**

H Tao (Presenter); Zhan Wang; Shuang Chen MD

**PURPOSE**

To quantitatively evaluate the MRI appearances of repair tissue (RT) after microfracture treatment for osteochondritis dissecans (OCD) models compared to joint debridement and investigate the correlation with histological examination.

**METHOD AND MATERIALS**

The animal experiment was approved by the Animal Care and Use Committee of our college. Twenty-seven OCD models in rabbit knee joints were assigned into 2 groups, 18 for microfracture group and 9 for joint debridement. At 3,5,7 weeks post-op respectively, a third of each group would take MRI scan mainly including 3D double echo steady state sequence (3D-DESS) and multi-echo spin-echo technique. Operation sites were removed to make H-E, Masson and Safranin-O staining sections. MR images were used to quantitatively calculate the thickness index and T2 value index of RT. The histological performances were semi-quantitatively evaluated (T2-mapping). Operation sites were removed to make H-E, Masson and Safranin-O staining sections. MR images were used to quantitatively calculate the thickness index and T2 value index of RT. The histological performances were semi-quantitatively evaluated (T2-mapping). Operation sites were removed to make H-E, Masson and Safranin-O staining sections. MR images were used to quantitatively calculate the thickness index and T2 value index of RT. The histological performances were semi-quantitatively evaluated (T2-mapping).

**RESULTS**

The thickness index and semi-quantitative histological scores of RT in two groups were increasing gradually post-op, while T2 value index was decreasing. At 3 weeks, the T2 value index of microfracture group was lower than that of joint debridement (P=.032 and .013). For microfracture group, the RT was mainly composed of hyaline-like cartilage tissue, with more production of well-organized collagen fibrils and glycosaminoglycan (GAG). However, for joint debridement, RT was mainly composed of fibrous and scar tissue.

**CONCLUSION**

The study revealed the correlation between MRI and histological performance, which indicated the potential value of using MRI 3D-DESS and T2-mapping as a noninvasive tool to evaluate the process of cartilage repair.

**CLINICAL RELEVANCE/APPLICATION**

MR 3D-DESS and T2-mapping which can reflex information about thickness and biochemical properties of RT provides a noninvasive and effective tool to evaluate RT condition after microfracture for OCD.

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**SSJ17-02 • In Vitro Comparative Study of T2 and T2* Mappings of Human Articular Cartilage Using 3-Tesla Magnetic Resonance Imaging: MRI-histologic Correlation after Total Knee Arthroplasty**

Tayhee Kim (Presenter); Kyu-Sung Kwack MD, PhD; Hakil Kim; Xuanen Cui
SSJ17-04 • Our data do not indicate that MTX may protect cartilage despite remission.

CONCLUSION

MCP III 523 ms ± 100 ms; eRA patients: MCP II 414 ms ± 119 ms (p<0.001). The dGEMRIC index was significantly decreased in eRA patients compared to healthy subjects (healthy volunteers: MCP II 488 ms ± 90 ms, MCP III 523 ms ± 100 ms; eRA patients: MCP II 414 ms ± 119 ms (p<0.001)).

RESULTS

The mean relaxation values for tibial cartilage were 56.6 ± 14.1 ms for T2 and 24.2 ± 14.3 ms for T2*. The mean difference between T2 and T2* values was 31 ± 20.5 ms. Pearson correlation analysis proved a positive correlation between T2 values and histologic grade (correlation coefficient = 0.386, p<0.05).

CONCLUSION

As previously reported in other studies, T2 mapping is well correlated to histological degeneration of the cartilage and may be good biomarker for osteoarthritis in human articular cartilage. Although T2* value had been known to be decreased with increasing cartilage degeneration, T2* value didn't show statistical significant correlation in this study. Therefore, T2* mapping may not be appropriate for initial diagnosis of cartilage degeneration.

CLINICAL RELEVANCE/APPLICATION

T2 mapping is superior to T2* mapping for the evaluation of human articular cartilage degeneration. T2* mapping may not be appropriate for initial diagnosis of cartilage degeneration.

SSJ17-03 • Assessment of Morphology, gagCEST and T2 Mapping in Cartilage Repair Tissue after Chondrosphere-based Autologous Chondrocyte Transplantation

Benjamin Schmitt (Presenter) *; Ferzan Suezer *; Patrik Zamecnik MD; Marco Essig MD *; Siegfried Trattnig MD; Rainer Siebold

PURPOSE

To compare results from morphological imaging, glycosaminoglycan-dependent chemical exchange saturation transfer (gagCEST) imaging and T2 mapping in a population of 30 patients after a novel chondrosphere-based autologous chondrocyte transplantation in the knee at 3 Tesla.

METHOD AND MATERIALS

Morphological MRI, T2 mapping and gagCEST imaging were performed on a clinical 3T MR scanner. Scan time for 3D gagCEST of one knee was 12:48 min with a saturation module optimized by simulation of Bloch equations, and T2 mapping was performed with a multi-echo spin echo approach. Results from gagCEST and T2 mapping in repair tissue were compared with results from native cartilage in the corresponding area of the contralateral knee as an unbiased reference. Due to regional variations in biological composition of cartilage, results from repair tissue grouped for trochlea, femoral condyles and patella were compared in groups with the native references. Differences between lesions and references were statistically analysed. Morphological scoring was done with the MOCART score.

RESULTS

Morphological imaging showed a total failure of transplants in only 3 cases (MOCART=0). The remaining cases largely presented with morphologically intact transplants, which is also supported by a high median MOCART score of 65 points (interquartile range=15 points). Regarding the entire population, neither gagCEST nor T2 mapping revealed any significant differences between cartilage transplants and reference cartilage in the contralateral knee. Nevertheless, few individual cases showed clear differences between transplant and reference. Analysis of relationships between T2 values and gagCEST signal intensities showed no significant correlation (P=0.536).

CONCLUSION

The high morphologic integrity of the transplants together with no significant differences between transplants and reference cartilage in the biochemical imaging techniques suggests a high quality of the transplants. Furthermore our study indicates that using the contralateral knee as a reference to assess outcomes of repair tissue is a key element to avoid a bias compared with using a potentially biochemically different native part of cartilage from the same knee.

CLINICAL RELEVANCE/APPLICATION

Functional and morphological imaging showed no differences to reference tissue for the assessed cartilage repair technique indicating better performance than alternative techniques.

SSJ17-04 • The Effect of Initial Methotrexate Therapy on Cartilage Composition in Early Rheumatoid Arthritis: Follow-up with Biochemical MRI of Finger Cartilage

Falk R Miese MD (Presenter); Benedikt Ostendorf; Hans-Joerg Wittsack PhD; Christoph Schleich; Christoph Nowak; Gerald Antoch MD *

PURPOSE

To test for initial status and subsequent recovery of cartilage glycosaminoglycan content in metacarpal phalangeal joints (MCP) in patients with early rheumatoid arthritis (eRA) undergoing Methotrexate (MTX) therapy with delayed Gd(DTPA)2- enhanced MRI of the cartilage (dGEMRIC).

METHOD AND MATERIALS

MCP II and III in 19 patients with eRA and 13 healthy volunteers and were examined (eRA patients: 13 females, six males, mean age 51 years, range 25-69; eRA 6 months follow-up patients: 7 females, one male, mean age 48 years, range 33-68; healthy volunteers: ten females, three males, mean age 51 years, range 25-66). dGEMRIC was acquired using the variable flip angle technique (VFA). dGEMRIC index was measured in phalangeal and metacarpal cartilage with manually drawn region-of-interest evaluation. Cartilage thickness was determined as a conventional measure of cartilage integrity. Statistical analysis used non-parametric Mann-Whitney-U-Test to test for significant differences between the groups. Remission was assessed using DAS 28 and CRP.

RESULTS

dGEMRIC index was significantly decreased in eRA patients compared to healthy subjects (healthy volunteers: MCP II 488 ms ± 90 ms, MCP III 523 ms ± 100 ms; eRA patients: MCP II 414 ms ± 119 ms (p<0.001)). In therapy naive eRA, there was a decrease in cartilage glycosaminoglycan content in metacarpophalangeal joints. Glycosaminoglycan content as assessed with dGEMRIC of normal appearing finger cartilage did not significantly improve after MTX therapy despite clinical remission. dGEMRIC may be a possible tool for studies on cartilage protection in RA therapy.

CONCLUSION

Our data do not indicate that MTX may protect cartilage despite remission.

SSJ17-05 • Aiming for a Shorter MR Screening Protocol of the Hand in Early Arthritis: Is there Additional Value of Gadolinium?

Aiming for a Shorter MR Screening Protocol of the Hand in Early Arthritis: Is there Additional Value of Gadolinium?

\[ \text{Math} \]

\[ \text{Equation} \]

\[ \text{Formula} \]
Gadolinium contrast enhanced MRI images are used to assess synovitis and tenosynovitis in arthritis. We compared wrist synovitis and tenosynovitis on MRI images without gadolinium (Gd-) with gadolinium-enhanced MRI (Gd+) as the reference method to determine whether contrast administration can be omitted.

METHOD AND MATERIALS
MRI imaging of the wrist was performed in 93 early arthritis patients on a 1.5 Tesla extremity MRI. Sequences included coronal T1, coronal fat-suppressed T2 and post-gadolinium coronal and axial T1 with fat suppression. Additionally a transversal T2-weighted sequence was added to facilitate evaluation. All datasets were scored twice by 2 experienced readers, once using only unenhanced images, and another time using the complete image sets, according the OMERACT RA MRI scoring system (RAMRIS) and a tenosynovitis score.

RESULTS
Intrareader intraclass correlations between Gd- and Gd+ sequences were 0.76 for synovitis and 0.71 for tenosynovitis for reader 1 and 0.83 and 0.57 for reader 2 respectively. At the individual joint/tendon level, concordance rates for presence or absence of inflammation were 74-77%/5 for synovitis and 84-85% for tenosynovitis. Disconcordance of more than 1 point in RAMRIS score was rare (1.8% of synovitis and 2.4% of tenosynovitis scores). Without gadolinium contrast, the sensitivity of synovitis depiction in individual joints was 72 and 91% for both readers; the specificity was 52 and 81% for both readers, indicating that without Gd synovitis was inappropriately identified in 19-48% of joints. For tenosynovitis sensitivity was 54 and 67% and specificity 88 and 91% for each reader.

CONCLUSION
When assessing articular joints, omitting gadolinium contrast gives suboptimal results. Although total scores show moderate to good agreement, sensitivity and specificity are markedly decreased and therefore it cannot be recommended for clinical evaluation. When only total scores are important, e.g. when monitoring therapy response, it may be considered at the cost of reduced reliability.

CLINICAL RELEVANCE/APPLICATION
Omitting gadolinium decreases invasiveness, lowers costs and shortens imaging time, however our data show that this is achieved at the cost of reduced sensitivity and specificity.

SSJ17-06 • Frequency of Subclinical Axial Inflammation in Skin Psoriasis by Whole-body MRI

Vlad A Bratu MD (Presenter) ; Ulrich Weber MD ; Peter Hausermann MD ; Ulrich A Walker MD ; Thomas Daikeler MD ; Veronika Zubler ; Ueli Studler MD

PURPOSE
Our aim was to assess the prevalence of axial skeleton changes by whole-body MRI (wbMRI) in skin psoriasis patients without clinical evidence of arthritis and in age- and sex-matched healthy controls.

METHOD AND MATERIALS
Twenty-five patients (median age 52; range 20-69) with plaque psoriasis and no history or clinical evidence of arthritis and twenty-five age- and sex-matched healthy controls with no history of inflammatory back pain or skin psoriasis were recruited by the Nordic questionnaire. All patients and controls were clinically examined by the same dermatologist and rheumatologist according to a standardized protocol. All subjects underwent standardized unenhanced 1.5 T wbMRI (coronal and sagittal T1w and STIR). Image sets including both the sacroiliac joints (SIJ) and the entire spine were read in a random order and independently by a radiologist and a rheumatologist blinded to the clinical and demographic parameters. The readers recorded the presence of spondyloarthritis (SpA) by a global assessment of the SIJ and spine images on a confidence scale of 0-10 (0=definitely no SpA, 10=definite SpA). Bone marrow edema (BME), fatty marrow infiltration (FMI) and erosive changes in each SIJ quadrant were recorded by the Morpho module. Spinal BME and FMI of all discovertebral units from C2/3 to L5/S1 were assessed according to the CanDen module. The lesion prevalence was expressed as mean percentage of subjects with ≥2 affected SIJ-quadrants or ≥2 spinal lesions in each group according to the two readers. Fisher's exact test was used to test for a significant difference in prevalence between the 2 groups (p=0.05).

RESULTS
24% of healthy controls and 30% of skin psoriasis patients were classified as axial SpA by global wbMRI assessment. A high classification confidence (8-10) was recorded in 12% of controls and 18% of patients. The differences between the 2 groups were not statistically significant, both for the global and the lesion-based assessment in the spine and the SIJ.

CONCLUSION
On wbMRI every fourth healthy control was falsely classified as axial SpA. Skin psoriasis patients without clinical evidence of axial or peripheral arthritis showed a similar frequency of SIJ and spinal changes as healthy controls.

CLINICAL RELEVANCE/APPLICATION
Subclinical axial inflammation in skin psoriasis patients might be overestimated on wbMRI since matched healthy subjects showed a similar frequency of MRI-findings.
Twenty-three SLE patients with (n = 7) or without (n = 16) neuropsychiatric symptoms were enrolled; all of them showed no abnormalities in the basal ganglia at conventional MR study. The age/sex-matched 23 controls were also enrolled. For SLE patients and controls, two radiologists independently measured mean susceptibility values and R2* rates in seven brain structures (thalamus, putamen, caudate, globus pallidus, pons, splenium of corpus callosum, and frontal white matter) that appears normal on conventional MR images.

RESULTS
In the putamen and globus pallidus, the mean susceptibility values were significantly higher for the SLE patients than for the controls (P < .05 corrected by Monte-Carlo simulation) in regions including precentral, postcentral and supramarginal in the left hemisphere, and none in the right hemisphere. When SLE patients with EM deficit were compared to control subjects, there were only precuneus and superior parietal in left hemisphere. Comparing SLE patients without EM deficit and controls, none survived the Monte-Carlo simulation.

CONCLUSION
Corroborating previous findings among the areas of statistic significant reduction of cortical thickness, the precuneus has been implicated in visuo-spatial imagery, episodic memory retrieval, perspective taking and the experience of ‘agency’. Moreover, the precuneus has rich cortical and subcortical connections with other regions, including the supramarginal and postcentral gyri, with also have reduced cortical thickness in these patients. These findings corroborate the central nervous system involvement in patients with SLE and demonstrate the correlation between structural and functional abnormalities.

CLINICAL RELEVANCE/APPLICATION
SLE is a disease with frequent associated cognitive impairments, and there is not enough knowledge on the relationship between the cortical thickness of brain regions and episodic memory deficits.

SSJ18-03 • A Diffusion Tensor Imaging and Neuropsychological Study of Abstraction/Executive Impairment in HIV-infected Patients

Rafael F Cabral MD (Presenter); Denise Greca; Tania M Netto PhD; Thomas M Doring MSc; Tadeu T Kubo MSc; Rochele P Fonseca; Romeu C Domingues MD; Emerson L Gasparetto MD

PURPOSE
HIV-infected patients develop brain injury and neurocognitive impairment despite the regular use of highly active antiretroviral therapy (HAART). The purpose of this study is to evaluate whether abnormal fractional anisotropy (FA) and mean diffusivity (MD) in normal-appearing white matter (WM) of HIV-infected patients is related to abstraction / executive impairment on neuropsychological tests.

METHOD AND MATERIALS
We evaluated 55 HIV-infected patients (40 males, mean age 41 years) and 27 healthy individuals matched by sex, age, years of education and Mini Mental State Examination. Images were obtained using a 1.5T scanner, with a single-shot spin-echo diffusion-weighted echo-planar pulse sequence with 73 sections covering the whole brain at 2.1-mm section thickness (TR / TE = 11320/ 94 ms). The assessment of the integrity of white matter was performed by measures of FA and MD using regions-of-interest (ROI). We analyzed correlation between the deficit score of abstraction / executive function within the mean values of FA and MD of specific areas of cerebral WM. The statistical analysis was performed assessing the relationship of deficit score of abstraction / executive function on HIV-infected patients and FA / MD values, and p

RESULTS
The mean FA was reduced in the white matter of frontal lobes, and there were small areas of increased MD in these lobes. There was a high and significant inverse correlation between FA and deficit score of abstraction / executive function on HIV-infected patients (p

CONCLUSION
The presented results corroborate previous studies that show CNS involvement in HIV-infected patients, showing specific areas of change in white matter in these cases. Correlation between these findings and neuropsychological evaluations allows us to suggest that injuries caused by HIV are strongly related to the onset of neurocognitive impairment in HIV-infected patients.

CLINICAL RELEVANCE/APPLICATION
The unique spatial distribution of white matter injury at different stages of HIV infection, as measured by DTI, may provide a useful marker to monitor HIV-associated central nervous system injury.

SSJ18-04 • Comparative 3T 1H MR Spectroscopy and FDG-PET Study of the Brain Metabolism in HIV-infection

Anna V Trofimova MD, PhD (Presenter); Tatiana Trofimova; Galina Kataeva; Svyatoslav Medvedev; Elena Gromova; Nikolay Belyakov

PURPOSE
To reveal patterns of brain metabolism changes in HIV using 3T 1H MR spectroscopy and FDG-PET

METHOD AND MATERIALS
We studied 15 patients with early HIV (plasma CD4-lymphocytes >350 cells/mcl),19 patients with later HIV (plasma CD4-lymphocytes 1H MR spectroscopy: frontal white matter, basal nuclei, hippocampus, brain stem. 2D 1H MR spectroscopy was performed with a preselected volume at the supraventricular level, metabolites ratios were analyzed in white and gray matter in anterior, posterior frontal
and parietal regions. PET-FDG study with relative evaluation of rCMRglu were performed. ROIs corresponded to Brodmann areas, subcortical nuclei and hemispheres of cerebellum. Individual images were spatially normalized with SPM. WFU Pick Atlas was used to calculate mean regional values. Statistics were calculated by using STATISTICA software package, factorial ANOVA with p

**RESULTS**

SV 1H MR spectroscopy did not reveal difference between groups. 2D 1H MR spectroscopy revealed decrease of Naa/Cr in the parietal white matter in later HIV (2,051±0,03) as compared to controls (2,189±0,03). In the cortex Naa/Cr was decreased in the frontal lobe in early (1,57±0,017) and later HIV (1,60±0,015) as compared to controls (1,68±0,017). Cho/Cr was significantly higher in early HIV in all white matter (1,146±0,013) and in the frontal gray matter (1,034±0,014) as compared to later HIV (1,069±0,012 and 0,900±0,014) and controls (1,005±0,013 and 0,880±0,014). Naa/Cho was decreased in all white matter in both HIV groups. In the cortex Naa/Cho was decreased in early HIV in anterior (1,552±0,031) and posterior frontal lobe (1,815±0,038), in later HIV was decreased in anterior frontal lobe (1,640±0,029). FDG-PET study revealed decrease of rCMRglu in Brodmann areas 24 and 32 bilaterally in both HIV groups, what corresponded to Naa/Cr, Naa/Cho decrease and Cho/Cr increase in the frontal gray matter. In other ROIs (cerebellum, Brodmann areas 27, 28, 34, 35, 36 of the left hemisphere) significant decrease was revealed only in early HIV.

**CONCLUSION**

Brain metabolism alterations are more prominent in early HIV, with similar pattern of cortex involvement revealed by 1H MR spectroscopy and FDG-PET.

**CLINICAL RELEVANCE/APPLICATION**

1H MR spectroscopy reveals brain metabolism alterations in early HIV and can be used to assess extent of the CNS involvement, disease progression.

**SSJ18-05 • Aberrant Brain Functional Connectivity Related to Insulin Resistance in Type 2 Diabetes: A Resting-state Functional MR Imaging Study**

**Yu-Chen Chen** (Presenter) ; **Yun Jiao** PhD ; **Ying Cui** ; **Gao-Jun Teng** MD

**PURPOSE**

Insulin resistance is a causal factor in type 2 diabetes mellitus (T2DM) patients, and plays a role in developing Alzheimer’s disease (AD). Our study mainly aims to investigate the relationship between abnormal resting-state brain functional connectivity and insulin resistance in T2DM patients.

**METHOD AND MATERIALS**

30 patients with T2DM and 31 healthy well-matched volunteers were prospectively examined. Resting-state brain functional connectivity analysis was used to examine the correlation between posterior cingulate cortex (PCC) and whole-brain regions. Further analysis involved evaluation of possible relationships between functional connectivity measures and insulin resistance indexed by the homeostasis model assessment of insulin resistance (HOMA-IR).

**RESULTS**

Compared with healthy controls, we observed significantly decreased functional connectivity within some default mode network (DMN) regions including the right middle temporal gyrus (MTG), right middle frontal gyrus, right inferior parietal lobe and other selected regions including left lingual gyrus, left middle occipital gyrus, and increased functional connectivity in right superior frontal gyrus, left precentral gyrus. Moreover, a significant negative correlation between the PCC-MTG connectivity and HOMA-IR was found in T2DM patients (p=0.022; r=-0.417).

**CONCLUSION**

T2DM patients have aberrant functional connectivity in the DMN, which is related to insulin resistance in selected brain regions. Resting-state connectivity disturbance of PCC-MTG may be a central role for cognitive dysfunction in T2DM patients with insulin resistance.

**CLINICAL RELEVANCE/APPLICATION**

fMRI can be used to track the very early progression of brain functional alterations associated with T2DM. Abnormal PCC-MTG values may be regarded as a potential marker to identify cognitive decline.

**SSJ18-06 • Study on Brain Structure and Cognitive Function in Patients with Chronic Mountain Sickness in 3T MRI**

**Hai Hua Bao** (Presenter) ; **Mingli He**

**PURPOSE**

To study cerebral white matter microstructure change in patients with chronic mountain sickness (CMS) with 3T MRI.

**METHOD AND MATERIALS**

17 cases of CMS and 15 normal subjects included in the study. The examination was performed on Philips 3T scanner and sequences were T1WI, T2WI, DWI and DTI. The FA and ADC values of the two groups were obtained from the regions of interest in the frontal lobe white matter, lenticular nucleus, external capsule, corpus callosum, et al, and then were compared. The relationships between FA/ADC values and CMS severity and cognitive function (Mini-Mental State Examination score) were investigated.

**RESULTS**

1) In the CMS group, 6 patients showed slight cerebral edema, multiple ischemic foci and lacunar infarction foci in 15 patients and lacunar infarction complicated by ischemic foci in 3 patients. 2) Statistical results showed that the FA values of the right frontal lobe white matter in the CMS group were significantly lower (t = -2.736, P < 0.05). The ADC values of the anterior limb of the right internal capsule in the CMS group were significantly higher (t = 2.353, P < 0.05). In the CMS group, the FA values in the left caudate nucleus and the ADC values in the left thalamus were positively correlated with hemoglobin values (r = 0.533, P = 0.027; r = 0.674, P = 0.003). In the CMS group, the FA values in the anterior limb of the left internal capsule and the ADC values in the right hippocampus were negatively correlated with the MMSE scores (r = -0.667, P = 0.009; r = -0.590, P = 0.026). In the CMS group, ruptured or twisted white matter fiber tracts at the bleeding part were observed in 3 patients with intracranial hemorrhage.

**CONCLUSION**

**CLINICAL RELEVANCE/APPLICATION**

Providing imaging reference materials of CMS patients for clinical doctors.
CONCLUSION
Poorly-controlled patients showed a significantly higher degree of connectivity than well-controlled patients in the connections between isthmus of cingulate gyrus and parahippocampal cortex (PHC), fusiform gyrus and PHC, and inferior temporal cortex and PHC.

Patients showed a significantly lower degree of connectivity than controls in the connections between the following pairs of regions:

RESULTS
To quantify the WM connectivity of the temporal lobe ipsilateral to the seizure on set zone.

Nineteen patients with MTLE and 28 age- and sex-matched healthy control subjects underwent dMRI scans. Patients were divided into a

METHOD AND MATERIALS
To report the increasing frequency of temporal anteroinferior encephalocele diagnosis in our tertiary care epilepsy center and to illustrate mainly the imaging characteristics of this condition in a series of 19 patients. Altogether 22 patients have been reported in the literature, largest series being 3 patients.

RESULTS
Nineteen epilepsy patients (12 females, mean age 40 years) were diagnosed with temporal anteroinferior encephalocele. Eleven patients had two or more encephaloceles and five patients had bilateral encephaloceles. The estimated prevalence of this condition was 0.3% in MRI examinations performed due to newly diagnosed epilepsy (n=4) and 2.2% in drug-resistant patients referred to our institute as epilepsy surgery candidates (n=15). High-quality, thin-slice, preferably three-dimensional MRI and computed tomography studies facilitated the detection of this condition. The mean of maximal diameter of the lesions was 11.6 mm (range, 3-48 mm) and the mean of maximal diameter of the bony defect orifice was 8.7 mm (range, 3-46 mm). PET-CT showed temporal lobe hypometabolism in 6/9 patients, all were ipsilateral to the lesion. Ten patients had epilepsy surgery. Patients with local encephalocele disconnection (n=3) or anterior temporal lobectomy and amygdalohippocampectomy (n=5) have become seizure free in a mean 1.6 years (range 3 months - 3 years) of follow up. The remaining two surgically treated patients are very recent and lack follow up data. Histologically gliosis was present in temporal lobe samples in all surgically treated patients and encephaloceles also showed cortical laminar disorganization.

CONCLUSION
The possibility of temporal anteroinferior encephalocele should be considered when interpreting MRI examinations of patients with medically intractable temporal lobe epilepsy. These patients can significantly benefit from epilepsy surgery.

CLINICAL RELEVANCE/APPLICATION
Identifying temporal anteroinferior encephalocele as the cause for medically intractable epilepsy is important as these patients are excellent candidates for epilepsy surgery.

SSJ19-02 • Temporal Anteroinferior Encephalocele: A Poorly Recognized Etiology of Temporal Lobe Epilepsy?
Taavi Saavalainen MD (Presenter) ; Leena Jutila ; Esa Mervaala MD, PhD ; Arto Immonen MD, PhD ; Reetta Kalviainen ; Ritva L Vanninen MD

PURPOSE
To report the increasing frequency of temporal anteroinferior encephalocele diagnosis in our tertiary care epilepsy center and to illustrate mainly the imaging characteristics of this condition in a series of 19 patients. Altogether 22 patients have been reported in the literature, largest series being 3 patients.

METHOD AND MATERIALS
Epilepsy patients diagnosed with temporal anteroinferior encephalocele during the study period (January 2007 - March 2013) in our hospital were included. All patients had MRI examinations (mainly 3T, Philips Achieva TX) according to an epilepsy protocol which was complemented with additional sequences. 3D-CT and PET-CT were acquired from surgical candidates when necessary.

RESULTS
Nineteen epilepsy patients (12 females, mean age 40 years) were diagnosed with temporal anteroinferior encephalocele. Eleven patients had two or more encephaloceles and five patients had bilateral encephaloceles. The estimated prevalence of this condition was 0.3% in MRI examinations performed due to newly diagnosed epilepsy (n=4) and 2.2% in drug-resistant patients referred to our institute as epilepsy surgery candidates (n=15). High-quality, thin-slice, preferably three-dimensional MRI and computed tomography studies facilitated the detection of this condition. The mean of maximal diameter of the lesions was 11.6 mm (range, 3-48 mm) and the mean of maximal diameter of the bony defect orifice was 8.7 mm (range, 3-46 mm). PET-CT showed temporal lobe hypometabolism in 6/9 patients, all were ipsilateral to the lesion. Ten patients had epilepsy surgery. Patients with local encephalocele disconnection (n=3) or anterior temporal lobectomy and amygdalohippocampectomy (n=5) have become seizure free in a mean 1.6 years (range 3 months - 3 years) of follow up. The remaining two surgically treated patients are very recent and lack follow up data. Histologically gliosis was present in temporal lobe samples in all surgically treated patients and encephaloceles also showed cortical laminar disorganization.

CONCLUSION
The possibility of temporal anteroinferior encephalocele should be considered when interpreting MRI examinations of patients with medically intractable temporal lobe epilepsy. These patients can significantly benefit from epilepsy surgery.

CLINICAL RELEVANCE/APPLICATION
Identifying temporal anteroinferior encephalocele as the cause for medically intractable epilepsy is important as these patients are excellent candidates for epilepsy surgery.

SSJ19-03 • Altered Axonal Connectivity in Medial Temporal Lobe Epilepsy: Association with Disease Severity
Ali Tabesh PhD (Presenter) ; Travis O Nesland ; Jens H Jensen PhD ; Maria Vittoria Spampinato MD ; Jonathan C Edwards ; Joseph A Helpern PhD * ; Leonardo Bonilha MD, PhD

PURPOSE
Although medial temporal lobe epilepsy (MTLE) is a common neurological disorder, there remains a lack of reliable biomarkers for monitoring its clinical course and treatment response. Diffusion MRI (dMRI) tractography is a unique and powerful tool for characterization of white matter (WM) connectivity and may provide entirely new insights into network abnormalities associated with MTLE. The goals of this study were to investigate WM connectivity changes in MTLE, and to evaluate the association between these alterations and disease severity (seizure frequency) in patients.

METHOD AND MATERIALS
Nineteen patients with MTLE and 28 age- and sex-matched healthy control subjects underwent dMRI scans. Patients were divided into a well-controlled (= 4 seizures a year) and a poorly controlled subgroup based on their response to antiepileptic drug therapy. The two subgroups did not significantly differ in terms of age, age of seizure onset, or duration of disease. Streamline tractography was employed to quantify the WM connectivity of the temporal lobe ipsilateral to the seizure onset zone.

RESULTS
Patients showed a significantly lower degree of connectivity than controls in the connections between the following pairs of regions: isthmus of cingulate gyrus and parahippocampal cortex (PHC), fusiform gyrus and PHC, and inferior temporal cortex and PHC. Poorly-controlled patients showed a significantly higher degree of connectivity than well-controlled patients in the connections between the following regions: temporal pole and putamen, and entorhinal cortex and amygdala.

CONCLUSION
Our results suggest that WM connectivity measures derived from dMRI tractography may be sensitive to altered axonal connectivity in MTLE. Moreover, WM connectivity markers may potentially enable more reliable identification of patients with medication-refractory MTLE. Supported by the Foundation of the American Society of Neuroradiology and the South Carolina Clinical and Translational Research Institute.

**CLINICAL RELEVANCE/APPLICATION**

Axonal connectivity measures based on dMRI tractography may provide complementary information for clinical evaluation of MTLE.

**SSJ19-04 • Evaluation of Focus Laterality in Temporal Lobe Epilepsy: A Quantitative Study Comparing Double Inversion-recovery MR Imaging at 3T with FDG-PET**

Emiko Momoto MD (Presenter) ; Tomohisa Okada MD, PhD ; Mitsunori Kanagaki MD, PhD ; Akira Yamamoto MD, PhD ; Yasutaka Fushimi MD, PhD ; Riki Matsumoto MD, PhD ; Shigetoshi Takaya MD, PhD ; Akio Ikeda MD, PhD ; Takeharu Kunieda MD, PhD ; Takayuki Kikuchi MD, PhD ; Dominik Paul * ; Susumu Miyamoto MD, PhD ; Ryosuke Takahashi MD, PhD ; Kaori Togashi MD, PhD *

**PURPOSE**

To quantitatively compare diagnostic capability of double inversion recovery (DIR) with fluorine-18 fluorodeoxyglucose positron emission tomography (FDG-PET) for detection of seizure focus laterality in temporal lobe epilepsy (TLE).

**METHOD AND MATERIALS**

This study was approved by the institutional review board, and written informed consent was obtained. Fifteen TLE patients and 38 healthy volunteers were enrolled. All MR images were acquired using a 3T-MRI system. Voxel-based analysis was conducted for FDG-PET images and white matter segments of DIR images (DIR-WM) focused on the whole temporal lobe (TL) and the anterior part of the temporal lobe (ATL). Distribution of hypometabolic areas on FDG-PET and increased signal intensity areas on DIR-WM was evaluated, and their laterality was compared with clinically-determined seizure focus laterality. Correct diagnostic rates of laterality were evaluated, and agreement between DIR-WM and FDG-PET was assessed using χ² statistics.

**RESULTS**

Increased signal intensity areas on DIR-WM were located at the vicinity of the hypometabolic areas on FDG-PET, especially in the ATL. Correct diagnostic rates of seizure focus laterality for DIR-WM (0.80 and 0.67 for the TL and the ATL, respectively) were slightly higher than those for FDG-PET (0.67 and 0.60 for the TL and the ATL, respectively). Agreement of laterality between DIR-WM and FDG-PET was substantial for the TL and almost perfect for the ATL (κ = 0.67 and 0.86, respectively).

**CONCLUSION**

High agreement in localization between DIR-WM and FDG-PET and nearly equivalent detectability of them show us an additional role of MRI in temporal lobe epilepsy.

**CLINICAL RELEVANCE/APPLICATION**

For evaluation of seizure focus in TLE, DIR would play an indispensable role to avoid radiation exposure, especially in children, and when FDG-PET examination is not available.

**SSJ19-05 • DTI Fiber Tracking Biomarkers for Characterization of Focal Cortical Dysplasias**

Rammohan Vadapalli MD (Presenter) ; Sita Jayalakshmi ; Manas Panigrahi MChir ; Anuj Jain MD ; Abhinav Sriram S Vadapalli ; Meghna Vadapalli BEng

**PURPOSE**

Purpose To evaluate the role of new generation Diffusion tensor imaging Biomarkers for characterization of Focal cortical dysplasias, especially the Radial (perpendicular)Diffusivity(?2+ ?3 )?3 maps , Radial diffusivity:FA ratio by depicting the microstructural patterns.

**METHOD AND MATERIALS**

Material and methods

seventy six patients in age group of 6 -44 years with M: F ratio of 3:2 with refractory epilepsy had undergone a MRI study on a 3T MRI(achieva Philips) TLE+ETLE protocol (T2 relaxometry, volumetry and MRS of Hippocampi with MRS,3D T1,3D T2 followed by a Medium high resolution DTI(diffusion Tensor Imaging) with following parameters. Axial Plane B value: 1000 Number of directions 15 ,TR 6248 TE 60 Slice thickness 2mm with 0.5 inter slice gap,NSA 2,Matrix 112x112 bandwidth 29.8 . These data were post processed using Fibertrack and Intrasense (Myrian) SW to generate FA maps, Eigen vector Maps ? 1,2 ,3 Radial diffusivity maps with ROI and mirror ROI in contralateral side. Areas of Focal cortical dysplasia were mapped and analysed.

**RESULTS**

Results: Qualitative biomarkers like asymmetry,Fiber architecture in region of dysplasia and Quantitative Parameters like FA, Mean Diffusivity,Fiber density count were studied.

Type I B FCD(n=11)
1. reduced FA
2. Increased MD
3. Mean value of Radial Diffusivity(Perpendicular Diffusivity ) Increased
4. Fiber architecture appeared normal with Normal fiber density.
5. ?3 is significantly increased.

Type IIA IIB ((n=34).

-Reduced FA
- abnormal color coded directionality maps due to disorganized fiber structure in dysplasia(n=34).
- radial or Perpendicular diffusivity is significantly increased with RD :FA ratio of >10.

Type III : showed Ipsilateral MTS(n=26), Bilateral MTS(n=5).
In all the cases of associated FCD with Secondary MTS reduced FA,increased perpendicular diffusivity and fiber architectural abnormalities are evident.

**CONCLUSION**

1.FCD Type I B are better seen on Radial Diffusivity maps. 2.Radial diffusivity is Increased in TypeIIB>IIA>IB(p=MD or FA >Conventional MR sequences 4.FA/RD ratio is a specific biomarker of Type II FCD.(p=

**CLINICAL RELEVANCE/APPLICATION**

Dysplastic cortex is known to be extending beyond MR visible abnormality and DTI visible subtle White matter abnormalities also extend beyond ,hence these Biomarkers can map the true extent of FCD.

**SSJ19-06 • Three-dimensional MRI Texture Analysis Reveals Subtle Textural Alterations in the White Matter and Deep Gray Matter in Progressive Myoclonic Epilepsy Type 1 or Unverricht-Lundborg Disease (EPM1)**

Sanna Suoranta MD (Presenter) ; Kirsu K Holi MSC, PhD ; Eini I Niskanen PhD ; Paivi Koskenkorva MD ; Reetta Kalviainen ; Ritva L Vanninen MD

**PURPOSE**

To investigate the feasibility of three-dimensional MRI texture analysis (3DTA) in the detection of subtle white matter (WM) and deep gray matter (GM) changes in EPM1. EPM1 is a rare neurodegenerative disorder caused by the mutations in the Cystatin B gene (CSTB). Despite the severe neurological symptoms no focal MR changes of the brain are found in visual assessment. Diffusion tensor imaging...
Dynamic Contrast Enhanced-computed Tomography

SSJ20-02 • Implant Dentistry

Tuesday, 03:00 PM - 04:00 PM • N229

Kristine Blackham

Moderator

Colin P Derdeyn

Moderator

RESULTS

Visual assessment revealed no focal signal changes. Compared to the healthy controls, EPM1 patients showed statistically significant textural differences both in WM and GM. Compared to the WM VOIs, textural differences predominated in the deep GM. In right thalamus 28 %, left thalamus 37 %, and right putamen 26 % of the textural parameters differed amongst the 223 parameters analyzed. In WM, numbers of differing parameters were less frequent; left pons 19 %, corpus callosum genu 12 %, corpus 10 % and splenium 18 %; left corona radiate 14 %; right centrum semiovale 14 %. The number of differing parameters was less than 10 % in the remaining VOIs. The differing textural features included parameters based on histogram, gradient, co-occurrence matrix and run-length matrix.

CONCLUSION

WM textural alterations are widespread but less obvious than the deep GM findings. The 3DTA findings indicate that the texture of WM and deep GM in EPM1 patients is more coarse, complex and heterogeneous than in controls supporting widespread WM pathology in line with the previous DTI findings.

CLINICAL RELEVANCE/APPLICATION

3DTA is able to reveal subtle morphological changes in MR images that cannot be detected by visual inspection. In patients with EPM1 3DTA is more sensitive to show alterations in deep GM than in WM.

Neuroradiology (Neurointerventional Radiology)

Tuesday, 03:00 PM - 04:00 PM • N229

SSJ20 • AMRA PRA Category I Credit TM:1 • ARRT Category A+ Credit:1

Moderator

Colin P Derdeyn, MD *

Moderator

Kristine Blackham, MD *

SSJ20-01 • Radiological Sinus Lift: A New Minimally Invasive CT-scan Guided Procedure to Maxillary Sinus Floor Elevation in Implant Dentistry

Jean-François Matern, MD (Presenter); Francis P Veillon, MD; Thomas Bridonneau, MD; Jean Carvahlo, MD; Pierre Keller, DMD, MSc

PURPOSE

Implant therapy has become an excellent treatment modality since its inception into the modern era of dentistry. However, when patients present with advanced atrophy of the maxilla ridge, the procedure of choice to restore the anatomic bone deficiency is surgical maxillary sinus floor elevation. The purpose of this study is to describe the CT-scan guided sinus lift technique and to prove the minimal invasive aspect of this new radiological procedure.

METHOD AND MATERIALS

For this prospective study, 17 cadaver heads were analyzed by cone beam CT (CBCT) and panoramic to response to our inclusion criteria (maxillary edentulous posterior sector and bone height inferior to 5mm). For each step, procedure was controlled by CT-scan and sinusal endoscopy. The radiological sinus lift technique consists of the following 4 stages: 1. Approach. A 14.5 G OstyCut needle was inserted mesial to the canine eminence and manually drilling was performed in parallel direction to the sinus floor. 2. Osteotomy. Inner obturator was introduced to compress bone and to create an osseous window opened to the submucosal space. 3. Lifting. The sinus lift was performed by hydrodissection with diluted lidocaine contrast media agent. 4. Filing. The submucosal space filing was performed by injection of diluted collagen. A dome shape visualized in the maxillary alveolar recess defines the success of the radiological sinus lift procedure. All radiological maxillary sinus floor elevations were scanned postoperatively with panoramic and maxillary CBCT.

RESULTS

Twelve maxillary sinuses were included to radiological sinus floor elevation procedure. Dome shape of the Schneiderian membrane performed in 8 maxillary sinuses (66.7%). All failures (n=4) were caused by mucosal perforation at the time of maxillary sinus osteotomy. Mean elevated membrane height was 12.0mm for a mean intervention time of 45 minutes. Radiological exposures were 79.0 mGy.cm DLP and 22.8 mGy CTDOv.

CONCLUSION

The present experimental study reports a new minimally radiological procedure to maxillary sinus floor elevation. This study proposes a radiological interventional alternative to classic surgical approach with an equivalent success rate according to the literature.

CLINICAL RELEVANCE/APPLICATION

The radiological sinus lift will provide less tissue injury, a more physiological approach to more homogenous maxillary sinus membrane elevation and less failure over surgical procedure.

SSJ20-02 • Quantitative Evaluation of Acute Tumor Response Following Focused Ultrasound and Microbubble Treatment Using Dynamic Contrast Enhanced-computed Tomography

Hassaan Ahmed, BSc (Presenter); Ting-Yim Lee, MSc, PhD *; Kullervo H Hynynen, PhD; Rajiv Chopra, PhD *

PURPOSE

To quantitatively evaluate acute tumor response following focused ultrasound (FUS) and microbubble (MB) treatment using dynamic contrast-enhanced computed tomography (DCE-CT) in a rat glioma model.

METHOD AND MATERIALS

A stereotactic frame was used to surgically implant 1 x 10^6 C6 glioma cells in the right cerebral hemisphere of three rats. When the tumor occupied about 50% of the implanted hemisphere, it was trans-cranially sonicated with a 10ms burst length and a 1 Hz repetition frequency for 120s, at an acoustic power of 0.5W using a 563-MHz FUS system (FUS Instruments Inc., Canada). The sonications were guided by baseline axial CT images and the corresponding blood-brain-barrier (BBB) permeability surface area product (PS) and cerebral blood flow (CBF) maps calculated by CT Perfusion (GE Healthcare). A region in the contralateral hemisphere was also sonicated 5 minutes following the tumor sonication to confirm the targeted axial slice. Definity (Lantheus Medical Imaging, USA) microbubbles at a dose of 20 µl/kg were administered simultaneously with both sonications. Serial DCE-CT scans were performed out to 4 hours post sonication to monitor the acute response in BBB PS and CBF.

RESULTS

The tumor BBB PS at 150 minutes post sonication (2.7 +/- 1.3 ml/min/100g) was significantly lower (p < 0.05) than at baseline (5.7 +/- -
SSJ20-04 • MR Imaging in Intracranial Aneurysms Treated by Intra-aneurismal Flow Disrupter: the LUNA™ Aneurysm Embolization System (AES)

Elisa Pomero (Presenter) ; Arnaud Flores ; Clelia Billon Grand ; Francoise Cattin ; Alessandra Biondi MD *

PURPOSE
New devices in the treatment of intracranial aneurysms include intra-aneurysmal flow disrupters. The MR imaging of these new devices has not been reported. The purpose of our study is to report MRI findings in a consecutive series of patients treated with the LUNA™ Aneurysm Embolization System, a new intra-aneurysmal self-expandable, round-void flow disrupter implant.

METHOD AND MATERIALS
A total of 12 unruptured aneurysms were treated in 12 patients. Ten lesions were located in the anterior circulation and 2 lesions were in the posterior circulation. In addition, all patients underwent 24 hours DSA control and 24-48 hours MR study including evaluation of silent lesions. Three months MR FU was available in all patients and 1 year MR FU in 11. MR studies were performed on a 3Tesla MR unit. Our MR protocol included DWI, T2WI FLAIR, coronal TIWI, axial PDWI, axial T2WI, Angio-MR 3D-TOF. In all patients, 1 year MR FU included Inhanced 3D Velocity with Gadolinium injection. Follow-up included Digital Subtraction Angiography (DSA) at 6 and 12 months. Results were compared with the angiographic findings.

RESULTS
Immediate angiographic occlusion was achieved in 3 cases, near complete in 3 and incomplete occlusion in 6. The LUNA™ device presents a marked signal void in all sequence. Evaluation of aneurysm occlusion on MR images without contrast injection showed a good correlation with angiographic findings in 80% of cases. The thrombosed aneurysm sac was evident on PDWI and T2WI sequences. In patients with an angiographically thrombosed aneurysm, T1 WIs showed a hyperintense halo in 91% of cases corresponding to the thrombosed space between the device and the aneurysm wall. A “crescent moon sign” due to the device shape and related to persistent flow at the base of the aneurysm was seen in TOF sequences. Residual or recurrent aneurysm (20 %) could be visualized on the MR study only after contrast injection suggesting that LUNA™ device masks the slow flow signal.

CONCLUSION
Although DSA FU is mandatory, preliminary results suggest that contrast enhanced MRI is an efficient tool in assessing the occlusion of the aneurysms treated by the LUNA™ .

CLINICAL RELEVANCE/APPLICATION
To our knowledge, there are no MR studies specifically dealing with intra-aneurysmal flow disrupter devices. We report our experience in MRI and DSA correlation in patients treated with LUNA™ .

SSJ20-05 • Ethanol and/or Radiofrequency Ablation: Efficacy and Safety for Treatment of Venolymphatic Malformation Manifested as a Bulging Mass in the Head and Neck

Hyun Jung Koo MD (Presenter) ; Jeong Hyun Lee MD, PhD ; Rangyoung Yoon ; So Hyun Cho MD ; Young Jun Choi MD ; Jung Hwan Baek ; Seung-Ho Choi ; Soon Yuhl Nam ; Sang Yoon Kim ; Dae Chul Suh

PURPOSE
To evaluated the efficacy of safety of ethanol and/or radiofrequency ablation of venolymphatic malformation (VLM) manifested as a bulging mass in the head and neck

METHOD AND MATERIALS
From July 2009 to February 2013, thirteen patients (F : M = 7 : 4; a mean age of 26, ranging from 5 to 48 years) with VLM presented as a bulging mass in the head and neck were treated with ethanol ablation (EA) and/or radiofrequency ablation (RFA). Treatment response was assessed by the degree of volume reduction and cosmetic grading scores (1 – 4) which was recorded before and at the last follow-up. Volume reduction was compared with the characteristics of the target lesions including component (venous, macrocytic lymphatic, and microcytic lymphatic), the initial volume and the presence of any functional structure close to the treated lesions. Complication after EA and/or RFA was also evaluated.
RESULTS
Five patients with macrocystic lymphatic malformation (MLM) were treated with EA, 4 with venous malformation (VM) with RFA, and 4 with microcystic lymphatic malformation (mLM) with RFA (n=2) or both EA and RFA (n=2). Median number of total treatment sessions was 1 ranging from 1 – 4. Volume reduction at the last follow-up was near complete (> 90%) in all five patients with MLM, three of four with VM, and one of four with mLM. Moderate response (> 50% and <=90%) was seen in VM (n=1) or MLM close to the mandibular branch of the facial nerve (n=3) showed moderate response. The mean cosmetic grading score was decreased from 3.8 ± 0.4 to 1.5 ± 0.8 (p < 0.05). The initial volume was not significantly correlated with number of treatment session or treatment response. No major complications were encountered.

CONCLUSION
EA and/or RFA is an effective and safe treatment method for VLM presented as a bulging mass in the head and neck, which showed > 90% of volume reduction in 9 of 13 patients and significant cosmetic improvement in all patients regardless of the internal component, the initial volume or the presence of any functional structures close to the treated lesions.

CLINICAL RELEVANCE/APPLICATION
EA and/or RFA can be one of treatment methods to manage VLM in the head and neck, with providing excellent cosmetic outcome.

SSJ20-06 • An Assembled Prototype Multi-material 3D Printed Model of the Neck for CT and Ultrasound-guided Interventional Procedures
Ramin Javan MD (Presenter)

PURPOSE
The aim of this project was to design a prototype semi-realistic multi-material model of the neck for CT and ultrasound-guided interventions.

METHOD AND MATERIALS
Autodesk 3D Studio Max, MeshLab, OsiriX and Materialise Mimics software were used to three-dimensionally reconstruct a multitude of virtual 3D models, including the cervical spine vertebral column, cervical spinal cord, trachea, thyroid gland, internal jugular vein and carotid arteries. A variety of rapid prototyping techniques and materials were used to 3D print the elements of the final assembled model using commercially available services. A gypsum-based model of the cervical spine that contains the cervical portion of the spinal cord and its respective nerve roots extending outside the neuroforamina. The trachea was made with polyamide material and also serves as the assembly reference point of the entire model with struts as support apparatus. The hollow vessels were created with tango-black rubber-like flexible material. A thyroid gland mold was made with polyamide. The thyroid gland itself is composed of ballistic-grade gelatin mixed with psyllium to simulate echotexture and with calcium chloride to simulate iodine content. It contains masses of high or low density/echogenicity, which are made by injecting sodium alginate solution with or without hydrogel particles into calcium chloride solution. Level II lymph nodes and parotid glands, which are made the same way as the thyroid masses, are mounted on struts emanating from the trachea. The assembled model was submerged in a container filled with high-concentration gelatin/pectin, which was allowed to congeal in cold temperature, simulating soft tissues of the neck.

RESULTS
The cervical spine is radiodense due to high calcium content of the gypsum, which can be used to practice cervical spine pain management interventions. The rubber-like vessel walls allow for passage of needles simulating vascular access. The thyroid nodules and lymph nodes can be used for practicing fine-needle aspirations. The model is designed to be both CT and ultrasound compatible.

CONCLUSION
A prototype dual-modality interventional phantom of the neck was successfully developed using 3D printing and molding techniques with a multitude of materials.

CLINICAL RELEVANCE/APPLICATION
This neck model can be used for practicing CT and ultrasound-guided procedures and also serve as a prototype for developing more complex 3D printed models.
PURPOSE
Tc-99m sestamibi (MIBI) scintigraphy is commonly utilized for the preoperative location of parathyroid adenomas. A focal area of tracer retention that persists on delayed images is fairly specific for a parathyroid adenoma. Occasionally, there are 2 foci of MIBI retention on delayed imaging, which theoretically suggests a double parathyroid adenoma. Our aim was to determine just how often this finding was shown to represent a double adenoma.

METHOD AND MATERIALS
Over a 4-year interval, all parathyroid scans with the finding of 2 areas of MIBI concentration in initial images of the neck, that retained the tracer on 3-hour delayed images were collected and corresponding histopathological results were reviewed.

RESULTS
A total of 16 patients demonstrated the above finding. Of these, 14 underwent neck exploration; 12 were diagnosed as having asymmetric parathyroid gland hyperplasia, while only 2 were diagnosed with double parathyroid adenoma.

CONCLUSION
Of the group of 14 patients whose parathyroid scintigraphy showed 2 areas of MIBI retention on 3-hour delayed images of neck, 12 (85.7%) had asymmetric parathyroid hyperplasia, whereas only 2 patients with this finding had true double adenoma.

CLINICAL RELEVANCE/APPLICATION
In parathyroid scintigraphy, 2 foci of tracer retention more than likely indicate parathyroid gland hyperplasia, as opposed to double parathyroid adenoma.

SSJ21-03 • Bleeding Focus on Tc 99m Red Blood Cell (RBC) Scintigraphy in Acute Lower Gastrointestinal Bleeding (LGIB): Relationship between Intensity of Bleeding Focus and Positive Rate of Subsequent Conventional Angiography

Timothy L Haaga MD (Presenter) ; Sun Ho Ahn MD ; Gregory J Dubel MD ; Don C Yoo MD ; Richard B Noto MD *

PURPOSE
Tc99m-labelled red blood cell (Tc99m RBC) scans detect bleeding at a rate of roughly 0.1 mL/h, approximately ten times slower than that detectable with conventional angiography. The primary purpose of this study is to evaluate how the intensity of a bleeding focus on Tc99m RBC scanning relates to the likelihood of positive findings on conventional angiography.

METHOD AND MATERIALS
A retrospective review was conducted on PACS of all Tc99m RBC scans performed from 2003 through July 2011, and all visceral angiograms performed following Tc99m RBC scans during the same time period. Tc99m RBC scans initially interpreted as positive were reviewed independently by two board-certified, nuclear medicine (NM) fellowship-trained radiologists who were blinded to the initial interpretation. An RBC scan was considered 'intensely positive' by NM readers if intensity of the bleeding focus exceeded that of aortic blood pool and liver. Two board-certified, fellowship-trained interventional radiologists (IR), blinded to any interpretation of the Tc99m RBC scans, independently reviewed visceral angiograms. An angiogram was considered positive if it demonstrated extravasation or an etiology for bleeding.

RESULTS
174 Tc99m RBC scans and 112 visceral angiograms were reviewed. Of the 112 patients who proceeded to angiogram following RBC scan, 60 and 47 RBC scans were read as intensely positive by NM readers A and B, respectively. 21/112 angiograms were read as positive by one or both IR readers. Of 21 patients with positive angiograms, the preceding RBC scans were read as intensely positive in 19/21 cases for reader A and 15/21 cases for reader B. Sensitivity, specificity, PPV and NPV of an intensely positive RBC scan for a positive angiogram were thus 91%, 55%, 32% and 91%, respectively, for reader A and 71%, 65%, 32% and 96%, respectively, for reader B.

CONCLUSION
Intensity of a bleeding focus on Tc99m RBC scan greater than that of aorta and liver has a high negative predictive value for a positive angiogram. If a bleeding focus demonstrates equal or lesser activity than that of liver or aorta on Tc99m RBC scan there is thus a high likelihood of a negative subsequent conventional angiogram.

CLINICAL RELEVANCE/APPLICATION
By clarifying patients' pre-test probability of positive angiography, grading of bleeding intensity on RBC scan has the potential to lessen the number of unnecessary visceral angiograms performed.

SSJ21-04 • 18F-FDG PET/CT Imaging has High Sensitivity in Detecting Clinically Active IgG4-related Disease

Leslie K Lee MD (Presenter) ; Arezou Khosroshahi MD ; Emine Atac ; Mollie Carruthers MD ; John Stone MD, MPH ; Dushyant V Sahani MD

PURPOSE
IgG4-related disease (IgG4-RD) is an inflammatory disorder with varied manifestations that depend on the extent of organ involvement. Active disease may be clinically quiescent while rendering organ damage; serum markers can be insensitive in diagnosis and monitoring of the disease. In this retrospective series of 25 patients with biopsy-proven IgG4-RD, the sensitivity of serum IgG4 levels was compared to that of 18F-FDG PET/CT imaging.

METHOD AND MATERIALS
A retrospective review was conducted on PACS of all Tc99m RBC scans performed from 2003 through July 2011, and all visceral angiograms performed following Tc99m RBC scans during the same time period. Tc99m RBC scans initially interpreted as positive were reviewed independently by two board-certified, nuclear medicine (NM) fellowship-trained radiologists who were blinded to the initial interpretation. An RBC scan was considered 'intensely positive' by NM readers if intensity of the bleeding focus exceeded that of aortic blood pool and liver. Two board-certified, fellowship-trained interventional radiologists (IR), blinded to any interpretation of the Tc99m RBC scans, independently reviewed visceral angiograms. An angiogram was considered positive if it demonstrated extravasation or an etiology for bleeding.

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CLINICAL RELEVANCE/APPLICATION
By clarifying patients' pre-test probability of positive angiography, grading of bleeding intensity on RBC scan has the potential to lessen the number of unnecessary visceral angiograms performed.

SSJ21-05 • Can We Ignore Spleen Lesions that Are Not Metabolically Active?

Manish Dhyani MBBS (Presenter) ; Michael S Gee MD, PhD ; Anuradha S Shenoy-Bhangle MD ; Peter F Hahn MD, PhD *

PURPOSE
Tc-99m sestamibi (MIBI) scintigraphy is commonly utilized for the preoperative location of parathyroid adenomas. A focal area of tracer retention that persists on delayed images is fairly specific for a parathyroid adenoma. Occasionally, there are 2 foci of MIBI retention on delayed imaging, which theoretically suggests a double parathyroid adenoma. Our aim was to determine just how often this finding was shown to represent a double adenoma.

METHOD AND MATERIALS
Over a 4-year interval, all parathyroid scans with the finding of 2 areas of MIBI concentration in initial images of the neck, that retained the tracer on 3-hour delayed images were collected and corresponding histopathological results were reviewed.

RESULTS
A total of 16 patients demonstrated the above finding. Of these, 14 underwent neck exploration; 12 were diagnosed as having asymmetric parathyroid gland hyperplasia, while only 2 were diagnosed with double parathyroid adenoma.

CONCLUSION
Of the group of 14 patients whose parathyroid scintigraphy showed 2 areas of MIBI retention on 3-hour delayed images of neck, 12 (85.7%) had asymmetric parathyroid hyperplasia, whereas only 2 patients with this finding had true double adenoma.

CLINICAL RELEVANCE/APPLICATION
In parathyroid scintigraphy, 2 foci of tracer retention more than likely indicate parathyroid gland hyperplasia, as opposed to double parathyroid adenoma.
PURPOSE
We undertook this study to determine the negative predictive value of PET for splenic lesions. Although PET has been used extensively for evaluation of space-occupying lesions in other organs, the current medical literature is contradictory on the current role of 18F-FDG-PET for characterization of splenic masses. Some studies have demonstrated high accuracy with good sensitivity and specificity when clinical data was used as the gold standard while others have demonstrated poor accuracy when histopathology was used as a gold standard.

METHOD AND MATERIALS
In this IRB approved single center retrospective study we searched an institutional database and reviewed imaging of all patients with a focal splenic lesion >6mm who had undergone an FDG-PET/CT scan with or without IV contrast. Splenic lesions with at least one-year follow-up and had metabolic activity less than or similar to the remainder of the spleen were identified. Lesions that exhibited >30% increase on the follow-up study were categorized as aggressive and included in the study.

RESULTS
Twenty-four subjects (M:F = 15:9) with a mean age of 55 years (mean = 21-80 years) with one or more PET-negative splenic lesions were identified to have aggressive splenic lesions on subsequent studies. 22 of 24 had a primary extra-splenic or systemic malignancy. The most common primary malignancy in this cohort of patients was lymphoma (n=6, 25%) followed by lung cancer (n=5, 21%) and melanoma (n=3, 12.5%). Two of the lesions were primary splenic tumors (follicular dendritic cell tumor, littoral cell angioma); the other 8 arose in patients with extra-splenic malignancy and were clinically considered metastases.

CONCLUSION
Aggressive PET-negative lesions can arise in the spleen.

CLINICAL RELEVANCE/APPLICATION
Low metabolic activity as determined by FDG-PET cannot be used alone to exclude aggressive behavior of a splenic lesion.

SSJ21-06 • Imaging Cold Activated Brown Adipose Tissue Using Functional MRI and 18F-FDG PET CT

Bart Van Rooijen (Presenter); Anouk A Van Der Lans; Boudewijn Brans; Joachim E Wildberger MD, PhD; Patrick Schrauwen; Wouter Van Marken Lichtenbelt; Walter H Backes PhD

PURPOSE
Brown adipose tissue (BAT) is involved in non-shivering thermogenesis (NST). Novel non-invasive imaging methods are required to monitor the pharmaceutical targeting of BAT as a potential treatment of obesity. FDG-PET combined with CT is so far the only non-invasive method to detect active BAT. The aim of this work was to investigate the use of MRI to determine the presence of active BAT.

METHOD AND MATERIALS
Eleven healthy young adults were included. The subjects underwent MRI and FDG-PET/CT imaging of the supra-clavicular/cervical fat depots containing BAT. Cooling was performed by wrapping the subjects in a water-perfused suit connected to temperature controlled water baths. Prior to the PET/CT, subjects were exposed to mild cold conditions during which maximum NST occurs. Subjects were injected with 74 MBq FDG as a tracer of metabolic activity. BAT activity was quantified by auto-contouring BAT with a set threshold. In the MRI water-fat (Dixon) imaging was performed under normal ambient conditions followed by dynamic T2* weighted imaging during which subjects were exposed to a repeated boxcar cooling paradigm to activate the BAT.

RESULTS
Water-fat MRI showed that supra-clavicular/cervical fat depots had an average fat content of 65.2 ± 7.0 %. For the regions identified as active BAT on PET/CT, the fat content was 66.0 ± 9.3 %. The volume fraction of activated voxels in the depots as measured by fMRI correlated with the activity concentration of FDG uptake on the PET/CT (R=0.63, P

CONCLUSION
Our results suggest (active) BAT cannot be identified based on the fat fraction of the supra-clavicular/cervical depots. The use of fMRI to measure the presence of active BAT is promising as the fraction of activating voxels correlated with FDG uptake on PET/CT.

CLINICAL RELEVANCE/APPLICATION
Pharmaceutical targeting of BAT may be a potential strategy in the treatment of obesity and imaging methods are needed to monitor its response.
SSJ22-02 • Fetal Radiation Doses in Computed Tomography Examinations of Pregnant Patients: A Comparison between Whole-body and Individual Organ Doses at Three Different Gestational Ages

Nelia Long MS (Presenter) ; Matthew Maynard MS ; Roger Y Shifrin MD ; Nash S Moawad MD, MS ; Wesley E Bolch PhD

PURPOSE
The purpose of this study was to compare values of whole fetal averaged absorbed dose to that for individual fetal organs following CT examination of the adult pregnant female. These differences were compared across three gestational ages and with variations in maternal perimeter at a given gestational age.

METHOD AND MATERIALS
In this study, the University of Florida (UF) series of anatomic computational models of the adult pregnant female were employed which provided detailed anatomical modeling of the developing fetus at 10, 25, and 38 weeks gestation to determine the fetal size range at which the average whole-body fetal dose would be sufficient to approximate the dose to specific fetal organs. Monte Carlo simulations were used to calculate individual fetal organ doses as well as whole-body doses for a Toshiba Aquilion ONE scanner at 100 mAs per rotation. Variations in radiation dose to the fetus with changes in maternal size as given by the maternal abdominal perimeter were also explored.

RESULTS
Calculated CT doses for abdomen-pelvis CT exams for soft-tissue organs differed by up to 26% from whole body averaged fetal doses. However, skeletal tissue doses were at most 110% larger than whole-body doses within the 25- and 38-week models. Skeletal doses were as high as 25 mGy per 100 mAs per rotation. Skeletal doses within the 10-week model were no more than 30% larger than the calculated whole-body dose. At greater gestational ages, the significant differences in results between the average whole-body dose and the skeletal dose during abdomen-pelvis CT exams should be considered when prospectively assessing stochastic risks to these tissues.

CONCLUSION
Although whole-body fetal dose is often the only quantity quoted in CT dosimetry, the imaging community should be aware that although soft-tissue organ doses are very similar to this number, the skeletal dose can be more than twice as large as the whole-body dose. These differences should be taken into consideration when making projections of stochastic risks resulting from exposures to the fetal skeletal tissues.

CLINICAL RELEVANCE/APPLICATION
Stochastic risk estimates to the skeletal tissues following in utero exposures during CT imaging of pregnant patients may be under reported if approximated using estimates of whole-body fetal dose.

SSJ22-03 • Radiation Dose from 3D Rotational Neurovascular Studies vs. Conventional 2D DSA
Elena Tonkopi MS (Presenter) ; Ahmed H Al-Habsi MD ; Jai Shankar

PURPOSE
To compare patient effective dose resulting from two alternative imaging methods for pre-intervention assessment of intracranial aneurysms: a series of Digital Subtraction Angiography (DSA) runs taken at different positions, and a 3D RA technique.

METHOD AND MATERIALS
In a retrospective analysis, we investigated the planning studies of 44 patients who underwent endovascular coiling in our institution between January and October 2012. Images were acquired on a bi-plane II-based system (Siemens Axiom Artis) not equipped with a DAP meter. Conventional 2D projection DSA images were simulated with an anthropomorphic head phantom using 12 s runs with a rate of 2 f/s. Entrance skin exposure was measured with a 60 cc ionization chamber (Radcal, Accu-Pro) for AP, LAT, and Oblique projections. A commercially available Monte Carlo simulation program PCXMC was used to calculate patient effective dose. The second technique involved acquisition of 128 images during a 200° rotation of the C-arm around the patient’s head resulting in the 3D reconstruction. A 16 cm CT dosimetry phantom and a 100 mm pencil ion chamber were used to measure the CT dose index resulting from the RA. The ImPACT patient dosimetry software was employed for patient effective dose calculations. Scatter radiation was measured at 152 cm from the head phantom during both acquisitions. An unpaired two-tailed t-test was used to determine the significance of differences between patient doses in each group.

RESULTS
The sixteen patients underwent 2D projection DSA with a mean number of cine runs of 5.1 (minimum 4, maximum 8). Twenty eight patients were assessed using the 3D RA protocol, which included an AP/LAT run and one rotational spin. In the 2D DSA group the mean effective dose was 2.11 mSv (range 1.69–3.43 mSv), and in the 3D RA group effective dose was 1.29 mSv (p=0.00028). Scatter radiation was measured at 152 cm from the head phantom during both acquisitions. An unpaired two-tailed t-test was used to determine the significance of differences between patient doses in each group.

CONCLUSION
Our study demonstrated that the patient effective dose and scatter radiation to the staff were significantly lower from the 3D RA than that from the 2D projection DSA runs used in the planning of cerebral aneurysm coiling.

CLINICAL RELEVANCE/APPLICATION
3D rotational angiography (RA) has the potential to decrease radiation dose and to improve the efficiency of the procedure.

SSJ22-04 • Predictive Models for Estimating Organ Dose from Fixed and Tube Current Modulated CT Scans Using Regional CTDIvol and Water Equivalent Diameter
Maryam Khatonbadi (Presenter) * ; Grace Kim MD ; Dianna D Cody PhD * ; Gary Arbique PhD * ; S. Bruce Greenberg MD ; Christopher H Cagnon PhD ; John J Demarco PhD ; Michael F McNitt-Gray PhD *

PURPOSE
To create predictive models that estimate organ doses from fixed mA or tube current modulated CT scans and that were applicable to both chest and abdomen exams. These models employ water equivalent diameter (WED) to describe patient size and a regional descriptor of scanner output, regional-CTDIvol.

METHOD AND MATERIALS
A total of 334 CT exams (188 chest and 146 abdomen/pelvis) of adult females, adult males and pediatric patients, were collected from 64-slice CT scanners from three different manufacturers (Siemens Healthcare, GE Healthcare and Toshiba Medical); all scans were performed with TCM. Voxelized patient models were created from image data from each exam and organs were identified by semi-automated segmentation to obtain: liver, spleen, and kidneys for abd/pel exams and lungs and glandular breasts tissue for chest exams. For patient size, WED was calculated for each image. For all patients, regional landmarks were manually identified and used to calculate regional CTDIvol. A validated Monte Carlo based CT dosimetry simulation package was used to estimate dose to all segmented organs, once using TCM data and once simulating fixed mA scans. Predictive models based on WED and regional CTDIvol values were developed to estimate organ dose using 60% of cases as a training set. The model was evaluated using the remaining 40% of cases as a test set and compared the predicted values to detailed simulated results for each case. RMS of absolute percent errors between simulated and estimated organ doses were reported across all organs, scanners and scan types as well as for individual organs.

RESULTS
The overall RMS of absolute percent error was 6.7% for fixed mA and 13.9% for TCM simulations. RMS errors were less than 10% for all organs in fixed mA simulations and range from 11-14.8%, for TCM CT scans. Smaller sized patients tended to have larger percent errors.

CONCLUSION
Predictive models were generated based on regional information of the scanner output and size and agreed with detailed simulations to within 7% for fixed and 14% for TCM across all scanners, organs, and exam types. The TCM predictive model could possibly be further improved by tailoring it to smaller patients.

CLINICAL RELEVANCE/APPLICATION
Organ doses can be estimated in a robust fashion for patients undergoing CT exams using predictive models based on regional descriptors of scanner output and patient size.

SSJ22-05 • Decreased Radiation Dose and Preserved Diagnostic Accuracy with Iterative Reconstruction at Coronary Computed Tomography Angiography: Intra-Individual Comparisons
Wei-Hua Yin (Presenter); Bin Lu MD; U. Joseph Schoepf MD *; Zhi-Hui Hou MD; Run-Ze Wu; Nan Li; Lei Han; Yang Gao; Fang-Fang Yu

PURPOSE
Iterative reconstruction techniques show promise to decrease radiation requirements at coronary CT angiography (CCTA). No study performed a direct head-to-head, intra-individual comparison of iterative reconstruction algorithms with traditional filtered back projection (FBP) vis-à-vis diagnostic accuracy and radiation dose at CCTA.

METHOD AND MATERIALS
RESULTS
Sensitivity and specificity for diagnosing =50% coronary artery stenosis on a per-segment level were 88.5% and 92.1% with FBP and 84.2% and 93.4% with iterative reconstruction (p=0.05). The area under the receiver-operating characteristic curve on a per-segment level was 0.930 [95% confidence interval (CI), 0.875-0.932] and 0.888 (95%CI, 0.856-0.920) with FBP and iterative reconstruction, respectively (p = 0.290). Compared with FBP, iterative series showed no significant (p>0.05) differences in image quality analyses. Median effective radiation dose was 52% lower for the iterative reconstruction protocol compared with FBP [0.73mSv (interquartile range, 0.55-1.18) vs. 1.53mSv (1.15-2.42)], p

CONCLUSION
Compared with a routine radiation dose FBP protocol, 50% reduced dose acquisition using iterative reconstruction preserves image quality and diagnostic accuracy at CCTA.

CLINICAL RELEVANCE/APPLICATION
Iterative CT image reconstruction techniques have potential to further reduce already low radiation requirements associated with CCTA.

SSJ22-06 • Quantifying the Spread in Deviation Index (DI) - An Initial Experience for a Tertiary Health Care Center and Its Affiliated Community Hospital
Jaydev K Dave PhD, MS (Presenter); Eric L Gingold PhD

CONCLUSION
Only 15%-18% of DI values fall within the target range of -0.5 to 0.5, and the SD ranged from 1.8 to 2.7. Thus, the range recommended in AAPM Report 116 is not being achieved in the current practice. This audit of DI values indicates the need for quality improvement projects and perhaps a re-evaluation of target values.

Background
Deviation Index (DI) expresses the deviation in image receptor dose utilized for a digital radiograph relative to a target value. The AAPM Report 116 recommends a desirable operating range of the DI to be between ±0.5. The goal of this work was to quantify the spread in the DI for radiographs under real-world clinical conditions.

Evaluation
IRB exemption was obtained. The DI values were evaluated for radiographs obtained using storage phosphor and flat-panel digital radiography systems at a tertiary medical center and an affiliated community hospital (Jan-2012 to Mar-2013). Descriptive statistics for the DI and percent cases within ranges listed in AAPM Report 116 were computed as a function of exam location and type.

Discussion
The mean ± standard deviation (SD) for all DI values (n=283141) was 1.4±2.7. For neonatal (n=1877) and adult (n=32785) radiographs with mobile equipment and manual exposure parameters the mean±SD for the DI were -1.1±2.4, and 0.3±2.4, respectively. The most common radiographic exposure using manual technique was anterior-posterior chest for the neonatal (45%) and adult (60%) populations with mean±SD for the DI to be -1.2±2.2, and 0.1±1.8, respectively. For radiographs obtained with automatic exposure control (n=90272) the mean±SD for the DI were 0.7±2.9; amongst these, radiographs of the chest were most frequent (58%) with a mean±SD for the DI of 0.9±2.2. The mean±SD of the DI for radiographs acquired with the flat-panel digital radiography system were 1.5±2.3. Only 15% to 18% of the cases were in the target exposure range for the entire data set and the subsets considered. Overall, 23% radiographs were in the underexposed category (5%: DI<-3.0 and 18%: DI from -3.0 to -0.6) and 62% radiographs were in the overexposed category with mean±SD to be -1.2±2.2, and 0.1±1.8, respectively. For radiographs obtained with automatic exposure control with mobile equipment and manual exposure parameters the mean±SD for the DI were -1.1±2.4, and 0.3±2.4, respectively. The most

Physics (Non-Conventional CT Imaging)

Tuesday, 03:00 PM - 04:00 PM • S403B

SSJ23 • AMA PRA Category 1 Credit ™: 1 • ARRT Category A+ Credit: 1
Moderator
Jeffrey H Siewersden, PhD *
Moderator
Stephen Rudin, PhD *

SSJ23-01 • Imaging-task-Optimized, Source-detector Trajectory Design and Reconstruction in 3D Interventional Imaging
Joseph W Stayman PhD (Presenter) *; Adam S Wang PhD *; Wojciech Zbijewski PhD *; Yoshito Otake *; Jeffrey H Siewersden PhD *

PURPOSE
Interventional cone-beam CT differs greatly from diagnostic CT not only in highly flexible positioning of the source and detector, but also in that interventional imaging tasks typically involve well-positioned detection and localization of targets which have been identified in pre-operative 3D imaging and planning. We propose to leverage this wealth of patient- and task-specific prior knowledge to design customized source-detector trajectories for subsequent intraoperative CBCT acquisitions to maximize imaging task performance.

METHOD AND MATERIALS

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Task-based performance in 3D imaging is predictable using analytical models of the imaging chain. Task-based detectability index, for example, can be computed upon specification of a task function, acquisition geometry, trajectory, detector physics, reconstruction process; and the patient anatomy. Using a preoperative CT volume to integrate patient-dependence, we compute a marginal detectability index related to individual rotation angle/obliquity pairs of an interventional C-arm. A task-based trajectory is formed by successively finding the angle pair yielding the greatest detectability (e.g., the "next best view") and adding it to a growing collection of angles. The trajectory design approach was applied to a simulated pulmonary nodule detection task where the data from a task-driven noncircular orbit was reconstructed using a model-based iterative approach.

RESULTS
The task-based trajectories designed for the pulmonary nodule detection task were largely continuous despite the lack of a continuity constraint and tended to avoid long radiological path lengths (e.g., avoiding projections involving overlap of the nodule with bone or a surgical tool). Image reconstructions using the task-based orbit show excellent visualization of the nodule. By comparison, the nodule was obscured in reconstructions from sub-optimal orbits due to noise/limited spatial resolution.

CONCLUSION
Leveraging patient-specific information and analytical model for task-based imaging performance within the 3D image acquisition process allowed the design of customized orbits that maximize task performance in image-guided interventions.

CLINICAL RELEVANCE/APPLICATION
Task-based trajectories yield improved imaging performance over standard orbits and can potentially automatically overcome challenging imaging scenarios near high-density objects and bone.

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SSJ23-02 • Bipolar Contrasts Generated by Microbubbles in Grating-based X-ray Phase Contrast CT

Xiangyang Tang PhD (Presenter) *; Yi Yang PhD

PURPOSE
We propose to utilize microbubbles as the contrast agent in grating-based x-ray phase contrast CT. Via a phantom study, we investigate the bipolar contrasts generated by microbubbles in grating-based x-ray phase contrast CT and its variation over the size of microbubble targets and detector cells.

METHOD AND MATERIALS
The phantom consists of seven targets that are clusters of microbubbles at diameters 2.5 μm. To simulate the small lesions in advanced clinical and preclinical applications, microbubbles are deployed along a spiral locus in each cluster with its outer dimension from the smallest to largest equal to 50, 75, 100, 250, 500, 1,000 and 2,500 μm. To assure a random deployment that mimics a chaotic distribution, the microbubbles in each cluster are randomly removed. The projection data are acquired at a 1° angular interval over 360° x-ray rotation. To simulate X-ray data acquisition, a 31.6 keV monochromatic x-ray source with infinitesimal focal spot is assumed. At each angular position, grating G shifts 8 steps, and the x-ray exposure is gauged as a summation over all the 8 steps of grating shifting and equal to 5.0x10⁻⁵ photon/cm². To investigate the contrast generated by microbubbles over spatial resolution, we conduct the study at detector cell sizes 48, 96, 128 and 256 μm, respectively.

RESULTS
The preliminary data show that the contrast generated by microbubbles in grating-based x-ray phase contrast CT is bipolar: the one generated by the differential phase contrast mechanism is negative, while that by the dark-field mechanism is positive. Moreover, the microbubbles' bipolar contrasts in x-ray phase contrast CT are significantly larger than its counterpart in the conventional attenuation CT.

CONCLUSION
Using microbubbles as the contrast agent, the grating-based x-ray phase contrast CT may outperform the conventional attenuation CT significantly, especially in the scenarios where small lesions are to be detected at high spatial resolution.

CLINICAL RELEVANCE/APPLICATION
The preliminary results reported in this study may be of relevance to the preclinical and eventually clinical applications of grating-based x-ray phase contrast CT.

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SSJ23-03 • Novel Results from a First Preclinical X-ray Phase-contrast CT Scanner

Astrid Velroyen (Presenter) ; Andre Yaroshenko ; Arne Tapfer ; Martin Bech ; Mark Muller ; Bart Pauwels ; Jeroen Hostens ; Peter Bruyndonckx ; Xuan Liu ; Alexander Sasov ; Franz Pfeiffer

PURPOSE
In the last years, x-ray phase-contrast and dark-field imaging have been proven to provide superior soft-tissue contrast and complementary information in comparison to conventional attenuation-based imaging, thus great potential for medical imaging is anticipated. As a first step towards clinical implementation, we have developed a grating-based compact preclinical phase-contrast CT scanner with rotating gantry [1], from which we present novel results.

METHOD AND MATERIALS
Our preclinical phase-contrast CT scanner is the first one to comprise a laboratory x-ray source, a detector and a three-grating interferometer installed on a rotating gantry. The interferometer is used to transfer minimal, sample-induced directional changes of the x-ray's light intensity variations on the detector. From these measurements, the two new contrast modalities, i.e. phase-contrast, which is based on the refraction of x-rays, and dark-field contrast, which indicates microstructured regions that scatter x-rays, are obtained in addition to the attenuation-based image. [2, 3]

By acquiring reference CT scans we studied thermal and rotation-induced instabilities that compromise the precise alignment and relative movement of the fine interferometric structures and thus cause image artifacts. Newly developed software tools are presented that allow to regain accurate images despite those instabilities. Also, technological advances that improve visibility and scanner performance in general are shown.

RESULTS
We show CT scans of several biological samples and phantoms to demonstrate the possibilities of the new system. First planar radiographic images of a living mouse in differential phase, dark-field and attenuation contrast are presented, as well as phase-contrast ex-vivo mouse CT images made possible by the software and hardware improvements introduced to the scanner.

CONCLUSION
Our measurements clearly show the improved soft-tissue contrast and complementary information that can be obtained by phase and dark-field imaging in comparison to the conventional attenuation image.


CLINICAL RELEVANCE/APPLICATION
By proving the feasibility of phase-sensitive imaging with a compact rotating gantry, this work represents an important milestone in translating phase-contrast from bench to bedside.

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SSJ23-04 • Grating-based Phase-Contrast Computed Tomography of Benign and Malignant Breast Tumors at Polychromatic X-ray Sources-An Ex-vivo Study

Susanne Grandl MD (Presenter) ; Marian Willner ; Julia Herzen ; Doris Mayr ; Sigrid Auweter ; Alexander C Hipp ; Aniko Sztrookay MD ; Franz Pfeiffer ; Maximilian F Reiser MD ; Karin Hellerhoff MD

PURPOSE

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Physics (MRI Techniques II)

Artifact-suppressed, Low-dose C-arm CBCT Imaging of Low-contrast Cerebral Lesions

Xiao Han MSc (Presenter) ; Satoru Oishi PhD * ; Tetsu Satow MD ; Hiromichi Yokoyama RT ; Masanobu Yamada RT ; Michael D Silver PhD * ; Yu-Bing Chang ; Emil Y Sidky PhD ; Xiaochuan Pan PhD *

PURPOSE
Three-dimensional images of a patient brain can be obtained by use of a C-arm-based CBCT system for clinical evaluation of cerebral lesions of low-contrast such as Intra cranial Hemorrhage (IH) to surrounding soft tissues. Current CBCT systems employ FDK-based algorithms for yielding brain images, which require data acquired at a large number of projection-views and thereby incur a high level of radiation dose. In addition, FDK-based reconstructions may be susceptible to noise and shading artifacts, which can mimic or obscure low-contrast lesions. In this work, we develop an optimization-based algorithm for reconstructing C-arm CBCT brain images, with specific objectives of suppressing artifacts and significantly lowering radiation dose.

METHOD AND MATERIALS
A clinical C-arm CBCT system was used for collecting brain data of patients at 607 views over 200° in 20 seconds. We refer to the acquired data as the full-view data, from which we formed a half-view data set by removing one projection frame at every other view. An iterative algorithm, referred to as ASD-POCS, was adapted to fully incorporate calibration information characterizing the actual scan geometry, which deviates from a circular trajectory due to gantry wobble. We applied the adapted ASD-POCS algorithm to the half-view data, and compared the reconstructions to the FDK reconstructions from full- and half-view data sets.

RESULTS
The half-view ASD-POCS reconstructions show suppressed artifacts than both full- and half-view FDK reconstructions. The soft-tissue contrast of the half-view ASD-POCS reconstruction is superior to the half-view FDK reconstruction, and is visually comparable to that of the full-view FDK reconstruction.

CONCLUSION
Our new algorithm is capable of reconstructing from half-view data patient-brain images with reduced artifacts and comparable soft-tissue contrast than the full-view FDK reconstruction.

Clinical Relevance/Application
We have demonstrated a C-arm CBCT imaging technique with improved image quality at considerably lowered imaging dose for clinical evaluation of low-contrast lesions such as IH.

Dynamic Range Extension in Flat Detector CT Using a Compressed Sensing-based Multi-exposure Technique

Ludwig Ritschi (Presenter) ; Jan Kuntz ; Michael Knaup PhD ; Marc Kachelriess PhD

PURPOSE
To increase the dynamic range of flat detectors in CT without increasing dose or scan time.

METHOD AND MATERIALS
The dynamic range $R$ of x-ray detectors is the ratio between the highest detectable signal (just before overexposure) and the lowest detectable signal (where x-ray quantum noise = electronic noise). Achieving low contrast resolution (e.g. 5 HU contrast of 5 mm objects) in human beings requires $R = 10^6$ which includes two factors: the accuracy of attenuation measurements in each ray and the capturing of significant attenuation differences between different rays due to differences of ray position (peripheral vs. central rays). Flat detectors, however, operate at $R < 10^3$ and avoiding underexposure for central rays typically means accepting overexposure for peripheral rays and thus truncation artifacts. Dual or multi-exposure techniques could be a remedy if dose and scan time did not increase. We propose a new multi-exposure technique that performs dense sampling with high exposure levels interrupted from time to time by a sparse low exposure sampling (e.g. every 16th projection). We generalized the compressed sensing-based iTV algorithm [Phys. Med. Biol. 56:1545] to optimally combine the highly sampled high exposure data with the interleaved sparsely sampled low exposure data. The generalized iTV method was verified using simulated as well as measured data, acquired with a Varian flat detector, and was compared to a situation where two exposures were made in a conventional way and with the standard situation of having only one exposure while accepting overexposure in the peripheral patient areas (e.g. in the skin).

RESULTS
The images with extended dynamic range and generalized iTV reconstruction are nearly indistinguishable from those with double exposure. Minor differences are visible only in the peripheral areas where only very sparse information was available for iTV. Dose and scan time remain the same as with today’s single exposure scans.

CONCLUSION
Sparse sampling the low exposure CT scan and interleaving many high exposure projections combined with compressed sensing reconstruction is sufficient to provide images nearly equivalent to a CT scan with a high dynamic range detector.

Clinical Relevance/Application
Flat detector CT, in particular images in interventional CT and in image-guided radiation therapy, can significantly benefit from the dynamic range extension and the improved low contrast resolution.
**SSJ24-01 • Feasibility and Accuracy of a New Virtual Real-time Navigation Option for MRI-guided Interventions in the Prostate**

**Harold F Busse** PhD (Presenter) ; **Gregor Thormer** * ; **Josephin Otto** ; **Nikita Garnov** ; **Arno Schmitgen** * ; **Axel Winkel** PhD * ; **Thomas K Kahn** MD ; **Michael Moche** MD

**PURPOSE**
To determine the targeting accuracy of a virtual real-time navigation option for MRI-guided interventions and to estimate the feasibility for transrectal prostate biopsies at 3 T.

**METHOD AND MATERIALS**
A standard MR-compatible interventional device (DynaTRIM, Invivo) was modified to provide real-time feedback of the virtual needle path. Intervventional instruments are tracked by a digitizer that measures the 3D offset between a set of reflective markers attached to the instrument manipulator and reference markers mounted in a fixed geometry to the MR table. Device-to-MRI transformation was determined in a one-time calibration step. Prior to the intervention, the device was registered by a custom-made 3D localization of reference MR markers. The navigation system (Localite, Germany) then provided MRI views centered at the position of the instrument tip and reformatted along either the axis or standard radiological planes. The accuracy was estimated in a 3-T MRI trial (Trio, Siemens) by targeting 30 invisible peas (mean diameter 8.5 mm) without any control imaging. Clinical application under IRB approval involved 18 patients (52-72 y.o., mean 65) that had negative biopsies under TRUS guidance: MRI intervention times and biopsy findings were documented.

**RESULTS**
The add-on components did not affect image quality or patient comfort. Device registration was successful and fast (< 30 s). Experimental biopsy samples contained pea material in 28/30 cases corresponding to a maximum 3D error of 4.3 mm in 93% of the cases. Median clinical intervention time was 55 (36-89) minutes and involved two lesions in 7/18 patients (39%). No procedure-related complications were observed. The obtained specimens were diagnostic in all cases. In 8 patients (44%), histopathology revealed prostate cancer of Gleason Score 6 and 7.

**CONCLUSION**
Virtual real-time MRI navigation was found to be feasible and accurate in combination with an existing interventional device for the prostate. Potential stereotactic errors, in particular from prostate motion, can be rapidly detected and corrected for by updating the 3D navigation dataset. The underlying technique can be modified to work with other devices, scanner models and clinical applications as well.

**CLINICAL RELEVANCE/APPLICATION**
The presented virtual real-time navigation solution is a convenient and accurate add-on option to facilitate interventional instrument guidance in organs like the prostate.

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**SSJ24-02 • 4D Flow MRI Assessment of Cerebral Blood Flow after Extracranial-intracranial Bypass**

**Tetsuro Sekine** (Presenter) ; **Yasuo Amano** MD ; **Ryo Takagi** MD ; **Yoshio Matsumura** RT ; **Yuriko Suzuki** BS * ; **Shinichiro Kumita** MD

**CONCLUSION**
The hemodynamics after EC-IC bypass is assessed by 4D Flow comprehensively.

**Background**
Extracranial-intracranial (EC-IC) bypass is performed to maintain blood flow in the brain of patients with internal carotid artery (ICA) occlusion. However, hemodynamics after EC-IC bypass is not well known. The aim of this study was to comprehensively assess the hemodynamics in patients after EC-IC bypass using time-resolved 3D phase contrast MRI (4D Flow).

**Discussion**
4D Flow shows that the type of bypass affects flow direction and BFV, and that ?P correlates with ?BFV. 4D Flow can quantify BFV and ?P after EC-IC bypass as well as visualize flow direction.

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**SSJ24-03 • Diffusion Analysis with Triexponential Function in Liver Steatosis**

**Tatsuya Hayashi** (Presenter) ; **Toshiaki Miyati** PhD ; **Junji Takahashi** ; **Yoshinori Tsuji** ; **Masakatsu Tano** ; **Satoshi Saito**

**PURPOSE**
Our previous study has shown that triexponential function analysis noninvasively obtains more detailed information on diffusion in liver; however, the influence of fat accumulation to liver quantitative diffusion analysis is not clear. The purpose of this study was to assess the influence of liver steatosis on diffusion and perfusion by using the triexponential function analysis.

**METHOD AND MATERIALS**
On a 1.5 T MRI, navigator-echo triggered single-shot diffusion echo planar imaging was used with multiple b values of 0 to 1500 s/mm², TE of 77 ms, TR of 1 respiratory cycle, and an imaging matrix of 128×74. Thirty-three patients underwent diffusion-weighted magnetic resonance imaging (DWI) with multiple b-values to obtain perfusion-related diffusion, fast free diffusion, and slow restricted diffusion coefficients ($D_p$, $D_f$, $D_s$) and fractions ($F_p$, $F_f$, $F_s$) with triexponential function analysis. They also underwent dual-echo gradient echo imaging for the measurement of hepatic fat fraction (HFF). Of these, 13 patients were included in the control group and 20 in the fatty liver group with HFF >5%. Parameters of two groups were compared using the Mann-Whitney U test. The relationships between each diffusion coefficient and HFF were assessed using the Pearson correlation.

**RESULTS**
Perfusion-related diffusion coefficient $D_p$ and fast free diffusion coefficient $D_f$ were significantly reduced in the steatotic liver group compared with the control group ($D_p = 27.72 ± 6.61 × 10^{-3}$ mm²/sec vs. $33.33 ± 6.47 × 10^{-3}$ mm²/sec, $P = .0072$; $D_f = 1.70 ± 0.53 × 10^{-3}$ mm²/sec vs. $2.06 ± 0.40 × 10^{-3}$ mm²/sec, $P = .0224$). There were no significant differences in other parameters between both groups. Furthermore, $D_p$ and $D_f$ were correlated with HFF ($P < .0001$, $r = 0.64$ and $P = .0008$, $r = -0.56$, respectively).

**CONCLUSION**
Decreased liver perfusion in steatosis cause the reduction in $D_p$, and extracellular fat accumulation and intracellular fat droplets in steatosis lead to the reduction in $D_f$. Thus, the influence of hepatic steatosis should be taken into consideration when the triexponential function analysis is used to assess diffuse liver disease.

**CLINICAL RELEVANCE/APPLICATION**
Steatosis can act as a potential confounder in quantitative diffusion analysis and to know the influence of steatosis on diffusion and perfusion parameters is important.
SSJ24-04 • Quantitative Comparison of Varying Combinations of MRI Metal Artifact Compensation Techniques (HBW-TSE, VAT and SEMAC) for Hip Prosthesis Imaging

Chen Lin PhD (Presenter) *; Trenton D Roth MD; Larry Friggle ARRT; Eric Tarkowski MD; Kenneth A Buckwalter MD

PURPOSE
The goal of this study is to quantify and compare the reduction of metal artifacts using combinations of high transmit and receive bandwidths (HBW-TSE), View Angle Tilting (VAT) and Slice Encoding for Metal Artifact Correction (SEMAC) in order to derive an appropriate MRI protocol for hip prosthesis imaging that maximizes artifact reduction in a clinically realistic scan time.

METHOD AND MATERIALS
A hip phantom was constructed using human cadaveric bones and a total hip prosthesis (Biomet Orthopedics). The acetabular cup (titanium) and femoral stem (titanium with a cobalt chrome ball) were implanted during a simulated total hip arthroplasty. The prosthesis was placed in a bath of fat, agar, and water to simulate the soft tissues. The inclusion of fat allows the evaluation of artifacts resulting from failure of fat suppression.

2D Correlation sequences (FOV=38cm, matrix=384x307, TR/TE/TI=5000ms/36ms/145ms, Si Thk=3.5mm, ETL=23) were acquired with a HBW-TSE sequence and with the addition of the VAT and SEMAC using slice encoding steps of 2, 4, 6, 8, 10, 12 and 14 (SEMAC x2-14) on a 1.5T MR scanner (Siemens Aera). Parallel imaging acceleration factor (iPAT) of 2 and 4(max) were applied with SEMACx2 and SEMACx4-14 to compensation for the increase of acquisition time. The dimension of the artifact along the short and long axis in the same middle slice was measured independently by three reviewers and blinded to the metal artifact compensation techniques and parameters.

RESULTS
As shown in the plot, the measured dimension of in-plane artifact initially decreases with the addition of VAT (p=0.004, 0.0003 for long and short axis) and SEMAC x2 (p=0.045, 0.16 for long and short axis). However, there is no further reduction with higher SEMAC (ANOVA p=0.95, 0.98 for long and short axis). The results from these three reviewers are in good agreement, suggesting that the measurements are reproducible and reliable.

CONCLUSION
The combination of HBW STIR with VAT and SEMAC reduces metal artifact from a phantom metal hip prosthesis, but approaches a limit with VAT and SEMAC x2 where further increases of SEMAC steps increase the acquisition time without significant reduction of the artifact.

CLINICAL RELEVANCE/APPLICATION
In the presence of a hip prosthesis, VAT and SEMAC slice encoding steps of 2 should be applied on high bandwidth coronal STIR images for optimal metal artifact reduction and minimal scan time.

SSJ24-05 • Time-resolved Quantitative Ventilation and Perfusion Imaging in Free Breathing without ECG Triggering Using Non Contrast Enhanced DC Gated FLASH MRI Imaging

André Fischer DIPLPHYS, PhD (Presenter); Christian O Ritter MD; Dietbert Hahn MD; Thorsten A Bley MD; Herbert Koestler PhD *

CONCLUSION
Quantification of time-resolved ventilation/perfusion datasets using DC gated rH FLASH imaging is feasible and in accordance with literature. This technique offers high patient comfort since data are acquired without applying contrast agents in free breathing and without ECG triggering.

Background
Recently, a non contrast enhanced technique acquiring quasi-randomly MRI data of the human lung in free-breathing and without ECG triggering was introduced [1]. To prevent artifacts due to respiratory/cardiac motion, these data are simultaneously acquired with the DC self gating signal. The DC signal enables accurate determination of the respiratory/cardiac phase. Thereby, complete respiratory/cardiacycles without motion artifacts can be reconstructed. From these datasets qualitative functional lung maps can be obtained [2]. In this abstract we describe a way to quantify the reconstructed time-resolved respiratory/cardiac cycles.

Evaluation
A quantification method for time-resolved ventilation data has been presented earlier [3]. For perfusion, the main task is to find a relationship between the FLASH signal equation in dependency on the number of applied excitation pulses and vpoold which is related to the perfusion rate. This concept is abbreviated AQUAPICSS (Absolute QUAntification of Perfusion-Induced Changes in the Steady-state Signal). Using AQUAPICSS and [3], we successfully obtained quantitative time-resolved ventilation/perfusion maps of the human lung from 7 healthy volunteers (5m/2f, age 20-25). Imaging parameters: 3.0T, TR/TE/TI=0.7ms/2°, 192x192, 450x450mm, 7,10min, 5,10s, SThk=4mm, 45°. The quantitative perfusion maps were additionally compared to SEEPAGE [4]. Figure 1a demonstrates that perfusion values are in good accordance between SEEPAGE and AQUAPICSS. Figure 1b shows an exemplary quantitative ventilation map.

Discussion
The observed perfusion/ventilation values were in accordance with literature values [5,6]. Furthermore, the AQUAPICSS perfusion maps correspond well to quantified rates from additionally acquired SEEPAGE datasets. Since simultaneous quantification of ventilation and perfusion is feasible, this technique enables the determination of the V/Q ratio without applying contrast agents.

SSJ24-06 • Evaluation of Short Term Reproducibility of Apparent Diffusion Coefficients for Diffusion-weighted Imaging of the Prostate

Meredith Sadinski BA (Presenter); Milica Medved PhD; Ibrahim Karademir MD; Yahui Peng PhD; Gregory S Karczmar PhD *; Aytekin Oto MD *; Yulei Jiang PhD; Steffen Sammet MD, PhD *; Shiyang Wang PhD *

PURPOSE
To evaluate the short-term reproducibility of DW-MR imaging of the prostate through consistency in ADC maps between subsequent scans of the same patient using the same scanner and identical imaging parameters.

METHOD AND MATERIALS
14 patients with biopsy proven prostate cancer were evaluated under an IRB-approved protocol. Each patient underwent two, identical DW-MRI scans gathered back-to-back with the patient remaining on the table between acquisitions. ADC maps for each scan were generated using a least squares fit and a defoamable registration was performed on the scan pairs using the Plastimatch software employing a Demons algorithm. The prostate and ROIs within cancer lesions were delineated on each scan per patient by two radiologists employing a Demons algorithm. The prostate volume was divided into sextants (anterior apex, posterior apex, anterior basal, posterior basal) and absolute and magnitude percentage difference in ADC per voxel was calculated and compared across sextants. Voxel-based as well as ROI-based variation in ADC was also calculated for cancerous ROIs.

RESULTS
The absolute difference in ADC per voxel within the prostate ranged from 2.33x10^-10 to 1.60x10^-3 mm²/sec (per voxel magnitude percentage difference of 0.00%-200%, mean 10.52%). Variation in ADC was found to be largest in the posterior apex (0.00%-200%, mean 11.5%) although difference between sextants was not statistically significant. Cancer ROIs showed a voxel-based difference in ADC per voxel of 6x10^-10 to 8.41x10^-4 mm²/sec (0.00%-67.37%, mean 11.16%). ROI-based analysis showed that the difference in mean ADC of a cancerous ROI between the two scans ranged from -4.22x10^-4 to 4.63x10^-4 mm²/sec with mean absolute difference 3.63x10^-5 mm²/sec.

CONCLUSION
DW-MRI has strong potential to become a powerful quantitative imaging biomarker for prostate cancer but it is necessary to characterize the reproducibility of DW-MRI when using it in the clinic or developing new approaches for its use. Our data demonstrates that ADC variation within the prostate is modest, on the order of 10%.

**CLINICAL RELEVANCE/APPLICATION**

DW-MRI is a mainstay of MRI of prostate cancer, but although a fundamental limitation of its use in the clinic or as a potential quantitative biomarker, reproducibility has not been well established.

### Radiation Oncology and Radiobiology (Outcomes)

**Tuesday, 03:00 PM - 04:00 PM • S104A**

**SSJ25-01 • Mentoring Students in Radiation Oncology: A Nine-year Retrospective Analysis of Students Participating in a Radiation Oncology Mentorship Program**

Ankit Agarwal BS (Presenter); Nicholas J Denumzio BS; Alexander E Rand BA; Ariel E Hirsch MD

**ABSTRACT**

**Purpose/Objective(s):**

Mentorship in academic medicine, including mentorship specifically in the field of radiation oncology, has been discussed in the literature. The purpose of this analysis is to document the impact of a mentorship program in radiation oncology at our institution.

**Materials/Methods:**

The analysis tracked 37 former medical students who took part in the Radiation Oncology Mentorship Program between 2004 and 2012 and graduated from our institution. The students participated in the clinical mentorship track, which included formal clinical experience in radiation oncology, or the research mentorship track, which included dedicated research time in radiation oncology, or both.

We analyzed the impact of the mentorship program on specialty choice and determined which mentorship track led to the greatest percentage of students choosing radiation oncology.

**Results:**

Of the 37 students tracked, 21 (56.8%) participated in the clinical mentorship program, ten (27.0%) participated in the research mentorship program, and 6 (16.2%) participated in both programs. In terms of specialty selection, 14 (37.8%) chose radiation oncology, seven (18.9%) chose internal medicine, four (10.8%) chose radiology, three (8.1%) chose general surgery, two (5.4%) chose ENT, two (5.4%) chose urology, two (5.4%) chose ob/gyn, one (2.7%) chose dermatology, one (2.7%) chose pediatrics, and one (2.7%) chose orthopedic surgery.

Three (30%) research students, seven (33.3%) clinical students and four (66.7%) students who obtained research and clinical experiences chose radiation oncology. Table 1 summarizes these results.

**Conclusions:**

Early and active mentoring of medical students in radiation oncology will enhance general understanding of the field as well as improve its professional base to enhance patient care. While the sample sizes are too small to reach statistical significance, they seem to indicate that the involvement in formal clinical and research mentorships in radiation oncology is common among students pursuing the field. Furthermore, other studies have shown a statistically significant increase in medical student knowledge about cancer and radiation therapy following formal radiation oncology experiences in medical school. Given the large epidemiological impact of cancer on the population, physicians must be competent in understanding and addressing their cancer patients’ needs, regardless of chosen specialty.

#### Radiation Oncology Mentorship Program

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**SSJ25-02 • Outcomes of Stereotactic Body Radiotherapy (SBRT) Treatment of Skeletal Muscle/Soft Tissue Metastases**

Reed Cope (Presenter); Kenneth R Olivier MD; Robert L Foote MD; Paul D Brown MD

**SSJ25-03 • Achieving Optimal Patient Setup Imaging and Treatment Workflow Configurations in Multi-Room Proton Centers via Monte Carlo Simulation**

Hao H Zhang (Presenter); Karl Prado; Katja M Langen PhD; Miness P Mehta MD*; William F Regine MD; Warren D D’Souza PhD

**SSJ25-04 • Toxicity Associated with Intensity-modulated Pelvic Radiation Treatment in the Post-operative Setting**

Carla Hajj MD (Presenter); Abraham J Wu MD; Karyn A Goodman MD

**ABSTRACT**

**Purpose/Objective(s):**

Preoperative chemoradiotherapy (CRT) is the recommended standard therapy for patients with locally advanced rectal cancer and is associated with reduced grade 3 or 4 toxicities compared with post-operative CRT. However, pre-operative staging studies may not correctly identify all patients with node positive or T3 disease, thus, some patients undergo upfront surgical resection and are found to have more advanced disease. In the small subset of rectal cancer patients who require post-operative CRT, the question of potential toxicity may affect the decision to offer therapy. The toxicity of post-operative CRT is primarily related to the large volume of small bowel that falls into the pelvis after rectal resection. The aim of this study was to evaluate the role of intensity modulated radiotherapy (IMRT) planning in reducing toxicity of CRT in the post-operative pelvis, either for adjuvant therapy or for a local recurrence.

**Materials/Methods:**

We retrospectively reviewed records of 22 colorectal cancer patients treated between 2007 and 2012 who received CRT using IMRT after prior radical resection with a low anterior resection (LAR) or abdominoperineal resection (APR). We reviewed the patients’ characteristics and analyzed the clinicians’ reported toxicities (CTCAE v 3.0).

**Results:**

The median age at treatment was 63 years, and 12 patients (56%) were males. Fourteen patients (64%) received post-operative CRT for locally recurrent disease, whereas 8 (36%) were treated in the adjuvant setting, at initial diagnosis of locally advanced rectal cancer. The median radiation dose was 50 Gy (range: 45 to 56 Gy). The median dose to the bowel was 2380 cGy, with a median in-field bowel volume of 621 cc. Grade 2 dermatitis, diarrhea, and proctitis occurred in 9%, 14%, and 45% of the patients, respectively. None of the patients had grade 3 or 4 toxicities. None of the patients experienced grade 2 nausea, vomiting, or cystitis.

**Conclusions:**

The median age at treatment was 63 years, and 12 patients (56%) were males. Fourteen patients (64%) received post-operative CRT for locally recurrent disease, whereas 8 (36%) were treated in the adjuvant setting, at initial diagnosis of locally advanced rectal cancer. The median radiation dose was 50 Gy (range: 45 to 56 Gy). The median dose to the bowel was 2380 cGy, with a median in-field bowel volume of 621 cc. Grade 2 dermatitis, diarrhea, and proctitis occurred in 9%, 14%, and 45% of the patients, respectively. None of the patients had grade 3 or 4 toxicities. None of the patients experienced grade 2 nausea, vomiting, or cystitis.
In this small series, postoperative CRT with IMRT planning was associated with minimal acute GI or skin toxicity. While pre-operative CRT is preferable, if necessary, CRT in the adjuvant setting or for locally recurrent can be delivered safely using IMRT. While large prospective studies of IMRT in this setting are unlikely to be performed, retrospective studies can help clarify the role of IMRT planning for pelvic radiotherapy with the goal of reducing acute toxicity and ultimately minimizing late effects and long-term quality of life for these patients.

SSJ25-05  •  Questionnaire Survey Regarding Radiotherapy of Metastatic Brain Tumors: Results from the North Japan Radiation Oncology Study Group

Kensuke Tanaka (Presenter) ; Gen Kawaguchi ; Ei-suke Abe ; Hiraku Sato MD ; Junyang Liu MD ; Hidefumi Aoyama MD, PhD ; Mika Obinata ; Kaidu Motoki ; Fumio Ayukawa MD

ABSTRACT

Purpose/Objective(s): Although brain stereotactic irradiation (STI) has been made increasingly in Japan in conjunction with the improvement of radiotherapy equipment, renewed measures are needed to form treatment policies on brain metastases and STI treatment planning in Japan. We conducted a questionnaire survey to investigate current radiation therapy practices for brain metastases in the North Japan Radiation Oncology Study Group.

Materials/Methods: In August 2011, questionnaires were sent to sixty institutions associated with the North Japan Radiation Oncology Study Group. The questionnaires consisted of questions on five major subjects; the availability of STI, treatment policies of brain metastases, STI treatment planning, whole brain radiotherapy (WBRT) and the treatment choice for four representative cases.

Results: Thirty-seven institutions responded. STI was available at 20 institutions (54%) at the time of the survey. Regarding treatment policy of brain metastases, WBRT and STI were equally emphasized (40%) at institutions where STI was available, whereas WBRT was given preference (69%) at institutions where STI was not available. Especially for patients with poor performance status (PS), STI monotherapy was used preferentially at institutions where STI was available, while WBRT was used frequently at institutions where STI was not available. Tumor size (94%), tumor number (91%), PS (91%), control of the primary site (64%) and extracranial metastasis (61%) were regarded as important factors in the choice of STI monotherapy. In STI treatment planning, more institutions used stereotactic radiotherapy than stereotactic radiosurgery, particularly in the treatment of lesions larger than 2 cm in diameter. The reference point for the dose prescription was set at the isocenter in 13 institutions (62%) and at the tumor margin in 6 institutions (29%), and 2 institutions (9%) used dose volume prescription. 30 Gy in 10 fractions (73%) was the most frequently used for WBRT, but for the patients with good PS or good prognosis, 2 or 2.5 Gy per fraction was also selected. The treatment decision for the four representative cases was made by majority agreement.

Conclusions: Brain STI has been carried out in more than half of the institutions in this survey. Because it is available at more institutions, STI is expected to be given higher priority in the treatment of brain metastases. Tumor size, tumor number, and PS are important factors when the respondents select STI monotherapy. For comparison between different STI treatments, the dose prescription in STI should be better defined.

SSJ25-06  •  Impact of ASTRO 2011 Guideline for Palliative Radiotherapy for Bone Metastases on Treatment Patterns at a Multicenter Academic Radiation Oncology Practice

Jagdeep Raince MD (Presenter) ; Beatrice Bloom MD ; Ankit Modh BS ; Henry Chou ; Jacob Pinsky

CONCLUSION

Our findings suggest that while the publication of ASTRO 2011 guidelines for palliative radiotherapy for uncomplicated bone metastases did shift our facility’s treatment pattern to shorter course, i.e. 5 fractions vs. 10 fractions, or SRS palliative treatment, it did not lead to adoption of a single 8 Gy fraction. Further exploration with data mining of our IMS is ongoing to determine the reasons for this apparent barrier.

Background

The ASTRO 2011 guideline for palliative radiotherapy for uncomplicated bone metastases stated that a single 8 Gy fraction would provide equivalent pain relief and/or prevention of morbidity as a more prolonged RT course. As part of a Quality Management initiative, we utilized our in house information management system (IMS) to determine if treatment patterns for metastatic bone disease shifted at our large, multicenter academic radiation oncology practice as a result of this guideline.

Evaluation

Through the use of our IMS we queried our electronic medical record for the diagnosis code of 198.5(bone metastases) and the associated treatment prescriptions. The query period extended from January 1, 2010 through December 31, 2012 affording the opportunity to evaluate treatment pattern before and after the official publication of the Guideline. Between 2010 and 2012 a shift in treatment pattern away from 30 Gy/10 fractions (28% in 2010 to 12% in 2012) in favour of 20 Gy/5 fractions (36% in 2010 to 39% in 2012). Increased utilization of stereotactic radiosurgery was also noted (4% in 2010 to 38% in 2012).

Discussion

Between 2010 and 2012 a shift in treatment pattern away from 30 Gy/10 fractions (28% in 2010 to 12% in 2012) in favour of 20 Gy/5 fractions (36% in 2010 to 39% in 2012) and increased utilization of stereotactic radiosurgery (4% in 2010 to 38% in 2012).

SSJ26-01  •  Electromagnetically Navigated in situ Fenestration of Aortic Stent Grafts: In-vitro Experiments and Pilot Animal Study

Hong-Sik Na MD (Presenter) ; Philipp Bruners MD ; Peter Isfort MD ; Andreas H Mahnken MD * ; Thomas Schmitz-Rode MD ; Johannes Jansing DIPLEN ; Christoph Wilkmann DIPLEN ; Sabine Osterhues DIPLEN * ; Andreas Besting DIPLEN * ; Catherine Dissehorst-Klug PhD ; Matias De La Fuente ; Christiane K Kuhl MD * ; Tobias Penzkofer MD *

PURPOSE

To evaluate the feasibility of electromagnetically navigated in-situ fenestration of aortic stent grafts to revascularize renal arteries in EVAR using a phantom and swine model.

METHOD AND MATERIALS

The proposed electromagnetic tracking system is operated by a custom-made navigation software working with a steerable EM-tracked catheter (8F) and a custom-made navigated guidewire (0.035") and being equipped with a gating algorithm to correct for breathing
In the phantom model of an abdominal aorta with a stent graft in place fenestration was performed 40 times on each side with 20 approaches from each iliac artery. Catheterization times, number of attempts and quality of fenestration were assessed and analyzed. Quality was measured on a scale from 1 to 3, judged by the distance from the ostial center.

In 3 domestic swine a high porosity stent graft was placed in the abdominal aorta covering the two renal ostia after previous cone-beam CTA. Using the pre-procedural dataset, both renal arteries were reperfused by fenestrating the stent graft and deploying covered stents at the ostia. Successful reperfusion was documented by cone-beam CTA.

RESULTS
In the phantom model average catheterization time was 88.6±79.8s (18-474 s) with 1.48±0.9 attempts. Mean quality of the fenestration was 2.0±0.7.

In the in vivo setting reperfusion was successfully performed in 5 renal arteries. In one case a stent strut was placed in front of the right ostium, as fenestration was possible only after introducing a Koch-Uchida needle. In the successful procedures, fenestration time was 8.4±9.2 min (catheter introduction to successful fenestration), stent placement time (catheter introduction to securing the branch with stent) was 32.0±27.1 min and average total stent-placement (aortic stent graft placement to placement renal stent) was 93.2±51.9 min. Problems delaying stent placement were attributable to the prototypical nature of the material (e.g. uncoated navigated guidewires, malfunctioning navigation coils).

CONCLUSION
Although the overall procedure times are currently not within acceptable ranges for renal ischemia time, the completion rates and short fenestration times warrant further development of the proposed procedure.

CLINICAL RELEVANCE/APPLICATION
Though EVAR is a valuable alternative to surgery nowadays it is still not suitable for emergency cases especially when side branches are involved. Our approach may allow EVAR even in those cases.

SSJ26-02 ● Abdominal Aortic Aneurysm Follow-up after Endovascular Repair by Non-invasive Vascular Elastography: Feasibility in a Canine Model

Elie Salloum MSc, BEng (Presenter) ; Antony Bertrand-Grenier ; Sophie Lerouge ; Claude Kauffmann PhD ; Guy Cloutier PhD ; Gilles P Soullez MD *

PURPOSE
Non-invasive vascular elastography (NIVE) is a new ultrasonic technique enabling the measurement of tissue deformation. We aim to apply and optimize elastography of abdominal aortic aneurysm (AAA) after endovascular aneurysm repair (EVAR) with stent-graft (SG) in a canine model to detect endoanleaks and characterize thrombus organization.

METHOD AND MATERIALS
SGs were implanted in a first group of 3 dogs with an aneurysm created in iliac arteries (6 aneurysms) and in a second group of 3 dogs in abdominal aorta. Type I endoleak was created in 6 iliac and 1 aortic aneurysms and type II in two aortic aneurysms. DUS (SuperSonic Imaging) and elastography examinations (Sonix RP, Ultrasoundx) were performed at baseline, 1 week, 1 month, 3 month (first group) and 6 month (second group) follow-up. Angiography, CT-scan and histology were also performed at sacrifice. Ultrasonic raw radio frequency data were acquired on longitudinal and three axial planes (proximal, mid and distal part of the aneurysm) in order to generate time-varying strain images. Elastograms of zone of interest were computed using the Lagrangian Speckle Model Estimator (LSME). Area of endoanleaks, liquid thrombus (non-organized) and solid thrombus (organized) were identified and segmented by comparing the results of CT-scan and histology. Strain values in area with endoleak, liquid and solid thrombus were compared.

RESULTS
Five iliac and one aortic aneurysms had type I endoleaks. A type II endoleak was observed in two aortic aneurysms whereas one iliac aneurysm was sealed. Maximal axial strain values in endoleak, liquid and solid thrombus areas were respectively estimated at 0.73 ± 0.14 %, 0.22 ± 0.035 %, 0.11 ± 0.035 %. Strain values were significantly different between endoleak and liquid or solid thrombus areas (p = 5.136E-09) and between solid and liquid thrombus areas (p = 0.00063). All endoleak areas were clearly identified on elastography examinations using axial or shear strain parameters.

CONCLUSION
The results show that NIVE is capable of detecting endoanleaks and characterize thrombus organization. Further development is needed to enable real time elastograms optimized for AAA follow-up after EVAR.

CLINICAL RELEVANCE/APPLICATION
NIVE is a new technique that could reduce the cost and the exposition to ionizing radiation and contrast agents of follow up of AAA after EVAR. It also has a potential to evaluate thrombus organization.

SSJ26-03 ● Abdominal Aortic Aneurysm Follow-up by Dynamic Elastography after Endovascular Repair

Antony Bertrand-Grenier (Presenter) ; Elie Salloum MSc, BEng ; Sophie Lerouge ; Claude Kauffmann PhD ; Guy Cloutier PhD ; Gilles P Soullez MD *

PURPOSE
Supersonic Shear Wave Imaging (SSWI) measure the tissue elasticity in real-time. Our goal is to characterize the mechanical properties of abdominal aortic aneurysm (AAA) after endovascular aneurysm repair (EVAR) in a canine model (endoanleaks, thrombus, walls) and correlate results with CT-Scan, Doppler Ultrasound (DUS) and pathologic findings.

METHOD AND MATERIALS
Stent Grafts (SGs) were implanted in 2 groups of dogs after creation of aortic or iliac aneurysms. The first group of 3 dogs (6 iliac arteries) had creation of type I or type II endoleaks. DUS and elastography examinations (SSWI) were performed at implantation, 1 week, 1 month, 3 months (groups 1 and 2) and 6 months (group 2). Angiography, CT-scan and histology were also performed at sacrifice to evaluate the presence, the size and the type of endoanleak and characterize aneurysm thrombus organization. Areas of endoleak, liquid thrombus (non-organized) and solid thrombus (organized) were identified and segmented by comparing histology to others techniques. Elasticity moduli values in area with endoleak, liquid thrombus and solid thrombus were compared on longitudinal and three axial planes (proximal, mid and distal part of the aneurysm).

RESULTS
Five iliac and one aortic aneurysms had type I endoleaks and one iliac and two aortic aneurysms had type II endoleaks. Elasticity moduli of 0.20 ± 0.30 kPa has been found in endoleak regions, 63.40 ± 66.28 kPa in solid thrombus and 2.97 ± 1.96 kPa liquid thrombus. Elasticity moduli values were significantly different between endoleak and solid thrombus areas (p = 0.0002), endoleak and liquid thrombus areas (p = 0.0090) and liquid thrombus and solid thrombus areas (p = 0.0003). All endoleak areas were clearly identified and significantly different of solid thrombus areas. Dynamic elastography detected endoleaks in which DUS failed (n = 3) and detected liquid thrombus (*possibility associated with type V endoleak).

CONCLUSION
The results show that SSWI is able to detect endoanleaks and characterize thrombus organization. The next objective is to evaluate in a phase II clinical study the feasibility and efficacy this approach.

CLINICAL RELEVANCE/APPLICATION
SSWI has the potential to evaluate thrombus organization, detect endoanleaks and possibly endotension, reducing the cost, the exposition to radiation and contrast agents of follow up of AAA post-EVAR.
SSJ26-04 • Acute Limited Intimal Tears of the Aorta Diagnosed with ECG-gated CT Angiography: A 4-Year Single Center Experience

Anne S Chin MD (Presenter); D. Craig Miller; Gerry Berry; Dominik Fleischmann MD *

PURPOSE
Limited intimal tears (LIT) of the aorta presenting as acute aortic syndrome (AAS) are notoriously difficult to diagnose prospectively, reported to elude all cross-sectional imaging techniques. Although this entity has been included in the AHA classification of aortic dissection (class 3), this entity is thought to be rare and remains largely unknown to radiologists. We have observed his lesion at our institution on ECG-gated CT angiograms prospectively with concordant surgical/pathologic confirmation. The aim of this research is to evaluate the ability of state-of-the-art CT angiography to detect subtle limited aortic tears.

METHOD AND MATERIALS
All CTAs from Jan 1, 2009 – Dec 31, 2012 in patients presenting to our institution for AAS were retrospectively reviewed. LITs were diagnosed on CTA according to AHA and Svensson’s original surgical description as subtle aortic wall contour bulges, without frank dissection. The presence and extent of associated intramural hematoma (IMH), and any other lesion descriptors were also noted. Various post-processing techniques were also performed in an attempt to increase lesion conspicuity and diagnostic confidence. Exam review was performed by two cardiovascular radiologists with 8 and 20 years’ experience in CV imaging. The number of “missed” cases were noted.

RESULTS
196 patients were diagnosed with AAS between Jan 2009-Dec 2012. The incidence of LIT was 8.1% (16 LITs, 115 classic dissection, 49 IMH, 11 penetrating atherosclerotic ulcer, and 5 rupturing aortic aneurysm). Of the 16 acute LITs, 14 were type A (ascending aorta involvement), and 2 were type B (one arch, one descending aorta). Of the nine patients who underwent urgent surgical repair, there was 100% concordance with CTA diagnosis. All type-A lesions were diagnosed prospectively, and only one type B LIT was “missed” on initial review.

CONCLUSION
Accurately and consistent detection of limited aortic tears is possible with ECG-gated CTA, although awareness of this lesion and meticulous review of the datasets is requisite; additional post-processing increases lesion conspicuity. To the best of our knowledge, this is a first report of the ability of CTA to detect LITs as well as the first to identify type B LIT lesions.

CLINICAL RELEVANCE/APPLICATION
Timely detection of acute limited intimal tears is critical for patient management, and can be accurately performed with ECG-gated CTA.

SSJ26-05 • Study of Relation between 320 Multidetector CT Renal Perfusion and the Size, Number and Position of Intimal Entries of Aortic Dissection Patients

Dongting Liu (Presenter); Zhaoqi Zhang; Jiayi Liu; Zhanming Fan

PURPOSE
To investigate the characteristic of renal perfusion in aortic dissection patients using 320 multidetector CT and to access it’s clinical value.

METHOD AND MATERIALS

RESULTS

The size, number and position of intimal entries can influence renal perfusion of patients with aortic dissection.

CLINICAL RELEVANCE/APPLICATION
MDCT is convenient to assess renal perfusion in aortic dissection patients. Perfusion imaging is helpful to make adequate preparations before the operation. It has important clinical significance.

SSJ26-06 • CT Assessment of Pattern and Presence of Intimal Defect in Aortic Intramural Hematoma

Clement Proust (Presenter); Jean Laurent Lambole; Loic Boussel MD; Philippe C Douek MD, PhD; Didier Revel MD *

PURPOSE
In patients presenting with an acute aortic intramural hematoma (IMH) the detection of an associated intimal defect is important for patient treatment and prognosis. The purpose of this study was to investigate the prevalence of intimal rupture detected by multidetector computed tomography (MDCT) in patients with IMH.

METHOD AND MATERIALS

RESULTS

An intimal defect was found in 30 patients (81% of the patients). ULP was the most frequent pattern (15 cases, 50%). Intimal tear was found in 13 (43,3%) patients. ULP was more frequent in IMH involving the descending aorta (71,4% vs 31,25%, p<0.05).

CONCLUSION
MDCT showed an intimal defect in up to 80% of the patients presenting with an acute IMH with a pattern depending on aortic IMH location.

CLINICAL RELEVANCE/APPLICATION
In patients presenting with an acute IMH, MDCT allows to detect different pattern of intimal defect.

Vascular/Interventional (CTA: Dose and Contrast Reduction)

Tuesday, 03:00 PM - 04:00 PM • N230
Injecting Contrast Media with Reduced Iodine Concentration at Higher Speed Results in Improved and Prolonged Arterial Enhancement in CT Angiography

Toon Van Cauteren MSc (Presenter); Gert Van Gompel PhD; Nico Buls DSc, PhD *; Koenraad H Nieboer MD *; Inneke Willekens MD; Guy Verfaillie PhD, MD; Daniel Jacobs Tulleneers Thevissen MD; Johan De Mey *

PURPOSE
To assess the impact of contrast media concentration on the height and length of arterial enhancement at constant iodine dose delivery rate (IDR) and total iodine dose (TID).

METHOD AND MATERIALS

RESULTS
Iodine concentration had a significant effect: the injection of lower concentrations at higher speed was associated with increased enhancement. Compared to 370 mgI/l, all concentrations equal and below to 270 mgI/ml resulted in both a broader and higher arterial peak (all p values<0.02). The contrast time increased from 7.3 ± 4.0 s at 370 mgI/ml up to 15.8 ± 4.0 s at 120 mgI/ml, whereas CT max increased from 237 ± 33 HU to 271 ± 20 HU, respectively. Despite higher injection speed, only a marginal increase in injection pressure was observed for lower iodine concentrations due to their reduced viscosity.

CONCLUSION
Despite constant IDR and TID, injecting a reduced contrast media concentration at higher speed results in a higher arterial peak enhancement and improved time window above 200 HU compared to the administration of a high contrast media concentration at lower speed.

CLINICAL RELEVANCE/APPLICATION
At equal iodine burden, reduced contrast media concentration improves image quality and relaxes the timing of the acquisition in CT angiography studies.

Image Quality of Whole Aortic Angiography with Low Contrast Flow Rate and Dual-energy CT Non-linear Blending Technique

Jie Liu (Presenter); Jianbo Gao MD

PURPOSE
To investigate the image quality of thoracoabdominal aortic angiography with a low contrast medium flow rate and DECT non-linear blending technique.

METHOD AND MATERIALS

RESULTS
The patient weight was 72.5 ± 12.6 kg. The contrast volume was 36.5 ± 6.3 ml. The flow rate was 3.2 ± 0.4 ml/s. The CT attenuation with optimal contrast was significantly higher than simulated 120 kVp group (AA: 358.4 ± 35.9 vs. 276.7 ± 34.9 HU, p < 0.001; DA: 326.8 ± 41.1 vs. 258.1 ± 31.2 HU, p < 0.001; 350.7 ± 44.3 vs. 271.5 ± 29.5 HU, p < 0.001). The noise of optimal contrast was significantly higher than the simulated 120 kVp images in the aorta, but not on the muscles. The SNR was significantly different between two groups. The CNR of optimal contrast was significantly higher than simulated 120 kVp images (AA: 12.4 ± 1.8 vs. 7.0 ± 1.5, p < 0.001; DA: 11.1 ± 2.1 vs. 6.5 ± 1.9, p < 0.001; AB: 12.0 ± 2.0 vs. 6.8 ± 1.5, p < 0.001). The volume CT dose index and dose-length-product were 7.7 ± 1.6 mGy and 526.2 ± 125.7 mGy*cm.

CONCLUSION
DECT non-linear blending technique can improve the image quality of whole aortic angiography and permit a low contrast medium volume and flow rate injection protocol.

CLINICAL RELEVANCE/APPLICATION
DECT permitted low contrast medium volume and flow rate which improve the patient care and maintain diagnostic image quality.

Validation of a Low Dose Simulation Method for Evaluation of Sub-mSv Computed Tomography

Daniela Muenzel MD (Presenter); Thomas Koehler PhD *; Kevin M Brown MS *; Stanislav Zabic PhD *; Alexander A Finger MD; Simone Waldt MD; Edgar Bendik; Tina Zahel; Ernst J Rummenny MD; Martin Dobritz MD; Peter B Noel MD (Presenter); Simone Waldt MD (Presenter); Gert Van Gompel PhD; Nico Buls DSc, PhD *; Koenraad H Nieboer MD *; Inneke Willekens MD; Guy Verfaillie PhD, MD; Daniel Jacobs Tulleneers Thevissen MD; Johan De Mey *

PURPOSE
To evaluate the image quality and diagnostic value of using spectral CT imaging and ioxixanol 270mgI/ml in abdominal CTA.
**PURPOSE**

Evaluation of a new software tool for generation of simulated low-dose computed tomography (CT) images from an original higher dose scan.

**METHOD AND MATERIALS**

Original contrast-enhanced and non-enhanced CT examinations (120 kVp; 100 mAs, 80 mAs, 60 mAs, 40 mAs, 20 mAs, and 10 mAs) of a swine with 4 arteries. Simulations of CT images with a lower radiation exposure (range 10-80 mAs) were calculated using a low-dose simulation algorithm that simulates accurately both photon noise and electronic noise that would be present in a scan at lower dose. Simulated non-enhanced images were compared to the original non-enhanced CT data of the same radiation dose level regarding density values and image noise. Four radiologists assessed the visual appearance of the simulated contrast-enhanced CT data.

**RESULTS**

Image characteristics of simulated low-dose scans were similar to the original acquisitions. Mean overall discrepancy of image noise and CT values between original and simulated CT images was 0.2% (range -0.6% to 0.8%) and -0.3% (range -2.1% to 0.8%), respectively, p > 0.05. Subjective observer evaluation of image appearance showed no visually detectable difference.

**CONCLUSION**

Simulated low dose images showed excellent agreement with the original scan data concerning image noise, CT density values, and subjective assessment of the visual appearance of the simulated images.

**CLINICAL RELEVANCE/APPLICATION**

An authentic low-dose simulation from actual CT examinations opens up important opportunity with regard to staff education, protocol optimization and introduction of new reconstruction techniques.

**SSJ27-05 • Reduced Iodine Dose Single Source Dual-energy CT Angiography of Abdomen for Assessment of Aorto-Iliac Diseases: Is This the Killer Application for Dual-energy CT?**

Mukta D Agrawal MBBS, MD (Presenter) *; Surabhi Bajpai MBBS, DMRD; George R Oliveira MD; Sanjeeva P Kalva MD *; Jorge M Fuentes MD; Koichi Hayano MD; Yasir Andradi MD, MPH; Dushyant V Sahani MD

**PURPOSE**

To investigate the performance of ssDE-CTA using reduce iodine dose for abdominal angiography in comparison to currently applied iodine dose conventional single energy CTA (SE-CTA) and to determine the energy level (keV) that provide optimal imaging for vascular and extravascular evaluation.

**METHOD AND MATERIALS**

In a IRB approved ongoing clinical trial, 64 consecutive patients with AAA and prior SE-CTA exam using standard dose of iodine were enrolled. Their follow up CTA exam was undertaken on ssDECT (GE Discovery CT750 HD) with reduced iodine dose (21-24gms instead of 33-55gms). Patients received iso-osmolar iodinated CM (Iodoxinol, GE) of 270 mgI/ml (group A, n=32) or 320 mgI/ml (group B, n=32) concentration. The arterial phase DECT images were processed to generate virtual monochromatic images (VMC) of various energies (40 to 140 keV at an increment of 5 keV). Two-experienced radiologist independently evaluated VMC image sets for subjective image quality and noise. Readers also determined the diagnostic keV range and the optimal keV for vascular and extravascular assessments. The contrast to noise ratio (CNR) was calculated on VMC images at various energies and SE-CTA images. A paired student t-test was used to determine statistical significance.

**RESULTS**

All DE-CTA exams were considered diagnostic with an IQ score 4.2. Both readers observed a broad range of diagnostic keV images from 40 to 75; and 40-45 keV images were considered best for vascular assessment, whereas 60-65 keV images were rated best for both vascular and extravascular assessment. In comparison to SE-CTA images, VMC images (40 – 60 keV) provided significantly higher intravascular attenuation (200-20%) and CNR (40-20%) at 28% less iodine dose (p < .05). The arterial depiction and image quality were comparable between 240-80 and 300-80 groups (P < .05). Mean FOMs were greater with 300-80 group than with the other two groups in selected arteries (P < .05). Mean effective dose was higher with 370-120 group (2.8-5.4 mSv) than with 240-80 group (2.3-4.3 mSv) for the abdomen and pelvis (P < .05). Mean FOMs with 240-80 group (7.8-15.3) were greater for the abdomen (P < .05) and tended to be greater for the thorax and pelvis than those with 370-120 group (4.8-9.2).

**CONCLUSION**

Use of 240 mg/mL CM at 80 kVp seems appropriate for a routine whole-body CTA and beneficial to the reduction of iodine load and radiation dose, whereas the use of 300 mg/mL CM may marginally improve the delineation of selected small arteries.

**CLINICAL RELEVANCE/APPLICATION**

Whole-body CTA with 240 mg/mL CM and 80-kVp tube voltage may replace conventional CTA with 350-400 mg/mL CM at 120-kVp tube voltage, contributing to a reduction of iodine load and radiation dose.
To compare a triple-echo gradient-echo sequence for measuring the fat content of the liver with using hydrogen $^1$H

**PURPOSE**

Rossella Di Miscio

When NS is doubtful in US, MDCT should be considered for a more accurate diagnosis, even in pediatric patients.

**CLINICAL RELEVANCE/APPLICATION**

Based on MDCT, precise diagnosis of NS by US is difficult. Thus, US should be performed with care in patients who may have NS.

**CONCLUSION**

122.1±37.7 cm/s, and 7.8±9.0 cm/s vs. 5.9±2.3 cm/s, respectively; P>0.05).

2; P

5.9±3.2 mm, respectively. The mean CDh, CDa, and CDh/a in Gr 2 were 9.0±1.5 mm, 2.9±0.8 mm, and 3.4±1.1 mm, respectively. A

Gr 1 and 2 comprised 30 and 18 patients, respectively. The mean CDh, CDa, and CDh/a in Gr 1 were 9.9±1.2 mm, 1.9±0.5 mm, and 5.9±3.2 mm, respectively. The mean CDh, CDa, and CDh/a in Gr 2 were 9.0±1.5 mm, 2.9±0.8 mm, and 3.4±1.1 mm, respectively. A significant difference existed in the 24-h urine proteinuria level between the groups (216.3±49.0 mg/d in Gr 1 vs. 133.4±58.8 mg/d in Gr 2; P<0.05). Vh, Va, and Vh/a showed no significant difference (Gr 1 vs. Gr 2: 22.5±7.6 cm/s vs. 22.0±6.7 cm/s, 135.0±30.4 cm/s vs.

RESULTS

Both group included thirty-two patients (M:F=10:22; age 0.3-15, mean 4 years old). Height, weight, and body mass index were not
different between two groups. The mean SWVs of liver was 2.45 m/s in BA group and 1.14 m/s in the control group (p

CONCLUSION

SWVs of liver and spleen increased in children with biliary atresia compared with healthy children. And the SWVs of liver correlated with

TE scores. However, SWVs of liver and spleen was not helpful to predict the presence of esophageal varices.

**CLINICAL RELEVANCE/APPLICATION**

SWVs of liver increased in children with biliary atresia and correlated with TE scores. However, SWVs of liver and spleen was not helpful
to predict the presence of esophageal varices.

**VSPD32-03 • Diagnostic Accuracy of Ultrasonography (US) Examination for the Evaluation of Nutcracker Syndrome (NS): Comparison with Multidetector-row Computed Tomography (MDCT) as a Reference Standard**

Minho Park MD (Presenter); Sung Kyoung Moon; Seong Jin Park MD, PhD; Joo Won Lim; Dong Ho Lee MD; Young Tae Ko MD, PhD

**PURPOSE**

To assess the diagnostic accuracy of US for the evaluation of pediatric NS patients with urinalysis abnormality (UA) compared with MDCT as a reference standard.

**METHOD AND MATERIALS**

This study included 66 pediatric patients with UA who underwent MDCT and US for the past 7 years. Eighteen patients with other

biopsy-proven or clinically diagnosed renal diseases were excluded. MDCT and US images of 48 patients were reviewed retrospectively. By

CT, AP diameters of the left renal vein (LRV) at the hilum (CDh) and aortomesenteric space (AMS, CDa) and the diameter ratio (CDh/a)

were assessed. The presence of a beak sign of LRV at AMS and corticomedullary enhancement difference between both kidneys (CMD)

in the portal phase were assessed. Patients were grouped as Gr 1 (high NS probability) and Gr 2 (low NS probability) according to the

following CT criteria: 1) CDh/a>4; 2) presence of beak sign; and 3) presence of CMD. Patients with two or more criteria were categorized

as Gr 1. By US, the AP diameters of LRV at the hilum (UDh) and AMS (UDa), diameter ratio (UDh/a), flow velocity at the hilum (Vh) and

AMS (Va), and flow velocity ratio (Vh/a) were assessed. Twenty-four-hour urine proteinuria tests and US parameters were compared

using an independent t-test.

**RESULTS**

Gr 1 and 2 comprised 30 and 18 patients, respectively. The mean CDh, CDa, and CDh/a in Gr 1 were 9.9±1.2 mm, 1.9±0.5 mm, and 5.9±3.2 mm, respectively. The mean CDh, CDa, and CDh/a in Gr 2 were 9.0±1.5 mm, 2.9±0.8 mm, and 3.4±1.1 mm, respectively. A significant difference existed in the 24-h urine proteinuria level between the groups (216.3±49.0 mg/d in Gr 1 vs. 133.4±58.8 mg/d in Gr 2; P<0.05). Vh, Va, and Vh/a showed no significant difference (Gr 1 vs. Gr 2: 22.5±7.6 cm/s vs. 22.0±6.7 cm/s, 135.0±30.4 cm/s vs.

122.1±37.7 cm/s, and 7.8±9.0 cm/s vs. 5.9±2.3 cm/s, respectively; P>0.05).

**CONCLUSION**

Based on MDCT, precise diagnosis of NS by US is difficult. Thus, US should be performed with care in patients who may have NS.

**CLINICAL RELEVANCE/APPLICATION**

When NS is doubtful in US, MDCT should be considered for a more accurate diagnosis, even in pediatric patients.

**VSPD32-04 • Quantification of Liver Fat Content in Adolescents with Non-alcoholic Fatty Liver Disease: Comparison of Triple-Echo Chemical Shift Gradient-Echo Imaging and in Vivo Proton MR Spectroscopy**

Rossella Di Miscio; Lucia Pacifico; Michele Di Martino (Presenter); Concetta V Lombardo; Flavio Ferraro; Claudio Chiesa; Carlo Catalano MD

**PURPOSE**

To compare a triple-echo gradient-echo sequence for measuring the fat content of the liver with using hydrogen $^1$H
Correlation between Bowel Ultrasound and Magnetic Resonance Enterography in Children

VSPD32-05 • Vitamin E Effect Monitoring with Hepatic Fat Quantification MR in Pediatric Nonalcoholic Steatohepatitis

Mi-Jung Lee ( Presenter) ; Myung-Joon Kim ; Hong Koh

PURPOSE
To evaluate the possibility of Vitamin E effect monitoring with hepatic fat quantification MR in pediatric nonalcoholic steatohepatitis.

METHOD AND MATERIALS
We retrospectively reviewed pediatric patients who received Vitamin E for nonalcoholic steatohepatitis and underwent hepatic fat quantification MR in the first three years. Hepatic fat fraction (%) was measured using dual- and triple-echo gradient-recalled-echo sequences at 3T. Compliance group and non-compliance group for Vitamin E medication were compared clinically, biochemically, and radiologically. Continuous variables were analyzed with Mann-Whitney U test and categorical variables were analyzed with Fisher's exact test.

RESULTS
Twenty-seven patients (M:F=24:3, age 12 ± 2.3 years) were included with 22 in compliance group and five in non-compliance group. Baseline findings on all parameters were not different between two groups except triglycerides level (compliance vs. non-compliance group, 167.7 mg/dl vs. 74.2 mg/dl; p=0.001). In compliance group, high-density lipoprotein increased and all the other parameters decreased after medication. However, there were variable changes in non-compliance group. On comparing compliance and non-compliance group, there were significantly different change in dual fat fraction (-19.2% vs. 4.6%; p

CONCLUSION
Hepatic fat quantification MR is a useful tool for monitoring Vitamin E effect in pediatric nonalcoholic steatohepatitis. It can also help to avoid unnecessary biopsies in these patients.

CLINICAL RELEVANCE/APPLICATION
Hepatic fat quantification MR is a useful tool for monitoring Vitamin E effect in pediatric nonalcoholic steatohepatitis. It can also help to avoid unnecessary biopsies in these patients.

VSPD32-06 • Systematic Approach to Imaging Pediatric Liver Masses

Sudha A Anupindi MD (Presenter)

LEARNING OBJECTIVES
1) Identify the common and developing imaging techniques to evaluate liver masses in children. 2) Demonstrate an understanding of the clinical presentation, laboratory findings and imaging features of the most common pediatric liver tumors. 3) Apply these principles to distinguish benign from malignant hepatic tumors.

ABSTRACT
1. Identify the common and developing imaging techniques to evaluate liver masses in children.
2. Demonstrate an understanding of the clinical presentation, laboratory findings and imaging features of the most common pediatric liver tumors.
3. Apply these principles to distinguish benign from malignant hepatic tumors.

VSPD32-07 • Correlation between Bowel Ultrasound and Magnetic Resonance Enterography in Children

Tahani M Ahmad MD ( Presenter) ; Oscar M Navarro MD ; Mary-Louise C Greer MBBS, FRANZCR

PURPOSE
Introduction: Inflammatory bowel disease (IBD) is one of the most common gastrointestinal diseases affecting pediatric population in developed countries.Imaging is a crucial component of disease evaluation. Magnetic resonance enterography (MRE) is becoming the most widely accepted imaging modality in current practice although with some drawbacks including high cost, limited availability and long scan times. Aim: To compare the diagnostic yield and concordance of bowel ultrasound (US) with MRE in children.

METHOD AND MATERIALS
Prospective study in 33 children undergoing clinically indicated MRE. A dedicated bowel US was performed within 2 hours prior to MRE. Each of the US and MRE images were analyzed blindly by two pediatric radiologists. Inter-reader agreements of nine inflammatory markers for each modality and for each bowel segment were calculated as well as the coefficient of concordance between the consensus US and consensus MRE.

RESULTS
US showed substantial inter-reader agreement on large bowel and distal ileum but no agreement in the remainder of small bowel. MRE also showed excellent agreement on all bowel segments but moderate on the proximal small bowel. When consensus US was compared to MRE, US showed excellent diagnostic performance in replicating MRE results in most of the large bowel and distal ileum and showed moderate concordance in the remainder of the small bowel and transverse colon.

CONCLUSION
US is a reliable tool and showed substantial correlation with MRE in detecting inflammatory changes in the colon, terminal ileum and distal ileum. US remains inferior to MRE for the remainder of the small bowel with less reliability but moderate concordance. Therefore,
US can be an excellent complement to MRE particularly for follow-up of disease activity in patients with known IBD and as a primary imaging method for those with nonspecific symptoms or with low suspicion for having IBD at initial presentation. MRE remains the preferred method for evaluating disease involvement at presentation.

CLINICAL RELEVANCE/APPLICATION
Ultrasound is an excellent complement to MRE in evaluation of IBD in children and is recommended for follow-up of disease activity in patients with known IBD

**VSPD32-08 • Diffusion-weighted MR Imaging (DWI) for Detection of Bowel Inflammation in Pediatric Patients with Inflammatory Bowel Disease**

Kiran M Sargar MBBS,MD (Presenter) ; Simon C Kao MD ; Geetika Khanna MD,MS ; Yutaka Sato MD

**PURPOSE**
1. To determine the feasibility of diffusion weighted magnetic resonance imaging (DWI) in the detection of bowel inflammation in patients with inflammatory bowel disease. 2. To evaluate the changes in apparent diffusion coefficient (ADC) values in the inflamed bowel in patients with inflammatory bowel disease.

**METHOD AND MATERIALS**
We retrospectively analyzed 44 pediatric patients (ages between 10 to 17 years) with either known or clinically suspicious diagnosis of inflammatory bowel disease who underwent MR Enterography (including free breathing DWI). All of these 44 patients had colonoscopy and biopsy within 4 weeks of MR examination. Two radiologists reviewed DWI and ADC maps to evaluate for inflammation in each bowel segment (terminal ileum, cecum, ascending colon, transverse colon, descending colon, and rectosigmoid colon) and measured the ADC values of each bowel segment. Endoscopic and pathologic results were correlated with DWI findings.

**RESULTS**
Out of 44 patients 7 patients had normal results on endoscopy, pathology and DWI, 27 patients had Crohn’s disease (CD) and 10 patients had ulcerative colitis (UC). Among 27 patients with CD, 5 patients had negative endoscopy and pathology and negative DWI. In remaining 22 patients with CD who had positive endoscopy and pathology, DWI detected involved segments of bowel in 19 (86%). Out of 10 patients with UC, 2 patients had negative endoscopy and pathology as well as negative DWI. Among 8 patients with UC who had positive endoscopy and pathology, DWI detected inflammation in 6 patients (75%). On DWI, bowel segments with inflammation revealed higher signal. On quantitative analysis, ADC values of inflamed and normal bowel were measured and ADC values in inflamed bowel were significantly decreased as compared with normal bowel. The mean ADC value of proven inflamed bowel was 1.13 X 10-3 mm2/s (range, 0.81 – 1.41 X 10-3 mm2/s), compared to 2.74 X 10-3 mm2/s (range, 1.5 – 4.03 X 10-3 mm2/s) in normal bowel segments (P < .0001).

**CONCLUSION**
DWI is a valuable imaging tool for detection of bowel inflammation in pediatric inflammatory bowel disease. Sensitivity of DWI is better in CD than UC. ADC values are significantly low in inflamed bowel segments than normal bowel segments.

**CLINICAL RELEVANCE/APPLICATION**
DWI facilitates fast, accurate and comprehensive workup in pediatric inflammatory bowel disease; without the need for IV contrast administration and eliminating risk of radiation.

**VSPD32-09 • MR Colonography including Diffusion Weighted Imaging (DWI) in Children with Inflammatory Bowel Disease (IBD): Do We Really Need Intravenous Contrast?**

Sonja Kinner MD (Presenter) ; Maria L Hahnenmann MD ; Bernd Schweiger * ; Thomas C Lauenstein MD ; Selma Sirin MD

**PURPOSE**
MR colonography (MRC) is a well-accepted, non-invasive imaging modality for the depiction of inflammatory bowel disease. Diffusion weighted imaging (DWI) has been shown to show lesions in abdominal MRI as good as contrast enhanced imaging and can also be used for bowel imaging. The aim of this study therefore was to assess if contrast enhancement is really needed to depict inflammatory lesions in bowel MRI if DWI is available.

**METHOD AND MATERIALS**
38 patients (18 girls, 20 boys, mean age 14.6 years) underwent MRC on a 1.5T (Magnetom Avanto, Siemens). In addition to T2-weighted and contrast-enhanced T1-weighted (ce-T1-w) data, DWI sequences in axial and coronal plane (b = 50, 500, 1000) were acquired and ADC maps were calculated. Two reviewers evaluated i) DWI, ii) ce-T1-w MRC as well as iii) DWI and ce-T1-w MRC concerning lesions (1=none, 2=one/continuous lesion(s), 3=multiple, discontinuous lesions). Furthermore, bowel distension (1=good, 2=moderate, 3=poor distension) and the preferred b-value (0, 500, 1000) were assessed and correlated. Colonoscopy was performed in the following 48 hours and served as reference standard.

**RESULTS**
Ce-T1-w MRC showed lesions correctly in 32 of 38 patients. All 38 patients were diagnosed correctly with the DWI data set and with a combination of DWI and ce-T1-w MRC. In 4 patients DWI presented multiple, discontinuous lesions, while ce-T1-w MRC only showed one continuous lesion. Inflammatory bowel parts were detectable even if bowel distension was suboptimal: The missed lesions in ce-T1-w MRC were found in patients with only poor or moderate distension. Sigma values for the two readers were excellent (k=0.82). A combination of the two higher b-values (b=500 and 1000) was preferred for DWI.

**CONCLUSION**
DWI of the bowel shows inflammatory lesions with high accuracy and proved to show lesions that were not seen with ce-T1-w imaging. DWI can be used even in moderately or poorly distended bowel segments and is able to discriminate between one or more continuous or discontinuous lesions. B-values of 500 and 1000 should be used.

**CLINICAL RELEVANCE/APPLICATION**
DWI seems to be able to replace, in any case complement ce-T1-w MRC. This could be used for short examinations for therapy response assessments and has to be evaluated in future trials.

**VSPD32-10 • Relationship of the Detection Rate of Active Pediatric Ulcerative Colitis (PUC) and the Time Interval between MR Enterography (MRE) and Endoscopy**

Mohamed A Aggag MD (Presenter) ; Jorge H Davila Acosta MD ; Carmen Rotaru PhD ; Ericc Benchimol MD ; David Mack MD

**PURPOSE**
1. To correlate DWI and post gadolinium enhancement (PGE) findings with endoscopy findings in PUC
2. To evaluate the relationship of detection of active PUC and time interval between the MRE and endoscopy

**METHOD AND MATERIALS**
Retrospective study. Inclusion criteria: Newly diagnosed patients with PUC who underwent MRE and endoscopy between Feb 2010 and Dec 2012. Exclusion criteria: Interval time between studies > 31 days. bowel was divided in 6 segments: Cæcum (Ce), ascending colon (AC), transverse colon (TC), descending colon (DC), sigmoid colon (SC) and rectum (Re). MRE was performed in a 1.5 T Magnet. 3 planes SSFSE, axial 2D FIESTA, coronal multiphase 2D FIESTA, coronal and axial DWI b=1000, pre and post gadolinium coronal Dynamic multiphase LAVA fat sat and Axial LAVA fat sat were acquired. DWI was positive if high SI in DWI and low SI in ADC map. PGE was positive if there was avid mucosal enhancement in comparison with the remainder of the small bowel. Endoscopy was positive if ulceration, inflammation or edema were documented.
Evaluation of the Difference in Radiation Exposure Levels between Image Intensifier and Flat Panel Detector-based Systems in Pediatric Patients with Biliary Strictures Post-liver Transplantation Treated with Interventional Radiological Procedures

Robertino Miraglia MD ; Luigi Maruzzelli MD ; Kelvin Cortis MD, MRCS, FRCR (Presenter) ; Fabio Tuzzolino ; Roberta Gerasia ; Angelo Luca MD

PURPOSE
The aim of this study was to compare radiation exposure levels between biliary interventional procedures performed using an image intensifier and a flat panel detector-based system in liver transplant pediatric patients with biliary strictures (BS).

METHOD AND MATERIALS
We enrolled 34 consecutive pediatric liver transplant recipients with BS who underwent a total of 170 image-guided procedures in the period between January 2008 and March 2013. The Dose Area Product (DAP) and fluoroscopy time was recorded for each procedure. Mean age was 61 months (range 4 - 192) and mean weight 17 kg (range 4 - 41). The procedures were classified into 3 categories: percutaneous trans-hepatic cholangiography and biliary catheter placement (n=40), cholangiography and balloon dialatation (n=55), cholangiography and biliary catheter change or removal (n=75). Ninety two procedures were performed in a flat panel detector-based interventional suite. The difference between the two angiographic systems was compared using the Wilcoxon rank-sum test, using both DAP and angiographic system. All of the 78 procedures performed after July 2010 were performed in a flat panel detector-based interventional system.

RESULTS
Mean age was 61 months (range 4 – 192) and mean weight 17 kg (range 4 – 41). The procedures were classified into 3 categories: percutaneous trans-hepatic cholangiography and biliary catheter placement, 0.0002 in the cholangiogram and balloon dialatation, and 0.21 (p=0.02), DC: 0.12 (p=0.03), SC: 0.42 (p=0.04), Re: 0.42 (p=0.04).

CONCLUSION
The longer the interval between MRE and endoscopy, the lower the detection ratio of active PUC by MRE, this is likely due to treatment response. 2. DWI has better sensitivity than PGE in the detection of active PUC.

CLINICAL RELEVANCE/APPLICATION
These results support that treatment contributes to mucosal healing; therefore, correlation value of endoscopy and MRE is lower in longer time interval, for being considered during MRE interpretation.

VSPD32-11 • IR of Challenging Pediatric Liver Conditions
Philip R John MBChB, FRCR (Presenter)

LEARNING OBJECTIVES
1) To understand the range of hepatobiliary disorders where invasive imaging is required (using vascular and nonvascular interventional techniques). 2) To describe the spectrum of hepatobiliary disorders where IR plays an important role in patient management (hepatic vascular malformations, vascular shunts, transplant issues and the utilization of the liver as a window for cardiac intervention). 3) To emphasize the need for close collaboration and communication between diagnostic and interventional radiology in managing children with hepatobilia.

ABSTRACT
VSPD32-13 • Evaluation of the Difference in Radiation Exposure Levels between Image Intensifier and Flat Panel Detector-based Systems in Pediatric Patients with Biliary Strictures Post-liver Transplantation Treated with Interventional Radiological Procedures

Robertino Miraglia MD ; Luigi Maruzzelli MD ; Kelvin Cortis MD, MRCS, FRCR (Presenter) ; Fabio Tuzzolino ; Roberta Gerasia ; Angelo Luca MD

PURPOSE
The aim of this study was to compare radiation exposure levels between biliary interventional procedures performed using an image intensifier and a flat panel detector-based system in liver transplant pediatric patients with biliary strictures (BS).

METHOD AND MATERIALS
We enrolled 34 consecutive pediatric liver transplant recipients with BS who underwent a total of 170 image-guided procedures in the period between January 2008 and March 2013. The Dose Area Product (DAP) and fluoroscopy time was recorded for each procedure. Mean age was 61 months (range 4 – 192) and mean weight 17 kg (range 4 – 41). The procedures were classified into 3 categories: percutaneous trans-hepatic cholangiography and biliary catheter placement (n=40), cholangiography and balloon dialatation (n=55), cholangiography and biliary catheter change or removal (n=75). Ninety two procedures were performed in an image intensifier-based angiographic system. All of the 78 procedures performed after July 2010 were performed in a flat panel detector-based interventional suite. The difference between the two angiographic systems was compared using the Wilcoxon rank-sum test, using both DAP and angiographic system. All of the 78 procedures performed after July 2010 were performed in a flat panel detector-based interventional system.
In our experience, the use of flat panel angiographic equipment reduces radiation exposure in pediatric biliary interventional radiology procedures in children with liver transplantation.

CLINICAL RELEVANCE/APPLICATION
The use of flat panel angiographic equipment should be considered for pediatric interventional radiology procedures.

VSPD32-14 • Free Breathing Radial 3D VIBE- A Possibility to Perform Dynamic Contrast Enhanced Abdominal MRI Examinations of Children under General Anesthesia with an Improved Image Quality

Maya C Larson (Presenter); Philipp Weisser MD; Renate M Hammerstingl MD; Martin Beeres MD; Kai T Block; Thomas J Vogl MD, PhD

PURPOSE
To show that a MRI protocol including a free-breathing 3D VIBE sequence with radial k-space sampling allows dynamic contrast enhanced abdominal imaging in sedated and ventilated children undergoing MR scans with improved image quality.

METHOD AND MATERIALS
12 pediatric patients, aged from 2 months to 5 years, referred for clinically indicated contrast enhanced abdominal MRI scans underwent imaging at 1.5T under general anesthesia. The protocol included a free breathing T1 weighted GRE-sequence with radial k-space sampling that was used to acquire three dynamic image series including arterial, portal-venous and hepato-venous phases. Additionally a breath-gated fat suppressed T1 weighted FLASH 2D sequence with rectilinear k-space sampling was performed. All Image series were evaluated by two independent radiologists using a 3-point scale (1 excellent - 2 fully diagnostic - 3 non-diagnostic) regarding overall image quality, special focus was on vessel clarity, distinction of organ parenchyma, artifacts, and-if present- lesions.

RESULTS
The short acquisition time of the free-breathing T1 weighted 3D VIBE Sequence allowed dynamic contrast enhanced imaging in all examined sedated and ventilated patients without ventilation stop. Furthermore the image quality of all three dynamic image series of the free-breathing T1 weighted 3D VIBE sequence was rated with an average of 1.3 and is therefore considered by both radiologists in consensus as superior to the breath-gated T1 weighted FLASH 2D sequence which was rated with an average of 2.2 on a scale of 1-3 (1 excellent 2-diagnostic 3 non-diagnostic).

CONCLUSION
The free breathing T1 weighted radial VIBE sequence allows dynamic contrast enhanced imaging of pediatric patients undergoing MRI examination in general anesthesia and in deep sedation. This kind of examination cannot be performed with a standard breath gated T1-FLASH 2 D sequence without ventilation stop or in deep sedation without intubation. Furthermore as the acquisition times are very short and the radial VIBE proves to be very resistant to motion artifacts, the free-breathing 3D VIBE sequence provides improved image quality compared to the T1 FLASH 2D sequence.

CLINICAL RELEVANCE/APPLICATION
The radial VIBE MRI sequence allows dynamic contrast enhanced imaging of sedated and ventilated children in general anesthesia with an improved image quality and should be therefore recommended.

VSPD32-15 • Free Breathing Fast Pediatric MRI: Quantitative Analysis of View Sharing vs. Locally Low Rank Motion Weighted Reconstructions

Shaun V Mohan MD (Presenter); Tao Zhang; Richard A Barth MD *; Shreyas S Vasanawala MD, PhD *

PURPOSE
Dynamic contrast enhanced functional renal MRI requires well-registered kidneys over all temporal phases as well as high temporal resolution. Fast MR methods, such as compressed sensing and parallel imaging can significantly shorten scan time. Combined with respiratory motion correction, a locally low rank motion weighted (LLRMW) method may enable free breathing fast multi-phase MRI, potentially decreasing the depth and duration of anesthesia. Here we compare LLRMW and the commonly used view sharing (VS) reconstruction to assess motion artifacts quantitatively through measurements of kidney movement for free breathing MRI.

METHOD AND MATERIALS
With IRB approval, informed consent and HIPAA compliance, 25 pediatric MRI cases (14 male, 11 female, mean age 6) were obtained at our institution for 3T multi-phase DCE MRI with a free breathing acquisition accelerated approximately 6-fold. VS and LLRMW reconstruction were performed. To assess kidney movement, TeraRecon V4.4 was utilized to draw signal profiles across the inferior pole of each renal cortex and adjacent fat. Two patients only had one native functional kidney on which measurements were performed. A paired t-test was performed on the measurements for the left and right kidneys respectively, comparing VS and LLRMW reconstructions. The mean difference calculated greater overall motion in the VS than LLRMW reconstruction, with 0.5067 mm (95% CI: 0.3050 to 0.8325) for the right kidney and 0.5688 mm (95% CI: 0.3068 to 0.8325) for the left kidney, and was captured across all 18 temporal phases of the study to assess kidney movement over time. The greatest change between profile transition points indicated the greatest movement for each kidney for both reconstructions.

RESULTS
The short acquisition time of the free-breathing T1 weighted 3D VIBE Sequence allowed dynamic contrast enhanced imaging in all examined sedated and ventilated patients without ventilation stop. Furthermore the image quality of all three dynamic image series of the free-breathing T1 weighted 3D VIBE sequence was rated with an average of 1.3 and is therefore considered by both radiologists in consensus as superior to the breath-gated T1 weighted FLASH 2D sequence which was rated with an average of 2.2 on a scale of 1-3 (1 excellent 2-diagnostic 3 non-diagnostic).

CONCLUSION
The free breathing T1 weighted radial VIBE sequence allows dynamic contrast enhanced imaging of pediatric patients undergoing MRI examination in general anesthesia and in deep sedation. This kind of examination cannot be performed with a standard breath gated T1-FLASH 2 D sequence without ventilation stop or in deep sedation without intubation. Furthermore as the acquisition times are very short and the radial VIBE proves to be very resistant to motion artifacts, the free-breathing 3D VIBE sequence provides improved image quality compared to the T1 FLASH 2D sequence.

CLINICAL RELEVANCE/APPLICATION
The radial VIBE MRI sequence allows dynamic contrast enhanced imaging of sedated and ventilated children in general anesthesia with an improved image quality and should be therefore recommended.
Case-based Review of Nuclear Medicine: PET/CT Workshop-Cancers of the Thorax (In Conjunction with SNMMI) (An Interactive Session)

Tuesday, 03:30 PM - 05:00 PM • S406A

S406A


time at which the patient was examined, as well as the age and sex of the patient. The interpretation of the images

particularly challenging. This is because the normal FDG uptake in the lungs and heart can sometimes overlap with the lesions in the thorax. Hence, factors such as the spatial resolution and the contrast between normal and abnormal tissue need to be considered when interpreting the images.

FDG-PET/CT has proven diagnostic value for evaluating primary malignancy and metastatic disease within the thorax, and can have a significant impact on patient management. Malignancies that are frequently evaluated in the thorax include primary lung cancer, esophageal cancer, lymphoma, and pleural disease. Interpretation of thoracic FDG-PET/CT scans may be complicated by the presence of benign conditions that can have high metabolic activity simulating malignancy; examples include "brown fat", sarcoidosis, granulomatous disease, post-therapeutic changes, infection, and reactive inflammation. On the other hand, some malignant disease may exhibit only modest FDG accumulation; factors include tumor histology, partial volume averaging effects, and respiratory motion. Hence, factors other than intensity of FDG uptake are often essential to distinguish benign from malignant disease. Patient history and details of prior therapy are important. Additional helpful information includes patient history, lesion distribution and symmetry, and CT imaging characteristics of the lesions. Using a case-based approach, examples of FDG-PET/CT imaging will be presented for evaluating a variety of thoracic malignancies. The approach to interpretation and strategies for distinguishing malignant from benign processes will be highlighted.

Essentials of Trauma Imaging

Tuesday, 03:30 PM - 05:00 PM • S100AB

S100AB

1) The findings of liver, spleen and GU trauma will be described. These are mostly widely known and appreciated. 2) The importance of direct vascular injury in these organs will be shown. 3) Injury resulting in potential mortality versus potential morbidity will be addressed. 4) The value of specific imaging technique on identifying and characterizing injury to these organs will be discussed. 5) The limitations of conventional grading systems in these organs will be exposed. 6) A proposed management algorithm for each organ will be described based upon the severity of the injury.

ABSTRACT

Blunt abdominal trauma is all too common and frequently results in significant morbidity, and in many cases, mortality. Early recognition of injury with potential to result in death is preferable. Imaging that may predict significant morbidity is also useful to enable prompt early treatment to limit morbidity. Conventional grading systems for abdominal organ injury, although useful in their day, are now outdated and do not take into account the progress made in imaging since these systems were devised. Injury to vessels resulting in prolonged bleeding is the cause of mortality and this may be established with dedicated vascular imaging now available and we no longer rely on the size of laceration to predict outcome even in the solid parenchymal organs of the abdomen. Morbidity may also be predicted based on imaging and early treatment instituted where appropriate. The purpose of this talk will be to outline the imaging techniques required to optimize injury detection and characterization, classify injuries according to modern imaging techniques and put forth an proposed management plan for all types of injury to the liver, spleen and GU tract.

MSES34A • MDCT Techniques in Trauma Imaging

Stephan W Anderson MD (Presenter)

LEARNING OBJECTIVES

1) To discuss the appropriate use of oral and intravenous contrast in trauma imaging using CT. 2) To discuss the applications of multi-phasic imaging in trauma using CT. 3) To delineate methods to limit radiation in trauma imaging with MDCT. 4) To illustrate relevant imaging findings for a range of clinically relevant traumatic injuries using MDCT.

MSES34B • Liver, Spleen, and GU Trauma

Brian C Lucey MBCh (Presenter)

LEARNING OBJECTIVES

1) The findings of liver, spleen and GU trauma will be described. These are mostly widely known and appreciated. 2) The importance of direct vascular injury in these organs will be shown. 3) Injury resulting in potential mortality versus potential morbidity will be addressed. 4) The value of specific imaging technique on identifying and characterizing injury to these organs will be discussed. 5) The limitations of conventional grading systems in these organs will be exposed. 6) A proposed management algorithm for each organ will be described based upon the severity of the injury.

ABSTRACT

Blunt abdominal trauma is all too common and frequently results in significant morbidity, and in many cases, mortality. Early recognition of injury with potential to result in death is preferable. Imaging that may predict significant morbidity is also useful to enable prompt early treatment to limit morbidity. Conventional grading systems for abdominal organ injury, although useful in their day, are now outdated and do not take into account the progress made in imaging since these systems were devised. Injury to vessels resulting in prolonged bleeding is the cause of mortality and this may be established with dedicated vascular imaging now available and we no longer rely on the size of laceration to predict outcome even in the solid parenchymal organs of the abdomen. Morbidity may also be predicted based on imaging and early treatment instituted where appropriate. The purpose of this talk will be to outline the imaging techniques required to optimize injury detection and characterization, classify injuries according to modern imaging techniques and put forth an proposed management plan for all types of injury to the liver, spleen and GU tract.

MSES34C • Bowel, Mesentery, and Pancreatic Trauma

Jorge A Soto MD (Presenter)

LEARNING OBJECTIVES

1) Review CT findings associated with bowel, mesenteric and pancreatic trauma. 2) Explain concepts of CT technique that are relevant to evaluation of patients with bowel and pancreatic trauma. 3) Apply CT findings for adequate therapy for patients with blunt pancreatic and bowel injuries.

ABSTRACT

Although injuries to the pancreas, hollow viscera and mesentery are rare, they are important because delays in diagnosis as short as 8 to12 hours increase the morbidity and mortality from peritonitis and sepsis. Thus, radiologists need to be aware of the often subtle CT signs that are found in these injuries. Signs of bowel injury include focal wall discontinuity, extraluminal gas or oral contrast material (on the rare occasions when it is administered), focal wall thickening and abnormal bowel wall enhancement. Signs of mesenteric trauma include focal mesenteric hematoma, peritoneal extravasation of intravenous contrast-enhanced blood, abrupt termination of a mesenteric vessel and ill-defined increased attenuation (stranding) of the mesentery. The importance of each individual finding varies: the more specific signs are not highly sensitive, and the more sensitive signs are not highly specific. Although free intraperitoneal fluid occurs in both both and mesenteric injuries, this finding in isolation (i.e., without other suspicious signs) lacks specificity. The amount of fluid present, the mean attenuation and the location of the fluid collections are helpful when making management decisions. Pancreatic trauma usually occurs in association to the liver, spleen or bowel. The diagnosis of pancreatic injuries on CT relies on the identification of direct signs, such as contusions or lacerations, and indirect signs, such as fluid in the peripancreatic fat or in the plane
separating the pancreas from the splenic vein and thickening of the left anterior renal fascia. In problematic cases, MR with MRCP may provide additional clues to help in the diagnosis.

**Dell, Inc.: Cloud as a Platform for Collaboration in the Era of Accountable Imaging**

**Tuesday, 03:45 PM - 04:30 PM • South Building Hall A Booth 3314**

**EPT08**

Jim Phillips  
Global Product Manager  
Mitchell Goldburgh

**LEARNING OBJECTIVES**

Today, accountable imaging is the central nervous system of the diagnostic business. Image enabled medical records empower the entire continuum of care. This session will discuss how image Collaboration-as-a-Services can drive not only a higher standard of care, but also significantly reduced IT complexity through cloud-enabled enterprise image archiving.

**Interactive Game: The Audience Participation Game (Chest Imaging)**

**Tuesday, 04:30 PM - 06:00 PM • E451A**

**RC401 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5**

**LEARNING OBJECTIVES**

1) To provide an approach to the imaging evaluation of the patient with mediastinal and lung disease. 2) To list the imaging features that allow categorization of diseases as mediastinal, airway, or interstitial. 3) To enumerate the key radiographic and CT features of these abnormalities with emphasis on providing a focused differential diagnosis. 4) To establish the role of the radiologist in the multidisciplinary approach to the management of affected patients. This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

**ABSTRACT**

Diffuse lung disease is a challenging imaging finding as it is often nonspecific. Determination of potential etiologies relies on the clinical profile of the affected patient, the chronicity of symptoms, relevant laboratory findings and the distribution of disease on chest radiography. Although the above may provide clues to the diagnosis, many of these patients are evaluated with thin-section or high-resolution chest CT (HRCT). Diffuse lung diseases may affect the airways, the airspaces and/or the pulmonary interstitium.

Airways diseases may include abnormalities of airway caliber, wall thickness, and bronchiolitis (including cellular and constrictive types). Abnormalities of the airspaces may include alveolar filling with edema fluid, blood, infectious purulent material, lipoprotein and neoplastic cells, among various entities. Interstitial lung diseases are a complex group of idiopathic and secondary lung diseases (including smoking related diseases) often complicated by pulmonary fibrosis. The radiologist plays an important role in the prospective diagnosis of idiopathic interstitial fibrosis. Cystic lung diseases can also be considered within the spectrum of interstitial lung disease and may relate to abnormal cellular proliferations or may be the sequela of cigarette smoking.

This course will present a systematic approach to the imaging evaluation of patients with diffuse lung disease with emphasis on the formulation of a focused differential diagnosis, management recommendations and strategies for establishing the final diagnosis. The course will be presented as a series of case studies and enhanced by the use of the DX Live Audience Participation Game which will allow the audience to analyze the cases and make the diagnoses in a systematic fashion.

**RC401A • Interstitial Lung Disease**

Laura E Heyneman MD (Presenter)

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**ABSTRACT**

**RC401B • Mediastinal Disease**

Jared D Christensen MD (Presenter)

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**RC401C • Airway Disease**

Santiago Martinez-Jimenez MD (Presenter) *

**LEARNING OBJECTIVES**

View learning objectives under main course title.

** Resident Interviewing: Skills that Work!**

**Tuesday, 04:30 PM - 06:00 PM • E353A**

**RC402 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5**

**LEARNING OBJECTIVES**

1) Describe basic interview skills appropriate to various levels. 2) Conduct an effective interview. 3) Avoid interview "don'ts."

**ABSTRACT**

Interviewing is a critical part of the hiring process, often the decisive factor in hiring decisions. Additionally, virtually every radiologist will be required to be an interviewer or interviewee during his or her career. Despite the importance placed on interviews, candidates and interviewers rarely undergo training to either 1) present themselves in the most favorable light, or 2) optimize the interview to quickly and accurately assess a candidate's qualifications and personality fit for a particular job. Through didactic teaching and a series of vignettes, this course will review basic interview and interviewing skills for residents, fellows, and staff radiologists as well as for leadership positions at the department level and above (section chiefs, vice chairs, chairs, chief of staff, deans).

**RC402A • Program Director, Chair, and Dean as Interviewers**

Jonathan S Lewin MD (Presenter)
LEARNING OBJECTIVES
View learning objectives under main course title.

RC403B – Resident, Fellow, and Radiologist as Interviewees
Fred T Lee MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

ABSTRACT
Interviewing is a critical part of the hiring process, often the decisive factor in hiring decisions. Additionally, virtually every radiologist will be required to be an interviewer or interviewee during his or her career. Despite the importance placed on interviews, candidates and interviewers rarely undergo training to either 1) present themselves in the most favorable light, or 2) optimize the interview to quickly and accurately assess a candidate’s qualifications and personality fit for a particular job. Through didactic teaching and a series of vignettes, this course will review basic interview and interviewing skills for residents, fellows, and staff radiologists as well as for leadership positions at the department level and above (section chiefs, vice chairs, chairs, chief of staff, deans).

RC402C – Interview Role-Playing
Fred T Lee MD (Presenter) *; Jannette Collins MD, MEd (Presenter); Jonathan S Lewin MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

ABSTRACT
Interviewing is a critical part of the hiring process, often the decisive factor in hiring decisions. Additionally, virtually every radiologist will be required to be an interviewer or interviewee during his or her career. Despite the importance placed on interviews, candidates and interviewers rarely undergo training to either 1) present themselves in the most favorable light, or 2) optimize the interview to quickly and accurately assess a candidate’s qualifications and personality fit for a particular job. Through didactic teaching and a series of vignettes, this course will review basic interview and interviewing skills for residents, fellows, and staff radiologists as well as for leadership positions at the department level and above (section chiefs, vice chairs, chairs, chief of staff, deans).
LEARNING OBJECTIVES

Basic concepts behind acquiring a MRI and a PET image will be reviewed. Inherent resolution capabilities of MRI and PET imaging modalities as stand-alone scanners will be compared to that of combined MRI/PET scanners. The effect of MRI hardware on PET image quality and that of PET hardware on MRI image fidelity will also be explored.

Current Imaging of the Shoulder: Rotator Cuff and Glenohumeral Joint Instability including Normal Variants, Pitfalls, Controversies, and Postoperative Challenges

Tuesday, 04:30 PM - 06:00 PM ● E450A

RC404 • AMA PRA Category 1 Credit ™ ● ARRT Category A+ Credit:1.5

RC404A • MR Checklist Approach

David W Stoller MD (Presenter)

LEARNING OBJECTIVES

1) Develop a shoulder checklist method including interpretation techniques for the rotator cuff and interval, biceps labral complex, inferior glenohumeral ligament complex, and capsular structures including the anterior band. 2) Identify glenoid wear patterns in multidirectional instability, micoinstability, anterior and posterior instability.

ABSTRACT

The shoulder checklist represents a way of approaching shoulder MRIs consistently by emphasizing key structures that should be reviewed in specific planes. In the coronal plane, the AC joint should be evaluated for arthrosis; the rotator cuff should be evaluated first anteriorly and then posteriorly so that far anterior cuff tears or isolated infraspinatus tears posteriorly are not missed. The biceps labral complex is where the superior labrum and the intrarticular biceps are adherent. The superior labrum is evaluated for intralabral tear or detachment from the biceps. The IGLLC is evaluated for tear or hyperintensity and thickening. The articular cartilage of the humeral head is inspected for congruity. In the axial plane, the anterior inferior labrum is established on the inferior axial images with no fluid between the fibral cartilage and the articular cartilage of the glenoid. The anterior band of the IGL is usually identified at or above the equator. There is no fluid between the posterior labrum and the articular cartilage of the glenoid. The subscapularis tendon is evaluated along its entire insertion from inferior to superior. The extraarticular biceps is evaluated for medial subluxation. In the sagittal plane, the rotator cuff is evaluated to differentiate contributing tendons of the supraspinatus and the infraspinatus and to assess the size of the rotator cuff in the anterior to posterior plane. The biceps pulley at the mid rotator cuff interval is evaluated. The glenoid fossa is inspected for sclerosis or osteophytic ridging.

RC404B • MR of the Rotator Cuff and Impingement including Postoperative Cuff

Michael B Zlatkin MD (Presenter)

LEARNING OBJECTIVES

1) To understand and identify the relationship of the inferior glenohumeral ligament, and the anterior band attachment variants. 2) The role of the superior glenohumeral ligament relevant to the biceps pulley and its relationship to the CHL ligament. 3) Biceps labral complex will be defined and discussed with Type I-III. 4) BLC sulcus will be defined. 5) SLAP tear pattern recognition and subtypes 1-10 will be reviewed. 6) Relevance of ABER review and MR arthrography.

ABSTRACT

The anterior glenoid labrum provides the major area of attachment for the anterior band of the IGL. The middle glenohumeral ligament (MGL) is considerable more variable, but may also contribute fibers to the more superior aspects of the anterior glenoid labrum as it approaches the biceps tendon. Above the epiphysal line (i.e. the junctions of the upper and middle thirds of the glenoid body fossa), the attachment of the glenoid labrum is variable. Inferior to the epiphysal line, the labrum is continuous with the glenoid articular cartilage and serves as the insertion site for the IGL. It is the superior and anterosuperior portion of the labrum that can be variable attached to the glenoid. There are three different types of attachment of the biceps labral complex (BLC) to the glenoid. IGL-The IGL consists of anterior and posterior bands and an axillary pouch that attaches to the inferior two-thirds of the entire circumference of the glenoid by means of the labrum. The IGL is lax in the adducted position. As it tightens with increasing adduction, the anterior and posterior. MGL-The MGL attaches to the anterior aspect of the anatomic neck of the humerus, medial to the lesser tuberosity. It arises from the glenoid by way of the labrum and scapular neck. The foramen of Weitbrecht is located between the superior glenohumeral ligament (SGL) and MGL, and the foramen of Rouviere is located between the MGL and IGL. SGL-The SGL originates from the upper pole of the glenoid cavity and base of the coracoid process, and is attached to the MGL, to the biceps tendon, and to the labrum. It inserts just superior to the lesser tuberosity in the region of bicipital groove.

RC404C • MR of Glenohumeral Ligaments and Biceps Labral Complex

David W Stoller MD (Presenter)

LEARNING OBJECTIVES

1) Understand and identify the relationship of the inferior glenohumeral ligament, and the anterior band attachment variants. 2) The role of the superior glenohumeral ligament relevant to the biceps pulley and its relationship to the CHL ligament. 3) Biceps labral complex will be defined and discussed with Type I-III. 4) BLC sulcus will be defined. 5) SLAP tear pattern recognition and subtypes 1-10 will be reviewed. 6) Relevance of ABER review and MR arthrography.

ABSTRACT

The anterior glenoid labrum provides the major area of attachment for the anterior band of the IGL. The middle glenohumeral ligament (MGL) is considerable more variable, but may also contribute fibers to the more superior aspects of the anterior glenoid labrum as it approaches the biceps tendon. Above the epiphysal line (i.e. the junctions of the upper and middle thirds of the glenoid body fossa), the attachment of the glenoid labrum is variable. Inferior to the epiphysal line, the labrum is continuous with the glenoid articular cartilage and serves as the insertion site for the IGL. It is the superior and anterosuperior portion of the labrum that can be variable attached to the glenoid. There are three different types of attachment of the biceps labral complex (BLC) to the glenoid. IGL-The IGL consists of anterior and posterior bands and an axillary pouch that attaches to the inferior two-thirds of the entire circumference of the glenoid by means of the labrum. The IGL is lax in the adducted position. As it tightens with increasing adduction, the anterior and posterior. MGL-The MGL attaches to the anterior aspect of the anatomic neck of the humerus, medial to the lesser tuberosity. It arises from the glenoid by way of the labrum and scapular neck. The foramen of Weitbrecht is located between the superior glenohumeral ligament (SGL) and MGL, and the foramen of Rouviere is located between the MGL and IGL. SGL-The SGL originates from the upper pole of the glenoid cavity and base of the coracoid process, and is attached to the MGL, to the biceps tendon, and to the labrum. It inserts just superior to the lesser tuberosity in the region of bicipital groove.

RC404D • MRI of Instability Excluding SLAP Lesions

Timothy G Sanders MD (Presenter)

LEARNING OBJECTIVES

1) Understand and be able to recognize the MR imaging appearance of lesions of anterior and posterior instability of the glenohumeral joint. 2) Understand the anatomy of the rotator interval and to recognize the lesions of “micro-instability. 3) Understand the various injuries that occur in the overhead (throwing) athlete and to be able to recognize these injuries on MR imaging. 4) Recognize on MR imaging the common postoperative complications following shoulder reconstruction for glenohumeral instability.

ABSTRACT

The glenohumeral joint is an intrinsically unstable joint and MR imaging is a very effective noninvasive means of evaluating for the common postoperative complications following shoulder reconstruction for glenohumeral instability. The standard MR imaging protocols and use of MR arthrography will be discussed. 1. There are numerous osseous and soft tissue lesions which can occur in conjunction with anterior and posterior shoulder instability including; -Bankart lesion -Perthes -Anterior labralgamentous periosteal sleeve avulsion injury -Osseous Bankart/Hill Sachs lesions -Humeral avulsion of the glenohumeral ligament -Glenolabral articular disruption II. Lesions of Micro-instability refers to instability lesions which occur within the superior aspect of the glenohumeral joint and include: -SLAP lesions/SLAC lesions -Rotator interval lesions -Biceps anchor and pulley lesions III. Injuries that are commonly seen in overhead (throwing) athletes include: -Extrinsic impingement-instability overlap -Labral and rotator cuff injuries resulting from distraction forces -Internal impingement -Glenohumeral internal rotation deficit disorder IV.
Postoperative shoulder complications include: 
- Breakdown of labral repair/recurrent labral tear 
- Hardware complications 
- Chondrolysis of the glenohumeral joint

**RC404E ● The Role of Ultrasound in the Evaluation of the Shoulder**

J. A Bouffard MD (Presenter)

**LEARNING OBJECTIVES**
1) To enumerate the indications for shoulder ultrasound. 2) To describe the normal ultrasound anatomy of the shoulder. 3) To identify lesions of the rotator cuff. 4) To localize effusions of the shoulder. 5) To recognize shoulder impingement during dynamic imaging.

**Interactive Game: Pediatric CNS Disorders**

Tuesday, 04:30 PM - 06:00 PM ● E451B

**RC405 ● AMA PRA Category 1 Credit ™: 1.5 ● ARRT Category A+ Credit: 1.5**

**Moderator**

Erin S Schwartz, MD

**LEARNING OBJECTIVES**
This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

**RC405A ● Fetal and Neonatal Brain Disorders**

Ellen Grant MD (Presenter)

**RC405B ● Phakomatoses in Children**

Gilbert Vezina MD (Presenter)

**LEARNING OBJECTIVES**
1) Define the imaging characteristics of the common phakomatoses. 2) Understand the underlying genetic/molecular basis of the imaging findings in the phakomatoses.

**ABSTRACT**
Presentation summary:
The presentation will review the clinical and imaging findings of the common phakomatoses, primarily neurofibromatosis type 1 and 2, tuberous sclerosis complex, von Hippel-Lindau disease, and Sturge-Weber. The phakomatoses, also known as the neurocutaneous syndromes, are a heterogeneous group of disorders characterized by multiple hamartomas and other congenital malformations affecting mainly structures of ectodermal origin. Many are inherited through autosomal dominant means. The underlying genetic abnormalities that cause most of the phakomatoses are well-characterized, leading to a good understanding of the genotype-phenotype correlation. In most cases, the loss of a suppressor activity results in proliferation of normal and abnormal cells. This leads to the characteristic hamartomas and neoplasms seen in many of the phakomatoses.

**RC405C ● Pediatric CNS Cases**

Susan L Rebsamen MD (Presenter)

**LEARNING OBJECTIVES**
1) To familiarize the diagnostic radiologist as well as the fellowship trained neuroradiologist with the appearance and imaging characteristics of the more commonly encountered developmental brain anomalies as well as other pediatric intracranial pathology. 2) To demonstrate the utility of new technological advances and MRI sequences for the characterization of pediatric intracranial pathology and developmental brain anomalies.

**Skull Base and Nerves**

Tuesday, 04:30 PM - 06:00 PM ● N227

**RC406 ● AMA PRA Category 1 Credit ™: 1.5 ● ARRT Category A+ Credit: 1.5**

**RC406A ● The Central Skull Base**

Nancy J Fischbein MD (Presenter)

**LEARNING OBJECTIVES**
1) To review the anatomy of the Central Skull Base. 2) To present common and uncommon pathologies that affect the Central Skull Base. 3) To remind the audience of imaging pitfalls of the Central Skull Base. 4) To discuss the complementary roles of CT and MR in imaging the Central Skull Base.

**ABSTRACT**
Imaging of the skull base presents many challenges due to its anatomical complexity, numerous normal variants, and lack of familiarity to many radiologists. As the skull base is a region which is not amenable to physical exam, and as lesions of the skull base are generally difficult to biopsy and even more difficult to operate on, the radiologist plays a major role in directing patient management via accurate image interpretation. Knowledge of the skull base should not be limited to neuroradiologists and head and neck radiologists, however, as the central skull base in particular is routinely included in the field of view when cross-sectionally imaging the brain, cervical spine, or head and neck with CT or MRI, and hence its nuances should be familiar to general radiologists as well. We review the basic anatomy of the central skull base, including bony anatomy as well as the anatomy of adjacent soft tissue structures. We will also present imaging findings of common and uncommon pathologies of the central skull base, including primary tumors such as chordoma and chondrosarcoma, metastases and plasmacytoma, and non-neoplastic lesions of the central skull base. We will review some imaging pitfalls and “don’t touch” lesions of the central skull base, and will emphasize the complementary roles of CT and MR in solving difficult cases.

**RC406B ● Cranial Nerves I-VI**

Jenny K Hoang MBBS (Presenter) *

**LEARNING OBJECTIVES**
1) To review the anatomy and function of cranial nerves I-VI. 2) To have a systematic approach to evaluating imaging in patients present with suspected cranial nerve disease. 3) To recognize the signs of cranial nerve pathology and the most common differentials for disease in cranial nerves I-VI.
ABSTRACT

RC406C • Cranial Nerves VII-XII
Claudia F Kirsch MD (Presenter) *

LEARNING OBJECTIVES
1) To review anatomy and function of cranial nerves VII- XII. 2) To present a systematic approach to evaluating imaging in patients present with cranial nerve VII- XII pathology. 3) To recognize the imaging findings of cranial nerve pathology in CN VII- XII, and the differential diagnosis associated with the radiographic findings.

ABSTRACT

Bladder, the Forgotten Organ: Role of CT, MRI, and PET in Diagnosis, Staging, and Surveillance of Bladder Cancer

Tuesday, 04:30 PM - 06:00 PM • S402AB

LEARNING OBJECTIVES
1) Learn the latest developments on the role of CT, MRI, and PET/CT in the detection, diagnosis, staging, and surveillance of patients with bladder cancer. 2) Learn currently recommended CT, MRI, and PET/CT techniques and protocols and how to implement them in clinical practice. 3) Learn how to interpret CT, MRI, and PET/CT scans of the bladder with an emphasis on case review and diagnostic pitfalls.

ABSTRACT

The urinary bladder is the most common site of malignancy of the urinary tract and is imaged by radiologists on many abdominal imaging exams. However, historically the bladder has been a 'forgotten' organ and thought to be largely the purview of the urologist due to the central role that cystoscopy has played in both the diagnosis and local staging of bladder cancer. Recent advances in CT, MRI, and PET have emerged that now allow radiologists to play an important role in the detection, diagnosis, staging, and surveillance of patients with or suspected of having bladder cancer. This course will detail these advances and explain how, when, and why radiologists should be using these three modalities in clinical practice today. Using illustrative case examples, advances in knowledge such as how CT urography can be used to detect bladder cancer, how MR urography can be used to distinguish muscle-invasive from superficial tumors and evaluate the upper tracts, and how PET/CT (and the newly introduced PET/MRI) can be used to stage and follow patients. With additional advances in low dose CT, emerging MRI techniques, and novel PET agents, radiology will play an increasingly vital role in the care of patients with bladder cancer in the future.

Stroke Imaging for the Emergency Radiologist (An Interactive Session)

Tuesday, 04:30 PM - 06:00 PM • E450B

LEARNING OBJECTIVES
1) Discuss the role of CT angiography (CTA) and CT perfusion (CTP) in the evaluation of acute ischemic stroke. 2) Through the use of illustrative examples, identify CTA and CTP findings that contribute to the diagnosis and characterization of acute ischemic stroke. 3) Through the use of illustrative examples, recognize the limitations and pitfalls of CTA and CTP in the evaluation of acute ischemic stroke.

ABSTRACT

According to the American Heart Association, stroke is the third leading cause of death in the United States and a leading cause of serious, long-term disability. Based on data gathered from over twenty clinical trials, thrombolytic therapy has shown to be of substantial benefit for select patients with acute cerebral ischemia. Patient selection is based in part upon imaging. In patients with acute onset of stroke-like symptoms, CT angiography (CTA) and CT perfusion (CTP) can help to rule out a nonvascular etiology for the symptoms, define the extent of the acute ischemic process, and differentiate between the infarcted core and the ischemic penumbra. By characterizing the ischemia, CTA and CTP can help to identify which patients might benefit from thrombolytic therapy, direct the therapy for maximum effectiveness, and, on subsequent imaging, evaluate the effectiveness of therapy. Multiple examples will also illustrate the limitations and pitfalls of CTA and CTP in the evaluation of acute ischemic stroke.
LEARNING OBJECTIVES
1) To review the concepts behind development of anatomic imaging biomarkers. 2) To learn the strengths and weaknesses of RECIST and other anatomic imaging biomarkers. 3) New criteria for evaluation of gastrointestinal tumor response assessment.

ABSTRACT
Improvements in imaging technology and therapeutic options for the management of gastrointestinal tumors have revolutionized the way tumor response to therapy is assessed. Cytotoxic therapies result in tumor shrinkage and their efficacy is commonly assessed by evaluating tumor size based on strict guidelines such as the Response Evaluation Criteria in Solid Tumors (RECIST). This review will familiarize radiologists with the steps that have led to the development and modifications of the RECIST. New cytostatic and locoregional therapies may not change tumor size and have exposed many weaknesses of the RECIST. As a result, tumor and therapy specific response assessment criteria have been developed. These new criteria, including Choi, EASL, mRECIST and irRC will also be discussed.

LEARNING OBJECTIVES
1) Discuss the basic principles of CT-MR perfusion and limitations of each method. 2) Develop basic knowledge and skills for acquisition and interpretation of perfusion imaging in the abdomen and pelvis. 3) Assess the potential of perfusion imaging in the oncology trials and in non-oncologic clinical settings.

LEARNING OBJECTIVES
1) Understand newer concepts in oncology including tumor angiogenesis and the evolving role of imaging biomarkers in drug trials. 2) Discuss the basic principles of CT-MR perfusion and limitations of each method. 3) Develop basic knowledge and skills for acquisition and interpretation of perfusion imaging in the abdomen and pelvis. 4) Assess the potential of perfusion imaging in the oncology trials and in non-oncologic clinical settings.

LEARNING OBJECTIVES
1) To understand the PET-MR technology, types of current PET-MR scanners and challenges. 2) To understand the clinical application, comparison with PET-CT, protocols and optimizing work flow. 3) To understand the pitfalls, artifacts and future of PET-MR.

LEARNING OBJECTIVES
1) To review the concepts behind development of anatomic imaging biomarkers. 2) To learn the strengths and weaknesses of RECIST and other anatomic imaging biomarkers. 3) New criteria for evaluation of gastrointestinal tumor response assessment.

ABSTRACT
Improvements in imaging technology and therapeutic options for the management of gastrointestinal tumors have revolutionized the way tumor response to therapy is assessed. Cytotoxic therapies result in tumor shrinkage and their efficacy is commonly assessed by evaluating tumor size based on strict guidelines such as the Response Evaluation Criteria in Solid Tumors (RECIST). This review will familiarize radiologists with the steps that have led to the development and modifications of the RECIST. New cytostatic and locoregional therapies may not change tumor size and have exposed many weaknesses of the RECIST. As a result, tumor and therapy specific response assessment criteria have been developed. These new criteria, including Choi, EASL, mRECIST and irRC will also be discussed.

LEARNING OBJECTIVES
1) Discuss the basic concepts for DWI in body applications. 2) Describe the emerging role of DWI in assessing response in cancer. 3) Discuss the application of DWI in whole body imaging.

ABSTRACT
Diffusion-weighted magnetic resonance imaging (DWI) can provide functional information at a cellular level by measuring water diffusion values. DWI is sensitive to changes in the micro diffusion of water and the apparent diffusion coefficient (ADC) is an indicator of the movement of water within the tissue. In abdominal oncology, DWI has been successfully used in assessing treatment response of liver tumors. In addition, ADC values have been shown to predict tumor response to treatment. In some instances low tumor ADC before treatment can be predictive of better outcome. Assessing response of in the entire tumor volume may be more valuable than a single ROI measurement. Moreover, multiparametric response maps that include changes in both ADC and enhancement after therapy are more predictive of response and patient survival compared to ADC or enhancement alone. We will review the different response criteria for various liver tumors treated with intra arterial therapy. New application of DWI including whole body applications will also be discussed.

LEARNING OBJECTIVES
1) To understand the PET-MR technology, types of current PET-MR scanners and challenges. 2) To understand the clinical application, comparison with PET-CT, protocols and optimizing work flow. 3) To understand the pitfalls, artifacts and future of PET-MR.

ABSTRACT
Introduction of PET-CT had substantial influence on cancer staging and has become a standard practice of care in certain types of cancer staging, restaging and document tumor response to treatment. The low soft tissue contrast of the CT, especially the low dose non contrast CT is the main limitation of hybrid PET-CT imaging. MR imaging proved to be superior to even contrast enhanced CT certain anatomical regions such as pelvis, head and neck due to its excellent soft tissue contrast resolution. There has been a quest for combined PET-MR system to provide anatomical, physiological and molecular information with single integrated imaging. The main hurdle has been the sensitivity of PET photomultiplier tubes to magnetic field. This is overcome and integrated PET-MR systems are now available for clinical practice. There are currently two types of integrated PET-MR systems available from two different vendors. In the sequential type the photomultiplier tubes of PET are shielded from magnetic field by separating the PET and MR gantries. In the simultaneous type Photomultiplier tubes and MR coils are integrated in one system by using magnetically insensitive avalanche photo diodes. Both these systems have some advantages and disadvantages, but have common challenges. MR attenuation correction is the major challenge faced by both type of systems. World wide, there is limited literature available on the utility and clinical application of the PET-MR system. There has been lot of enthusiasm as well as anxiety in incorporating this integrated system into clinical practice by radiologists as well as physicians involved in managing cancer patients. This refresher course addresses these issues of clinical PET-MR system, key areas where they have impact on patient care and management. At the end of the course the attendees of the course will be familiar with current types of PET-MR systems, clinical applications in oncology, advantages, limitations, pit falls and challenges.
ABSTRACT

RC410C • Ultrasound Evaluation of the Upper and Lower Extremity Veins

Leslie M Scoutt MD (Presenter) *

LEARNING OBJECTIVES
1) Describe the US criteria for diagnosis of DVT in the upper and lower extremities. 2) Discuss common pitfalls in US evaluation of DVT. 3) Discuss current controversies in the US evaluation of DVT such as: acute vs chronic (residual) DVT; use of the D-dimer assay; should the calf veins be evaluated; is it appropriate to do unilateral exams. 4) Describe the role of US in identifying other causes of extremity pain and swelling.

ABSTRACT

This lecture will describe the technique and diagnostic criteria for the US diagnosis of DVT in the upper and lower extremities. Common pitfalls in sonographic assessment of DVT will be described as well as current clinical questions in US evaluation of patients suspected of harboring DVT such as: what is the importance of pre-test probability?, what is the role of the D-dimer assay?, how to differentiate acute from chronic DVT?, and should the calf veins be routinely examined? In addition, the US appearance of other causes of extremity pain and swelling will be described as US has been shown to be useful in making alternative diagnoses, which are often important for patient management, in up to 10% of cases.

Improving PET Interpretation: Present Updates in GI and GYN Cancers with Case Examples (An Interactive Session)

Tuesday, 04:30 PM - 06:00 PM • S505AB

RC411 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

RC411A • Updates in PET Imaging of GYN Malignancies

Drew A Torigian MD, MA (Presenter)

LEARNING OBJECTIVES
1) To learn about the diagnostic performance of PET/CT for evaluation of various gynecologic malignancies. 2) To better understand the practical utility of PET/CT for evaluation of gynecologic malignancies through case example. 3) To learn about new horizons in PET for evaluation of gynecologic malignancies.

ABSTRACT

RC411B • Updates in PET Imaging of Colorectal Malignancies

Harry Agress MD (Presenter)

LEARNING OBJECTIVES
1) Understand the increasingly important role of PET/CT imaging in the evaluation of staging and restaging of colorectal cancer with the use of case studies and literature review. 2) Demonstrate how PET/CT helps guide surgical, endoscopic and CT-guided approaches for evaluating the presence of colonic malignancy in such cases as unexpected pre-clinical colonic lesions and metastatic disease. 3) Learn how to deal with subtle findings and understand the important correlation of the PET and CT components of the examination to optimize interpretation.

ABSTRACT

URL’s
www.hrgimaging.com Go to "For Physicians" ? "Download" ? RSNA 2010

RC411C • Updates in PET Imaging of Other GI Malignancies

Paul D Shreve MD (Presenter)

LEARNING OBJECTIVES
1) List the gastrointestinal malignancies that tend not to be FDG avid. 2) Describe the role of FDG PET-CT in initial staging of pancreatic cancer. 3) Compare the GIST tumor response criteria of FDG PET vs CT. 4) Compare FDG PET-CT with MRI in evaluation of primary hepatic and biliary tract malignancies.

Advanced Vascular Imaging Techniques and Applications

Tuesday, 04:30 PM - 06:00 PM • S502AB

RC412 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

RC412A • MRI of Chronic Mesenteric Ischemia

Frandics P Chan MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) To review the natural history and treatment outcome for mesenteric ischemia. 2) To distinguish the imaging work ups for acute versus chronic mesenteric ischemia. 3) To learn how to image the abnormal physiologic responses of chronic mesenteric ischemia.

ABSTRACT

Mesenteric ischemia is the result of inadequate perfusion and oxygen delivery to the small intestine caused by vascular obstructions. Acute mesenteric ischemia (AMI) brought on by the abrupt occlusion of the superior mesenteric artery is a medical emergency. Mortality rate of AMI has been reported as high as 80%. Prompt CT angiography of the abdomen is the diagnostic imaging of choice. In contrast, chronic mesenteric ischemia (CMI) is the result of gradual obstructions of multiple splanchnic arteries. 90% of cases are caused by advanced atherosclerotic. Clinical diagnosis is difficult because symptoms are often vague and nonspecific. The classic clinical triad of gradual weight loss, fear of large meal, and post-prandial bowel angina may be absent. The gradual nature of the arterial obstruction promotes development of collateral arteries. The finding of an occluded splanchnic artery on angiography is not necessarily diagnostic of CMI. In difficult cases, a physiologic test that can demonstrate the sequelae of bowel ischemia would be helpful. Different imaging protocols have been proposed to detect changes in blood flow and oxygen saturation in the mesenteric circulation after a meal challenge.
LEARNING OBJECTIVES
1) To familiarize the audience with multi-parametric MRI of the kidneys including: MRA, MR-perfusion measurements, DWI, DTI and BOLD imaging. 2) To point out the physical basics of functional MRI of the kidneys. 3) To present clinical applications of functional MRI of the kidneys.

ABSTRACT
Due to its complementary information to standard morphologic imaging functional renal magnetic resonance imaging is a rapid growing field of radiology. This refresher course provides a comprehensive overview of state-of-the-art functional renal imaging techniques including renal magnetic resonance angiography (high-yield information on improving your clinical practice), first pass renal perfusion for assessment of renal function (how to and clinical applications), blood-oxygen level dependent imaging of the kidneys and diffusion-weighted imaging of the kidneys including diffusion-tensor imaging of the kidneys. Basic technical concepts for all sequences will be laid out and will be illustrated by current clinical examples. Future applications of functional renal imaging are presented which also include iron-enhanced MRI.

RC412C • Pre and Post Reconstructive Surgery Vascular Imaging

Frank J Rybicki MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) To understand the principles of vascular imaging in organ transplantation and reconstructive/ restorative surgery. 2) To learn common angiography protocols for vascular mapping and surgical planning. 3) To review image post-processing that renders findings optimal for communication with the comprehensive patient care team. 4) To review the most recent imaging results in pre- and post organ transplantation and reconstructive/ restorative surgery.

ABSTRACT
Complex transplantation and restorative surgery, such as full face transplantation, is a unique model for studying vascular adaptation and the interaction between donor's and recipient's vascularized tissue. There are important consequences for surgical planning, and to date there is no published data on the mechanisms of vascular reorganization after these complex procedures. Data will be presented that hold potential to better our understanding of the biology after complex restorations, and these data have important implications on graft survival and rejection. This refresher course lecture will provide an overview of these complex processes from the perspective of vascular imaging, and the lecture will illustrate the arterial and venous adaptation to this unique environment. As the number and complexity of these procedures increases on a global scale, this initial evaluation is designed to serve as a template for future studies that will positively impact surgical outcomes and patient care.

RC412D • Functional Vascular Imaging in Athletes

Richard L Hallett MD (Presenter)

LEARNING OBJECTIVES
1) Identify anatomic and functional lesions that predispose to vascular entrapment and fibrotic syndromes in athletes. 2) Describe methods to assess vascular entrapment and fibrotic syndromes in athletes using dynamic, functionally challenged CTA and MRA. 3) Describe the imaging findings for diagnosis and follow-up of affected athletes.

ABSTRACT
While exercise is a mainstay in preventing and treating atherosclerotic peripheral vascular disease, some vascular disorders manifest primarily in athletes. Both recreational and competitive athletes are at risk for development of non-atherosclerotic vascular diseases. These disease entities range from iliac endofibrosis in cyclists, popliteal entrapment syndrome in running sports, and thoracic inlet / outlet syndromes in "overhead" athletes. Recently, computed tomography angiography (CTA) and magnetic resonance angiography (MRA) have become valuable diagnostic options for many vascular diseases that can occur in the athlete. Optimum imaging in these disorders requires the ability to tailor the exam protocol to the specific disease entity and vascular territory in question. By combining rapid CT image acquisition with functional, physiologic provocative maneuvers, diagnostic information can be maximized. Newer blood-pool MR contrast agents also allow functional assessment without ionizing radiation exposure. This session will review the pathophysiology, risk factors, diagnosis, and classification of vascular diseases seen in the athlete. Logical protocol development utilizing (when necessary) provocative maneuvers will be reviewed. Interpretation strategies for interacting with these resulting large, dynamic datasets will also be reviewed.

No Course RC413. See Series VSPD32 Pediatric Radiology Series: Advanced Pediatric Abdominal Imaging

Tuesday, 04:30 PM - 06:00 PM

RC413

Pain and Sedation in 2013

Tuesday, 04:30 PM - 06:00 PM • N226

Max P Rosen, MD, MPH *
Fred E Shapiro, DO
Hesham H Malik, MD
Richard D Urman, MD, MBA

LEARNING OBJECTIVES
1) Review of institutional requirements for providing moderate and/or deep sedation vs. minimal sedation. 2) Medico-legal ramifications of moderate, deep or minimal sedation. 3) Nuts and Bolts: pearls on how to survive an accreditation visit. 4) Patient and Procedure selection: Should I consult an anesthesiologist? 5) Case presentation and discussion: Common disasters and how to avoid them.

Breast Interventional Procedures

Tuesday, 04:30 PM - 06:00 PM • S406B

RC415 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

Richard D Urman, DO (Presenter) *

LEARNING OBJECTIVES
1) To familiarize the audience with multi-parametric MRI of the kidneys including: MRA, MR-perfusion measurements, DWI, DTI and BOLD imaging. 2) To point out the physical basics of functional MRI of the kidneys. 3) To present clinical applications of functional MRI of the kidneys.

ABSTRACT
Due to its complementary information to standard morphologic imaging functional renal magnetic resonance imaging is a rapid growing field of radiology. This refresher course provides a comprehensive overview of state-of-the-art functional renal imaging techniques including renal magnetic resonance angiography (high-yield information on improving your clinical practice), first pass renal perfusion for assessment of renal function (how to and clinical applications), blood-oxygen level dependent imaging of the kidneys and diffusion-weighted imaging of the kidneys including diffusion-tensor imaging of the kidneys. Basic technical concepts for all sequences will be laid out and will be illustrated by current clinical examples. Future applications of functional renal imaging are presented which also include iron-enhanced MRI.

RC412B • Renovascular MRI

Henrik J Michaely MD (Presenter) *

LEARNING OBJECTIVES
1) To familiarize the audience with multi-parametric MRI of the kidneys including: MRA, MR-perfusion measurements, DWI, DTI and BOLD imaging. 2) To point out the physical basics of functional MRI of the kidneys. 3) To present clinical applications of functional MRI of the kidneys.

ABSTRACT
Due to its complementary information to standard morphologic imaging functional renal magnetic resonance imaging is a rapid growing field of radiology. This refresher course provides a comprehensive overview of state-of-the-art functional renal imaging techniques including renal magnetic resonance angiography (high-yield information on improving your clinical practice), first pass renal perfusion for assessment of renal function (how to and clinical applications), blood-oxygen level dependent imaging of the kidneys and diffusion-weighted imaging of the kidneys including diffusion-tensor imaging of the kidneys. Basic technical concepts for all sequences will be laid out and will be illustrated by current clinical examples. Future applications of functional renal imaging are presented which also include iron-enhanced MRI.
**LEARNING OBJECTIVES**

1) Understand the basis of performing stereotactically-guided breast biopsies. 2) Understand the practical use, indications, pitfalls and limitations of the procedural technique. 3) Demonstrate understanding of the importance of concordance and multidisciplinary management of results.

**ABSTRACT**

Stereotactically-guided breast biopsy has become a common procedure routinely used in the diagnosis of breast abnormalities. This discussion will review the basics of the procedural techniques and will focus on the indications and practical usage of stereotactically-guided breast biopsies. It will also detail troubleshooting techniques that may be useful while performing difficult cases; these include apparent lesion movement, targeting errors, targeting far posterior or superficial breast lesions and targeting lesions in the thin breast. Contraindications and pitfalls of the technique will be outlined, and limitations of the procedure will be elucidated. The discussion will also emphasize the importance of radiologic-pathologic concordance and the importance of a multidisciplinary approach to management of biopsy results.

**Patient-centered Radiology: How to Communicate Effectively (Sponsored by the RSNA Public Information Committee)**

Tuesday, 04:30 PM - 06:00 PM • N229

**LEARNING OBJECTIVES**

1) Discuss the types of US-guided breast intervention. 2) Review technical considerations related to US-guided intervention. 3) Describe post-biopsy management.

**ABSTRACT**

The proliferation of image-guided biopsies has been driven by the high levels of accuracy for percutaneous techniques, advantages over surgery, as well as a recognition that most lesions undergoing breast biopsy are benign and do not require surgery. US has emerged as the preferred guidance method for interventional procedures for several reasons. These include better patient tolerance, the speed with which the procedure can be performed, the benefit of real time visualization, greater accessibility to areas of the breast and axilla, lack of ionizing radiation, and lower cost.

**I-125 Seed Localization**

**LEARNING OBJECTIVES**

1) Understand procedural technique for I-125 seed localization utilizing mammographic and US guidance Be able to describe advantages and disadvantages of I-125 seed localizations compared to conventional hookwire localizations. 2) Be able to describe advantages and disadvantages of I-125 seed localizations compared to conventional hookwire localizations. 3) Understand importance of an intergrated multidisciplinary approach and involvement in Nuclear Regulatory requirements.

**ABSTRACT**

I-125 seeds are small radioactive sources measuring approximately 5mm that can be deployed thru a hollow needle. These seeds can be detected with a gamma probe in the operating suite and are therefore suitable to be placed for breast biopsy or lumpectomy localization for non palpable lesions. This discussion will focus on the advantages of implementing an I-125 seed localization program as compared to the use of a hookwire for localization of breast lesions for surgical excision including; no significant migration, uncoupling of the radiology and the surgery schedule, improved patient satisfaction and comfort, decreased tissue volume at time of surgery and an increased negative margin rate. Disadvantages to be detailed include; inability to place I-125 seeds under MRI guidance, significant restriction and hurdles to be overcome due to radiation safety concerns that vary widely between states and required integration between multiple specialties to track and retrieve seeds. Basic placement techniques will be reviewed using mammographic and ultrasonic guidance.

**Stereotactically-guided Breast Biopsy**

**LEARNING OBJECTIVES**

1) Understand the rationale for and growing value of increased personalization of patient interactions in diagnostic radiology. 2) Recognize the best opportunities for increasing patient awareness of radiologists' contributions and how to demonstrate this in various practice settings. 3) Identify and implement patients' preferred method of communications, including traditional, digital and current social media.

**ABSTRACT**

Stereotactically-guided breast biopsy has become a common procedure routinely used in the diagnosis of breast abnormalities. This discussion will review the basics of the procedural techniques and will focus on the indications and practical usage of stereotactically-guided breast biopsies. It will also detail troubleshooting techniques that may be useful while performing difficult cases; these include apparent lesion movement, targeting errors, targeting far posterior or superficial breast lesions and targeting lesions in the thin breast. Contraindications and pitfalls of the technique will be outlined, and limitations of the procedure will be elucidated. The discussion will also emphasize the importance of radiologic-pathologic concordance and the importance of a multidisciplinary approach to management of biopsy results.

**Quantitative CT and MR Perfusion Imaging**

**LEARNING OBJECTIVES**

1) To understand the principles of CT perfusion analysis for tumor assessment. 2) To understand the pathophysiological basis of CT perfusion parameters for tumors. 3) To understand unique CT perfusion analysis of the liver due to its characteristic dual blood supply. 4) To describe the potential clinical applications, with a focus on hepatic and extrahepatic applications and clinical trials. 5) To discuss several recent challenging issues regarding CT perfusion. 6) To discuss areas for further development including assessment of tumor heterogeneity.
ABSTRACT
With the emergence of novel targeted therapies for cancer, imaging techniques that assess tumor vascular support have gained credence for response assessment alongside standard response criteria. CT perfusion techniques that quantify regional tumour blood flow, blood volume, flow-extraction product, and permeability-surface area product through standard kinetic models, are attractive in this scenario by providing evidence of a vascular response or non-response. Additionally, these techniques may provide prognostic and predictive information to the clinician. Their increasing acceptance in oncological practice in recent years has been related to the combination of clinical need and technological improvements in CT, including faster tube rotation speeds, higher temporal sampling rates, the development of dynamic 3D acquisitions and development of commercial software programmes embedded within the clinical workflow. Recently published consensus guidelines provide a way forward to performing studies in a more standardized manner. To date single centre studies have provided evidence of clinical utility. Future studies that include good quality prospective validation correlating perfusion CT to outcome endpoints in the trial setting are now needed to take CT perfusion forward as a biomarker in oncology. These presentations will cover the principles of CT perfusion analysis for tumor assessment and its pathophysiological basis. Clinical applications will be discussed focusing on hepatic and extrahepatic applications and clinical trials. Areas for further development including assessment of tumor heterogeneity will also be discussed.

RC417A • CT Perfusion in Oncology: Hepatic Imaging
Se Hyung Kim (Presenter)

LEARNING OBJECTIVES
1) To understand unique CT perfusion analysis of the liver due to its characteristic dual blood supply. 2) To describe the potential clinical applications, with a focus on hepatic applications. 3) To discuss several recent challenging issues regarding CT perfusion.

RC417B • CT Perfusion in Oncology: Extrahepatic Imaging
Vicky J Goh MBCh (Presenter) *

LEARNING OBJECTIVES
1) To understand the principles of CT perfusion analysis for tumor assessment. 2) To understand the pathophysiological basis of CT perfusion parameters for tumors. 3) To describe the potential clinical applications, with a focus on extrahepatic applications and clinical trials. 4) To discuss areas for further development including assessment of tumor heterogeneity.

ABSTRACT
With the emergence of novel targeted therapies for cancer, imaging techniques that assess tumor vascular support have gained credence for response assessment alongside standard response criteria. CT perfusion techniques that quantify regional tumour blood flow, blood volume, flow-extraction product, and permeability-surface area product through standard kinetic models, are attractive in this scenario by providing evidence of a vascular response or non-response. Additionally, these techniques may provide prognostic and predictive information to the clinician. Their increasing acceptance in oncological practice in recent years has been related to the combination of clinical need and technological improvements in CT, including faster tube rotation speeds, higher temporal sampling rates, the development of dynamic 3D acquisitions and development of commercial software programmes embedded within the clinical workflow. Recently published consensus guidelines provide a way forward to performing studies in a more standardized manner. To date single centre studies have provided evidence of clinical utility. Future studies that include good quality prospective validation correlating perfusion CT to outcome endpoints in the trial setting are now needed to take CT perfusion forward as a biomarker in oncology. These presentations will cover the principles of CT perfusion analysis for tumor assessment and its pathophysiological basis. Clinical applications will be discussed focusing on extrahepatic applications and clinical trials. Areas for further development including assessment of tumor heterogeneity will also be discussed.

RC417C • Technical Considerations for Perfusion Imaging: CTP, DSC, and ASL
Roland Bammer PhD (Presenter) *

LEARNING OBJECTIVES
1) Understand the key technical principles of Dynamic Susceptibility Contrast, Arterial Spin Label, and CT Perfusion Imaging. 2) Know the basic MR pulse sequences and CT acquisition schemes for perfusion imaging. 3) Appreciate the strengths and weaknesses Between CT and MR Perfusion imaging methods. 4) Understand the Central Volume Principle, Diffusible Tracer, and Deconvolution Methods.

RC417D • Quantitative MR Perfusion Imaging of the Brain
Greg Zaharchuk MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Understand the difference between quantitative and qualitative perfusion measurements. 2) Distinguish several approaches for obtaining quantitative perfusion maps in the brain. 3) Appreciate the strengths and weaknesses between the two major techniques, arterial spin labeling and bolus contrast dynamic susceptibility imaging.

Imaging Mimics of Common Malignancies

Tuesday, 04:30 PM - 06:00 PM • N230

RC418 • AMA PRA Category 1 Credit ™•1.5 • ARRT Category A+ Credit:1.5
RC418A • Brain Tumor Mimics
Soomnee Cha MD (Presenter)

LEARNING OBJECTIVES
1) Present an overview of various brain tumor mimicking lesions on imaging that can pose diagnostic dilemma and challenges in clinical management and assessment of prognosis. 2) Illustrate the three different disease processes—infectious, ischemic, and inflammatory—in the brain that most often mimic brain tumor on imaging. 3) Discuss imaging strategies to avoid making erroneous diagnosis and present specific imaging features that can help to differentiate brain tumor and brain tumor mimics.

RC418B • Mimics of Thoracic Cancers
Steven L Primack MD (Presenter)

LEARNING OBJECTIVES
1) To present a category based differential approach to mimics of thoracic malignancy. 2) To demonstrate imaging features of a variety of entities that can mimic thoracic malignancy. 3) To present an approach to help distinguish mimics from malignancy.

ABSTRACT
RC418C ● Mimics of Abdominal Malignancy
Cynthia S Santillan MD (Presenter)

LEARNING OBJECTIVES
1) To familiarize radiologists with congenital, infectious, and inflammatory entities that may mimic abdominal malignancies. 2) To demonstrate some artifacts that can be misinterpreted as abdominal malignancies. 3) To demonstrate imaging features that can distinguish between these entities and neoplasms.

ABSTRACT

RC418D ● Mimics of Gynecologic Cancers
Liina Poder MD (Presenter)

LEARNING OBJECTIVES
1) Present an overview of various mimics of cancers of GYN origin, a case-based approach. 2) Discuss multi-modality approach to imaging and imaging strategies to avoid pitfalls in diagnosis.

ABSTRACT
Review of more common as well as rare benign conditions that can mimic malignancy of gynecologic origin.

Medical Physics 2.0: Radiography
Tuesday, 04:30 PM - 06:00 PM ● E351

RC421A ● Radiography Perspective
Ehsan Samei PhD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

RC421B ● Radiography 1.0
Aaron K Jones PhD (Presenter)

LEARNING OBJECTIVES
1) Review the testing philosophies, tests, and foci of current quality control programs in radiography. 2) Understand the motivation and basis for these current foci. 3) Investigate the limitations, shortcomings, and relevancy of these current foci in the modern radiography era.

RC421C ● Radiography 2.0
Eric L Gingold PhD (Presenter)

LEARNING OBJECTIVES
1) Identify the likely changes in medical physics services for radiographic systems over the next 5-10 years. 2) Recognize the value of data logging capabilities of modern digital radiographic systems. 3) Understand how to utilize data to identify quality issues and recommend changes that can improve performance in digital radiography. 4) Understand how to employ modern image performance metrics to analyze image quality and assist facilities in optimizing the capabilities of radiographic systems. 5) Utilize modern process control methods to monitor stability.

ABSTRACT

Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques-Imaging for Target Definition
Tuesday, 04:30 PM - 06:00 PM ● S102D

RC422A ● Uncertainties in Physical Target Definition Using PET
Assen S Kirov PhD (Presenter) *

LEARNING OBJECTIVES
1) PET segmentation requirements for target definition. 2) Types of PET auto-segmentation approaches. 3) Challenges for PET segmentation.

URL's
http://www.mskcc.org/staff/assen-kirov
MINICOURSE: CURRENT TOPICS IN MEDICAL PHYSICS–NUCLEAR CARDIAC IMAGING FOR PHYSICISTS

TUESDAY, 04:30 PM - 06:00 PM • S403B

RC423 • AMA PRA Category 1 Credit ™: 1.5 • ARRT Category A+ Credit: 1.5

Moderator
G. Donald Frey, PhD

LEARNING OBJECTIVES
1) The participant will understand the role of nuclear cardiology in the diagnosis of cardiac disease. 2) The participant will understand the role of the medical physicist in PET imaging of the heart. 3) The participant will understand the role of SPECT imaging of the heart.

RC423A • Introduction

G. Donald Frey PhD (Presenter)

LEARNING OBJECTIVES
1) The participant will have an overall orientation to the role of medical physics in nuclear cardiology.

ABSTRACT
This section of the course will provide and overall introduction.

RC423B • SPECT Imaging of the Heart

Mark T Madsen PhD (Presenter)

LEARNING OBJECTIVES
1) Understand how cardiac SPECT studies are acquired. 2) Understand how cardiac SPECT studies are reconstructed and what corrections are required. 3) Understand how cardiac SPECT studies are analyzed. 4) Become familiar with cardiac SPECT instrumentation.

ABSTRACT
Cardiac SPECT is the most common nuclear medicine procedure and it contributes nearly 85% of the radiation dose associated with nuclear medicine imaging. In this presentation, the instrumentation and algorithms associated with cardiac SPECT will be reviewed. We begin with conventional general purpose SPECT systems that rely on parallel collimation along with the associated special purpose cardiac SPECT systems that are based on the conventional approach. Recent advances in SPECT instrumentation have made available cardiac systems that rely on novel collimation and detector systems and these will also be reviewed. SPECT reconstruction approaches will be discussed including methods for motion, scatter and attenuation correction. Commercially available resolution recovery software for improving image quality and potentially reducing patient dose will round out the presentation.

RC423C • PET Imaging of the Heart

Sameer Tipnis PhD (Presenter)

LEARNING OBJECTIVES
1) To understand the basic physics of cardiac PET imaging and the differences with cardiac SPECT. 2) To learn the proper way of acquiring data, including ECG gating, choice of bins, list mode data acquisition. 3) To understand the factors that affect image quality. 4) To learn tips for acquiring good clinical images. 5) To understand the role of dynamic PET imaging for determination of coronary flow reserve (CFR).

ABSTRACT
Publishing in Radiology: What You Always Wanted to Know and Never Asked

TUESDAY, 04:30 PM - 06:00 PM • E352

RC424 • AMA PRA Category 1 Credit ™: 1.5

Moderator
Herbert Y Kressel, MD *
Deborah Levine, MD *
Alexander A Bankier, MD, PhD *
Elkan F Halpern, PhD *
David F Kallmes, MD *

LEARNING OBJECTIVES
1) Understand on what a manuscript submitted to RADIOLOGY is judged during the review and decision process. 2) Understand why it is important to clearly represent research results so that all parts of the written manuscript clearly reflect the research question. 3) Understand how to organize the inner logic of a manuscript submitted to RADIOLOGY. 4) Illustrate how graphs and charts can be best utilized to appropriately illustrate your results. 5) Understand the common statistical errors in manuscripts and how they can be avoided.

ABSTRACT
More than 2000 manuscripts per year are submitted to RADIOLOGY. Despite their variety in their subject matter and content, many manuscripts share common problems in the research design, description, and style which need improvement. The Publication Information for Authors is available on-line at http://www.rsna.org/publications/rad/PIA/index.html. This provides a basic set of guidelines for manuscript preparation and submission. This presentation will complement and extend beyond these guidelines by further illustrating points from the Publication Information for Authors with realistic examples and tangible scenarios based on our experience with the submission, review, and decision making process. The Editor, three Deputy Editors, and statistician of RADIOLOGY will provide practical tips as well as Do's and Don'ts for preparing the major elements of a RADIOLOGY manuscript. In addition, we will discuss the most common statistical problems we encounter in reviewing manuscripts, and discuss the issue of why many published research results turn out to be incorrect. At the end of the session, the registrants will gain an enhanced understanding of the required elements of an original submission, and have a better understanding of common author pitfalls encountered during manuscript review and the editorial process.

QUANTITATIVE IMAGING: DYNAMIC CONTRAST ENHANCED MRI (DCE-MRI)
**LEARNING OBJECTIVES**

1. Understand selected applications of quantitative MR imaging biomarkers, particularly DCE-MRI applications. 2. Understand the factors that currently limit widespread acceptance and use of such quantitative MR imaging biomarkers, including sources of bias and variance. 3. Understand some of the current initiatives focused on the standardization, qualification, and validation of selected quantitative MR imaging biomarkers.

**ABSTRACT**

Clinical and clinical research applications of quantitative anatomical and functional MR imaging biomarkers, including those focused on treatment assessment, have continued to dramatically expand. Studies at single centers have clearly demonstrated the potential of such applications. However, sources of bias and variance of quantitative MR imaging biomarkers have not previously been adequately investigated, thus limiting the implementation of robust methods to mitigate their effects. Therefore, when it comes to applications of such techniques across vendor platforms, centers, and time, challenges arise due to lack of standards, appropriate phantoms, and protocols. During the past few years, several quantitative MR imaging initiatives have been instigated. This symposium presentation will review selected applications of quantitative MR imaging biomarkers, illustrate some of the current challenges in broadening the use of such biomarkers, and discuss some of the current initiatives of various scientific and federal organizations that are focused on the standardization, qualification, and validation of MR quantitative imaging biomarkers. Specific examples of DCE-MRI applications and standardization efforts will be provided.

URL's
web.me.com/efjackson

**LEARNING OBJECTIVES**

1. To apply the concepts and pathophysiology of quantitative DCE MRI in clinical applications. 2. To review technical and procedure considerations for clinical applications. 3. To familiarize with current and evolving clinical applications of qDCE-MRI. 4. To utilize qDCE-MRI in and interpret clinical applications.

**ABSTRACT**

Dynamic contrast enhanced MRI has evolved over the last two decades into a readily available MRI add-on procedure that enables a spatial and time resolved insight into the microcirculation of tissues, both neoplastic as well as benign. While the cinematic display of the temporal contrast enhancement as well as the visual inspection of a signal intensity curve placed over a region of interest enables a ready visual perception of the characteristics of contrast enhancement, a methodological data reduction to a quantitative readout has been more challenging to validate, implement and interpret. Today, the fundamental pathophysiology, appropriate MRI acquisition and post-processing approach are well understood. Quantification is a key enabler to use imaging more as a disease (bio) marker especially for monitoring disease response or progression, as well as putting a more structured interpretation of the dynamic imaging findings into the patient care process. The clinical applications that benefits the most are those were the extent and/or intensity of tissue microcirculation can serve as a marker of biologic characteristics, guide the further diagnostics (tissue biopsies) and/or therapy management. The most common use of applying the fundamental methodologies of DCE-MRI is MR Mammography which is further evolving from a purely morphologic to a semi-quantitative or quantitative imaging procedure. Characterizing malignant tissues, inflammation or angiogenic processes with quantitative approaches is expanding our radiologic toolbox and ability to provide outcome impacting information. Quantitative DCE MRI is evolving to be an increasingly meaningful, clinically relevant and obtainable functional readout of the underlying tissue microcirculation and it will depend on our expansion of radiologic disease insight to truly capitalize on its capabilities.

**LEARNING OBJECTIVES**

1. To show that DCE-MRI can be analyzed using qualitative to quantitative methods. 2. To illustrate that routine clinical use of DCE-MRI makes use of qualitative assessments. 3. To indicate that early drug development requires quantification including reproducibility considerations for clinical applications. 3) To familiarize with current and evolving clinical applications of qDCE-MRI. 4) To utilize qDCE-MRI in and interpret clinical applications.

**ABSTRACT**

Using DCE-MRI in oncologic clinical practice should not be delayed/hindered by the complexities of the technique. The last 20 years of validation work allows us to be confident that DCE-MRI (morphology, subtraction maps, curve shapes and semi-quantitative methods) work in the clinic. Complex quantitative DCE analysis has roles in validation, drug development, and is needed for multiparametric assessments. Future work should now focus on incorporating mpMRI imaging for directing personalized medicine.
Modern radiology workflow requires consumption, choreography, and orchestration of content from multiple disparate information systems that do not natively “talk to each other.” Without optimal integration and interoperability amongst these systems, humans are required to serve as “integrating agents;” this frequently results in inefficiency and error. This session will provide an introduction to the importance of system integration and will provide a practical introduction to commonly used integration strategies. In addition, more advanced integration approaches, including leveraging vendor APIs (application programming interfaces), IHE, and SOA (service oriented architecture) will be discussed.

**RC426B • Image Sharing-A Fond Farewell to CDs**

David S Mendelson MD (Presenter) *

**LEARNING OBJECTIVES**
1) Understand the importance of Image Sharing / Exchange with regard to the quality of care a radiologist delivers as well as to efforts to control costs. 2) Understand the benefits and pitfalls of CDs and the transition to internet based sharing. 3) Understand the different internet (Cloud) based solutions that are available and what distinguishes them. 4) Learn that the cloud can be employed not only for archival but for a variety of radiology services. 5) Learn about the IHE XDS-I and related profiles and their role in internet based image exchange. 6) Understand what solutions a radiologist might implement at this time. 7) Understand how image exchange fits into the broader efforts directed at healthcare information exchange and interoperability through EHRS.

**ABSTRACT**

**RC426C • Vendor Neutral Archives vs Archive Neutral Vendors: Towards the Next Generation Archive**

Richard L Kennedy MSc (Presenter)

**LEARNING OBJECTIVES**
1) Understand the differences between vendor neutral archives, archive neutral vendors, and and cloud archives. 2) Identify key strategic advantages and disadvantages of these three respective models of archival. 3) Observe some potential obstacles to implementation of these three respective models of archival.

**Aligning Incentives between the Physician Practice and the Hospital: Finding the Win:Win**

Tuesday, 04:30 PM - 06:00 PM • S104A

**RC427 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5**

Norman J Beauchamp , MD *
Angelisa M Paladin , MD
Edward Weinberger , MD *
Cheryl Wieber

**LEARNING OBJECTIVES**
As healthcare costs become a primary area of emphasis, the 'premium' that was allowed for academic medical centers is no longer in place. However, optimal care at acceptable cost is readily attainable in an academic center when the missions of the academic department and the hospital are aligned. In this presentation, the learner will recognize approaches to educating the next generation of radiologists while improving access, decreasing overutilization, enhancing safety and decreasing cost.

**MRI Safety Update (An Interactive Session)**

Tuesday, 04:30 PM - 06:00 PM • E353C

**RC429 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5**

**RC429A • Implants and Devices**

Frank G Shellock PhD (Presenter) *

**LEARNING OBJECTIVES**
1) To understand the MRI issues for implants and devices. 2) To comprehend the MRI labeling terminology for implants and devices. 3) To understand current information pertaining to managing patients that present with passive and active implants (e.g., neurostimulation systems, pacemakers, etc.). 4) To apply knowledge about implants and devices to ensure safety for patients undergoing MRI examinations.

**ABSTRACT**

**RC429B • MRI Technologist Perspectives**

William H Faulkner BS, RT (Presenter) *

**LEARNING OBJECTIVES**
1) To understand the steps required to research information relating to MR safety status of implants and / or devices. 2) To learn how to properly screen patients for MR procedures. 3) To understand the importance of being able to control access to Zones III and IV. 4) To lean how to manage patient warming and avoid patient burns.

**ABSTRACT**

**RC429C • Standard and MR Conditional Cardiac Pacemakers**

Patrick M Colletti MD (Presenter) *

**LEARNING OBJECTIVES**
1) Identify, schedule, prepare, examine with MRI, and confirm reprogramming for patients with MR conditional pacemaker systems. 2) Consider the risks and benefits for MR imaging in patients with non-conditional electrophysiology devices. 3) Optimize 3rd party coverage for MR services in patients with MR conditional pacemaker systems.

**ABSTRACT**

There are more than 1.5 million patients in the US with implanted cardiac devices. It is estimated that 750,000 to 1M may have indications for MRI. There have been more than 15 monitored cardiac device/ MR trials involving over1419 participants examined at 0.2T to 3T. At least 17 deaths with unmonitored MRI examination have been reported. Until recently, most radiologists and MR centers have opted out of examining patients with cardiac devices. In 2008, Gimbel presented results of MR examination of patients with cardiac...
pacemakers at 3-Tesla with no restrictions placed on pacemaker dependency, region scanned, device type, or manufacturer, suggesting that monitored pre-programmed 3T MRI scans may be safely performed. There is currently one available FDA approved MR conditional system available for limited use. Protocol for MR conditional MR includes:

1. Confirm clinical requirement for MR.
2. Confirm functioning MR conditional device.
4. Program device to scan mode.
5. Monitor and scan patient at 1.5T.
6. Reprogram device, confirm, and discharge.

**Impact of Legislative Policy and Regulations on Imaging Informatics**

**Tuesday, 04:30 PM - 06:00 PM ● S403A**

**RC430A • Clinical Decision Support and CMS**

Safwan Halabi MD (Presenter)

**LEARNING OBJECTIVES**

1) Identify the primary drivers of imaging utilization. 2) Understand the impact of legislative policy aimed at curbing imaging utilization growth rates. 3) Demonstrate the utility of clinical decision support tools in reducing inappropriate medical imaging. 4) Compare and contrast the impact of radiology benefits managers vis a vis clinical decision support tools built upon the ACR appropriateness criteria in reducing imaging growth rates. 5) Review the purpose of the Medicare Imaging Demonstration project.

**ABSTRACT**

Increased imaging utilization rates have contributed significantly to the growth of health care expenditures in the United States, particularly over the last decade. In response, a series of legislative policies have been enacted to curb the growth of imaging but thus far none have focused specifically on reducing the inappropriate use of advanced imaging modalities, a major contributor to rising imaging costs. To date two major approaches have been employed to reduce inappropriate imaging utilization rates: 1) Incorporation of clinical decision support (CDS) tools into computerized physician order entry systems and 2) Use of external authorization bodies such as radiology benefit managers (RBMs). While both approaches have been shown to reduce imaging utilization rates, clinical decision support tools are more transparent in their approach and have been shown to specifically address inappropriate use of advanced imaging modalities. Due to the lobbying efforts of the American College of Radiology and the growing body of literature demonstrating the effectiveness of CDS tools in reducing inappropriate imaging, language was included in the Medicare Improvements for Patient and Providers Act of 2008 (MIPPA) which mandated an appropriate use of imaging services demonstration project. The Medicare Imaging Demonstration project (MID) has been deployed at 5 institutions across the US to assess the impact that decision support systems have on the appropriateness and utilization of advanced imaging services ordered for the Medicare fee-for-service population. It is incumbent upon radiologists to be aware of current efforts at decreasing inappropriate imaging utilization so as to drive this progress moving forward.

**RC430B • Legislative Impact of CT Radiation Dose Reporting Requirements**

Jonathan Breslau MD (Presenter)

**LEARNING OBJECTIVES**

1) Understand the motivation for dose reduction legislation in California. 2) Understand the structure, benefits and limitations of required metrics. 3) Understand the processes for complying with new regulations in California.

**ABSTRACT**

**RC430C • Informatics Solutions for Meaningful Use**

Alberto F Goldszal PhD, MBA (Presenter)

**LEARNING OBJECTIVES**

1) Learn what informatics and IT solutions can be used to help practices achieve meaningful use. 2) Understand real-world challenges and solutions faced by existing practices in deploying MU.

**RC430D • Mobile Computing, Radiology, and the FDA**

David S Hirschorn MD (Presenter)

**LEARNING OBJECTIVES**

1) Understand the FDA approval process for mobile computing applications in radiology. 2) Learn about new application available for mobile devices in radiology.

**Value-Added Initiatives for a Healthcare System**

**Tuesday, 04:30 PM - 06:00 PM ● S504AB**

**RC432A • Radiology Support for Major Centers of Excellence**

Barry Stein MD (Presenter)

**LEARNING OBJECTIVES**

1) Recognize the opportunities for Radiology to contribute to healthcare systems in a value added fashion. 2) Provide framework for Radiology departments to illustrate their clinical value to the healthcare system. 3) Understand the importance and transformative potential of imaging informatics to the healthcare system and to the armamentarium of the Radiology department. 4) Appreciate the power of metric and analytic dashboards to the Radiology department and the healthcare system.

**ABSTRACT**

A. Clinical Integration & Innovation: 1. Critical role Radiology plays in supporting major clinical centers of excellence (stroke,
cardiovascular, oncology, transplant, trauma, women's health, spine/joint etc). 2. Strategic multi-dimensional marketing within and for a healthcare system, B. Imaging Informatics: 1. Provide relevant imaging and reports anywhere and anytime, 2. Opportunity to change referring physician workflow with: a. powerful technology allowing easy effortless access to imaging, standardized reports, b. Zero foot print viewing solutions & mobile device technology, c. EMR & HIE integration, d. Multi modality & interdisciplinary common viewer, e. CPOE with appropriateness criteria 3. Patient access C. Improving the Bottom Line, 1. Discuss methods to derive meaningful financial & clinical metrics & analytics demonstrating how Radiology contributes to the bottom line (tangible added value), 2. Departmental dashboards supporting Healthcare system balanced score cards, 3. Improving imaging report turn around times to support initiatives to decrease hospital length of stays

RC432B • Imaging Informatics
Keith J Dreyer, DO, PhD (Presenter) *

LEARNING OBJECTIVES
1) Develop an understanding of the essential Informatics skills required for a leader to be successful. 2) Develop an understanding of the common Informatics errors made by leaders in academic and private practices. 3) Acquire the skills of Informatics planning needed to ensure that the success of your organization is sustainable over time.

RC432C • Radiology's Impact on the Hospital's Bottom Line
Bernard F King, MD (Presenter)

LEARNING OBJECTIVES
1) Identify methods to derive meaningful financial and clinical metrics and analytics demonstrating how Radiology contributes to the bottom line (tangible added value). 2) Developing departmental dashboards supporting Healthcare system balanced score cards etc. 3) Identify methods for improving imaging report turn around times to support initiatives to decrease hospital length of stays thus improving bottom line.

Vertebral Augmentation (How-to Workshop)

Tuesday, 04:30 PM - 06:00 PM • E260

RC450 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
A. Orlando Ortiz, MD, MBA *
Bassem A Georgy, MD, MSc *
John M Mathis, MD, MSc
Allan L Brook, MD *
Ashin Gangi, MD, PhD *

LEARNING OBJECTIVES
1) Discuss appropriate algorithms for patient selection. 2) Review anatomic and technical considerations for vertebral augmentation. 3) Present an update of the recent advances in vertebroplasty and kyphoplasty. 4) Emphasize safety issues and how to avoid complications. 5) Understand the applications of vertebral augmentation in osteoporotic and neoplastic spine pathology. 6) Update participants with respect to advances in equipment and biomaterials.

ABSTRACT
Understand the applications of vertebral augmentation in osteoporotic and neoplastic spine pathology. 6) Update participants with respect to advances in equipment and biomaterials.

Imaging in Practice: DWI in the Abdomen and Pelvis (How-to Workshop)

Tuesday, 04:30 PM - 06:00 PM • E261

RC451A • How to Perform DWI - Principles and Protocol
Shreyas S Vasanawala, MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Understand basic principles of contrast formation in diffusion weighted MRI. 2) Understand sources of artifacts in diffusion weighted MRI. 3) Know techniques to reduce artifacts to produce diagnostic quality diffusion weighted images.

ABSTRACT
Diffusion-weighted imaging is being used with increasing frequency in body MRI. The basic mechanism of contrast generation is the use of large motion-sensitizing gradients such that water molecules undergoing random motion are dephased, resulting in signal loss. Tissues and lesions with high cellularity have reduced diffusive motion of water, which results in relatively high signal. However, a number of issues must be considered in the body challenging relative to neurological applications. First, the vast majority of clinical DWI is performed with an echo-planar technique, which suffers from image distortions due to field inhomogeneity. These become problematic particularly where there are gas-tissue interfaces, such as at the dome of the liver and near gas-filled bowel. The presentation will discuss methods to minimize these distortions. Second, the T2 relaxation rates of abdominal tissues are less than that of pelvic viscera and much less than that of the brain, whereas normal water diffusivity is higher; as the choice of diffusion sensitivity (b value) heavily influences the echo time, lower b values must be used. Third, motion from cardiac pulsations, respiration, and peristalsis produce artifacts, some of which are easily recognizable, and others which can subtly hide pathology. Techniques to minimize these pitfalls will be presented. Finally, issues of reproducibility that affect the practical clinical use of DWI for lesion characterization in body MRI will be discussed, along with approaches to improve reliability.

RC451B • Interpretation of DWI - How to Create and Use ADC Maps in Your Practice
Thomas A Hope, MD (Presenter)

LEARNING OBJECTIVES
1) Understand the principles of calculating ADC. 2) Understand the effect of b-value selection and weighting on diffusion calculations. 3) Explore the value of IVIM and other parameters.

ABSTRACT
In order to incorporate diffusion weighted imaging into clinical practices, it is important to understand how diffusion data is evaluated. Qualitatively, one can simply say that lesions are “bright” on diffusion, but intensity on high b-value imaging is not always equate to a lesion that has reduced diffusion. The understanding and implementation of quantitative analysis is therefore critical for both research and everyday clinical practice. The first step is the calculation of the apparent diffusion coefficient (ADC) map, which is used to help tease out the differences in intrinsic T2 hyperintensity and diffusivity. The calculation of the ADC map is greatly affected by the methodology used as well as the selection of b-values acquired. The ADC of a tissue describes how quickly signal decreases as the b-value is increased. Those lesions with high diffusivity will have high ADC values, while those lesions with reduced diffusion will have lower ADC values. In...
addition to ADC, other parameters have been describe that affect the measured diffusivity. The most commonly discussed is intravoxel incoherent motion (IVIM) that is thought to represent the random movement of blood within the capillary system, often called pseudodiffusion. This parameter has its greatest effect on diffusion weighted images at low b-values.

RC451C • Applications of DWI in Clinical Practice - When It Does and Doesn’t Help

Frank H Miller MD (Presenter)

LEARNING OBJECTIVES
1) Demonstrate the utility of diffusion weighted imaging in the abdomen. 2) Show advantages and limitations of diffusion weighted imaging in the abdomen.

ABSTRACT
Diffusion weighted imaging (DWI) has been used in neuroimaging for many years. It has only more recently become feasible in the abdomen. The objective of this talk is to emphasize the important role that diffusion-weighted imaging can have in your practice and that it can be used routinely without difficulty in the abdomen and pelvis. DWI potentially can detect additional lesions and direct the radiologist to lesions that are not as well seen on conventional imaging. DWI helps in characterization of lesions but does have limitations in specificity which will be discussed. Qualitative and quantitative evaluation can be performed and the applications of these techniques clinically will be described. The strengths and limitations of DWI in multiple organs including the liver, pancreas, adrenal gland, kidney, and evaluation for metastases and infections will be discussed. DWI is especially helpful for identify lymph node and peritoneal metastases. Emerging techniques include the use of diffusion weighted imaging to assess response to therapy following liver-directed therapy will also be discussed. In summary, DWI should be used routinely if not being used at your institution. This talk will show benefits and limitations of DWI in a number of organs in the body.

Real-time Interventional US (Hands-on Workshop)

Tuesday, 04:30 PM - 06:00 PM • E264

RC452 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

Christopher A Molvar , MD
Kent T Sato , MD
Albert A Nemec, MD *
Robert J Lewandowski , MD *
Ramona Gupta , MD
Terry D Wilburn , MD
Kevin L Keele , MD
Michael H Hamblin , MD
Terence A MataIon , MD

LEARNING OBJECTIVES
1) Acquire the skill to direct a needle to a target for diagnostic or therapeutic purposes with Real-time US-guidance.

ABSTRACT
Participants will have the opportunity to hone their skills in ultrasound guided interventions using phantoms. Experienced practitioners in ultrasound guided intervention will serve as faculty.

Hands-on DICOM Metadata Manipulation (Hands-on Workshop)

Tuesday, 04:30 PM - 06:00 PM • S401CD

RC453 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

Richard J Bruce , MD *
Walter W Peppler , PhD *

LEARNING OBJECTIVES
1) Get introduced to a variety of the available open source tools and have a chance to experiment and familiarize yourself with the software hands-on. 2) Understand how open source DICOM software can help solve common workflow issues. 3) Understand how open source DICOM software can be used in research and education. 4) Learn to use open source tools to address DICOM data management challenges.

Next-Generation Educational Content Creation: Screencasting and Video Editing (Hands-On)

Tuesday, 04:30 PM - 06:00 PM • S401AB

RC454 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

George L Shih , MD, MS *
Richard S Ha , MD
Kurt T Teichman , BSC, MENG
Ian R Drexler , MD,MBA

LEARNING OBJECTIVES
1) Assess the potential of online and mobile e-learning innovations to augment your residents', medical students', and staff's educational curricula. 2) Acquire the domain knowledge to use already available content (eg, PowerPoint presentations) to both create video content and deploy e-learning courses on modern web-based and mobile platforms. 3) Acquire the domain knowledge to use already available content (eg, PowerPoint presentations) to electronic books (e-books), with or without digital rights management (DRM), and obtain an ISBN number for publishing.

ABSTRACT
From OpenCourseWare to the Khan Academy, and now to Coursera, e-learning has been dramatically improved over the last decade, changing education from the normal classroom into learning done at convenience, and also allows for more creative and engaging content during the typical lecture. Stanford Med recently published positive initial findings in utilizing video-based lectures in an interactive class setting. Leveraging this new way of learning, requires knowledge about the types of technology and platforms for these courses. 2. The workflow required to host an e-learning course can be summarized in 3 steps: (a) creating the educational content, (b) hosting the materials, and (c) making the materials available to the intended audience. E-content today typically consists of lecture slides along with video recordings captured by technology like TechSmith Camtasia (non-free) and Apple Quicktime (free). Once the materials are created and edited, one must choose a suitable hosting platform realistic to the skills and goals of the instructor with options that include coursesites.com, iTunes U, and YouTube / Google Hangouts. Students can then be invited to view the material or the content can be made available to the public. 3. Creating and publishing e-books is a great way to share your teaching material as an engaging interactive tool. Publishing in e-book format solves many logistical problems of conventional publishing and the e-book format has interactive features that paper books can't match. We will review the process of creating your own e-book from assembling material to layout design to submitting
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