physicians, serves as the legal record that documents the episode of care and records information for future use. A structured report is uniform, comprehensive, detailed, and easily auditable. It includes structured data that can be easily analyzed for clinical and operational insights.

LEARNING OBJECTIVES
1) Understand how structured reporting differs from conventional dictation. 2) Learn the strengths and weaknesses of structured reporting. 3) Evaluate the impact of structured reporting on workflow and patient care. 4) Understand the technical aspects of implementing structured reporting systems.

SPSC20 • AMA PRA Category 1 Credit™: 1 • ARRT Category A+ Credit: 1

Curtis P Langlotz, MD, PhD
Richard B Spielman, MD, PhD

LEARNING OBJECTIVES
1) Understand how structured reporting differs from conventional dictation. 2) Learn the strengths and weaknesses of structured reporting. 3) Evaluate the impact of structured reporting on workflow and patient care. 4) Understand the technical aspects of implementing structured reporting systems.

Controversy Session: Radiology Reporting: Is Structured Reporting the Answer?
Monday, 07:15 AM - 08:15 AM • E350

Hot Topic Session: Concussion and Traumatic Brain Injury
Monday, 07:15 AM - 08:15 AM • E451B
LEARNING OBJECTIVES
1) To understand the role, benefits and risks of stereotactic radiation in the treatment of early-stage lung cancer. 2) To understand interventional oncology and surgical options in the treatment of early-stage lung cancer. 3) To gain a critical appraisal of all three options and risks and benefits of each for personalized care in challenging patients population with common multi-morbidity.

LEARNING OBJECTIVES
1) To describe the purpose of a Disaster Mortuary Operational Response Team (DMORT) during the aftermath of a National Disaster. 2) Identify and discuss the general roles of the key individuals that participate in a DMORT facility. 3) Identify and describe the specific duties of a Forensic Radiographer and the radiographic equipment utilized in a DMORT facility. 4) Describe the problems of obtaining radiographic images of victim remains after a natural catastrophic disaster.

The 2010 earthquake devastated the city of Port au Prince, Haiti, leaving at least 230,000 dead, 200,000 injured and 1 million homeless. The aftermath overwhelmed the Haitian government of this third world country. Massive aid poured into Haiti from many countries, including the USA. Many of the dead were United States citizens who needed to be recovered and identified. To help in the process of recovering the remains of American citizens, DMORT, a unit of the National Disaster Medical System (NDMS) was deployed. DMORT’s role in Haiti, the interdisciplinary team members and their responsibilities with specific emphasis on the role of the Radiographer will be discussed. The difficulties posed in performing this type of US government operation in a foreign country in the immediate aftermath of a natural disaster are presented.
injuries. 3) Have improved knowledge of implications of sports injuries in the adolescent population.

ABSTRACT
To view presentation go to www.bone.tju.edu

MSCM21B • Wrist/Hand
Leon Lenchik MD (Presenter)

LEARNING OBJECTIVES
1) To review normal anatomy on hand and wrist MR. 2) To show bone and soft tissue injuries on hand and wrist MR. 3) To describe pitfalls in hand and wrist MR interpretation.

ABSTRACT

MSCM21C • Musculoskeletal MR Imaging In Children
Tal Laor MD (Presenter)

LEARNING OBJECTIVES
1) To recognize changes in the musculoskeletal system that occur with growth. 2) To identify injuries of the musculoskeletal system that are unique to growing children. 3) To become familiar with various non-traumatic musculoskeletal disorders that affect children.

ABSTRACT

Cardiac CT Mentored Case Review: Part I (In Conjunction with the North American Society for Cardiac Imaging) (An Interactive Session)

Monday, 08:30 AM - 10:00 AM • S406A

CT CA

MSMC1 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Pamela K Woodard, MD *
Moderator
David A Bluemke, MD, PhD *

LEARNING OBJECTIVES

1) To recognize changes in the musculoskeletal system that occur with growth. 2) To identify injuries of the musculoskeletal system that are unique to growing children. 3) To become familiar with various non-traumatic musculoskeletal disorders that affect children.

ABSTRACT

Molecular Imaging Symposium: Preparing for Tomorrow: The Application of Novel and Advanced Imaging in Clinical Oncology

Monday, 08:30 AM - 10:00 AM • S406B

MSMC21A • Normal Coronary Anatomy
Shawn D Teague MD (Presenter) *

LEARNING OBJECTIVES
1) Recognize normal anatomy and common variants of the coronary arteries. 2) Understand the unique advantages and disadvantages of CT for coronary artery evaluation. 3) Describe the current State-of-the-Art capabilities for CT in coronary artery evaluation.

ABSTRACT

MSMC21B • Coronary Artery Anomalies
Cylen Javidan-Nejad MD (Presenter) *

LEARNING OBJECTIVES
1) Using Coronary Artery CT cases to review anomalous origins of the coronary arteries.

ABSTRACT

Molecular Imaging Symposium: Preparing for Tomorrow: The Application of Novel and Advanced Imaging in Clinical Oncology

Monday, 08:30 AM - 10:00 AM • S406B

MSMC21A • Normal Coronary Anatomy
Shawn D Teague MD (Presenter) *

ABSTRACT

MSMC21B • Coronary Artery Anomalies
Cylen Javidan-Nejad MD (Presenter) *

ABSTRACT

Fluorescence and Optoacoustic Imaging Heads to the Clinics
Vasilis Ntziachristos PhD (Presenter) *

LEARNING OBJECTIVES
1) Learn the technology basics and assess the current state of the art in fluorescence and optoacoustic imaging. 2) Understand the imaging performance achieved and major improvements over past approaches. 3) Learn on how this new-generation imaging performance offers a paradigm shift in optical and clinical imaging. 4) Link the developments described to unique contrast generation in clinical and pre-clinical applications. 5) Gain insights into current clinical pilot studies using these approaches.

MSM21B • CT Biomarkers and How to Use Them
Kenneth Miles (Presenter) *

LEARNING OBJECTIVES
1) Describe the oncological imaging biomarkers available from CT. 2) Demonstrate knowledge of the processes required for qualification of CT biomarkers in oncological drug development and clinical practice. 3) Compare the applications of CT biomarkers for prognosis, response prediction and response assessment.

ABSTRACT
By measuring size and attenuation with or without contrast material, CT can provide a range of oncological biomarkers including T-stage, RECIST, enhancement, CT perfusion and CT texture analysis. Implementation of these biomarkers requires prior assessments of technical/biological performance and establishment of biomarker performance characteristics. For clinical applications, assessments of therapeutic and health impact are also required. Technical/biological validation includes assessments of test-retest performance and identification of relevant biological correlates. Evaluations of biomarker performance should report cross-validated diagnostic/prognostic thresholds, hazard ratio and biomarker prevalence. Based on these parameters, modelling studies can evaluate the potential therapeutic and health impacts that would result from clinical deployment. Current evidence supporting the use of CT biomarkers in drug development and clinical practice are summarised.

MSM21C • The Use of Novel PET Tracers. What is in the Pipeline for Approval
Jonathan E McConathy MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Describe the PET tracers in late phase clinical trials for oncologic imaging in terms of their molecular targets and potential clinical indications. 2) Identify the major regulatory and financial challenges encountered during the translation of PET tracers into widespread clinical use. 3) Compare the properties, strengths, and weaknesses of PET tracers for prostate cancer imaging as case studies.

ABSTRACT
Positron emission tomography (PET) with the glucose analogue 2-deoxy-2-[F-18]fluoro-D-glucose (FDG) combined with computed tomography (CT) is currently the workhorse for clinical molecular imaging in oncology. While very successful, FDG-PET/CT has limitations in certain cancers and provides a readout of only one aspect of cancer biology. Novel PET tracers have great promise to improve diagnostic imaging, and a wide range of small molecule, peptide, antibody, and nanoparticle-based PET tracers are in development for oncologic imaging. This presentation will provide an overview of PET tracers in late phase clinical development with an emphasis on mechanism of action and potential clinical indications. Additionally, some of the key challenges to the widespread clinical use of PET tracers including regulatory and financial issues will be reviewed. Finally, several classes of PET tracers for prostate cancer photography
imaging will be discussed in greater depth to illustrate key points.

MSMI21D • Systems Diagnostics - The Future of Diagnostic Medicine?

Michael D Kuo MD (Presenter) *

LEARNING OBJECTIVES
1) To understand systems diagnostics as a new diagnostics paradigm. 2) To explore clinical applications and future directions of systems diagnostics.

BOOST: Head and Neck-Anatomy and Contouring (An Interactive Session)

Monday, 08:30 AM - 10:00 AM • S103AB

MSRO21A • Anatomy of the Lymph Nodes

Suresh K Mukherji MD (Presenter)

LEARNING OBJECTIVES
1) Review the normal anatomy of the lymph nodes of the neck. 2) Review the radiological anatomy and landmarks for identifying lymph node groups. 3) Review the primary echelon drainage patterns of various head and neck subsites.

ABSTRACT
1. Review the normal anatomy of the lymph nodes of the neck
2. Review the radiological anatomy and landmarks for identifying lymph node groups
3. Review the primary echelon drainage patterns of various head and neck subsites

MSRO21B • Current Concepts and Controversies in Contouring and Treatment of Lymph Nodes

Sung Kim MD (Presenter)

LEARNING OBJECTIVES
1) Learn and discuss what lymph node levels are appropriate to target depending on primary site. 2) Discuss the appropriate dose and margins for lymph node coverage.

MSRO21C • Anatomy and Staging of the Brachial Plexus

Suresh K Mukherji MD (Presenter)

LEARNING OBJECTIVES
1) Review the normal anatomy of the brachial plexus. 2) Review the pertinent radiologic landmarks that permits accurate contouring of the brachial plexus. 3) Review the common inoplastic processes of the brachial plexus.

ABSTRACT
This session will be a detailed review normal anatomy of the brachial plexus and focus on the landmarks that help permit accurate contouring of the plexus

MSRO21D • Current Concepts and Controversies in Contouring the Brachial Plexus

Sung Kim MD (Presenter)

LEARNING OBJECTIVES
1) Discuss a reproducible method for contouring brachial plexus.

BOOST: Gynecology-Anatomy and Contouring (An Interactive Session)

Monday, 08:30 AM - 10:00 AM • S103CD

MSRO24 • 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
Beth A Erickson, MD
Paul M Knechtges, MD *
Mark D Hohenwalter, MD

LEARNING OBJECTIVES
1) Review the radiologic features of female gynecologic cancers for both intact and post-operative presentations. 2) Review the radiologic features of female gynecologic cancers before, during and after external beam irradiation and brachytherapy. 3) Review the recommended external beam and brachytherapy contouring guidelines for intact and post operative gynecologic cancer presentations.

ABSTRACT
The treatment of gynecologic cancers with radiation as a component of treatment requires a clear understanding of the imaging characteristics of disease before and after radiation. Knowledge of the patterns of cancer spread, both locally and regionally, is important in designing radiation treatment plans which may include external beam and/or brachytherapy. Proper contouring of radiation targets and organs at risk is essential in developing treatment plans which maximize the benefits and minimize the risks of radiation, both for external beam and brachytherapy. The subsequent follow up of patients with imaging after radiation is also important in helping to identify recurrent disease and complications. Radiation oncologists and radiologists working in collaboration can enhance the care of these patients before, during and after treatment.

Practical Issues in Chest Imaging: Case-based Approach (An Interactive Session)

Monday, 08:30 AM - 10:00 AM • E353C

RC201 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

RC201A • Pulmonary Infection

Lacey Washington MD (Presenter)

LEARNING OBJECTIVES
1) Recognize a broad range of potential radiographic findings of acute infection. 2) Recognize clinically relevant features in infection imaging. 3) Recognize findings that are not characteristic of community-acquired pneumonia and that suggest an alternate diagnosis.

RC201B • Lung Cancer: Hiding in Plain Sight

Eric J Stern MD (Presenter)

LEARNING OBJECTIVES
ABSTRACT
Have you ever missed a lung cancer on CXR? Missed lung cancer is one of most frequent causes for malpractice lawsuits in radiology in USA This lecture:
1) Understand characteristics of missed lung cancers on CXR. 2) Understand how we visually search. 3) Be aware of common observer errors. 4) Know CXR hiding spots. 5) Be aware of some ancillary diagnostic tools.

LEARNING OBJECTIVES
1) Understand characteristics of missed lung cancers on CXR.
2) Learn how we visually search.
3) Be aware of common observer errors.
4) Know CXR hiding spots.
5) Be aware of some ancillary diagnostic tools.

RC201C • Management of Sub-Solid Lung Nodules: How I Do It...
Myrna C Godoy MD, PhD (Presenter)

LEARNING OBJECTIVES
1) To comprehend the new IASLC/ATS/ERS classification of lung adenocarcinomas and its correlation with sub-solid nodules. 2) To review the current approach to diagnosis and management of sub-solid pulmonary nodules.

ABSTRACT
The term sub-solid nodule includes pure ground-glass nodules (GGNs) and part-solid nodules (PSNs), which are mixed ground-glass/solid lesions. Strong correlation has been demonstrated between the histologic findings of lung adenocarcinoma with lepidic growth pattern and the CT appearance of persistent sub-solid nodules. Radiologists should be familiar with the new classification of lung adenocarcinoma that has been recently proposed by the International Association for the Study of Lung Cancer, American Thoracic Society and European Respiratory Society. Serial CT imaging has demonstrated stepwise progression of these nodules in a subset of patients, characterized by increase in size and density of GGNs and development of a solid component. Given the slow growth rate of GGNs, standardized guidelines with long-term (= 3 years) CT follow-up have been proposed using low-dose CT technique.

Scott D Flamm MD (Presenter)

RC203A • CT
Benoit Desjardins MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Identify the aspects of clinical cardiac electrophysiology which can benefit from imaging. 2) Compare the use of different imaging modalities in cardiac electrophysiology. 3) Understand the technical difficulties and solutions to image patients with arrhythmia and/or implanted devices. 4) Practice the current techniques for imaging in cardiac electrophysiology. 5) Assess the potential of the latest technological innovations and advances in imaging to enhance clinical practice and problem solving in cardiac electrophysiology.

ABSTRACT
This lecture is part of a vertical combined refresher course and scientific abstract session. The lectures will alternate with the relevant scientific abstracts. The content of these refresher course lectures will therefore vary according to the content of the accompanying scientific abstracts. The lecture will include some of the following topics: - Overview of the different imaging modalities in cardiac electrophysiology, including CT, MRI, echocardiography, rotational angiography and electroanatomical mapping. - Technical difficulties and solutions to image patients with arrhythmia. - Technical difficulties and solutions to image patients with implanted devices. - Latest cutting edge imaging techniques for cardiac electrophysiology. - Use of 3D imaging to guide cardiac ablation therapy. - Real time image-guided cardiac electrophysiology

Jo-Anne O Shepard MD (Presenter) *

LEARNING OBJECTIVES
1) To demonstrate the radiologic appearance of expected and unexpected complications of thoracic surgical appearances through a case-based approach. 2) An understanding of the surgical procedures and expected findings will facilitate the recognition of complications. 3) Prompt identification of post-operative complications in a timely and accurate way will improve post-operative morbidity.

ABSTRACT
Leadership skills will be essential to the successful careers of all radiology residents and fellows. Ten key points aimed at improving your success in academic medicine will help you in planning your career and gaining effective mentoring as you start your career.

RC203C • Post-Operative Chest Imaging
Jo-Anne O Shepard MD (Presenter) *

LEARNING OBJECTIVES
1) To demonstrate the radiologic appearance of expected and unexpected complications of thoracic surgical appearances through a case-based approach. 2) An understanding of the surgical procedures and expected findings will facilitate the recognition of complications. 3) Prompt identification of post-operative complications in a timely and accurate way will improve post-operative morbidity.

ABSTRACT
Leadership skills will be essential to the successful careers of all radiology residents and fellows. Ten key points aimed at improving your success in academic medicine will help you in planning your career and gaining effective mentoring as you start your career.

Imaging for Electrophysiology
Monday, 08:30 AM - 10:00 AM • E351

Benoit Desjardins MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Recognize the advantages and limitations of MRI versus CT for the pre- and post-ablation imaging in cardiac electrophysiology. 2) Identify the clinical scenarios where clinical cardiac electrophysiology may benefit from MR imaging. 3) Understand the technical difficulties and potential solutions to image patients with arrhythmias. 4) Recognize the limitations and necessary precautions and planning needed when considering imaging patients with implanted devices.

ABSTRACT
See Abstract above.
LEARNING OBJECTIVES
1) To identify imaging findings in some of the most commonly missed diagnoses in the Head and Neck, including those within the neck, temporal bone, paranasal sinuses, skull base and orbits. 2) To review the most salient radiologic and clinical features of these diagnoses, as well as the most important differential considerations. 3) To suggest scan review techniques that will help the radiologist consistently make these diagnoses.

ABSTRACT
The Head and Neck can be a challenging area for the radiologist, in that some findings are easily missed, and others are frequently misinterpreted. Some of the more common ‘misses’ in HandN radiology occur because findings are subtle and will not be obvious to the examiner unless they are the subject of a specific and systematic search. A classic example is fenestral otosclerosis. This relatively common diagnosis (found in up to 10% of autopsy specimens!) will invariably be missed unless the radiologist specifically interrogates its most common site of presentation, the fissula ante fenestram, along the anterior margin of the oval window. There, only a small lucent focus may be discovered, yet this will reflect the etiology of the patient’s hearing loss, while the remainder of the scan is entirely normal. The temporal bone is the site of another commonly missed diagnosis, labyrinthitis. In this scenario, the patient presents with sensorineural hearing loss, though the findings of abnormal signal in the membranous labyrinth may be extremely subtle. When ‘tunnel vision’ is applied in the setting of hearing loss, and scan interrogation is limited to the IAC and CPA, the findings of labyrinthitis will invariably be missed. Familiarity with some of the diseases specific to the HandN will help reduce the likelihood of misinterpretation of findings. An example that has recently gained attention in the literature is HPV-related squamous cell carcinoma of the oropharynx. These cancers frequently metastasize to upper jugular lymph nodes, and these nodes are frequently cystic. As such, there has been a near epidemic of cystic metastatic lymph nodes mistakenly called second branchial cleft cysts. Beware this diagnosis in the adult patient!

Interactive Game: A Case-based Audience Participation Session (Genitourinary)

LEARNING OBJECTIVES
1) The participant will be introduced to a series of Genitourinary case studies via an interactive team game approach designed to encourage “active” consumption of educational content. 2) The participant will be able to use their mobile wireless device (tablet, phone, laptop) to electronically respond to various Genitourinary case challenges; participants will be able to monitor their individual and team performance in real time. 3) The attendee will receive a personalized self-assessment report via email that will review the case material presented during the session, along with individual and team performance.

ABSTRACT
The extremely popular audience participation educational experience is back! GU Diagnosis Live is an expert-moderated session featuring a series of interactive Genitourinary case challenges. Diagnosis Live is a lively, fast-paced game format: participants will be automatically assigned to teams who will then use their personal mobile devices to test their knowledge of GU radiology in a fast-paced session that will be both educational and entertaining. After the session, attendees will receive a personalized self-assessment report via email that will review the case material presented during the session, along with individual and team performance.

No Course RC208. See Series VSGI21 Gastrointestinal Series: Emerging Issues in Abdominal CT

Monday, 08:30 AM - 10:00 AM

RC209

First Trimester Ultrasound

Monday, 08:30 AM - 10:00 AM • S405AB

RC210 • AM A PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

Peter M Doubilet, MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Know the sonographic criteria for definite miscarriage and probable miscarriage in the early first trimester. 2) Understand that any saclike intrauterine structure (rounded edges, no yolk sac or embryo) in a woman with a positive pregnancy test is highly likely to be a gestational sac. 3) Understand that...
nonvisualization of an intrauterine gestational sac in a woman with hCG above the ‘discriminatory’ level (2000 mIU/ml) does not exclude the possibility of a viable pregnancy.

ABSTRACT
1. Sonographic Criteria for Diagnosing Pregnancy Failure (Miscarriage) in an Intrauterine Pregnancy of Uncertain Viability [Note: an intrauterine fluid collection with rounded edges in a woman with positive hCG is almost certainly a gestational sac; it is definitely a gestational sac if it contains a yolk sac or embryo.] 1. Criteria for definite miscarriage (i) CRL =2 weeks after a scan that showed a gestational sac without yolk sac. (ii) Empty amnion (amnion seen adjacent to yolk sac, with no visible embryo); (ii) Enlarged yolk sac (> 7 mm); (iii) Small gestational sac size in relation to the embryo II. Guidelines Related to the Possibility of a Viable Intrauterine Pregnancy in a Pregnancy of Unknown Location (positive pregnancy test and no intrauterine or ectopic pregnancy seen on ultrasound) 1. A single hCG, regardless of its level, does not reliably distinguish between ectopic and intrauterine pregnancy (viable or nonviable). 2. If a single hCG is >3000 mIU/ml, a viable intrauterine pregnancy is possible but unlikely. However, the most likely diagnosis is nonviable IUP, so it is generally appropriate to get at least one followup hCG before treating for ectopic pregnancy.

RC210B • Diagnosis and Treatment of Ectopic Pregnancy
Hope E Peters MD (Presenter)

LEARNING OBJECTIVES
1) Recognize the spectrum of findings at transvaginal ultrasound in ectopic pregnancy. 2) Report TVUS findings in suspected ectopic pregnancy when a non-specific intrauterine fluid collection is present. 3) Differentiate usual vs. "unusual" ectopic pregnancies and understand their different treatment algorithms. 4) Understand the limitations of ultrasound related to maternal and technical factors. 5) Assist clinicians with appropriate follow up/management recommendations in excluding and diagnosing ectopic pregnancy.

ABSTRACT
Transvaginal ultrasound is the primary imaging modality to evaluate suspected ectopic pregnancy, performed in patients with a positive pregnancy test and pain or bleeding. 1) If pregnancy is confirmed by ultrasound demonstrates no intrauterine gestational sac and an extravaginal adnexal mass is found. Ectopic pregnancies occur in the ampulla of the fallopian tube >90% of the time and therapy is well established including systemic methotrexate and/or salpingectomy. 2) When attempting to exclude or diagnose ectopic pregnancy, TVUS may demonstrate a non-specific intrauterine fluid collection. The term "pseudogestational sac" should not be used to describe an intrauterine fluid collection as this term can be confusing and improperly imply ectopic pregnancy prompting premature treatment. Rather, any intrauterine fluid collection should be regarded as a potential intrauterine pregnancy and reported as such. Ectopic pregnancies may also occur in "usual" locations such as the cervix, cesarean section scar, the interstitial portion of the fallopian tube, within the ovary or concomitant with an intrauterine pregnancy. These "unusual" ectopic pregnancies are a unique subset of ectopic pregnancies requiring prompt diagnosis and alternative treatment options. Ultrasound does carry with it some limitations in the diagnosis of ectopic pregnancy related to both maternal and technical factors. Prompt diagnosis of all types of ectopic pregnancy and recognizing potential early intrauterine pregnancies will allow for appropriate follow up, optimal treatment and improve outcomes for these patients.

RC210C • The Fetus in the First Trimester
Carol B Benson MD (Presenter)

LEARNING OBJECTIVES
1) Use ultrasound during the first trimester to confirm the normal development of various fetal structures at specific gestational ages. 2) Acquire the correct sonoanatomy to use ultrasound to detect certain serious anomalies of the fetal cranium and brain during the latter half of the first trimester. 3) Use ultrasound to detect certain serious anomalies of the fetal cranium and brain during the latter half of the first trimester. 4) Distinguish between normal physiologic herniation of the bowel into the base of the umbilical cord from a ventral wall defect, such as an omphalocele or gastroschisis in the first trimester.

ABSTRACT
As sonographic technology has improved, diagnosticians have gained the ability to visualize more fetal structures during the first trimester than used to be possible with older equipment. Because of this, it is important that practitioners who perform and interpret first trimester ultrasound understand how the fetus develops and recognize the sonographic appearance of fetal structures as they become apparent at different gestational ages during the first trimester. Some fetal structures are only visible in the first trimester, but are no longer apparent after that. These include the nuchal translucency and physiologic bowel herniation. The nuchal translucency is a hypoechoic band behind the fetal neck, that, when thickened, is associated with increased risk of aneuploidy and cardiac anomalies. Physiologic bowel herniation is a normal protrusion of bowel into the base of the umbilical cord that can usually be distinguished from abnormal herniations through the ventral wall, such as omphalocele and gastroschisis. The fetal cranium and brain can be evaluated during the latter half of the first trimester, and anomalies such as anencephaly and holoprosencephaly can often be diagnosed. Likewise, other anomalies of the fetus can sometimes be diagnosed during the first trimester, including amniotic band syndrome, posterior urethral valves, and cardiac anomalies. Recognition of these anomalies in the first trimester will assist in early detection of fetal abnormalities, allowing for earlier and improved counseling for patients.

No Course RC211. See Series VSNM21 Nuclear Medicine Series: Assessment of Cancer Treatment Response: Updates

RC211

Imaging and Endografts

Monday, 08:30 AM - 10:00 AM • S504AB

RC212A • TEVAR Indications and Outcomes
Michael D Dake MD (Presenter) *

LEARNING OBJECTIVES
1) Understand the current applications of thoracic endografts for management of thoracic aortic pathologies. 2) Recognize the benefits and existing limitations of current endografts and the technologies for treatment of different aortic lesions. 3) Identify the complications and failure modes of TEVAR. 4) Know the current outcome metrics typically evaluated after TEVAR treatment of thoracic aneurysms and aortic dissections. 5) List the important imaging findings and criteria currently used to assess the suitability of aortic anatomy for TEVAR.

RC212B • New Endografts for AAA
Constantino S Pena MD (Presenter) *

LEARNING OBJECTIVES
1) Discuss the status of established AAA endografts. 2) Discuss new endografts for the treatment of AAA. Particularly discuss areas of improvement over established endografts. 3) Present data on novel endografts being developed.

RC212C • Post Endograft Essentials
Geoffrey D Rubin MD (Presenter) *

LEARNING OBJECTIVES
1) To better select the best imaging modality for assessing stent-grafts. 2) To assure that CT acquisition technique is optimized for endoleak detection. 3) To learn how to identify structural failures in endografts.

No Course RC213. See Series VSPD21 Pediatric Radiology Series: Fetal-Neonatal Imaging

Monday, 08:30 AM - 10:00 AM
Pitfalls In Oncologic Imaging

Monday, 08:30 AM - 10:00 AM

RC214

No Course RC214. See Series VSIR21 Interventional Radiology Series: Peripheral and Visceral Occlusive Disease

Monday, 08:30 AM - 10:00 AM

RC215

No Course R215. See Series VSBR21 Breast Series: Breast MR Imaging

Monday, 08:30 AM - 10:00 AM

RC216

PET-MR/Hyperpolarized MR

Monday, 08:30 AM - 10:00 AM • E450B

LEARNING OBJECTIVES
1) Understand error disclosure as an essential tenet of patient care and medical professionalism. 2) Identify barriers to effective error disclosure. 3) Develop strategies for effective disclosure of radiological errors to referring physicians, patients and families.

ABSTRACT
Disclosure of medical error is a daunting communication challenge for all physicians. Like many physicians, radiologists are unlikely to demonstrate full transparency and honesty when a medical error occurs. No educational programs have been developed specifically to help radiologists overcome barriers to disclosure of clinical errors, and learn how to approach communication about disclosure optimally. The objective of this Refresher Course is to enhance radiologists' understanding of and comfort with disclosure of radiological errors to referring physicians and patients. The 90-minute Course will include didactic presentations by clinician scholars in the field of medical error disclosure, and live enactments between trained personnel/actors and Course participants. Didactic material will discuss background information, risks, benefits, and barriers to disclosure, and introduce strategies toward discussing medical errors with patients and treating physicians. Enactments will entail conversations between volunteer Course participants and trained personnel who will portray physicians and patients to whom the Radiologist/participant must disclose an error. The enactments will be followed by debriefings and group discussions.

LEARNING OBJECTIVES
1) For the study of neurochemical and molecular activities in the human brain In-Vivo. 2) Roles of the ultra-high field MRI and high resolution brain PET and MR/PET.

ABSTRACT
Last decade or so nuclear medicine or molecular imaging has progressed substantially, especially with new brain dedicated PET such as HRRT and the ultra-high field MRI such as 7.0T. Combination of the two, that is HRRT-PET and 7.0T MRI MRI, designed for the brain dedicated molecular imaging began to provide a number of markedly improved images hitherto unavailable by the conventional systems. In this talk, recent development of PET-MRI fusion Imaging focused onto the study of a number deep brain structures such as the hippocampus, the thalamus and brainstem would be discussed. For instance, brainstem molecular imaging of the raphe nuclei began to show individually resolved raphe nucleus glucose and serotonin transporter activities and suggesting us the potentials of the technique for to the study of the emotional and affect related disorders.

LEARNING OBJECTIVES
1) For the study of neurochemical and molecular activities in the human brain In-Vivo. 2) Roles of the ultra-high field MRI and high resolution brain PET and their fusion product.

ABSTRACT
Last decade or so nuclear medicine or molecular imaging has progressed substantially, especially with new brain dedicated PET such as HRRT and the ultra-high field MRI such as 7.0T. Combination of the two, that is HRRT-PET and 7.0T MRI MRI, designed for the brain dedicated molecular imaging began to provide a number of markedly improved images hitherto unavailable by the conventional systems. In this talk, recent development of PET-MRI fusion Imaging focused onto the study of a number deep brain structures such as the hippocampus, the thalamus and brainstem would be discussed. For instance, brainstem molecular imaging of the raphe nuclei began to show individually resolved raphe nucleus glucose and serotonin transporter activities and suggesting us the potentials of the technique for to the study of the emotional and affect related disorders.
oncologic imaging is substantially different. Accordingly, the recognition of potential pitfalls that may lead to mistakes in diagnosis, especially those that lead to inappropriate management, is of major importance. This course will highlight some of the common and important sources of error, especially those that are not widely appreciated or are newly described.

RC218A • Neuroradiology

Andrei I Holodny MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

RC218B • Body Imaging

Fergus V Coakley MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

RC218C • Musculoskeletal Radiology

David M Panicek MD (Presenter)

LEARNING OBJECTIVES
1) Describe various imaging pitfalls in characterizing soft tissue and bone lesions. 2) Review several post-treatment pitfalls in bones and bone marrow.

ABSTRACT

Molecular and Functional Imaging/Surrogate Markers in Radiation Oncology

Monday, 08:30 AM - 10:00 AM • S104A

Nina A Mayr, MD
Carryn Anderson, MD
Jinxing Yu, MD
William T Yuh, MD

LEARNING OBJECTIVES
1) To understand challenges in the optimal and timely assessment of tumor response in clinical cancer therapy and in clinical trial testing new therapy regimens. 2) To understand the role and the potential of functional and molecular imaging modalities and techniques used prior, during or after cytotoxic therapy in head and neck, brain, lung, prostate and gynecologic malignancies. 3) To apply and integrate imaging modalities into the therapeutic management of cancer. 4) To review the role of imaging as predictors of tumor control and survival and their emerging role as short-term surrogate markers for long-term therapeutic outcome of cancer treatment regimens and its potential for adaptive therapy.

ABSTRACT

Medical Physics 2.0: Mammography

Monday, 08:30 AM - 10:00 AM • S404AB

Co-Director
Ehsan Samei, PhD *
Co-Director
Douglas E Pfeiffer, MS *

RC221 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

Melissa C Martin MS (Presenter)

LEARNING OBJECTIVES
1) Current requirements for Quality Control for Hologic Digital Mammography Units. 2) Current requirements for Quality Control for General Electric Digital Mammography Units. 3) Current requirements for Quality Control for Fuji Computed Radiography for Mammography Units. 4) Current requirements for Quality Control for Printers used with Digital Mammography Units. 5) Current requirements for Quality Control for Monitors used with Digital Mammography Units.

RC221A • Mammography Perspective

Douglas E Pfeiffer MS (Presenter) *

LEARNING OBJECTIVES
1) Understand the history and development of mammographic imaging equipment. 2) Understand the impact of equipment development on testing protocols. 3) Understand the impact of equipment development on regulation.

ABSTRACT

Mammographic imaging has undergone tremendous change since its inception. Rapid development from screen-film imaging to nearly universal acceptance of digital imaging has required a shift in testing methodology. This talk will briefly introduce the developments that have taken place and discuss the impact that this development has had on testing and regulation.

RC221B • Mammography 1.0

LEARNING OBJECTIVES
1) Current requirements for Quality Control for Hologic Digital Mammography Units. 2) Current requirements for Quality Control for General Electric Digital Mammography Units. 3) Current requirements for Quality Control for Fuji Computed Radiography for Mammography Units. 4) Current requirements for Quality Control for Printers used with Digital Mammography Units. 5) Current requirements for Quality Control for Monitors used with Digital Mammography Units.

RC221C • Mammography 2.0

Eric A Berns PhD (Presenter)

LEARNING OBJECTIVES
1) To provide an overview of how the Medical Physicist can prepare for the future of clinical mammography physics. 2) To provide a landscape of mammography imaging technologies. 3) To describe methods of image quality metrics, dose reduction, and quality control in relation to mammography technologies. 4) To describe the future roles of the Medical Physicist in clinical mammography physics.

Uncertainties in Imaging for Radiation Oncology: Sources and Mitigation Techniques-Margins and Margin Design

Monday, 08:30 AM - 10:00 AM • S102C

Co-Director, Moderator
Laurence E Court, PhD

LEARNING OBJECTIVES
1) Incorporating IGRT uncertainties into treatment margins. 2) Approaches to using margins to mitigate uncertainties.

RC222 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

Co-Director, Moderator
Laurence E Court, PhD

LEARNING OBJECTIVES
1) Incorporating IGRT uncertainties into treatment margins. 2) Approaches to using margins to mitigate uncertainties.

RC222A • Incorporating IGRT Uncertainties into Treatment Margins

Timothy Craig PhD (Presenter) *

LEARNING OBJECTIVES
1) Be able to identify the different terminology used to describe margins in radiation therapy. 2) Understand how different types of uncertainty contribute to the appropriate treatment margin. 3) Demonstrate an understanding of the many factors that can influence the margins required to account for treatment uncertainties. 4) Have the rationale to determine which approaches could/should be applied in their own practice.

ABSTRACT

During treatment planning a safety margin is added to the clinical target volume to ensure that the planned dose is actually delivered to the target. This margin must be calculated by correctly combining the contributions to the overall treatment uncertainty from numerous individual uncertainties. Once the uncertainties have been categorized, there are many ways in which they can be combined to give the actual treatment margin, and this must be done in a considered way. In this presentation we will describe how different uncertainties should be combined. We will describe published margin recipes, including the impact of different assumptions made in each recipe. These concepts will be discussed in the context of guidance documents from the International Commission on Radiation Units and Measurements.

RC222B • Approaches to Using Margins to Mitigate Uncertainties

Laurence E Court PhD (Presenter)

LEARNING OBJECTIVES

1) Understand practical approaches used to determine appropriate treatment margins. 2) Have the knowledge/skills to apply margin formulae in the IGRT era. 3) Appreciate the limitations and risks of applying margin formulae.

ABSTRACT

One advantage of IGRT is the potential for reducing margins. Clinical margins are typically determined in one of 3 ways: (1) Use same margins as before (pre-IGRT). (2) Reduce margins based on supposed improvement in accuracy/precision, perhaps based on published data, or (3) Evaluate institutions own uncertainties, and establish appropriate margins. The first two are probably the most common. However, each of these approaches has its own pitfalls: (1) does not take full advantage of our new technologies, (2) is fraught with potential error, including the fact that many published works do not adequately assess uncertainties, and (3) can be difficult, and not all physicists have the background knowledge to do this. In this presentation we will describe some practical approaches to using margin formulae and other methods used to determine safe clinical margins. The limitations, risks and pitfalls will be described.

Minicourse: Current Topics in Medical Physics-Practice Quality Improvement: Basics and Issues for Medical Physicists

Monday, 08:30 AM - 10:00 AM • S403B

RC223 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

Moderator

G. Donald Frey, PhD

RC223A • Introduction

Richard L Morin PhD (Presenter)

LEARNING OBJECTIVES

1) The participant will have an overall orientation to the role of medical physics in nuclear cardiology.

RC223B • Practice Quality Control: The ABR Perspective

G. Donald Frey PhD (Presenter)

LEARNING OBJECTIVES

1) The participant will understand the role of PQI in the ABR MOC process.

ABSTRACT

This section is an overall introduction to the course and will place Practice Quality Improvement (PQI) into the perspective of the ABR Maintenance of Certification (MOC) process.

RC223C • Basics and Practical Projects

Paul G Nagy PhD (Presenter)

LEARNING OBJECTIVES

1) Learn why quality methodologies can be useful for physicists. 2) Discuss PQI projects a physicist can do in diagnostic radiology. 3) Learn the basics of quality techniques with a discussion around practical PQI projects. 4) Talk about how the physicist can be a real resource to physicians conducting PQI projects.

ABSTRACT

Mentored Case Approach to Pediatric Cardiovascular Disease 1: Vascular Disease (An Interactive Session)

Monday, 08:30 AM - 10:00 AM • E353B

RC224 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

Director

S. Bruce Greenberg, MD

Director

Rajesh Krishnamurthy, MD *

S. Bruce Greenberg, MD

Cynthia K Rigby, MD

Taylor Chung, 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 vascular rings and slings, coarctation, aortopathy, coronary anomalies, and congenital pulmonary arterial and venous anomalies. 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: Diffuse Lung Disease Assessment Using CT

Monday, 08:30 AM - 10:00 AM • N229

RC225 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

Director

Michael F McNitt-Gray, PhD *

RC225A • The Role of Quantitative CT in the Assessment of Diffuse Lung Disease

Jonathan G Goldin MBChB, PhD (Presenter)

LEARNING OBJECTIVES

1) Identify the application of quantitative imaging principles in the assessment of patients with Diffuse Lung Disease. 2) Identify conditions required for successful application of quantitative imaging principles. 3) Analyze quantitative imaging techniques and apply this knowledge to protocol development and patient management in the setting of both clinical workup and clinical trials involving patients with Diffuse Lung Disease.
RC225B • Quantitation in the Assessment of COPD
David A Lynch MBCh (Presenter) *

LEARNING OBJECTIVES
1) Describe the methodology and limitations of non-invasive imaging in quantifying lung structure. 2) Describe the opportunities for non-invasive imaging in understanding the structure of the lung, and how that relates to phenotyping subjects for clinical trials and longitudinal studies. 3) Understand the clinical relevance of quantitative imaging of COPD. 4) Learn how to interpret quantitative CT results in the lung.

ABSTRACT
COPD is characterized on CT by emphysema, bronchial wall thickening, and small airway abnormalities. These morphologic findings may be quantified and grouped into phenotypes, with different clinical presentations and prognosis. Clinicians are increasingly using these quantitative imaging techniques to study COPD. This course will provide information on the results of large-scale clinical trials ongoing in COPD. The limitations and sources of variation of current quantitative imaging methods will be discussed. Relationships between quantitative CT measures, genetic markers, and clinical abnormalities will be stressed.

RC225C • Standardization of Imaging and Measurement Protocols
Matthew S Brown PhD (Presenter) *

LEARNING OBJECTIVES
1) Understand sources of quantitative lung CT measurement variation including technical, physiologic, and algorithmic. 2) Review strategies for standardization across multiple sites and imaging platforms. 3) Assess the impact on sample size in multicenter clinical trials.

No Course RC226. See Series VSIN21 Radiology Informatics Series: Mobile Computing Devices

Monday, 08:30 AM - 10:00 AM

RC226

Changing Role of Radiology in the U.S. Health Care System

Monday, 08:30 AM - 10:00 AM •N226

RC227 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
James V Rawson, MD
Marta E Heilbrun, MD
Alexander M Norbash, MD *

LEARNING OBJECTIVES
1) Discuss barriers and tools for incorporating guidelines and evidence based recommendations into radiology practice. 2) Review both the systemic shortfalls and benefits delivered to the citizens of Massachusetts during that state's implementation of universal health care. 3) Learn to identify alignment of incentives across multiple stake holders in the evolving landscape of US healthcare.

ABSTRACT
As the U.S. Health Care system continues to evolve, the role of the Radiologists will also change. The Radiologist will likely play a role in managing issues such as incorporation of evidence based guidelines into clinical practice, access to care, alignment of stakeholders and clinical outcomes.

Should I Scan That Patient? A Very Interactive Session on MR Safety and Regulations (An Interactive Session)

Monday, 08:30 AM - 10:00 AM •S402AB

RC229 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Jeffrey C Weinreb, MD *
Emanuel Kanal, MD *

LEARNING OBJECTIVES
1) Recognize a spectrum of common MR safety issues and regulations. 2) Assess the benefits and limitations of ferromagnetic detector technology. 3) Formulate policies for contrast administration and MR imaging of pregnant patients. 4) Compare current approaches to MR scanning of patients with pacemakers and other implanted cardiac devices.

Technologies for Creating Educational Content and Teaching Files

Monday, 08:30 AM - 10:00 AM •S102D

RC230 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Kitt Shaffer, MD,PhD

LEARNING OBJECTIVES
1) Identify techniques to incorporate mobile technology into your teaching program. 2) Appraise your current teaching practices in light of the new pedagogical approaches introduced in the lecture.

Master Class in Musculoskeletal Ultrasound (How-to Workshop)

Monday, 08:30 AM - 10:00 AM •E258
**Learning Objectives**

1. Recognize and identify pitfalls of scanning that lead to false positive or false negative musculoskeletal ultrasound results.
2. Perform skills for scanning difficult patients.
3. Follow rigorous protocols for the examination of different anatomic regions.
4. Position patients for more complicated musculoskeletal ultrasound examinations.
5. Recognize and integrate the importance of tissue movement in judging the functionality of the extremities.

**Abstract**

Using CT images acquired at different dose levels, radiologists will learn about general image quality metrics, such as image noise, sharpness, contrast, texture, and artifacts. In addition, they will learn from images, how dose and different scan parameters affect these image quality metrics. In order to accomplish this, radiologists will scroll through clinical cases at different dose points in different body regions. Next, the radiologists will learn about the specific effects of dose on lesion detection and appearance. In this section, radiologists will go through multiple series of CT images at different dose levels to assess the effect of changing dose on specific lesion and image appearance for specific lesion types. They will be asked to perform a directed search for structures and lesions, some of which will exist and others will not exist in the provided datasets. At the end of each case, they will get to see the specific example template protocol for at least two scanner vendors. This course will help radiologists understand the need for specific clinical indication and size driven protocols.

**Learning Objectives**

1. Visual impression of general image quality parameters such as image noise, texture, sharpness and artifacts in CT.
2. Image guided tour on effects of different scan parameters on general image quality metrics.
3. Image based display of effects of different scan parameters on appearance of specific lesion subtypes in adult and pediatric body CT examinations.

**CT Dose Reduction: Diagnostic Information, Image Quality and CT Radiation Dose (How-to Workshop)**

**Monday, 08:30 AM - 10:00 AM • E261**

**Learning Objectives**

1. View learning objectives under main course title.

**Abstract**

Using CT images acquired at different dose levels, radiologists will learn about general image quality metrics, such as image noise, sharpness, contrast, texture, and artifacts. In addition, they will learn from images, how dose and different scan parameters affect these image quality metrics. In order to accomplish this, radiologists will scroll through clinical cases at different dose points in different body regions. Next, the radiologists will learn about the specific effects of dose on lesion detection and appearance. In this section, radiologists will go through multiple series of CT images at different dose levels to assess the effect of changing dose on specific lesion and image appearance for specific lesion types. They will be asked to perform a directed search for structures and lesions, some of which will exist and others will not exist in the provided datasets. At the end of each case, they will get to see the specific example template protocol for at least two scanner vendors. This course will help radiologists understand the need for specific clinical indication and size driven protocols.

**Learning Objectives**

1. View learning objectives under main course title.
LEARNING OBJECTIVES
1) Describe the equipment needed for ultrasound guided interventional breast procedures. 2) Review the basic principles of ultrasound guidance and performance of minimally invasive breast procedures. 3) Practice hands-on technique for ultrasound guided breast interventional procedures.

ABSTRACT
The session will begin with a description of what a workflow engine is, and how it compares with other technologies used in imaging departments. We will then attempt to create a simple workflow, deploy it, and then run it. At the end of the session, attendees should be familiar with the strengths and weaknesses of workflow engines, and how they complement existing systems in an imaging department.

THe session will begin with a description of what a workflow engine is, and how it compares with other technologies used in imaging departments. We will then attempt to create a simple workflow, deploy it, and then run it. At the end of the session, attendees should be familiar with the strengths and weaknesses of workflow engines, and how they complement existing systems in an imaging department.

LEARNING OBJECTIVES
1) Become familiar with workflow engine technology and how it relates to databases and imaging systems. 2) Attempt to build a workflow for an imaging task using a graphical workflow builder and workflow engine.

Abstract
In this hands-on session, attendees will be given the chance to observe and then operate a workflow engine that has been adapted to medical imaging tasks.

Breast MRI at 7 Tesla: Image Evaluation and Comparison to 3 Tesla

RC252 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Gary J Whitman, MD *
Annamaria Wilhelm, MD *
Richard M Chesbrough, MD *
Michael N Linver, MD *
Paula B Gordon, MD *
Stamatia V Destounis, MD
Anna I Holbrook, MD
Alice S Rim, MD
Aida F Cossi, MD
Eren D Yeh, MD
Gary W Swenson, MD
Catherine W Piccoli, MD *
Michael P McNamara, MD *
Selim Carkaci, MD
Jean M Seely, MD
Phan T Huynh, MD *
H. Carisa Le-Petross, MD
Basak E Dogan, MD
Jay A Baker, MD *
Tanya W Stephens, MD
Jiyon Lee, MD

LEARNING OBJECTIVES
1) To describe the technical elements needed to perform high-quality breast MRI. 2) To describe and illustrate the pulse sequences needed for high-quality breast MRI. 3) To describe and illustrate the importance of simultaneously achieving high in-plane spatial resolution, thin slices, adequate temporal resolution, adequate signal-to-noise ratios, and full coverage of both breasts in breast MRI. 4) To show examples of high-quality and sub-standard breast MRI exams.

Purpose
To evaluate the image quality of T1-weighted fat suppressed breast MRI at 7T, with 3T images in the same subjects serving as a baseline reference.

Method and Materials
3D T1w images were acquired in 17 subjects using a bilateral transmit-receive coil and adiabatic inversion-based fat suppression (FS) at 7T, and a seven channel receive array and saturation-based FS at 3T. Images were qualitatively graded on a five-point scale by two radiologists and quantitatively assessed through fibroglandular/fat contrast, and signal uniformity measurements. Acquisition time and voxel size for the four unilateral sequences were: 1. 7T standard resolution, 119s, 1.1x1.1x1.6mm; 2. 7T high resolution, 390s, 0.6mm isotropic; 3. 3T standard resolution, 71s, 1.1x1.1x1.6mm; 4. 3T high resolution, 324s, 0.6mm isotropic.

Results
Image quality scores at 7T and 3T were similar (4.3 at 7T vs 4.1 at 3T, p=0.27) in standard-resolution images, indicating that breast imaging with clinical protocol parameters can be performed with high image quality at 7T. The 7T SNR advantage was underscored in high-resolution images, where image quality was significantly greater than at 3T (4.2 at 7T vs 3.1 at 3T, p<0.05).
CLINICAL RELEVANCE/APPLICATION

High breast image quality and uniformity was achieved with clinical parameters at 7T. 7T SNR improves delineation of small structures that may be beneficial for lesion classification.

VSBR21-03 • Determining Breast Cancer Grade with 3T-TWIST MRI

Roel D Mus MD (Presenter); Ritse M Mann MD, PhD ; Jelle O Barentsz MD, PhD; Peter Bult MD, PhD; Nico Karssemeijer PhD *; Bram Platel PhD

PURPOSE

To assess the correlation between time to enhancement (TTE) and tumor grade using an ultrafast DCE MR Mammography protocol.

METHOD AND MATERIALS

1031 patients underwent contrast enhanced breast MRI at 3.0T (Siemens, Magnetom Trio and Skyra) using a 16 channel bilateral breast coil. A bi-temporal protocol was employed, interleaving a TWIST (Time-resolved angiography With Stochastic Trajectories) sequence during and immediately after IV administration of 0.1mmol/kg Gd-DOTA (20 time points, spatial resolution 1° x 0.9° x 2.5 mm, temporal resolution 4.32 seconds). 102 consecutive patients with invasive ductal carcinoma (IDC) and invasive lobular carcinoma (ILC) were included in this analysis. The TTE was determined on maximum intensity projections from the TWIST acquisitions as displayed on a dedicated DynaCAD breast MRI workstation (InVivo). TTE was defined as “the timepoint where the lesion started to enhance” minus “the timepoint where the aorta started to enhance” for different patient history and grade categories. The TTE was calculated and TTE distribution was compared using one way anova.

RESULTS

Mode TTE was 4.3 sec for 32 grade III IDC, 8.6 sec for 40 grade II IDC and 12.9 sec for 12 grade I IDC. There was no significant difference in TTE between IDC and ILC (p=0.465). In IDC TTE distribution was significantly different between tumor grade categories (p<0.05). TTE provides a non-invasive method to predict histological grade. Lesions that enhance very rapidly are more likely to enhance than lesions that enhance relatively Slow.

CLINICAL RELEVANCE/APPLICATION

Breast cancer therapy is dictated by pathological features of the tumor with the poorest prognosis. Because pathology is subject to sampling errors, TTE can be used to ascertain sampling of the most relevant part of the tumor.

VSBR21-04 • Dynamic Contrast-enhanced (DCE) Breast MR of DCIS: A Comparison of Same-patient Quantitative Features at 3T and 1.5T

Amie Y Lee MD (Presenter); Habib Rahbar MD; Wendy B Demartini MD *; Savannah C Partridge PhD *; Matthew L Olson; Sue Peacock MSC; Constance D Lehman MD, PhD *

PURPOSE

Breast MR is increasingly performed at 3T, which is hypothesized to improve lesion characterization over 1.5T due to higher spatial and contrast resolution. More accurate depiction of extent with 3T may be especially important for DCIS as surgical re-excision is often required due to imaging-occult components. Our purpose was to assess same patient MR features of DCIS at 3T and 1.5T.

METHOD AND MATERIALS

This IRB-approved prospective study included 20 patients (6/2010 to 5/2012) with newly diagnosed pure DCIS who underwent preoperative MR at both 3T and 1.5T. Both examinations had 3D T1-weighted fast gradient echo protocols with one pre- and three post-contrast series of approximately 180 seconds each. 3T (Philips Achieva TX) spatial resolution was 0.5 x 0.5 x 0.65 mm and 1.5T (GE Lx) was 0.85 x 0.85 x 1.6 mm. 3T and 1.5T MR examinations were interpreted by different radiologists blinded to results of the second MR. Radiologist-assessed maximum lesion sizes were recorded, and whole-lesion kinetic synopses were computed using in-house automated software for 90 seconds initial and 450 seconds delayed phase enhancement. Sizes at 3T and 1.5T were correlated to final surgical pathology and differences in MR kinetics at 3T and 1.5T were evaluated (Spearman correlation, Wilcoxon signed-rank test).

RESULTS

DCIS mean sizes were 18.2 mm (0-67) on 3T, 18.2 mm (0-60) on 1.5T, and 14.1 mm (0-55) on pathology. Size correlation between imaging and pathology was higher for 3T (0.66, p=0.002), mean difference 7.5 (0-35) mm, compared to 1.5T (0.36, p=0.13), mean difference 11.5 (0-50) mm. Initial phase mean peak and % rapid enhancement were higher at 3T, but overall there were no statistically significant differences in initial or delayed phase kinetics at 3T compared to 1.5T, with mean peak enhancement 173.8 vs. 118.2 (p = 0.08), % medium 68.7 vs. 80.2 (p = 0.12), % rapid 33.3 vs. 19.8 (p = 0.12), % persistent 54.6 vs. 62.8 (p = 0.29), % plateau 23.2 vs. 21.0 (p = 0.05) and % washout 22.2 vs.16.1 (p = 0.22).

CONCLUSION

In patients with newly diagnosed DCIS, lesion size at 3T MR had higher correlation than 1.5T with final pathology. Initial and delayed phase kinetics did not differ significantly between field strengths.

CLINICAL RELEVANCE/APPLICATION

3T may be more accurate than 1.5T in preoperative assessment of DCIS extent. Despite a hypothesized improved contrast resolution at 3T, DCIS kinetics did not differ significantly between 3T and 1.5T.

VSBR21-05 • Time-resolved Gadolinium-enhanced Imaging of the Breast

Hanan Sherif MD (Presenter); Ahmed-Emad Mahfouz MD; Amal Alobadly MD; Issam Albozom MD

PURPOSE

To evaluate the very early onset of lesion enhancement on time-resolved ultrafast gadolinium-enhanced MR imaging as a differentiating sign between benign and malignant breast lesions.

METHOD AND MATERIALS

This IRB-approved prospective study included 20 patients (6/2010 to 5/2012) with newly diagnosed pure DCIS who underwent preoperative MR at both 3T and 1.5T. Both examinations had 3D T1-weighted fast gradient echo protocols with one pre- and three post-contrast series of approximately 180 seconds each. 3T (Philips Achieva TX) spatial resolution was 0.5 x 0.5 x 0.65 mm and 1.5T (GE Lx) was 0.85 x 0.85 x 1.6 mm. 3T and 1.5T MR examinations were interpreted by different radiologists blinded to results of the second MR. Radiologist-assessed maximum lesion sizes were recorded, and whole-lesion kinetic synopses were computed using in-house automated software for 90 seconds initial and 450 seconds delayed phase enhancement. Sizes at 3T and 1.5T were correlated to final surgical pathology and differences in MR kinetics at 3T and 1.5T were evaluated (Spearman correlation, Wilcoxon signed-rank test).

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CONCLUSION

In patients with newly diagnosed DCIS, lesion size at 3T MR had higher correlation than 1.5T with final pathology. Initial and delayed phase kinetics did not differ significantly between field strengths.

CLINICAL RELEVANCE/APPLICATION

3T may be more accurate than 1.5T in preoperative assessment of DCIS extent. Despite a hypothesized improved contrast resolution at 3T, DCIS kinetics did not differ significantly between 3T and 1.5T.

VSBR21-06 • Sensitivity of an Abridged Breast MRI Protocol to Detect a Known Breast Cancer

Laura Heacock MS, MD (Presenter); Amy N Melsaether MD; Kristine M Pyszarenko MD; James S Babb PhD; Hildegard B Toth MD; Linda Moy MD

PURPOSE

A shorter MRI may be cheaper, better tolerated by patients and faster for the radiologist to interpret. These changes may lead to wider access to Breast MRI. We evaluated the ability of an abridged MRI protocol to detect a known breast cancer.

METHOD AND MATERIALS

An IRB approved retrospective review of 100 breast MRI exams at 3T; with a unifocal biopsy-proven carcinoma was performed by two radiologists. Initially they evaluated the precontrast T1, first post-contrast T1 and first subtraction T1 post-contrast images blinded to the clinical history and prior films. Then they...
assessed the images given the above information and once more with the addition of the pre-contrast 1/2 images. The scan time for the 3 T1-sequences was 4 mins; the scan time for the T2-sequence was 4 mins. The time to interpret the study and the confidence score was assessed for each study. Comparison was made to the original diagnostic interpretation.

RESULTS
Of 100 cancers, 58 were masses, 25 were nonmass enhancement (NME) and 17 were categorized in the original report as both masses and NME. Thirty-two were invasive carcinomas, 29 were ductal carcinoma in situ (DCIS), and 9 were invasive carcinomas and DCIS. The mean size was 1.8 cm (range 0.6 – 10 cm). The sensitivity for both readers was 98% (CI 93.4% - 99.6%). Mean time for interpretation for reader 1 (R1) was 24secs (range 1 – 55sec.s) for reader 2 (R2) was 14secs (range 3-75secs). R1 took an additional 10 secs to read and correlate the T2 image and R2 took 4.2 secs. R1 showed a significant increase in confidence (p<0.1) with the addition of either priors or T2 images. There was no significant correlation (r) between lesion size and either evaluation time (r[10.5] or reader confidence (r[0.35]). Also, there was no significant difference (p>0.25) between lesion types in terms of evaluation time or reader confidence. Two cases of DCIS were missed; both were seen on the 2nd post-contrast scan.

CONCLUSION
An abridged protocol has a high sensitivity for detecting known DCIS and invasive carcinoma and significantly reduced the interpretation time.

CLINICAL RELEVANCE/APPLICATION
Almost all cancers are detected with an abridged MRI protocol. The specificity and recall rates of a shorter exam should be examined to determine if this change may lead to wider access to breast MRI.

VSBR21-07 • DCE MRI of the Breast: The Effect of Breast Compression on the Diagnosis and Staging of Breast Cancer
Riham H El Khouli MD, PhD (Presenter) ; Katarzyna J Macura MD, PhD * ; Ihab R Kamel MD, PhD * ; David A Bluemke MD, PhD * ; Michael A Jacobs PhD

PURPOSE
Breast compression stabilizes the breast to reduce motion and is used in conjunction with MRI guided breast biopsy. Our study aim was to evaluate the effect of breast compression on A) enhancement of both breast cancer and glandular tissue (GT) B) DCE MRI performance

METHOD AND MATERIALS
For this IRB approved retrospective study, we reviewed 425/210 studies/cases. Each patient had 2 or more MRI studies, 1 with and at least 1 without breast compression. We included 302 studies in total divided in 3 groups:1) Biopsy proven breast cancer (102/59 studies/lesions), 2) Breast lesion detected on one MRI study and not the other (18/9 studies/lesions), 3) Cases with 1 study with unilateral compression (for GT enhancement difference, 90), and a noncompressed study (control, 92). %Enhancement difference between noncompressed and compressed studies for early and delayed post-contrast phases was calculated. Breast density, type of lesion (mass versus NMLE), lesion size, %Compression and kinetic curve type were evaluated

RESULTS
%Compression varied between 0 and 61%. Among 59 cancer cases, 39% were DCIS and 61% invasive. %Enhancement was higher in noncompressed versus compressed studies in both early and delayed phases (p-value 0.1)

CONCLUSION
Breast compression affected cancer detection, lesion size, and DCE MRI interpretation and performance. We recommend limiting the application of breast compression except when clinically necessary

CLINICAL RELEVANCE/APPLICATION
Many breast coils are capable of applying compression with a patient dependent degree. Compression significantly affected enhancement characteristics of breast cancer and DCE MRI diagnostic accuracy

VSBR21-08 • Diffusion-weighted Imaging and Advanced Techniques
Savannah C Partridge PhD (Presenter) *

LEARNING OBJECTIVES
1) Understand the physical basis of diffusion imaging and methods used to acquire diffusion-weighted data. 2) Understand the clinical applications of diffusion-weighted imaging for cancer diagnosis and assessment of response to therapy. 3) Be familiar with the challenges of breast diffusion imaging and technical considerations for protocol optimization. 4) Future directions.

ABSTRACT

VSBR21-09 • Diffusion Weighted Imaging and Dynamic Contrast Enhanced Imaging in Breast Cancer at 7 Tesla
Stephan Gruber MD (Presenter) ; Olgica Zaric; Katja Pinker-Domenig MD; Lenka Minarikova; Thomas H Helbich MD *; Siegfried Trattning MD; Pascal A Baltzer MD; Wolfgang Bogner MSC

PURPOSE
To assess the feasibility and diagnostic value of diffusion weighted imaging (DWI) in addition to contrast-enhanced imaging (DCE-MRI) with high spatial and/or temporal resolution in breast cancer at 7 Tesla. DWI has been shown to add important diagnostic value at lower field strengths (G)

METHOD AND MATERIALS
Both DWI and DCE-MRI provided excellent data quality with sub-millimeter spatial resolution approving great feasibility of these techniques in morphological evaluations. Based on the ADC threshold of 1.35x10-3mm²/s, DWI showed a 100% sensitivity and 100% specificity to distinguish between malignant and benign lesions. DCE-MRI, based on contrast enhancement kinetics and morphologic features, had a sensitivity and a specificity of 100%, 96%, respectively in breast lesions diagnostics.

CONCLUSION
This study shows that DWI and DCE-MRI at 7T are feasible in patients with breast cancer. In our pilot data we could demonstrate high sensitivity and specificity at 7T for both methods. At 7T, DWI automatically provides high-quality T2-weighted reference images (b=0 s/mm²) that can replace additional T2-weighted MRI and, thereby, save valuable measurement time.

CLINICAL RELEVANCE/APPLICATION
Many breast coils are capable of applying compression with a patient dependent degree. Compression significantly affected enhancement characteristics of breast cancer and DCE MRI diagnostic accuracy

VSBR21-10 • Apparent Diffusion Coefficient in Invasive Ductal Breast Carcinoma: Correlation with the Tumor-stroma Ratio of Breast Cancer and Detailed Histologic Features
Eun Sook Ko MD (Presenter) ; Boo-Kyung Han MD, PhD ; Eun Young Ko MD, PhD ; Jung Hee Shin MD ; Soo Yeon Hahn MD

PURPOSE
The purpose of this study was to determine whether ADC values vary according to tumor-stroma ratio, dominant stroma type or presence of central fibrosis.

METHOD AND MATERIALS
61 patients with invasive ductal carcinoma not otherwise specified (IDC NOS) who underwent breast MRI with diffusion-weighted imaging (DWI) were included in this study. Apparent diffusion coefficient (ADC) values of lesions were measured. Two pathologists evaluated the tumor-stroma ratio, dominant stroma type (collagen, fibroblast, lymphocyte), and central fibrosis. Detectability on DWI was compared according to tumor-stroma ratio. Mean ADC values were compared with tumor-stroma ratio, dominant stroma type, presence of central scar. Multiple linear regression analysis was also performed to determine variables independently associated with ADC values.

RESULTS
On DWI, detectability was not significantly different between two groups (P = 0.244). ADC values were significantly lower in stroma-poor group (P < 0.001). There was statistically significant difference of mean ADC values according to dominant stroma type (P = 0.021). Mean ADC values in collagen dominant type were lower than fibroblast dominant or lymphocyte dominant type. At multiple linear regression analysis, tumor-stroma ratio (R = 0.007), tumor size (P = 0.007) and dominant stroma type (fibroblast dominant, P = 0.029) were independently correlated with ADC values.

CONCLUSION
ADC values showed significant difference according to tumor-stroma ratio and dominant stroma type.

CLINICAL RELEVANCE/APPLICATION
Tumor-stroma ratio is known as independent prognostic factor of breast carcinoma. We hypothesized that these histopathologic features affect ADC values.
Breast Cancer

1H MRS could potentially aid in predicting risk of relapse in patients diagnosed with HER2-positive breast cancer. More studies are needed to assess the role of MRS in breast cancer prognostic.

CONCLUSION

CLINICAL RELEVANCE/APPLICATION

Due to equal sensitivity, ueMRI has potential to be applied as a screening sequence before ceMRI. Further studies are needed in order to clarify whether it could be a cost effective alternative.

VSB21-12 • Is Unenhanced Breast MRI Using Diffusion Weighted Imaging at 3 Tesla an Alternative to Dynamic Contrast Enhanced Breast MRI?

Pascal A Baltzer MD (Presenter); Hubert Bickel MD; Wolfgang Bogner MSC; Thomas H Heibich MD *; Stephan Gruber MD; Katja Pinker-Domenig MD

PURPOSE

Contrast enhanced breast MRI (ceMRI) is the most sensitive method for detection of breast cancer. Limiting factors for a broader availability of this method are costs caused by magnet time and the contrast agent. Diffusion Weighted Imaging (DWI) is increasingly used in clinical practice. It has shown its value for lesion detection and differentiation and has been used together with T2w TSE images as an unenhanced alternative (ueMRI) to ceMRI in mass lesions. The purpose of this study was to apply DWI only to a non-selected group of MRI patients referred during routine clinical practice and to compare the results to ceMRI in a multi-reader study.

METHOD AND MATERIALS

Patients from routine breast MRI at 3 Tesla referred due to conventional BI-RADS 3-5 ratings were eligible for this retrospective study and retrieved from our prospectively populated database. No dropouts due to incomplete examinations occurred. Two radiologists with >5 years experience in breast MRI (O1, O2) independently read uemRI and ceMRI examinations and gave them a BI-RADS rating (1=no lesion, 2=benign lesion, 3=probably benign lesion, 4=suspected malignancy, 5= definite malignancy). Furthermore, lesion size, ADC values and BI-RADS criteria were assessed. Reference standard for radiological ratings was histopathology or imaging follow up. Statistical analysis included Receiver Operating Characteristics (ROC) analysis and kappa statistics.

RESULTS

67 malignant and 56 benign findings were identified in 119 patients (mean age 54±/14y). Area under the ROC curve was 0.901 (O1) and 0.905 (O2) for ceMRI and 0.882 (O1) and 0.854 (O2) for uemRI. The difference between observers and techniques were not statistically significant (P>0.05). However, specificity was 75% (O1) and 71% (O2) in uemRI and 80% (O1) and 77% (O2) in ceMRI. Kappa agreement was high with 0.968 (ceMRI) and 0.893 (uemRI).

CONCLUSION

Unenhanced MRI of the breast is feasible in clinical practice. While invasive cancers can be detected with equal sensitivity compared to ceMRI, uemRI showed lower specificity and reproducibility.

CLINICAL RELEVANCE/APPLICATION

Due to equal sensitivity, uemRI has potential to be applied as a screening sequence before ceMRI. Further studies are needed in order to clarify whether it could be a cost effective alternative.

VSB21-13 • MR Spectroscopy

Michael S Middleton MD, PhD (Presenter) *

LEARNING OBJECTIVES

1) Understand spectroscopy techniques. 2) Learn the biochemical basis for breast spectroscopy. 3) Interpret spectroscopy. 4) Understand potential applications of breast spectroscopy.

ABSTRACT

VSB21-14 • Role of 1H MRS Metabolic Profiling in Assessing Breast Cancer Recurrence

Dania Daye BS (Presenter); Suzanne L Wehrli PhD; Dhruv Pant; Christopher Sterner; Mitchell D Schnall MD, PhD; Lewis Chodosh MD, PhD

PURPOSE

While dysregulated metabolism has long been recognized as a key feature of cancer development, the metabolic changes accompanying cancer recurrence are largely unexplored. The goal of this study was to identify key metabolic differences between primary and recurrent mammary tumors using 1H MRS in combination with expression analysis of key metabolic enzymes and to assess the role of those findings in predicting human breast cancer recurrence.

METHOD AND MATERIALS

Our lab has developed an inducible bitransgenic mouse model which accurately reproduces key features of the natural history of human breast cancer progression; primary tumor development, tumor dormancy and recurrence. 9 primary and 9 recurrent mammary gland tumors were dissected from a cohort of 18 MMTV-rtTa;TetO-NeuNT mice in which Her2/neu is overexpressed specifically in the mammary glands. 1H MRS was performed at 400 MHz on a Bruker.

RESULTS

Recurrent mammary tumors displayed higher levels of lactate (p=0.009) and glycine (p=0.001), lower levels of succinate (p=0.009) and phosphocholine (PC) (p=0.019), and a higher glutamate:glutamine ratio (glu/gln) (p

CONCLUSION

Our results suggest that tumor metabolism evolves during breast cancer progression and raise the possibility that tumor metabolic changes may be useful for predicting clinical outcomes in breast cancer patients.

CLINICAL RELEVANCE/APPLICATION

1H MRS could potentially aid in predicting risk of relapse in patients diagnosed with HER2-positive breast cancer. More studies are needed to assess the role of MRS in breast cancer prognostic.

VSB21-15 • Three Dimensional MR Spectroscopic Imaging Using DIXON Imaging for Water Content Correction and Improved Cho Quantification in Breast Cancer

Stephan Gruber MD (Presenter); Lenka Minarikova; Katja Pinker-Domenig MD; Thomas H Heibich MD *; Wolfgang Bogner MSC; Siegfried Trattnig MD; Marek Chmelik MS

PURPOSE

Three Dimensional MR Spectroscopic Imaging Using DIXON Imaging for Water Content Correction and Improved Cho Quantification in Breast Cancer

1H MRS could potentially aid in predicting risk of relapse in patients diagnosed with HER2-positive breast cancer. More studies are needed to assess the role of MRS in breast cancer prognostic.
Fat contamination in breast tissue alters measured Cho SNR and consequently, the estimated Cho concentration measured by three dimensional MR spectroscopy (3D-MRSI). We propose a semi-quantitative Cho signal estimation with additional correction to tissue water content for each voxel, using information extracted from Dixon imaging.

METHOD AND MATERIALS

RESULTS

Average variance of initial Cho signal amplitude from selected voxels was 16.1 and 5.72 before and after correction. In vivo results showed a variance for Cho SNR of 2.05 and 0.256 before and after correction.

CONCLUSION

Variations of Cho concentrations in the phantom and in vivo were reduced after correction for fat/water content by a factor of ~3 and ~8, respectively. Furthermore, the influence of the CSI matrix position on Cho SNR in patient’s data is minimized. Our method is able to compensate for deviations in matrix positioning (i.e. partial volume effects), which improves quantification of Cho. In this study we have shown that information deriving from Dixon images can be used as a partial water reference for Cho SNR in 3D-MRSI.

CLINICAL RELEVANCE/APPLICATION

Semi-quantitative 3D-MRSI based on fat/water-Dixon imaging reduces the variance of Cho signal. This is important for therapy monitoring and to distinguish between malignant and benign lesions.

VSBR21-16 • Quantitative Imaging of Breast Cancer: Association between Receptor Status, 18FDG-PET and 3 Tesla MRI Using DWI and 3D-MR-spectroscopy

Katja Pinker-Domenig MD (Presenter); Pascal A Baltzer MD; Heinrich Magometschnigg; Michael Weber; Wolfgang Bogner MSC; Stephan Gruber MD; Georgios Karanikas MD; Zsusanna Bago-Horvath; Thomas H Helbich MD*

PURPOSE

Expression of specific molecular markers such as estrogen receptor (ER), progesterone receptor (PR), and HER2 status assessed by invasive tissue sampling, has direct prognostic and therapeutic implications in breast cancer (BC) patient management. The aim of this study was to determine whether correlations exist between molecular markers such maximum standardized up-take value (SUVmax) with 18FDG breast PET-CT or apparent diffusion coefficient (ADC) with diffusion weighted imaging and signal-to-noise ratio with 1H MR spectroscopy (MRSI) of the primary breast cancer lesions and IHC derived receptor status.

METHOD AND MATERIALS

In this IRB approved prospective study 249 patients with primary BC were included. Before surgery all patients underwent 3T MRI including DWI with ADC measurements in all patients. Cho-SNR obtained by 3D-MRSI was available in 62 cancers. 134 patients underwent 18FDG breast PET-CT and SUVmax of tumors was calculated. Standard immunochemistry was performed on a surgical specimen. Appropriate statistical tests were used to test for possible associations among ER, PR, HER2 and imaging biomarkers.

RESULTS

CONCLUSION

Assessment of the non-invasive imaging biomarker SUVmax with 18FDG breast PET-CT can provide valuable information about the state of ER, PR, and HER2 receptors of BC.

VSBR21-17 • MR Spectroscopy of the Breast at 3 Tesla: A Clinical Experience

Stefania Montemezzi MD (Presenter); Francesca Caumo MD; Ilaria Baglio; Lucia Camera; Gabriele Miliado; Carlo Cavedon DPhil

PURPOSE

The study was aimed at improving the feasibility of total choline (tCho) detection in breast lesions and at estimating sensitivity and specificity of breast 3T-MR spectroscopy (MRS) to aid MR-based diagnosis of malignancy.

METHOD AND MATERIALS

141 patients (157 lesions, range 0.05-108.86 cm3, mean 6.62 cm3) were enrolled (21-84 yrs, mean 58.5 yrs). All patients had breast abnormalities on mammography or sonography, confirmed by cytology and/or micro-biopsy. Single-voxel MRS was performed by means of a Philips Achieva STx 3.0T scanner. First-order pencil-beam shimming was used on a 15.6 cm3 volume centred on the region of interest (ROI), which ranged 0.24-8.0 cm3 (mean 1.33 cm3). MRS used TE=135ms, TR=3000ms, 128 samples, water (window 140Hz) and fat (SPAIR, offset 80Hz) suppression. When possible, MRS was performed before contrast agent injection and repeated thereafter. Pre-saturation was used to suppress signal from nearby regions. Local field homogeneity was evaluated by means of the FWHM of the unsuppressed water peak. A threshold was placed at 45Hz, above which MRS was not performed due to insufficient field homogeneity. tCho was estimated by means of the signal-to-noise ratio (SNR) of the peak at 3.2 ppm.

RESULTS

MRS was feasible in 89.5% of the lesions using pencil-beam shimming (mean FWHM of water peak 34Hz), compared to 54.2% (29Hz) when standard iterative shimming was used (first 80 patients). 59 lesions (52.2% of reliable spectra) showed detectable tCho (SNR 1.4-53.7, mean 8.5). Comparison with available histopathological examination of surgical specimens (or micro-biopsy for benign lesions) showed 87.5% sensitivity and 86.0% specificity. No correlation between lesion volume and SNR of the tCho peak was observed. Malignant lesions that showed no tCho had a volume of 0.7cc or less.

CONCLUSION

High-field MR spectroscopy is expected to improve SNR of the investigated metabolites, however field homogeneity is more difficult to achieve compared to 1.5T. The adjustment of the shimming process improved the fraction of cases for which high-field MRS resulted feasible. Further research is warranted to improve choline detectability and to confirm the observed sensitivity and specificity of the method.

CLINICAL RELEVANCE/APPLICATION

MRS at 3T could improve the specificity of breast MR. Improving its feasibility is a key factor, however the possible correlation between tCho concentration and malignancy needs further investigation.

Emergency Radiology Series: Advanced Concepts in Imaging of Trauma

Monday, 08:30 AM - 12:00 PM • E350

VSBR21-01 • Penetrating Wounds to the Torso: Evaluation with Multi-Detector CT

Felipe Munera MD (Presenter)

LEARNING OBJECTIVES

1) To discuss the role of MDCT in patients with penetrating torso trauma. 2) Describe MDCT protocol for penetrating torso injuries. 3) Review the MDCT findings of selected penetrating abdominal injuries.

ABSTRACT

Penetrating injuries account for a large percentage of visits to emergency departments and trauma centers worldwide. Emergency laparotomy is the accepted standard of care in patients with a penetrating torso injury who are not hemodynamically stable and have a clinical indication for exploratory laparotomy, such as evidence of hemorrhage or gastrointestinal bleeding. Continuous advances in technology have made MDCT an indispensable tool in the evaluation of many patients who are hemodynamically stable, but do not have clinical indication for exploratory laparotomy, and are candidates for conservative treatment. Multidetector CT may depict the trajectory of a penetrating injury and help determine what type of intervention is necessary on the basis of findings such as active arterial extravasation and major vascular, hollow viscus, or diaphragmatic injuries. Because multidetector CT plays an increasing role in the evaluation of patients with penetrating wounds to the torso, the radiologists who interpret these studies should be familiar with the CT findings that mandate intervention.

VSBR21-02 • Value of Contrast-enhanced CT in Detecting Active Hemorrhage Associated to Major Pelvic Trauma and Guiding Angiographic
Purpose
In patients with major abdominal trauma, pelvic fractures associated to active hemorrhage are a common cause of hemodynamic instability. Therapeutic options depend on source and entity of bleeding: arterial hemorrhage requires angiographic embolization; the venous one or that from bone ends is treated conservatively with pelvic packing or external fixator. Our purpose is to establish the role of CT in the detection of active hemorrhage after major pelvic trauma compared to angiography.

Method and Materials
Between 9/2010 and 12/2012, 773 patients with major trauma underwent a CT examination in emergency department. Pelvic fractures were present in 180/773 patients. In all patient affected by pelvic fracture the presence of pelvic hematoma, intra- or retroperitoneal and/or in the soft tissue (glutes, adductors muscles), was searched. Authors look also for the presence of active contrast blush during the early arterial, the portal phase and near the stumps of bone fracture. Angiography was performed in 57 patients after CT detection of active bleeding or in case of not explained hemodynamic instability.

Results
Among 180 patients with pelvic injury, 163 showed a pelvic hematoma; 27 a soft tissue hematoma. At CT active hemorrhage was identified in 47/180 cases (29 bleedings were visible in the arterial phase; 9 in the venous one; 2 in both of them; 11 near bone ends). All 47 patients underwent arteriography who showed hemorrhage in 22/29 cases of arterial bleeding, 3/9 case of venous phase bleeding, 2/11 cases of bleeding near bone ends. 20 patients underwent arteriography without evidence of active bleeding at CT; 4/20 showed active extravasation of contrast material. 2/20 underwent internal iliac embolization even in absence of extravasation.

Conclusion
CT has high sensitivity to detect active bleeding and to establish its origin, thus guiding the optimal therapeutic option. Our experience suggest to perform arteriography even in case of bleeding from bone ends or from venous origin, and when there is an hemodynamic instability without relevant CT findings.

Clinical Relevance/Application
Our study highlights a new flow chart to follow in bleeding trauma of the pelvis in the polytrauma patient.

VSER21-03 • Trauma Whole Body MDCT: An Assessment of Image Quality in Conventional Dual Phase and Modified Triphasic Injection
Raghavendra Kamanahalli MD, FRCR; Nishat Bharwani MBBS; Elizabeth A Dick MD, FRCR; Shirley Fetherston BS; Erika Kashef FRCR

(Presenter) *

Purpose
To compare image quality of conventional arterial and portal venous (PV) phase CT with 2 modified triphasic injection protocols in trauma patients.

Method and Materials
60 whole body trauma MDCT were included. 20 consecutive MDCT were reviewed in each group. Group A arterial (30s) and PV (60s) phase acquisitions; Group B 'triphasic' contrast injection with acquisition at 60s and Group C 'modified triphasic' injection with acquisition at 70s delay. All patients were imaged on a 256-slice scanner using IV Iomeron 400.

Images were analysed for arterial, venous and parenchymal attenuation profiles with regions of interest in the major arteries, veins and solid abdominal organs.

A 5-point scoring system was used to assess image quality: excellent studies with optimal arterial, venous and parenchymal opacification scored 5 while studies scoring

Results
In 57 of 60 patients (95%) image quality was scored as good or excellent (=4). 1 study from each group scored 3, however all studies were considered to be of diagnostic quality.

With the exception of the common iliac arteries in group C (p=0.03), no statistically significant difference was demonstrated in the vascular attenuation using triphasic or conventional protocols. The average HU of the portal vein was significantly higher in group B and C (p=0.0001). Attenuation profiles in the solid abdominal viscera were significantly higher (p=0.002) using both triphasic protocols than with conventional protocols.

Triphasic injection scans at 60s delay provided better arterial opacification than at 70s with comparable venous and parenchymal opacification.

Conclusion
In polytrauma, comparable image quality can be achieved using a triphasic IV contrast injection protocol with single MDCT acquisition as with conventional trauma MDCT using arterial and PV phase acquisitions.

Clinical Relevance/Application
The use of a triphasic injection protocol with 256-slice MDCT results in dose reduction over conventional arterial followed by PV phase CT in polytrauma patients with no compromise in image quality.

VSER21-04 • Thoracic Spine Fractures in Patients with Minor Trauma: Is the Conventional X-ray Necessary?
Murat Karul MD (Presenter); Peter Bannas MD; Amelie Hoffmann; Bjorn P Schonnagel; Gerhard B Adam MD; Jin Yamamura MD

Purpose
To investigate the accuracy of biplane radiography in detection of thoracic spine fractures in patients (pts) with minor trauma using multidetector computed tomography (MDCT) as reference and to compare the mean effective dose of both techniques.

Method and Materials
107 consecutive pts (age 67±20y) with minor trauma and low to moderate back pain on physical examination were included retrospectively. All had undergone biplane radiography first, followed by MDCT in a time frame of 10 days because of aggravation of their symptoms. Contingency table was used for classification of screening test results. Both Chi-square test (72) and mean effective dose were used to compare diagnostic methods.

Results
MDCT revealed 77 fractures in 65/107 pts (60.7%), Biplane radiography was true positive in 32 pts (29.9%), false positive in 19 pts (17.8%), true negative in 23 pts (21.5%), and false negative in 33 pts (30.8%), showing a sensitivity of 49.2%, a specificity of 54.7%, a positive predictive value of 62.7%, a negative predictive value of 41.1%, and an accuracy of 51.4%. Most fractures were diagnosed in the thoracolumbar junction (39/77; 50.6%). None of the fractures missed on biplane radiography was unstable. Presence of a fracture on biplane radiography was highly statistical significant, if this was simultaneously proven by MDCT (2×7.6; p=0.01). Mean effective dose on biplane radiography was 0.7mSv, and on MDCT was 7.5mSv.

Conclusion
Sensitivity and specificity of biplane radiography in diagnosis of thoracic spine fractures in pts with minor trauma are low. The mean effective dose of MDCT was more than 10 times as high as on biplane radiography.

Clinical Relevance/Application
Considering the wide availability of MDCT that is usually necessary for taking significant therapeutic steps, indication for biplane radiography in minor trauma pts should be very restrictive.

VSER21-05 • Solid Organ Injury: What's New?
Kathirkamanathan Shanmuganathan MD (Presenter)

Learning Objectives
1) Demonstrate common and uncommon solid organ injuries. 2) Discuss the performance and utility of arterial phase imaging the solid organs. 3) Compare liver and splenic injury.

Abstract

VSER21-06 • Hyperdense Adrenal Glands on Contrast-enhanced CT Scans: Evaluation of the Clinical Impact in Polytrauma Patients
Julia Schek MD; Patric Kroepl MD; Janina Klasen; Philipp Heusch MD; Gerald Antoch MD *; Rotem S Lanzman MD (Presenter)

Purpose
The purpose of this study was to evaluate the clinical impact of hyperdense adrenal glands seen on contrast-enhanced CT scans of polytraumatized patients.

Method and Materials

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Clinical Relevance/Application

The presence of hyperdense adrenal glands on contrast-enhanced CT scans have a higher mortality rate as compared to patients with regular attenuation of the adrenal glands.

VLST21-07 • Can MDCT Features of Mesenteric Injuries Be Used to Predict the Presence of a Surgical Bowel Injury?

Scott D Steenburgh MD (Presenter); Matthew J Petersen MD

Purpose

The purpose of this study was to determine if 64 slice MDCT imaging features of blunt mesenteric injuries can be used to predict the presence of a surgical bowel injury.

Method and Materials

Two board certified emergency radiologists, blinded to clinical outcomes and surgical findings, independently reviewed each case. The size and number of each mesenteric injury, as well as the presence or absence of active mesenteric bleeding, bowel wall thickening, free fluid, extraluminal gas, mesenteric vessel termination, mesenteric vessel "beading", focal bowel wall defect, bowel wall perfusion abnormality, and bowel wall thickening >3mm were recorded. The radiologists subsequently assessed, based on the imaging findings, if they thought the patient had a surgical bowel injury requiring definitive therapy.

Results

A total of 131 patients with MDCT diagnosis of mesenteric injury were identified. Mean age was 48.7 years (range 18-86) and 66.4% (n=87) were male. Active bleeding was seen in 14.5% (n=19), bowel wall thickening in 92.3% (n=112) free fluid in 54.2% (n=71), mesenteric vessel termination in 10.7% (n=14), mesenteric vessel "beading" in 9.9% (n=13), focal bowel wall defect in 3.0% (n=4), and bowel wall perfusion abnormality in 12.2% (n=16) of patients. No patient had extraluminal or extraluminal gas. No patients received oral contrast medium per institutional trauma protocol. A total of 18 patients underwent laparotomy based on imaging findings and/or clinical exam. Surgical bowel injuries were confirmed in 15/18 patients (83.3%). The remaining 113 patients were successfully managed non-operatively with no delayed diagnosis of bowel injury with a mean follow up interval of 27 days (range 1-2012 days).

Active bleeding, free fluid and mesenteric vessel beading were more common in patients with surgical bowel injuries. The accuracy, sensitivity, specificity, PPV and NPV of 64 slice MDCT in predicting the presence of a surgical bowel injury were 74.8%, 80.8%, 74.4%, 28.6% and 96.6%, respectively.

Conclusion

MDCT has only modest accuracy and sensitivity for predicting the presence of surgical bowel injuries.

Clinical Relevance/Application

The diagnosis of surgical bowel injuries remains challenging despite 64-slice MDCT technology.

VLST21-08 • Qanda/Break

VLST21-09 • CT of Cardiac Trauma in the ED

Sanjeev Bhalla MD (Presenter)

Learning Objectives

1) Understand the spectrum of cardiac injury in the setting of blunt and penetrating trauma mainly on CT. The role of cardiac MR will also be discussed.

VLST21-10 • Radiological Findings and Severity of Injuries in Patients with Acute Alcohol Intoxication

Yuka Morita MD (Presenter); Taiki Nozaki MD; Jay Starkey MD; Masaki Matsusako MD, PhD; Hiroshi Yoshioka MD; Yukihsia Saita MD; Yoshinio Sato MD; Saya Horuchi MD; Makoto Goto; Takaharu Suzuki

Purpose

To review the radiological findings of fractures with acute alcohol intoxication and discuss their characteristic features.

Method and Materials

The institutional review board approved this retrospective study with a waiver of informed consent. A total of 1286 adult patients (median age 57.0 years, range 20-102 years; male 748 (58.2%), female 538 (41.8%)) who visited our emergency department (ED) and presented with fractures during July 2010 and December 2011 were retrospectively reviewed. Patients were divided into 2 groups: the intoxicated group and non-intoxicated group before the injury by chart review. Differences of the clinical features and radiological findings were compared between the two groups.

Results

One-hundred and eighty one (14%) patients were grouped into the intoxicated group (median age 51.0 years, range 20-85 years; male 148 (81.8%) and female 33 (18.2%)) and 1105 (86%) were grouped into the non-intoxicated group (median age 58.0 years, range 20-102 years; male 600 (54.3%) and female 505 (45.7%)). The intoxicated group showed higher rate of head/neck fractures and lower rate of extremities than the non-intoxicated group with statistical significance (skull 23.2% vs 5.8%; p <0.001). 8 of 18 (44.4%) patients in group A and 33 of 274 (12.4%) patients in group B died during hospitalization (p < 0.05). Patients in group A deceased 2.1 ± 3.7 days following trauma as compared to 6.4 ± 11.8 days in group B. Mean ISS did not differ significantly between both group A and B (26.2 ± 24.0 and 18.06 ± 16.72, respectively) (p>0.05).

Conclusion

Polytrauma patients with hyperdense adrenal glands on contrast-enhanced CT scans have a higher mortality rate as compared to patients with regular attenuation of the adrenal glands.

Clinical Relevance/Application

To understand the characteristic patterns of fractures in alcohol intoxicated patients and the differences from non-intoxicated patients is essential for our radiological assessments.

VLST21-11 • Relevance of Incidental Findings in Seriously Injured Patients - The Necessity of Appropriate Management Procedures

Thomas Lehnert MD (Presenter); Josef Matthias Kerl MD *; Julian L Wichmann MD; Ralf W Bauer MD *; Claudia Frellesen; Thomas J Vogl MD, PhD

Purpose

The multislice computed tomography (MSCT) is the gold standard in the initial evaluation of trauma patients. Besides providing information regarding the presence or absence of acute trauma-related injuries, MSCT scans also reveal pathologies unrelated to the trauma which may be clinically significant. The aim of the present study was to determine the frequency and clinical importance of incidental findings in multiple injured patients at a level one trauma centre.

Method and Materials

This is a retrospective analysis of prospectively collected data on 2242 multiple injured patients at a level I trauma centre from 2006 to 2010. A total of 2023 patients (91%) underwent an initial MSCT. The MSCT reports were retrospectively reviewed regarding unexpected findings not related to trauma. These incidental findings were rated on a 4-point level scoring system regarding clinical importance and urgency of initiation of further steps.

Results

A total of 2844 incidental findings were detected. Overall 349 tumor findings were noted (12.3% of all incidental findings). 113 findings were suspicious for malignant processes or metastasis. Regarding the clinical importance, 168 (5.9%) of the incidental findings required urgent follow-up (Level 4) and 527 (18.5%) of the incidental findings required a follow-up prior to discharge (Level 3).
VSER21-12 • Simplified Approach to Midface Trauma

O. Clark West MD (Presenter) *

LEARNING OBJECTIVES
1) Apply a simplified approach to midface trauma CT as described by James T. Rhea, MD. 2) Identify major patterns of midface injury. 3) Incorporate “buttress” terminology into facial CT reports.

VSER21-13 • Comparison of MRI, CT Scan and Plain Hip Radiograph for the Early Diagnosis of Hip Fracture in Emergency Patients

Laleh Daftaribesheli MD (Presenter) ; Shima Aran MD ; Hani H Abujudeh MD, MBA *

PURPOSE
Comparison of hip MRI results with plain hip radiograph and CT, and evaluating their role in diagnosis of patients with suspected hip fracture in emergency room

METHOD AND MATERIALS
The medical records of 314 patients who had MRI in emergency room of Massachusetts General Hospital from January 2008 to January 2013 with a suspected hip fracture were retrospectively reviewed. Patients’ mean age was 63 years old and 70% of patients were female. 281/314 had hip x-ray and 18/314 had both MRI and CT in addition to x-ray.

RESULTS
MRI could diagnose 96/314 patients with hip fracture, 6/96 reports were non definitive. X-ray reported 27/281 positive cases with 16/27 being non definitive. CT was positive in 9/18, with 1/9 being non definitive. In patients with all 3 examinations, according to MRI 9/18 patients had fractures and 9/18 were negative. In 12/18 cases MRI and CT report were completely consistent with each other. In 2/18 patients both CT and x-ray were negative for the fractures reported in MRI. In one case (1/18) with positive CT and negative x-ray happened to be negative by MRI.

Of 90/314 definite cases with MRI, 88/90 patients had plain hip x-ray which was positive in 9/98 patients. In 3/9 its diagnosis was ruled out by MRI. 7/88 of x-ray reports were non definitive for fracture. X-ray reported the wrong site of fracture in 3/88 cases and in 2/88 cases it diagnosed fractures which were ruled out by MRI. Our results showed that plain hip radiograph in addition to being negative in nondisplaced fractures was reported negative in patients with minimally displaced to displaced fractures, and in patients with both types of displaced and nondisplaced. Plain hip radiograph could not detect the fracture in 75/88 (85%) of patients with definite fractures.

CONCLUSION
These results favor the advantage of immediate MRI imaging specially in female elderly patients with suspected hip fracture.

CLINICAL RELEVANCE/APPLICATION
Use of MRI instead of CT and routine use of plain hip radiograph as a first step in diagnosis of patients with suspected hip fracture in emergency room eliminates the unnecessary exposure to radiation.

VSER21-14 • The Degree of Articular Depression as a Predictor of Soft-tissue Injuries in Tibial Plateau Fracture

Marc Regier (Presenter) ; Frank Oliver G Henes MD ; Azien Laqmami ; Gerhard B Adam MD ; Alexander Spiro

PURPOSE
Magnetic resonance imaging (MRI) provides sufficient information with regard to specific soft-tissue injuries in the knee, but in daily clinical routine it is not generally used to evaluate acute tibial plateau fractures. The aim of the present study was to intraindividually evaluate whether the amount of tibial plateau fracture depression at multi-detector computed tomography (MDCT) scans correlates with the incidence of associated soft-tissue injuries determined at MRI.

METHOD AND MATERIALS
A total of 54 consecutive patients with a mean age of 51.2 years (range, 33 – 69 years) were included in this intraindividual comparative study. All patients were admitted to the emergency department of a university medical center with acute tibial plateau fracture. Within the emergency department a 256 slice MDCT was conducted in each patient (Voltage, 120 kVp; current-time product, 110 mAs). Within a mean time interval of 2.8 days (range, 0 – 5 days) MR imaging was performed using standard T1w and T2w sequences at 3 Tesla. Image readout was consensually performed by an experienced musculoskeletal radiologist and an orthopedic traumatologist, who assigned the Schatzker classification and measured the articular depression. Statistical analysis included ANCOVA and logistic regressions.

RESULTS
Articular depression assessed by MDCT seems to be a potential predictor of specific meniscal and ligamentous injuries in acute tibial plateau fractures. Therefore, if articular depression is observed at MDCT, MR imaging should generally be recommended in addition with respect to associated soft-tissue lesions.

CLINICAL RELEVANCE/APPLICATION
If articular depression due to acute tibial plateau fracture is detected at MDCT, MRI should be considered indispensable in order to prevent missing concomitant soft-tissue injuries.

VSER21-15 • Panel/QandA

Gastrointestinal Series: Emerging Issues in Abdominal CT

Monday, 08:30 AM - 12:00 PM • N227

VSGI21 • AIMA PRA Category 1 Credit ™; 3.25 • ARRT Category A+ Credit:4

Moderator
Giles W Boland , MD
Moderator
Jonathan B Kruskal , MD, PhD *

VSGI21-01 • Oral Contrast Issues

Perry J Pickhardt MD (Presenter) *

LEARNING OBJECTIVES
1) Understand the relative advantages and disadvantages of the use of positive oral contrast in abdominal CT imaging for a wide variety of clinical scenarios.

VSGI21-02 • Discontinuation of Positive Oral Contrast for Routine CT Scans Does Not Result in Substantial Repeat Scans

Wilbur Wang BA (Presenter) ; Nikita Shah ; Michael A Ohliger MD, PhD ; Yanjun Fu PhD ; Zhen J Wang MD ; Benjamin M Yeh MD *

PURPOSE
To evaluate the rate of repeat scans after an institution-wide policy to discontinue the routine administration of positive oral contrast in favor of oral tap water for routine abdominal CT examinations.

METHOD AND MATERIALS
From a total of 12,370 abdominal CT scans performed at our institution from March 9, 2009 to June 26, 2012, we identified all repeat abdominal CT scans occurring between 1 and 2 hours and 14 days after an initial abdominal CT scan. On March 9, 2009 our department discontinued the routine administration of positive oral (iodinated) contrast in favor of oral tap water for such scans. Readers recorded the presence of oral and IV contrast in both initial and repeat abdominal CT scans images. For scans in which positive oral contrast was given, the reason for administering oral contrast was given.
RESULTS
From a total of 12,370 abdominal CT examinations, 439 (3.5%) were repeat scans, and of these, 47 scans (10.7%) used oral contrast on the repeat CT scan but not the initial. The most common reasons for administration of oral contrast were for evaluation of abscess (40.0%), evaluation for perforation (33.1%), and obstruction (13.1%). Only 11 out of the 439 repeat scans (2.5%) were explicitly performed due to a need for oral contrast in the repeat scan (0.09% of all scans). Significantly fewer repeat scans used oral contrast (either on the initial study or repeated study) in 2012 (5 of 60 scans, or 8.3%) compared with 2009 (76 of 215 scans, or 35.3%, \(P < .01\)). Overall, the frequency of repeat abdominal CT scans significantly decreased from 4.7% in 2009 to 2.8% in 2012 (\(P < .001\)).

CONCLUSION
The discontinuation of positive oral contrast from routine abdominal CT protocols at our institution led to a miniscule frequency of repeat examinations (0.09% of all scans) which diminished over 3 years. Our findings support the continuation of this policy, especially when weighed against the inconvenience, expense, and potential complications of administering oral contrast to every patient.

CLINICAL RELEVANCE/APPLICATION
Discontinuation of positive oral contrast from routine abdominal CT exams does not result in a substantial frequency of repeat examinations with oral contrast.

VSGI21-03 • Radiation Dose Reduction Techniques
Rendon C Nelson MD (Presenter) *

LEARNING OBJECTIVES
1) To understand the pros and cons of radiation dose reduction in CT. 2) To learn methods for radiation dose reduction that do not impact image quality. 3) To learn methods for radiation dose reduction that do impact image quality. 4) To understand the implications of using iterative reconstruction techniques for CT.

VSGI21-04 • Abdominal CT Radiation Doses (Conventional and Organ Doses) from Large Academic Institute with 3 Scan Vendors and Different Iterative Reconstruction Techniques

Sarvenaz Pourjabbar MD (Presenter) ; Sarabjeet Singh MD ; Mannudeep K Kalra MD * ; Atul Padole MD ; Ranish D Khawaja MBBS, MD ; Diego A Lira MD ; Sanjay Saini MD

PURPOSE
To assess and compare radiation doses for abdominal CT examinations performed with different scanning protocols, various scan manufacturers and models, with and without iterative reconstruction in routine clinical settings.

METHOD AND MATERIALS
This IRB-approved, HIPAA-compliant study included 8758 consecutive abdomen-pelvis CT exams (mean age: 59.3±16.6 years; M: F=4469:4288). Automatic dose monitoring software (Exposure, Bayer) was used to retrieve patient demographics, including date of birth, gender, weight, patient maximum skin to skin diameters, CTDIvol, DLP, effective doses, Size Specific Dose Estimates (SSDE), as well as organ doses. Selected scan protocols and scanner models with information on Iterative Reconstruction (IR) were also recorded. Analysis of variance was used to evaluate differences across above variables. P-value of 0.05 with 95% confidence interval was considered significant.

RESULTS
Distribution of CT examinations per scanner included 16-slice GE (n=3200), 64-slice GE (n=1730), 64-slice Philips (n=176), 128-Siemens (n=221) and 256-Philips (n=144). Abdominal CT were performed with several clinical protocols; abdominal routine CT (n=2963), stone/ hematoma (n=570) and cancer follow up (n=1385). Stone protocols were performed more commonly on 64-GE with mean CTDIvol (n=344, 8.5±3.3 mGy), 16 GE (n=220, 10.5±3.8 mGy), and 256-Philips (n=144, 8.4±5.5 mGy). Routine abdominal CT were stratified in 4 weight groups, less than 135lbs (n=683, 6±2 mGy), 136-200lbs (n=2257, 9±2.5 mGy), 200-300lbs (n=812, 13 ± 3.2 mGy) and more than 300lbs (n=51, 26±4.8 mGy). Estimated effective doses for iterative reconstruction scanners were 8 ± 3 (n=764, Discovery750HD) 9 ± 3 (n=133, Definition FLASH) and 7 ± 3 (n=124, Brilliance iCT). Organ doses are summarized in a graphical manner in figure 1.

CONCLUSION
Indication, CT scanner, and size based variations in abdominal CT protocols help in optimization of radiation doses. Although CT dose indexes provide good estimates for comparing across CT scanners, organ doses should be used for comparing patient doses.

CLINICAL RELEVANCE/APPLICATION
Abdominal CT examinations doses ranged from 6 to 26 mGy and hence it is important to optimize based on clinical indication, weight and iterative reconstruction technique.

VSGI21-05 • Observer Performance for Site-Specific Detection and Correct Classification of Malignant Liver Lesions for an Image-Based Denoising Method and Iterative Reconstruction

Joel G Fletcher MD (Presenter) * ; Lifeng Yu PhD ; Zhoubo Li ; Armando Manduca PhD * ; Daniel J Blezek PhD ; David M Hough MD ; Sudhakar K Venkatesh MD, FRCR ; Gregory C Brickner MD ; Joseph G Cernigliaro MD ; Amy K Hara MD * ; David Lake ; Maria Shuang ; David Lewis ; Shuai Leng ; Kurt E Augustine MS ; Rickey Carter PhD ; David R Holmes PhD ; Cynthia H McCollough PhD *

PURPOSE
Noise reduction techniques may improve subjective image quality, but few studies have addressed impact on diagnostic performance. Our purpose was to determine if lower dose (LD) CT images reconstructed with image-based noise reduction (Noise Map; NM) or an IR technique (SAFIRE; Siemens Healthcare) resulted in reduced observer performance for detection of primary or secondary liver tumors (LT’s), compared to routine dose filtered back projection (FBP) images.

METHOD AND MATERIALS
CT projection data from 60 CT exams were collected (30 abdomen at 16 mGy, 30 liver at 23 mGy; 21 with LT’s). Presence of LT’s was defined by progression/regression on CT/MD or pathology. Using a validated noise insertion tool, LD NM, LD FBP, and LD SAFIRE images were created corresponding to 12 mGy (abd) or 14 mGy (liver). In each reading session, 3 readers randomly evaluated either routine dose FBP, LD FBP, LD NM, or LD SAFIRE images. 3 mm CT images were reconstructed in a dedicated computer workstation, with readers circling all liver lesions, then selecting a diagnosis (LT vs. individual benign diagnoses) and confidence score (0 – 100), and grading image quality. Reference detections were similarly marked, with automated matching of reference and reader lesions using an overlapping spheres method. JAFROC analysis was performed on a per-lesion basis for LT’s, compared to routine dose filtered back projection (FBP) images.

RESULTS
There were 73 LT’s with a median size of 1 +/- 1 cm. The JAFROC figure of merit (FOM) overlapped for routine dose FBP, LD FBP, and LD NM (FOM 95% CI’s: 0.84 – 0.95, 0.79 – 0.93, 0.82 – 0.93, respectively for routine FBP, LD FBP, LD NM), with the estimated differences between routine FBP and LD FBP or NM being non-similar. Similarly, JAFROC FOM’s were similar between routine dose FBP and each LD approach in the subset of 44 cases with SAFIRE (0.97 vs. 0.94, 0.93, 0.94), with LD approaches being non-inferior. Diagnostic image quality was greatest for LD images with noise reduction (p < 0.03 all readers).

CONCLUSION
Lower dose CT images reconstructed with FBP, NM and SAFIRE can be interpreted without loss of diagnostic performance despite the improved image quality of NM and SAFIRE.

CLINICAL RELEVANCE/APPLICATION
Although perceived quality of LD images was improved with use of noise reduction methods, observer performance was not significantly different than for FBP even for challenging liver tumors.

VSGI21-06 • Prospective Evaluation of Prior Image Constrained Compressed Sensing (PICCS) Algorithm in Abdominal CT: Preliminary Results Comparing Reduced Dose with Standard Dose Imaging

Meghan G Lubner MD (Presenter) ; David H Kim MD * ; Jie Tang PhD ; Perry J Pickhardt MD * ; Alejandro Munoz Del Rio PhD ; Guang-Hong Chen PhD *

PURPOSE
To report prospective preliminary results of an ongoing CT dose reduction trial using Prior Image Constrained Compressed Sensing (PICCS).

METHOD AND MATERIALS
50 patients (23 F, 27 M, mean age 57.7 years, mean BMI 28.6) were scanned in this HIPAA compliant, IRB approved study. Immediately following routine contrast-enhanced (n=26) or unenhanced (n=24) abdominal MDCT, a second reduced dose (RD), matched series scan was performed (target dose reduction 70-90%). DLP, CTDIvol and SSDE were compared between scans. Multiple reconstruction algorithms (standard filtered back projection (FBP), adaptive statistical iterative reconstruction (ASIR), and Prior Image Constrained Compressed Sensing (PICCS)) were applied to the RD series. Standard dose images (SD) were reconstructed with FBP (reference standard). Two blinded readers evaluated each series for subjective image quality and focal lesion detection. Objective noise and region of interest attenuation (HU) were measured at designated sites.
RESULTS
Mean DLP, CTDIvol, effective diameter and SSDE for the RD series was 140.3 mGy*cm (median 79.4, range 15.9-526.6), 3.7 mGy (median 1.8, range 0.4-26.4), 30.1 cm (median 30, range 24.6-38.0), and 4.15 mGy (median 2.31 range 0.59-24.3) compared to 493.7 mGy*cm (median 345.8, range 57-1453.7), 12.9 mGy (median 7.9 mGy, range 1.43-79.8) and 14.6 mGy (median 10.1, range 2.1-73.4) for the SD series respectively. This is a mean SSDE reduction of 72%. RD PICCS image quality score was 2.8±0.5, improved over the RD FBP and RD ASIR scores (1.7±0.7 and 1.9±0.8 respectively), but less than the SD score of 3.5±0.5 (p

CONCLUSION
PICCS allows for marked dose reduction at abdominal CT at the expense of subjective image quality scores and diagnostic performance. Further study is needed to determine optimal dose reduction level to maintain acceptable diagnostic accuracy.

CLINICAL RELEVANCE/APPLICATION
PICCS allows for substantial CT dose savings (70-90%), lowering the dose for some applications (urolithiasis, colon ca screening) into the sub-mSv range.

VSGI21-08 • Dual Energy CT
Alec J Megibow MD, MPH (Presenter) *

LEARNING OBJECTIVES
1) Understand basic physical principles that support Dual Energy CT applications for abdominal imaging. 2) Familiarize audience with radiation dose and image quality as they relate to Dual Energy CT. 3) Demonstrate the value of unique dual energy CT capabilities drawing on examples from abdominal imaging capabilities.

VSGI21-09 • Can Multi-material Decomposition Algorithm Generated Virtual Unenhanced (VUE) Images from Single Source Dual-energy CT meet the Qualitative and Quantitative Expectations of True Unenhanced (TUE)?
Mukta D Agrawal MBBS, MD (Presenter); Jorge M Fuentes MD; Avinash R Kambadakone MD, FRCR; Yasir Andradi MD, MPH; Shaheen Sombans MBBS; Jannareddy Namrata Reddy MBBS; Koichi Hayano MD; Dushyant V Sahani MD

PURPOSE
We investigated the performance of recently commercially available multi-material decomposition (MMD) algorithm rendered VUE images for image quality/texture improvements and attenuation (HU) measurements.

METHOD AND MATERIALS
In IRB approved prospective study, 33 consecutive patients had arterial and delayed phase ssDE-CTA (GE discovery CT750 HD) of the abdomen for AAA. The VUE images were generated using MMD algorithm. Each patient also had true unenhanced exam (TUE) for comparison. Three independent readers assessed the images of quality and acceptance of VUE for TUE using a four-point scale. Visualization of incidental findings such as renal stones, vascular calcification, fatty liver, and cysts was evaluated. For quantitative measurement, attenuation values (HU) of liver, kidney, muscle and background fat were obtained on TUE and VUE. Pearson correlation coefficient was used for statistical analysis.

RESULTS
The MMD-VUE images were rated acceptable in all 33 exams and actually preferred by all three readers over TUE (IQ score 3 vs 2.1). All renal stones (n=17), vascular calcification (n=33) and fatty liver infiltration (n=13) were accurately detected on MMD-VUE images. The mean HU on MMD-VUE demonstrated good to excellent correlation with TUE values for liver (r=0.85), kidney (r=0.7), muscle(r=0.82) and fat (r=0.9). The mean attenuation difference (HU) between TUE-VUEa, TUE-VUEd and VUEa-VUEd for liver, kidney, muscle and fat was

CONCLUSION
The MMD algorithm rendered VUE images meet the clinic expectations of quality and quantitative measurements and therefore a viable replacement of TUE.

CLINICAL RELEVANCE/APPLICATION
Virtual unenhanced CT images that are quantitatively and qualitatively comparable to true unenhanced CT images are expected to bring workflow and radiation dose savings benefits.

VSGI21-10 • The Clinical Impact of Retrospective Analysis of a Dual Energy CT Device
Michal H Gabbar MD (Presenter); Isaac Leichter PhD; Zimam Romman *; Amiaz Altman PhD *; Jacob Sovsna MD *

PURPOSE
In existing tube-based dual-energy CT (DECT), dual-energy protocols must be prescribed in advance to select tube voltage or operate the two tubes at different kV. Spectral detector-based DECT enables retrospective reconstruction and analysis of data obtained from a single CT acquisition with no requirement to plan a dual-energy protocol in advance. The purpose of this study was to assess the potential added value of retrospective dual-energy reconstruction features.

METHOD AND MATERIALS
A total of 43 patients were scanned with a novel Spectral Detector CT (SDCT) prototype (Philips Healthcare, Cleveland, OH, USA). IRB approval and patient consent were obtained. The clinical indication for each case was evaluated, and indications were compared to the final diagnosis by two radiologists in consensus. The number of cases in which retrospective analysis of spectral data could potentially assist in the diagnosis while the indication on the request did not suggest in advance the use of dual-energy reconstruction was analyzed.

RESULTS
SDCT data helped to achieve the diagnosis for 19 out of 43 patients (44%). In 8 of the 43 (18.6%), clinical history on the study request indicated potential advantage from use of a dual-energy protocol (4 suspected pulmonary embol, 2 suspected kidney stones, 1 suspected insulinoma, 1 suspected hepato cellular carcinoma). In the remaining 35 patients, dual-energy reconstruction was not indicated from the referral. In 11 of the 35 patients (31%) retrospective spectral detector reconstruction improved visualization of the following unexpected pathologies: 2 incidental adrenal adenomas (contrast enhanced CT, virtual non-enhanced CT images), 2 pelvic DVT cases (low kE images), 3 pancreatic cysts (with low kE, improved contrast-to-noise), 3 metal implants (reduced artifacts at higher kE), and one abdominal aortic aneurysm (suboptimal CTA visualized at low kE).

CONCLUSION
Retrospective spectral image reconstruction and analysis may frequently offer clinical advantage in cases where DECT is not indicated based on clinical history.

CLINICAL RELEVANCE/APPLICATION
Spectral detector-based dual-layer CT allows retrospective reconstruction and post-processing image analysis that may frequently be useful in clinical practice.

VSGI21-11 • CT Perfusion
Benjamin M Yeh MD (Presenter) *

LEARNING OBJECTIVES
1) Understand the potential benefits and drawbacks of imaging contrast material inflow and outflow for improving clinical diagnoses in the abdomen and pelvis, including characterization and monitoring of tumors and fibrosis. 2) Review methods for quantifying different parameters associated with contrast material distribution into abdominopelvic tissues. 3) Show methods to improve consistency and radiation dose with CT perfusion imaging.

ABSTRACT
Use of intravenous contrast material is critical to the evaluation of a broad range of abdominopelvic diseases at CT. The rate of inflow and outflow of contrast material relative to arterial flow and intravascular concentrations, as well as distribution of contrast materials into tissues, reflect the underlying vascular and micro vascular physiology of tissues. On a simplistic level, subjective evaluation of enhancement relative to normal tissue is routinely used by radiologists to detect, characterize and monitor tumors and inflammatory processes. More advanced dynamic contrast enhanced imaging can be used to quantify such microvascular parameters as blood volume, blood flow, mean transit time, arterial perfusion, extracellular fraction, and permeability surface, and has been studied in particular for monitoring treatment response in tumors. Simple equilibrium imaging can be used to assess relative washout and extracellular fraction, and appears to be a potentially valuable method to quantify and monitor a wide range of disease.

VSGI21-12 • Role of Perfusion CT in Characterization of Pancreatic Mass Lesions
Raju Sharma MD (Presenter); Ajay K Yadav MBBS; Devasenathipathy Kandasamy; Shivanan R Gamanagatti MBBS, MD; Ashu Seth Bhalla MBBS, MD; Peush Sahni MBBS, MS; Arun K Gupta MBBS, MD

PURPOSE
Perfusion CT (PCT) provides quantitative information regarding blood perfusion and permeability in tissues in a noninvasive way. This prospective study was conducted to evaluate the utility of PCT findings in characterization of pancreatic mass lesions.

METHOD AND MATERIALS
PCT was done in 67 patients with histopathologically proven pancreatic mass. The spectrum of pancreatic pathology included adenocarcinoma (30), cystic neoplasm (21), neuroendocrine tumor (8), mass forming chronic pancreatitis (3), metastatic mass (3) and pancreatic tuberculosis (2). Perfusion parameters

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RESULTS
No significant difference in perfusion parameters was noted in head, neck, body and tail of pancreas in control groups (BF 52-150 ml/100 ml/min and BV 22-50 ml/100 ml). Neuroendocrine tumors showed the highest perfusion values (BF 122-260 ml/100 ml/min and BV 30-40 ml/100 ml) in comparison to normal pancreas. Cystic pancreatic tumors showed the least perfusion values (BF 0.2-34 ml/100 ml/min and BV 0.5-15 ml/100 ml) followed by adenocarcinoma (BF 2.8-36 ml/100 ml/min and BV 0.5-18 ml/100 ml), metastatic and inflammatory pancreatic masses in increasing order. BF and BV were significantly reduced in the center of pancreatic adenocarcinoma and gradually increased from center to periphery of the lesion, as opposed to cystic tumors which showed homogeneous reduction.

CONCLUSION
Significant decrease in BF and BV values as compared to normal pancreas was seen in all pancreatic masses except neuroendocrine tumors. PCT may also help to differentiate pancreatic adenocarcinoma from inflammatory masses.

VSGI21-13 • Perfusion CT in Patients with Hepatocellular Carcinoma: Comparison with Intravoxel Incoherent Motion Diffusion (IVIM)-Diffusion Weighted Imaging (DWI)

Mi Hye Yu MD (Presenter); Jeong-Min Lee MD *; Joon Koo Han MD; Byung Ihn Choi MD, PhD *

PURPOSE
To determine the value of perfusion parameters from perfusion CT in patients with hepatocellular carcinoma (HCC) and analyze the correlation with those obtained from intravoxel incoherent motion diffusion (IVIM)-diffusion weighted imaging (DWI)

METHOD AND MATERIALS
A total of 30 patients (M:F=23:7; mean age, 58.7±13.27; age range, 20-77) suspected having HCC were prospectively enrolled in this study. They underwent IVIM-DWI (10 b values, 1.5T) and liver perfusion CT (4D spiral mode, scan range 10 cm, 21 scans, cycle time 1.3 seconds) within 2 days before hepatic resection. Following perfusion parameters were calculated: blood flow (BF), blood volume (BV), permeability surface (PS), arterial perfusion (AP), portal perfusion (PP), total liver perfusion (TLP) and hepatic perfusion index (HPI) from perfusion CT; apparent diffusion coefficient (ADC), pseudodiffusion coefficient (D*) from IVIM-DWI. Those parameters statistically analyzed comparing HCC and liver parenchyma. Pearson’s correlation test was also used to correlate perfusion CT and IVIM-DWI parameters.

RESULTS
Regarding the perfusion CT, BF, BV, AP, TLP and HPI were significantly higher, whereas PS and PP were significantly lower in HCC than in the liver parenchyma (BF ~39.46 ml/100ml/min, BV = 11.80 ml/100ml, AP = 41.86 ml/min/100ml, TLP = 47.24 ml/min/100ml, HPI = 87.88%, PS = 16.03 ml/100ml/min, PP = 5.37 ml/100ml, p < 0.05). Among the IVIM-DWI parameters, D* was significantly lower, whereas f was significantly higher in HCC than in the liver parenchyma (D*, 4.95 vs. 9.71 10^-3 mm^2/s; f, 20.17 vs. 16.37 %; p < 0.05). However, no significant correlation found between the perfusion CT and IVIM-DWI parameters.

CONCLUSION
Perfusion CT and IVIM-DWI can quantitatively assess the hepatic perfusion in patients with HCC, even though there was no significant correlation between the parameter of the two modalities.

VSGI21-14 • Panel Discussion

Radioinformatics Series: Mobile Computing Devices

Monday, 08:30 AM - 12:00 PM • S404CD

VSIN21 • AMA PRA Category 1 Credit ™: 3.25 • ARRT Category A+ Credit: 3.5
Moderator
David S Hirschorn, MD

VSIN21-01 • Introduction
David S Hirschorn MD (Presenter)

VSIN21-02 • Platforms and Security
George L Shih MD, MS (Presenter) *

LEARNING OBJECTIVES
1) iOS vs. Android platforms: a. Provide basic understanding of the differences and similarities between the Apple iOS and Google Android operating systems, as it mainly applies to the realm of medical imaging for end-users and developers; b. Introduce other competing platforms. 2) Mobile Security: Provide basic understanding of different security concerns and technologies (VPN, wifi, etc) available on mobile devices.

ABSTRACT
The physician dream of replacing the ubiquitous clipboard is now almost a reality. Radiologists and non-radiology clinicians will benefit from the enlarged screen size of the iPad and other mobile devices. The two main platforms for tablet mobile devices are currently the Apple iOS and the Google Android operating systems. While they share many similarities in terms of user interface functionality, they also have differences in the ways applications are created and used. This session will compare and contrast those differences, and also introduce other competing platforms. These devices will need to have the same or similar performance as the in-clinic deployment options, as they will be used in a wide variety of medical settings. We will discuss the advantages and disadvantages of each platform, and how they can be used in clinical settings.

Evaluation
Two radiologists at a major academic medical center in North America created and deployed seven clinical imaging practice mobile applications for the iOS platform addressing anatomy, oncology, differential diagnosis generation, and common practice guidelines. One mobile application was specifically deployed with independent versions for tablets and smartphones in order to assess differences between these devices in the mobile market. All mobile applications were distributed free of charge and without in-app advertising in over 150 nations. Trends in sales volumes and sales by country were observed during a 4-month period following a 3-month rollout window.

Discussion
A total of 6,116 unique sales were observed during a 4-month period. The top 8 national markets for clinical imaging practice mobile applications included the United States, Brazil, Italy, United Kingdom, Spain, Turkey, India, and China. Customers in the U.S. represented the largest national market, accounting for 27% of all sales. Analysis of mobile application sales with independent smartphone and tablet versions revealed that the ratio of tablet versus smartphone
uptake among providers is different in emerging markets than in markets in North America and Europe. Whereas the tablet version of one application outsold the smartphone version by 22% in the U.S. and 12% in the U.K., tablet versions outsold smartphone versions by 144% in India, 70% in China, and 300% in Russia.

**VSIN21-04 • The Process of Creating and Deploying a Mobile Application for iOS: An Introduction for Radiologists**

**Charles T Lau MD (Presenter) ; Ahmed El-Sherief MD**

**CONCLUSION**

Most radiologists are familiar with the process of publishing in a peer-reviewed journal or speaking at a national conference. Mobile platforms such as iOS will be an important alternative venue of communication, and an understanding of this medium is required for those who hope to take advantage of it.

**Background**

Mobile applications on platforms such as the iPhone and iPad represent an exciting venue for radiologists seeking to enhance their impact on colleagues’ practices. Individuals interested in leveraging the iOS platform can benefit from an understanding of how this process works from beginning to end.

**Evaluation**

Many smartphone and tablet users are familiar with mobile applications. However, the process that proceeds from the genesis of an idea and results in a mobile app in the iTunes App Store can be complex.

**Discussion**

Developing a powerful mobile iOS application for health care providers in radiology is a long and multi-step process. The process begins with the identification of a concept or practice guideline that can be enhanced by electronic and mobile media, but underutilized because of the limitations of current media. A convenient, user-friendly interface providing a simple and understandable way of supplying user input and displaying answers is designed within Xcode Interface Builder. Software code is written in Objective-C to convert user-supplied input values to appropriate output. The resulting mobile app represents a unification of user interface design and software code tailored for a small screen, an app that must be rigorously tested and subsequently vetted by the App Store. Marketing efforts to communicate user value must be undertaken. User feedback is solicited to guide continued improvement. Many hurdles and pitfalls during these steps may be encountered and are discussed.

**VSIN21-05 • Digital Improvement of Mobile X-ray Machines Based on Wi-Fi Flat Panel System**

**Jian Guan MD (Presenter) ; Xiao Mei Cheng ; Ling Zhang MD ; Shengwen Deng ; Shao Chun Lin**

**CONCLUSION**

Digital improvement of mobile X-ray machines based on Wi-Fi flat panel system is practical and proven to have many advantages by clinical application.

**Background**

There are 5 mobile X-ray machines distributed in different buildings in our hospital. The aging of equipment obviously influence image quality. Medical technologist (MT) have to take a stack of imaging plates and make many times trips between department of radiology and different wards. The cost for replacement with new mobile DR is great and all old machines will be abandoned. So we need to find a simple and available way to improve them.

**VSIN21-06 • Apps, Bandwidth, and Integration**

**Asim F Choudhri MD (Presenter)**

**LEARNING OBJECTIVES**

1) To have an understanding of available applications available for mobile medical imaging, including native clients, web clients, and virtual desktop/terminal server approaches. 2) To have an understanding of bandwidth concerns in mobile medical imaging, including device data handling, network speeds, and possible bandwidth cost issues. 3) To have an understanding of possible clinical implementations of mobile medical imaging within radiology departments and in health care networks overall.

**ABSTRACT**

Applications: There are several vastly different approaches to mobile viewing of medical images. Native clients are programs written using a software development kit for a given platform. These clients can retrieve data from remote servers and view locally stored image data. Web clients are web-based programs which are often (but not always) platform independent. They will typically access remotely stored data which may be stored in a local cache but is usually not possible to store on the mobile device. Virtual desktop/terminal server software allows a mobile device to access a remote computer or server. The remote server handles all higher level processing and data storage, minimizing the processing requirements within a healthcare network. Bandwidth: Viewing medical images may require transfer of datasets that are tens or hundreds of megabytes in size. This provides a special challenge for mobile devices which typically receive data via wireless communication. If using a cellular network, network bandwidth can be a limiting factor (as can data transfer costs). File compression can reduce the size of files, however, devices may not have enough processing power and may involve compromises in image quality. Once data is on a device, image processing may overwhelm its processing capabilities compared with dedicated PACS workstations. We will discuss both network and device bandwidth concerns as it relates to mobile medical imaging, and possible solutions for overcoming obstacles. Integration into a healthcare system: Mobile review of medical imaging is a tool which has the potential to significantly change healthcare delivery, but the specifics for implementation are unclear. After a device platform has been selected, however, there are many approaches to solving image processing and data handling issues. Each institution will need to determine what role this technology will play. Possibilities include radiology residents (or even faculty) consulting with subspecialty faculty, surgeons and interventionalists triaging patients for procedures and for procedure planning, or referring images to a remote image analysis station. New frontiers in consultation will be discussed, including an example involving mobile imaging review in a multidisciplinary stroke team. Guidance will also be provided regarding training and establishing institutional standard operating procedures documents. The current state of medical-legal concerns and risk management strategies will also be discussed.

**VSIN21-07 • A Secure, Mobile Device-based System for Rapid Consultation and Sharing of Interesting Cases**

**Loyririk Temiyakarn MD (Presenter) ; Asim F Choudhri MD**

**CONCLUSION**

Mobile device-based systems show great promise for secure yet rapid consultation and sharing of interesting cases. Such systems have already been deployed on an institutional and cross-institutional basis and have demonstrated great success.

**Background**

With the wide variety of PACS in use, radiologists in a group covering different hospitals often find communication between different PACS difficult. This is especially cumbersome when quick and informal consultations are desired between colleagues. With the recent improvements in camera optics and sensors in mobile devices, coupled with highly secure text and picture messaging networks, such limitations in communication can be made more easily overcome.

**Evaluation**

Several mobile device-based applications were evaluated for ease of use, fidelity of image capture, security of transmission, and ease of sharing images among a group of colleagues. Applications tested were on different mobile device platforms and deployed across different mobile service providers. One particularly commercially available application/device combination was chosen as a proof of concept at our institution. The chosen device demonstrated the ease with which images could be captured, regardless of PACS used. Captured images retained enough quality for viewing and diagnosis on the device, and could be cropped to exclude protected health information (PHI). In addition, the chosen application for image transmission has recently demonstrated encryption security sufficiently high to limit court-mandated law enforcement efforts at interception and decryption. Finally, the chosen application allowed for easy yet secure dissemination of images to a group of colleagues for rapid consultation or review.

**Discussion**

As a proof of concept, the chosen device/application combination has proven extremely effective in the dissemination of still images for rapid consultation and sharing. The ubiquity of mobile devices combined with the flexibility in image capture allows for great versatility. However, the ability to share a series of consecutive images (e.g., cine clips) remains somewhat dependent on the user’s ability to capture a movie clip of the desired image series.

**VSIN21-08 • Optimization of Patient and Staff Radiation Protection in X-ray Imaging Procedures Using a Mobile Phone Application**

**Francis R Verdun PhD (Presenter) ; Nick Ryckx Msc ; Jean-Christophe Stauffer ; Jean-Jacques Goy MD ; Reto A Meuli MD, PhD ; Nicolas Goy**

**CONCLUSION**

The promotion of radiation protection must be done using all available means. The tremendous growth of mobile devices in the recent years called for a gap to be filled. This mobile application could help the physician to practice possible while still keeping diagnostic accuracy by estimating his/her practice with respect to the local diagnostic reference levels and giving useful working tips.

**Background**

The number and complexity of interventional radiology and cardiology (IR/IC) procedures has been steadily increasing over the last twenty years. This implies an increased risk of stochastic and even deterministic effects (skin burns) to the patient, as well as an increased exposure of IR/IC staff. Radiation protection must thus become of prime importance and should be promoted by all possible means.
Evaluating radiation protection risk and measuring the patient's dose are key aspects of radiation protection. The key elements to achieve this goal are:

- Comparing his/her patient delivered doses to the local diagnostic reference levels (DRL).
- Estimate the risk and severity of potential radiation-induced skin burns and the necessity of patient follow-up.
- Estimating the patient’s average personal dose.
- Give advice in order to reduce patient and staff exposure.
- Give general information about radiation protection.

Discussion

As radiation-induced erythema occur several days or weeks the X-ray exposure, it can be easily diagnosed as being caused by another factor, such as medication or allergy. Giving the patient more information about his/her personal dose risk would greatly improve his/her follow-up to minimize negative side effects of a high dose IR/IC procedure. As for the staff, it will help them with their daily practice by giving them useful tips aiming to reduce the dose delivered to the patient and, as a consequence, their personal dose.

VSIN21-09 ● The Use of Mobile Devices for Specimen Mammography Interpretation: Feasibility Study

Bo La Yun MD (Presenter) ; Sun Mi Kim MD, PhD ; Mijung Jang ; Hye Shin Ahn MD

PURPOSE

To assess feasibility of mobile device in specimen mammography interpretation by using safety margin on pathologic result as reference standard.

METHOD AND MATERIALS

This retrospective study was approved by the institutional review board. Patient informed consent was waived. A total of the 79 consecutive breast specimen mammography (52 invasive cancer, 26 DCIS, and 1 mixed DCIS and LCIS) in 79 women (median age, 49 years; age range, 30–76 years) was included. Three radiologists independently reviewed specimen mammography with three different mobile devices (Nexus10, Google, CA; Galaxy note 10.1, Samsung, Korea; New iPad, Apple, CA). Other two radiologists independently interpreted the same set of specimen mammography on 3megapixel LCD monitor. Margin evaluation on pathologic report was reviewed as the reference standard. Each reader was asked to measure the shortest distance from the lesion to the margin lesion. The interpretation time was also assessed. Absolute measurement discrepancy defined as the difference between measured shortest distance on specimen mammography and pathological safety margin, and interobserver agreement, sensitivity and specificity were analyzed.

RESULTS

Intra-class correlation coefficients were 0.546 for LCD monitor, 0.459 for Nexus, 0.508 for Galaxy, and 0.392 for iPad. The mean absolute measurement discrepancy were 66 ± 49 for LCD monitor, 61 ± 47 cm for Nexus, 59 ± 47 cm for Galaxy, 60 ± 48 cm for iPad without statistical significant difference among devices. The mean sensitivity and specificity were 66.8% and 35.2% for LCD monitor, 73.3% and 24.3% for Nexus, 77.8% and 30.2% for Galaxy and 73.3% and 26.0% for iPad. The mean assessment time were 44 seconds (sec) for LCD monitor, 42 sec for Nexus, 38 sec for Galaxy, 45 sec for iPad. There were no statistical significant between LCD monitor and mobile devices interpretation time (P= .18).

CONCLUSION

The mobile devices and 3-megapixel LCD monitors are comparable in terms of surgical margin evaluation of breast cancer in digital mammograms. The mobile devices could be an option to safety margin evaluation on specimen mammography.

CLINICAL RELEVANCE/APPLICATION

Mobile devices are comparable in 3-megapixel LCD monitor in evaluation of specimen mammography margin and could be used for display tool of immediate assessment when LCD monitor is unavailable.

VSIN21-10 ● Displays and Quality Assurance

David S Hirschorn MD (Presenter)

LEARNING OBJECTIVES

1) Discuss aspects of spatial and contrast resolution for medical imaging. 2) Explore options for calibration and quality assurance. 3) Understand the impact of ambient light and viewing distance and angle on medical image display.

ABSTRACT

Mobile devices have significantly smaller displays than desktop or even laptop computers to make them lighter and more easily transported. They are also designed for shorter viewing distances which require smaller pixels. The smaller total display size tends to reduce the number of pixels, while the smaller pixel size tends to increase the number of pixels. On balance, these displays typically have considerably fewer pixels than their stationary counterparts. Nonetheless, even desktop displays typically have less resolution than the original image size of a radiograph which is typically about 5 megapixel (MP) for a chest radiograph. And both types of displays have more resolution than a single CT image, which is 0.25 MP. Since these devices do allow zooming and panning, it is possible for image interpretation under controlled circumstances. The main purpose of the DICOM Part 14 Grayscale Display Function is to ensure that contrast is preserved across the range of shades of gray from black to white, particularly at the edges where uncalibrated displays tend to fall off. With desktop displays this can be measured with a photometer, either external or built-in, and graphics adapter adjustments can be made to make the display conform. Mobile devices typically do not offer this degree of adjustability. This requires a different approach to DICOM curve conformance, and a reasonable alternative is to present the user with a visual challenge to identify low contrast targets placed randomly on the display. If the user can find them and tap on them, then the display may be considered compliant, and if not, the display should not be relied upon.

VSIN21-11 ● How Good Is the iPad for Detection of Pneumothorax on Chest X-ray? Diagnostic Performance of Radiologists and Emergency Medicine Physicians

Rameysh D Mahmood MBCh, FRCR (Presenter) ; Justin Sim Jw MBBS ; Angeline, Choo Choo Poh MBBS ; C. C. Tchoyson Lim MBBS

PURPOSE

Tablets like the iPad have been successfully used as remote image review devices for emergency teleconsultation of high contrast studies e.g. CT. However, their utility in the interpretation of radiographs which require higher spatial and contrast resolution displays is less certain. This study aims to compare the accuracy of pneumothorax (PTX) detection on chest x-rays (CXRs) between the iPad and the PACS monitor and the diagnostic performance between radiologists and emergency medicine (EM) physicians.

METHOD AND MATERIALS

Anonymized full DICOM images of 140 CXRs (70 normal, 48 small PTX, 22 large PTX) were retrospectively chosen from the PACS database and uploaded to 3 iPads (3rd gen). Three radiologists and 3 EM physicians of equivalent experience (2 residents, 1 attending physician each) independently read the CXRs on the iPad running iRAS viewing application (ASTAR, Singapore) and a 5MP Barco monitor running Amalga PACS (Microsoft, USA). The sets were randomized and the PACS and iPad reading sessions were separated by 1 month to avoid memory bias. Each reviewer had to indicate the absence or presence and location of the PTX. The percentage of correct diagnosis was calculated for each display and reader. The detection accuracy of small and large PTX between both displays was also compared.

RESULTS

The iPad diagnoses of the 140 CXRs were accurate in 97.4% compared to 97.6% for PACS. In the CXRs that had PTX, the accuracy of the iPad was 95.0% compared to 97.4% for the PACS monitor (p=0.03). The diagnostic accuracy of the radiologists with the iPad was 97.8% compared to 94.5% with the EM physicians (p=0.002). 8.8% of small and 1.6% of large PTX were missed on the iPad, compared to 4.5% and 0.9% on PACS respectively.

CONCLUSION

Although there is overall high accuracy in diagnosis of PTX on CXR with the iPad, there was a statistically significant difference compared to conventional PACS monitors, and between radiologists and EM physicians, possibly due to small PTX.

CLINICAL RELEVANCE/APPLICATION

Potential clinical applications of 3rd generation iPad in the field of remote emergency diagnostic teleconsultation.

VSIN21-12 ● The Diagnostic Performance of a Tablet-PC with a High-resolution Display in Emergency MDCT Interpretation as Compared to a Dedicated 3D PACS Workstation

Susanne Tewes ; Thomas Rodt MD ; Steffen Marquardt ; Evdokia Evangelidou ; Frank K Wacker MD * ; Christian Von Falck MD (Presenter) *

PURPOSE

To evaluate a potential role of tablet PC with a high-resolution display (iPad 3) for the interpretation of emergency CT examinations in comparison to a dedicated 3D PACS workstation.

METHOD AND MATERIALS

Three readers compared the detectability of early signs of cerebral infarction and subtle pulmonary embolism in 40 CCT and 40 CTPA examinations using both,
Interventional Radiology Series: Peripheral and Visceral Occlusive Disease

Monday, 08:30 AM - 12:00 PM • E352

VSIR21-13 • Can the iPad Be Used in the Diagnosis of Bone Fractures: Preliminary Results

Spyros D Yarmenitis MD ; Maria T Tzalonikou MD (Presenter) ; Socratis Gavrillidis MD ; Grigoris Rigas MD ; Irene Vraka MD ; John Spigos BS ; Athanasios D Goulimas MD ; John Andreou MD ; Dimitrios G Spigos MD

LEARNING OBJECTIVES
1) Describe recent evidence concerning the use of renal denervation for malignant hypertension. 2) Explain the use of stent grafts in vascular disease. 3) Review the role of imaging in the diagnosis and management of peripheral and visceral occlusive disease.

RESULTS
On the diagnostic monitors, the attendings made 130 correct and 26 incorrect diagnoses, while the residents made 127 correct and 29 incorrect diagnoses. On the iPad, the attendings made 126 correct and 28 incorrect diagnoses, while the residents made 125 correct and 31 incorrect diagnoses. In the detection of fractures, the residents had a Sensitivity of 0.87%, a Specificity of 99.9%, and a Negative Predictive Value of 97.8%. As a group, the attendings and residents made 257 correct and 55 incorrect diagnoses on the monitors and 253 correct and 59 incorrect diagnoses on the iPad. There was no difference in the accuracy of interpretation among attendings and residents and no difference was found in their performance depending on the device used.

CONCLUSION
Based on this study, tablets will play an increasingly important role in the radiographic detection of bone fractures. Although the FDA approved monitors will continue as the diagnostic devices in Radiology departments, tablets will play an essential role as they are mobile and can be used in the Emergency department or for teleradiology purposes.

CLINICAL RELEVANCE/APPLICATION
Tablets can be used in the diagnosis of fractures in the emergency department and for consultation between physicians from afar.

Interventional Radiology Series: Peripheral and Visceral Occlusive Disease

Monday, 08:30 AM - 12:00 PM • E352

VSIR21-01 • CTA and MRA for PVD: Pitfalls of Peripheral Vascular CTA and MRA -Don't Make These Mistakes!

Barry Stein MD (Presenter)

LEARNING OBJECTIVES
1) Describe three pitfalls of CTA or MRA in peripheral vascular disease. 2) Examine the explain of stent grafts in vascular disease. 3) List two important studies published on vascular disease in the past year.

METHOD AND MATERIALS
Seventy-eight consecutive trauma cases were evaluated retrospectively. Skeletal radiographs and the corresponding diagnostic reports were retrieved from the PACS-RIS database. They included 39 upper extremities, 28 lower extremities, 7 spinal, 3 rib cages and 1 skull x-rays. Of the cases reviewed, 35 had fractures. The images were anonymized and distributed after randomization to two attending radiologists and to two radiology residents. They used diagnostic monitors and a non-retina display iPad2 device. DICOM images were transferred in a compressed 1263x1536 matrix.

RESULTS
The Tayside Screening for Cardiac Events (TASCFORCE) study assessed the ability of a number of biomarkers to identify subclinical atherosclerosis in individuals free from, and at low risk of cardiovascular (CV) disease. The CV imaging biomarker studied was a whole body atheroma score derived from whole body contrast enhanced magnetic resonance angiography (WBCE-MRA).

CONCLUSION
The image quality of the iPad 3 with a high-resolution display allows for a preliminary interpretation of typical emergency CT datasets.

CLINICAL RELEVANCE/APPLICATION
The image quality of the iPad 3 with a high-resolution display allows for a preliminary interpretation of typical emergency CT datasets.
METHOD AND MATERIALS
S000 volunteers > 45 yrs with no history of CV disease, a 10 year risk of CV disease less than 20% as assessed by the ASSIGN CV risk score and a B-type natriuretic peptide (BNP) greater than their gender specific median were invited. Of 1651 volunteers, 34 were ineligible due to safety issues, 107 were claustrophobic, and 1510 (91.4%) completed the 3T MRI (Siemens Trio, Erlangen, DE) MRI. WBCE-MRA was acquired from skull vertex to feet using following intravenous injection gadolinium gadoterate meglumine (Dotarem, Guerbet, FR). The subtracted WBCE-MRA data comprised 31 anatomical arterial segments. Each segment was scored according to the extent of luminal narrowing: 0 normal, 1 Results
277 of 46,810 (0.5%) arterial segments were un-interpretable due to poor quality images, or anatomical variation. Only 606 (40.1%) participants had a normal WBAS. The distribution of arterial abnormalities was head, neck and thorax in 403 (26.7%), abdominal 361 (24.0%) and peripheral arteries 366 (24.2%) of volunteers. The number of volunteers with WBAS of 1-267 (18%), 2-204 (13.5%), 3-117 (7.8%), 4-86 (5.7%), 5-68 (4.5%), 6-47 (3.1%), >7-114 (7.6%) volunteers respectively. Of the affected segments detected 1644 (76%) were <50% stenosis, 234 (11%) were 50-75% stenosis, 161 (7.5%) were 70-99% stenosis, 80 (3.7%) were occluded and 32 (1.5%) were aneurysmal vessels.

Conclusion
WBCE-MRA demonstrates the prevalence of atherosclerosis in 60% of asymptomatic people at low risk of cardiovascular disease based on accepted risk factors. The severity of disease ranged from

Clinical Relevance/ Application
Cardiovascular events occur in low risk people. WBCE-MRA demonstrates the sites and severity of atherosclerotic lesions in asymptomatic low risk individuals that may allow preventative therapy.

VSIR21-04 • Recommendations for Endovascular Treatment of PVD in 2013
Johannes Lammer MD (Presenter) *
Learning Objectives
1) To learn the indications for interventions in PAD. 2) To learn the technique and devices for aortoiliac treatment. 3) To learn the technique and devices for femoropopliteal artery treatment. 4) To learn the technique and devices for below the knee (BTK) treatment. 5) To learn the results of most recent trials. 6) To learn the medical treatment after intervention.

Abstract
To learn the indications for interventions in PAD To learn the technique and devices for aortoiliac treatment To learn the technique and devices for femoropopliteal artery treatment To learn the technique and devices for below the knee (BTK) treatment To learn the results of most recent trials To learn the medical treatment after intervention.

VSIR21-05 • Influence of Tube Voltage Reduction on Image Quality in MDCTA of Arterial Stents Using Model-based Iterative Reconstruction: A Phantom Study
Jochen M Grimm MD (Presenter) ; Lucas L Geyer MD * ; Daniel Maxien MD ; Zsuzsanna Deak MD ; Fabian Mueck ; Michael K Scherr MD ; Stefan Wirth MD *
Purpose
To evaluate dose saving potential and impact on image quality of tube voltage reduction in MDCT imaging of arterial stents using model-based iterative reconstruction (MBIR) compared to adaptive statistical iterative reconstruction (ASIR) in an anthropomorphic phantom.

Method and Materials
Different artery segments were filled with iodinated contrast medium, placed in a thoracic Alderson-Rando phantom and scanned at 120, 100 and 80 kVp at fixed tube currents (200, 100, 50mA). Luminal attenuation values (HU) and standard deviation (image noise; IN) were measured, contrast- (CNR) and signal-to-noise ratio (SNR) were calculated for ASIR and MBIR. Image quality (IQ) was assessed by two blinded radiologists using a 4-point scale. Wilcoxon’s test was used for statistical evaluation.

Results
Average IQ using MBIR was superior compared to ASIR at 120 and 100 kVp (p = 0.03). MBIR performed superior to ASIR at 120 and 100 kVp independent of tube current. At 80kVp, ASIR performed slightly better than MBIR, especially at lower tube current settings. Best resolution between IQ and CTDI was found using MBIR at 100kVp and 50mA, delivering an image quality superior to the best ASIR image at 16% of its CTID. MBIR significantly outperforms ASIR at 100 and 120 kVp. Tube current can be greatly reduced without sacrificing image quality while tube voltage should not be reduced below 100 kV.

VSIR21-06 • Impact of a Novel CT-based Calcium Scoring System of the Lower Extremity Arteries on Primary Patency Rates after Endovascular Interventions for Peripheral Arterial Disease: Preliminary Results
Holly L Nichols BS (Presenter) ; Stacey Schriber ; Charles Y Kim MD *
Purpose
For lower extremity artery lesions, the type and extent of associated calcification has been shown to affect immediate post-angioplasty results but the impact on long-term patency is unknown. The purpose of this project is to utilize a novel calcium scoring system to characterize arterial lesions and correlate with the primary patency rate after endovascular interventions.

Method and Materials
We reviewed our procedural database between 1/2005 – 12/2009 for lower extremity arteriograms that included an intervention on a stenosis or occlusion. Patients were included if there was no more than one lesion per leg and if a CTA of the lower extremities was performed within the preceding 6 months. A total of 66 lesions were identified in 47 patients (22 males, mean age 63 years). Each treated lesion was reviewed on the CTA for calcium scoring. Calcium morphology was described as none, thin linear, thick linear, or bulky. The percent circumferential was scored as none, 1-50%, 51-95%, or >95%. Primary patency was determined by recurrence of symptoms in that extremity or development of 50%+ stenosis at the treated site based on CTA or conventional angiography if available. Patency estimation was performed using the Kaplan-Meier method and comparing using the log rank test. The cutoff for statistical significance was a p-value = 0.05.

Results
Of 66 treated lesions, 54 underwent stenting and 12 underwent angioplasty, without significant difference in patency (p = 0.76). Overall, no significant difference in patency was identified based on morphology score alone (p = 0.74) or circumference score alone (p = 0.13). Subanalysis of extensive calcifications (thick linear or bulky calcification with >50% circumference), eccentric calcifications (thick linear or bulky with 1-50% circumference), or bulky eccentric calcifications stratified by arterial distribution revealed that only bulky eccentric calcifications in the SFA distribution resulted in a significantly decreased patency rate (p = 0.03).

Conclusion
Our preliminary findings suggest that this proposed calcium scoring system is predictive of post-intervention patency outcomes in the SFA distribution. Additional data is needed to fully evaluate this correlation.

Clinical Relevance/Application
Calcium scoring of atherosclerotic lesions may be predictive of post-intervention patency rates, which can help determine whether endovascular therapy should be performed for a given lesion.

VSIR21-07 • Robust 3D MRI Segmentation of Superficial Femoral Artery for Morphological Analysis of Peripheral Arterial Disease Plaque Burden
Eranga Ukwatta MENG (Presenter) ; Jing Yuan ; Bernard Chiu ; Wu Qiu ; Martin Rajchl ; Aaron Fenster PhD *
Purpose
Current lumpenfographic techniques have limited utility in the longitudinal assessment of peripheral arterial disease (PAD). With the advent of fast and non-invasive 3D black-blood MRA sequences, such as 3D motion-sensitized driven equilbrium (MSDE) prepared rapid gradient echo sequence (3D MERGE), superficial femoral artery (SFA) vessel wall can be evaluated up to 50 cm coverage for generating morphological measurements of PAD plaque burden. This study aims develop and evaluate a fast and precise algorithm for segmentation of the femoral artery outer wall and lumen from 3D MR images.

Method and Materials
Using multi-planar reformating software, the user selects approximate mid-points on transverse cross-sections of the artery 30 mm apart. The user selected points are then connected using the live-wire algorithm to find the rest of the points on the medial axis. The 3D image is then reoriented using the medial axis of the artery. A novel algorithm was then applied to jointly delineate the SFA lumen and outer wall surfaces from 3D black-blood MR images in a global optimization manner, while enforcing the spatial consistancy of the reoriented MR slices along the medial axis of the SFA. The accuracy of the algorithm was
elevated with respect to the manual segmentation. Our data set comprised of 355 2D slices extracted from 10 3D MR images from seven subjects. Five of these subjects were symptomatic with intermittent claudication.

RESULTS
The algorithm required only 1.8 min of total time to segment a 3D MR image compared to 70-80 min of user time for manual segmentation. The algorithm yielded Dice coefficients of 89.1±3.7% and 85.4±3.4% and mean absolute boundary distances of 0.44±0.1 mm and 0.40±0.1 mm, and maximum absolute boundary distances of 0.97±0.23 mm and 0.87±0.13 mm for the SFA outer wall and lumen. The reproducibility of the algorithm was computed using five repeated segmentations and the algorithm yielded intra-class correlation coefficient of 0.95 and coefficient of variation of 6.69% for generating vessel wall area.

CONCLUSION
The algorithm requires only 2-3% of the time required for manual segmentation, which significantly alleviates measurement burden while maintaining high accuracy and reproducibility.

CONCLUSION

The algorithm is suitable for generating morphological measurements of PAD plaque burden with high accuracy and reproducibility and it requires only 2-3% of time required for manual segmentation.
VSMK21-03 • Comparison of Fat-suppressed Fast Spin-echo Images with Different TEs in 3T Knee MRI: Diagnosis of Meniscal, Cruciate Ligament Tears and Cartilage Lesions

Moon Young Lee (Presenter) ; Won-Hee Jee MD ; Sungwon Lee MD ; Joon-Yong Jung MD ; Yong In

PURPOSE
To retrospectively determine if the sagittal fat-suppressed fast spin-echo (FSE) imaging with intermediate echo time (TE) has comparable accuracy with the short TE imaging in detecting not only the cruciate ligament tears but also the meniscal tears and cartilage lesions in 3T magnetic resonance imaging (MRI).

METHOD AND MATERIALS
The institutional review board approved this HIPAA-compliant study, and informed consent was waived. The study included 31 patients (21 men and 10 women; age range, 18-80 years) who underwent both arthroscopic and 3T knee MRI including sagittal fat-suppressed FSE with a short TE and two different intermediate TEs (17, 38, and 58). MR imaging were retrospectively analyzed by two independent reviewers and correlated with arthroscopic findings. Medial and lateral meniscal (MM, LM) tears and anterior and posterior cruciate ligament (ACL, PCL) tears were assessed with 5-point confidence scale and the cartilage defect of the medial femoral condyle was graded. The sensitivity, specificity, accuracy and interobserver agreement were calculated for each TE and the ROC curve of the confidence scales were compared

RESULTS
A total of 28 meniscal tears (17 MM, 11 LM) and 14 ligament tears (12 ACL, 2 PCL) and 20 cartilage lesions were confirmed by arthroscopy. The mean sensitivity, specificity and accuracy for MM tears were 100%, 73%, 89% at TE 17, 100%, 77%, 90% at TE 38, and 94%, 81%, 89% at TE 58; For LM tears 95%, 95%, 95% at TE 17, 95%, 97%, 97% at TE 38, 95%, 97%, 97% at TE 58; For PCL tears 76%, 83%, 76% at TE 17, 76%, 83%, 79% for TE 38, 76%, 89%, 82% at TE 58; For PCL tears 100%, 89%, 89% at TE 17, 100%, 93%, 92% at TE 38, 100%, 96%, 95% at TE 58; For cartilage lesions 100%, 95%, 95% at TE 17, 100%, 95%, 95% at TE 38, 100%, 95%, 84% at TE 58. Interobserver agreements were moderate to almost perfect in the meniscus, ligament and cartilage lesions (κ =0.584 to κ = 0.950). The ROC analyses revealed no significant difference between the TEs (P > .05).

CONCLUSION
A single sagittal intermediate-weighted FSE imaging may replace the sagittal short TE FSE imaging in diagnosing all meniscal, ligament and cartilage lesions at 3T.

CLINICAL RELEVANCE/APPLICATION
A single sagittal intermediate-weighted FSE imaging may replace the sagittal short TE FSE imaging in diagnosing all meniscal, ligament and cartilage lesions and save scan time at 3T.

VSMK21-04 • Measurement of Meniscal Extrusion Using Radial Multiplanar Reconstruction MR Imaging in Osteoarthritic and Non-arthritic Knees

Anish Ghodadra MD (Presenter) ; Flavia A Sakamoto MD ; Faysal Altahawi MD ; Carl S Winalski MD *

PURPOSE
Identify meniscal extrusion and validate measurements made using radially-oriented multiplanar reconstruction (rMPR) images. Determine location-specific extrusion differences between osteoarthrosis patients (OA) and healthy controls.

METHOD AND MATERIALS
rMPR images of each meniscus were created from 3D-DESS MR images of randomly selected subjects in healthy control (n=40) and progression (n=124) subcohorts from the Osteoarthritis Initiative. Patients with macerated meniscus were excluded. Extrusion relative to tibial edge (excluding osteophytes) was measured every 10-degrees for the entirety of each meniscus by one of two trained readers. Medial meniscal extrusion was measured in 10 subjects by both readers for inter-reader agreement. Sixty mid-body rMPR measurements were compared to standard extrusion measurements from mid-coronal IW-FSE images.

RESULTS
Inter-reader agreement for rMPR extrusion at all locations was high (r = 0.78). Correlation with mid-body coronal IW-FSE images was r=0.81. Median extrusion in the anterior, middle and posterior thirds of the medial meniscus was 1.2mm, 0.4mm and 0.2mm, respectively, for controls and 2.2mm, 1.8mm, and 0.9mm for OA (p 1mm of extrusion of the mid-body of the medial meniscus vs. only 25% of control menisci. Although greater in OA, mild anterior extrusion was also common in control subjects. There was no lateral meniscal extrusion for any controls or 76% of the OA group.

CONCLUSION
Extrusion can be reliably measured for the entire circumference of the meniscus using the rMPR technique. Significant differences in extrusion patterns were found between control and OA subjects with OA subjects generally having a greater degree of medial extrusion. Mild anterior extrusion of the medial meniscus may be a normal finding. The rMPR extrusion analysis may prove valuable for studying the influence of patterns of meniscal deformaties on OA incidence and progression as well as to help improve our understanding of the biomechanical implications of meniscal tears and partial meniscectomy.

CLINICAL RELEVANCE/APPLICATION
Medial meniscal extrusion differences between OA and controls are greatest in the body and postero-medial region. Lateral meniscal extrusion should be considered normal as it was not seen in controls

VSMK21-05 • Advanced Imaging of Arthritis

Andrew J Grainger MRCP, FRCR (Presenter) *

LEARNING OBJECTIVES
1) Review target sites at the knee joint affected by different forms of arthritis. 2) Recognise features of enthesisitis seen in seronegative arthritis at the knee joint. 3) Identify imaging findings of arthritis that help to make a disease specific diagnosis.

ABSTRACT
The knee joint is frequently affected by osteoarthritis and the features of the disease at this joint have been extensively studied. Recently imaging research has started to elucidate information relating to the etiology and symptomatology of the disease. However the knee is also affected by other forms of arthritis, including sero-positive and negative inflammatory arthritis and the crystal arthritides. While certain features of arthritis such as synovitis and cartilage loss are non-specific and seen in arthritis due to a variety of causes, the patterns of knee involvement, along with other more specific features will often allow a specific diagnosis to be made. This lecture will review imaging features of arthritis as they affect the knee joint and discuss how they help in making a diagnosis and what they can tell us about the disease etiology.

VSMK21-06 • Diagnosis of Internal Derangement of the Knee: 3D Isotropic Intermediate-weighted Fast Spin-echo with Fat Saturation versus without Fat Saturation

Young Cheol Yoon MD ; Ki Jeong Park MD (Presenter)

PURPOSE
To compare three-dimensional (3D) isotropic intermediate-weighted (IW) fast spin-echo (SE) magnetic resonance (MR) imaging with fat saturation (FS) and without fat saturation in regard to evaluation of ligaments, menisci and cartilage.

METHOD AND MATERIALS
The institutional review board approval and waiver of informed consent were obtained for this HIPAA-compliant study. Two radiologists retrospectively and independently reviewed one hundred MR studies. Each MR study consists of 3D isotropic IW fast SE with FS and without FS. The presence of cartilaginous defects, anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), medial meniscus (MM), and lateral meniscus (LM) tears were evaluated. Arthroscopic surgery findings are used for the reference standard. Statistical analysis was performed to calculate sensitivities, specificities, and accuracies of the two methods.

RESULTS
For cartilaginous defects and MM, specificity and accuracy of 3D isotropic IW fast SE without FS was significantly greater than with FS (cartilaginous defects, sensitivity, 84% vs 79%, accuracy, 92% vs 87%; MM, sensitivity, 84% vs 75%, accuracy, 87.5% vs 82%). The accuracy of 3D isotropic IW fast SE without FS for LM was also significantly higher than with FS (88.1% vs 83.5%). There was no significant difference in sensitivity between the two methods.

CONCLUSION
The performance of 3D isotropic IW fast SE without FS is better than with FS to evaluation of cartilaginous defects and meniscus.

CLINICAL RELEVANCE/APPLICATION
The MRI could be a reliable tool in differentiating the AM and PL tears of the ACL and helping with case selection for the single bundle ACL augmentation.

CONCLUSION

other injuries to the distal femur and proximal tibia were of a slightly different pattern in these two types of injury. Hence, this could be of help when

scrutinised against the arthroscopic findings. The specificity and sensitivity of the MRI findings were also evaluated as well as the inter-observer variability in the

We selected 35 cases of ACL rupture with arthroscopically proved solitary tear of either AM or PL bundle. The pre-operative MRI of these cases were randomly

PURPOSE

The MRI could be a reliable tool in differentiating the AM and PL tears of the ACL and helping with case selection for the single bundle ACL augmentation.

METHOD AND MATERIALS

Postoperative MR examinations of 15 patients who underwent PLC reconstruction by PLC sling through the fibular tunnel using allograft from 1 to 36 months

RESULTS

All 15 grafts were intact without disruption and all had biopsy-confirmed foreign body reaction. Five knees were unstable on physical examination at the time of

ABSTRACT

Tears of the anterior cruciate ligament are exceedingly common, and MR imaging plays an important role in demonstrating the degree of ligament damage as

METHOD AND MATERIALS

In a single cadaveric knee, the tibial attachment of the AHLM root ligament and ACL was imaged on an 11.7T MR system with a 3D GRE (TR20ms, TE7ms) sequence (112x112x120 mm resolution). Two blinded readers retrospectively reviewed 500 consecutive knee MRI examinations (6 month period). Studies were

RESULTS

High-resolution cadaveric MRI showed contribution of ACL fibers to the AHLM root ligament. The study population consisted of 479 patients, mean age 46

CONCLUSION

In postoperative MRI imaging of PLC reconstruction, increased signal intensity in posterior limb of the PLC sling appears to be related with time interval since

CLINICAL RELEVANCE/APPLICATION

Postoperative MR imaging after the PLC reconstruction can depict the increased signal intensity of the graft and thickening of peroneal nerve.

VSMK21-10 • Association of ACL and Anterior Horn Lateral Meniscus Root Ligament Anatomy and Pathology: 11.7 T MRI Anatomic Study with Retrospective Review of 500 Knee MRIs

Monica Tafur MD (Presenter) ; Guilherme M Cunha MD ; Ja-Young Choi MD ; Eric Y Chang MD ; Tanya Wolfson MS ; Anthony Gamst PhD ; Paul A DiCamillo MD, PhD ; Graeme M Bydder MBChB * ; Donald L Resnick MD ; Sheronda Statum ; Christine B Chung MD

PURPOSE

Anatomic studies have shown that few fibers of the anteromedial and posterolateral bundles of the anterior cruciate ligament (ACL) partially blend with the anterior horn of the lateral meniscus root ligament (AHLMR) fibers. This close relationship between the ACL and the AHLMR through these blended fibers (BF) might be a pathway for spread of lesions affecting the ACL. We sought to systematically evaluate the prevalence and association of ACL degenerative and traumatic lesions with abnormal MR appearance of AHLMR.

METHOD AND MATERIALS

In a single cadaveric knee, the tibial attachment of the AHLM root ligament and ACL was imaged on an 11.7T MR system with a 3D GRE (TR20ms, TE7ms) sequence (112x112x120 mm resolution). Two blinded readers retrospectively reviewed 500 consecutive knee MRI examinations (6 month period). Studies were

RESULTS

All 15 grafts were intact without disruption and 1 had biopsy-confirmed foreign body reaction. Five knees were unstable on physical examination at the time of

CLINICAL RELEVANCE/APPLICATION

Pathology of root ligaments may alter normal biomechanics of menisci, therefore the importance to identify potential patterns for spread of diseases affecting closely related structures such as the AC.

VSMK21-11 • Single Bundle Anterior Cruciate Ligament ruptures: Can We See It on MRI?

Alirez A Zavareh MD, FRCR ; Mike Bradley MBChB ; James Robinson MBBS ; Martin Williams MBChB ; Hyeladzira Thahal MBCh, MRCP (Presenter)

PURPOSE

To demonstrate the accuracy of MRI in diagnosing the solitary anteromedial (AM) and posterolateral (PL) bundle tears of the anterior cruciate ligament (ACL) ruptures.

METHOD AND MATERIALS

We selected 35 cases of ACL rupture with arthroscopically proved solitary tear of either AM or PL bundle. The pre-operative MRI of these cases were randomly

RESULTS

Both radiologists were able to pinpoint the correct torn bundle of the ACL. The inter-observer variability is more pronounced regarding the PL bundle tear. The

CONCLUSION

The MRI could be a reliable tool in differentiating the AM and PL tears of the ACL and helping with case selection for the single bundle ACL augmentation.

CLINICAL RELEVANCE/APPLICATION

There is an increasing trend among the knee surgeons to perform single bundle ACL augmentation instead of whole ACL reconstruction. A more detailed MR report is very helpful for optimal case selection.
VSNM21-12 • Diffusion Tensor Imaging in the Assessment of Double-bundle Structure of Anterior Cruciate Ligament: A Preliminary Feasibility Study

Xianfeng Yang MBCh (Presenter)

PURPOSE
To evaluate whether double-bundle structure of ACL could be imaged using diffusion tensor imaging (DTI) and tractography with a 3T MRI scanner.

METHOD AND MATERIALS
RESULTS
To our best knowledge, we present the first DTI and tractography results of human ACL. The courses of double bundle of ACL were first analyzed quantitatively using fractional anisotropy (FA), and then visualized in 3D with tractography. Tractography illustrated nicely the 3D courses of double-bundle structure of ACL and corresponded well to the known anatomy.

CONCLUSION
Quantitative DTI and tractography can be used to image and visualize the double-bundle structure of ACL.

CLINICAL RELEVANCE/APPLICATION
Three-dimensional view of the AMB and PLB could be a powerful tool to aid image interpretation and guide surgical approach.

VSNM21-13 • Medial Synovial Fold of Posterior Cruciate Ligament: Cadaveric Investigation with MRI and Histologic Correlation

Mimi Kim MD (Presenter) ; Seunghun Lee MD ; Bong Gun Lee ; Doo Jin Paik MD ; Jiyoun Bae

PURPOSE
The purposes of our study were to illustrate the MRI and cadaveric findings of medial synovial fold of posterior cruciate ligament (PCL) and to classify the types according to anatomic position.

METHOD AND MATERIALS
RESULTS
MRI studies of 22 cadaveric knees were performed. Two musculoskeletal radiologists prospectively reviewed MR images to classify medial synovial folding type of PCL in consensus. MRI types were categorized into three groups, a) invisible type, b) inferior and short type, c) inferior and long type. First, Invisible types didn't show definitive medial fold of PCL on MRI. And, inferior and short types showed visible medial fold without impingement. Finally, inferior and long types had long synovial fold, enough for impingement in the medial femorotibial joint. Correlations were made between findings derived from MRI studies and cadaveric dissections. Histologic analyses were also performed.

CONCLUSION
Medial synovial folding of PCL is thought to be a normal variant and may be shown in the high frequency of populations according to MRI and cadaveric studies.

CLINICAL RELEVANCE/APPLICATION
The point is that medial synovial fold of PCL from MRI images is normal variant, it is possible to reduce unnecessary examination.

VSNM21-14 • Posterior Cruciate and Collateral Ligament Injury Patterns

Joshua M Polster MD (Presenter)

LEARNING OBJECTIVES
1) Understand the anatomy of the posterior cruciate ligament and collateral ligaments. 2) Understand the pathomechanics of injury of these structures. 3) Understand the relevant clinical decisions made in relation to imaging findings.

ABSTRACT
Although posterior cruciate ligament injuries are less common than anterior cruciate ligament injuries, they can lead to significant disability, particularly when seen in conjunction with associated collateral ligament/posterolateral corner injuries. We will review the anatomy, mechanics of injury and imaging findings of these injuries with the objective of being able to provide clinically useful information for referring physicians.
Lesions vs. PERCIST 1.0: 31 of 43 evaluable by both PCWG2 and PERCIST 1.0 with 72.1% concordance and 12 cases discordant; 10 were R by PCWG2 but NR by RECIST 1.0, 6 were NR by RECIST 1.0 but R by PERCIST 1.0 with 3 alive and 3 dead after 22 mo; 3 cases were R by RECIST 1.0 but NR by PERCIST 1.0, 2 died within 1.9 months post therapy. Concordant results were observed in only 12 (11.5%) of the 104 lesions.

CONCLUSION
In the post-treatment setting, both FDG PET/CT and WBMRI provide information about the extent of disease, allowing for a more comprehensive evaluation of persistent or recurrent myeloma. MRI may often be false positive because of persistent non-viable lesions. Therefore, PET/CT might be more suitable than MRI for determination of remission status.

CLINICAL RELEVANCE/APPLICATION
PET/CT is the method of choice for an imaging based determination of the remission status in multiple myeloma after stem cell transplantation.

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**VSNM21-03** • The PERCIST Assessment of Response to Radioimmunotherapy in Patients with Lymphoma by Measuring a Single, 5 and All Tumor Lesions

Joo Hyun O MD (Presenter) ; Heather Jacene MD ; Jeffrey P Leal BA ; Richard I Wahl MD *

**PURPOSE**
To determine how well the different PET metrics in PET response criteria in solid tumor (PERCIST) correlate to each other for measuring fractional change before and after radioimmunotherapy.

**METHOD AND MATERIALS**
Patients with refractory or relapsed non-Hodgkin’s lymphoma received Bexxar (n=35) or Zevalin (n=14) therapy. FDG PET/CT studies were obtained before the radioimmunotherapy and 12 weeks after single dose of radioimmunotherapy. Three different PERCIST metrics were measured from the baseline and the post therapy FDG PET studies: 1) the peak standard uptake value corrected for lean body mass (SULpeak) of the single hottest tumor, 2) the sum of up to the 5 hottest SULpeaks, and 3) the total lesion glycolysis (TLG) of the entire tumor burden. The three PET metrics represent measurement of a single, up to the 5 hottest lesions, or the entire tumor burden. The fractional change for each PET metric was computed. (Percent change = [baseline measurement - follow-up measurement] / baseline measurement.)

**RESULTS**
For patients treated with Bexxar, the percent change in a single SULpeak correlated with the change of up to 5 SULpeaks (r=0.932, p<0.001). There was also a strong correlation between SULpeak and TLG (r=0.932, p<0.001) as well as SULpeak and TLG (r=0.932, p<0.001). The correlation coefficients for the three metrics were high and significant. For patients treated with Zevalin, the percent change in SULpeak was also significantly correlated with the change of up to 5 SULpeaks (r=0.932, p<0.001).

**CONCLUSION**
Tracking the single hottest SULpeak before and after radioimmunotherapy shows high correlation with both the analysis of up to the 5 hottest lesions and the entire tumor burden, both for Bexxar and Zevalin.

**CLINICAL RELEVANCE/APPLICATION**
Measuring just the one hottest SULpeak may adequately represent the entire tumor burden, saving the time and effort that goes into measuring multiple lesions.

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**VSNM21-04** • Role of 18F NaF PET-CT in Tumor Response Assessment of Skeletal Metastasis from Prostate Cancer: A Preliminary Analysis

Bhushan Desai MD (Presenter); Evan Allgood; Steven Cen PhD; Hossein Jadvar MD, PhD

**PURPOSE**
Conventional morphologic (CT) and functional (99m Tc-MDP bone scintigraphy) imaging methods for qualitative treatment response assessment of bone metastases have been inaccurate and poses a challenge in routine oncological practice and clinical trials. We hypothesize that bone-specific imaging with 18F NaF PET-CT might address an urgent need to develop an objective method for assessing tumor response in bone lesions which can clinically help physicians determine the effectiveness of systemic therapy.

**METHOD AND MATERIALS**
Our preliminary analysis included 21 prostate cancer patients who underwent a baseline and a follow-up 18F NaF PET-CT scan. Clinical (treatment), biochemical (PSA), and quantitative imaging (SUVmax) parameters were collected on these patients. Response was assessed using operational Imaging and PSA based treatment response criteria. Percentage change in AVG of SUVmax of all lesions for each patient was compared to changes in PSA and treatment, to assess if these changes correlated and accurately predicted treatment response. Patients were categorized as Progressors (P) vs. Non-Progressors (NP); Responders (R) vs. Non-Responders (NP) and cross-tabulation was done comparing Imaging and PSA-based response criteria.

**RESULTS**
R vs. NR: 14 of the 21 patients showed concordant response (66.7%). Of the 7 cases which were discordant: 3 were NR by Imaging but R by PSA with a change in treatment after the scan and 4 were R by Imaging but NR by PSA with only 1 patient undergoing change in treatment after the scan. P vs. NP: 7 of the 21 patients showed concordant response (33.3%). Of the 13 cases which were discordant: 5 showed P by Imaging but NP by PSA with a change in treatment after the scan and 8 were NP by Imaging but P by PSA with a change in treatment for only 2 patients.

**CONCLUSION**
Imaging based criteria captured progressors earlier than PSA and this was well correlated with the corresponding change in therapy post scan. Results of our preliminary analysis demonstrate that semi-quantitative analysis of 18F NaF PET/CT might serve as an important imaging tool for monitoring tumor response in bone lesions. These preliminary findings need to be validated on a larger cohort of subjects and assessed in a variety of tumor types as it might have a major implication in patient management.

**CLINICAL RELEVANCE/APPLICATION**
18F NaF PET/CT might serve as an important imaging tool for monitoring tumor response in bone lesions.
Reduction and Metabolic PET Measurements in Prediction of Progression Free Survival (PFS)

VSNM21-07 • Recurrent or Metastatic Thyroid Cancer

Ehab H Youssef

A group of 53 patients (37 males, 16 females), with advanced (stage III or stage IV) chemotherapy-refractory follicular B-cell lymphoma, aged 33-81 years

METHOD AND MATERIALS

Ten pts with MEL scheduled for treatment with ipilimumab (8 pts) or anti-PD-L1 (2 pts; BMS-936559) were enrolled. FDG PET/CT was performed at baseline (day -28 to 0) (PET1), and 4 wks (PET2) and 12 wks (PET3) after treatment initiation. The CT portion of the PET/CT was used for conventional restaging with RECIST 1.1 (REC) and WHO criteria. FDG PET was used for quantitative assessment with PERCIST 1.0 (PER). One pt was not able to receive PET3 due to rapid PD.

RESULTS

At PET3, 9/10 demonstrated PD by all criteria; one pt with lymph node < 1.5 cm in short axis was not evaluable by REC, but had stable disease (SD) by WHO and complete response (CR) by PER. However, when evaluating only index lesions and excluding new lesions as PD, the response for these cohort of patients showed varying clinical benefit by REC (4 SD), WHO (3 SD, 1 partial response (PR)), or PER (1 CR, 1 PR, 2 SD). 8/9 pts had increased tumor FDG uptake at PET2 (7.8% to 211% increase from baseline) of whom 2 had CR or PR on PET3 (100% and 49% decrease from baseline). 1/9 pts had decreased tumor FDG uptake at PET2 (28% decrease from baseline). We observed a pattern of increased tumor FDG uptake and dimensions at PET2 with subsequent improvement by PET3, suggesting the presence of tumor inflammation (anti-tumor immune response) on PET2.

CONCLUSION

Increased tumor FDG uptake at 4 weeks (PET2) may indicate inflammation preceding lesional response, or actual tumor progression. These preliminary data suggest that early increased FDG uptake may be necessary but not sufficient for tumor regression in pts receiving immune checkpoint blockade, requiring validation in larger trials.

VSNM21-08 • The Clinical Value of FDG PET/CT in Assessing Therapeutic Efficacy of Non-surgical Ablation Therapy for Radioiodine-negative Recurrent or Metastatic Thyroid Cancer

Kunihiro Nakada (Presenter); Hiroki Sugie MD; Keiichi Kamiyo MD, PhD; Masayuki Sakurai

PURPOSE

Percutaneous ethanol injection (PEI) and radiofrequency ablation (RFA) serve as feasible options for local control of radioiodine-ineffective thyroid cancer after surgery. The purpose of the study was to determine clinical value of PET/ CT using F-18 fluoroethoxylucose (FDG) in assessing therapeutic efficacy of PEI or RFA for radioiodine- negative metastatic thyroid cancer.

METHOD AND MATERIALS

The study consists of 108 metastatic tumors from thyroid cancer (100 metastatic nodes in the neck or mediastinum and 8 metastatic bone tumors) in 76 patients (PCA/CA 68/8) who had undergone total thyroidectomy and radioiodine ablation. All patients received high dose 1-131 therapy. However, 1-131 uptake in the metastatic tumor on the post-therapy scan was no or equivocal. Additionally, patients had relucance to further surgery or were at high risk for surgery due to other complications. Patients underwent FDG PET/CT within 2mos. prior to and between 1 and 2 mos. post completion of ablation therapy. FDG uptake in the tumor was visually assessed as positive or negative. Patients were followed up for 14-56mos. (median 31) to investigate clinical course of the treated tumors. Efficacy of PEI or RFA was determined based upon RECIST 1.1. Achievement of CR or PR was considered as successful.

RESULTS

On the pre-treatment PET/CT, all 109 tumors were FDG positive. Then 99 were treated by PEI while 9 were treated by RFA. On the post-treatment PET/CT, FDG uptake was negative in 76 (70%) and was persistently positive in the remaining 33 (30%). In the FDG negative tumors, CR and PR were observed in 55 (70%) of the 79 tumors treated by PEI (73% successful). 14/56 (25%) and 8/79 (10%) of the tumors treated by RFA were PEI (100% successful). Both PEI and RFA demonstrated equivalent response rates with similar clinical outcomes. 11/131 (85%) of tumors showed improved clinical response by PEI or RFA.

CONCLUSION

Almost all tumors with negative FDG uptake after treatment showed good response. In contrast, tumors with persistent FDG uptake were associated with poorer response and the risk of tumor regrowth was 4 times higher than that in FDG negative tumors. FDG PET seems valuable in assessing efficacy of non-surgical ablation therapy for metastatic thyroid cancer.

VSNM21-09 • Response Assessment Recommendations after Radiation Therapy

Terence Z Wong MD, PhD (Presenter) *

LEARNING OBJECTIVES

1) Understand the physiology of normal tissue response to radiation therapy. 2) Understand potential limitations of PET/CT imaging following radiation therapy. 3) Suggest potential strategies for evaluating patients following radiation therapy.

ABSTRACT

FDG-PET/CT imaging following radiation therapy can be complicated, due to the resulting inflammatory response. These post-radiation effects can mimic residual or recurrent tumor, and may preclude accurate determination of response to therapy. The extent to which radiation therapy effects influence interpretation of PET/CT scans is highly dependent on the organ site and time-dependent normal tissue response. Armed with this knowledge, it is often possible to distinguish radiation changes from tumor. Several strategies are available to improve accuracy of post-treatment PET/CT. Waiting for several months following radiation therapy allows the inflammatory response to subside. Alternatively, imaging early in the course of radiation therapy may allow response to be evaluated before the inflammatory response occurs. Additional PET tracers, such as F-18 fluorothymidine as a marker of cell proliferation, may be less affected by the inflammatory reaction. Therapeutic strategies can be designed to minimize the impact of radiation effects; for example chemotherapy can be initiated prior to combined chemoradiation, allowing PET/CT to measure the response to the chemotheraphy prior to starting radiation therapy.

VSNM21-10 • Early Assessment of Therapeutic Response of Radioimmunotherapy (RIT) in Non-Hodgkin Lymphoma: Comparing Tumor Volume Reduction and Metabolic PET Measurements in Prediction of Free Survival (FPS)

Ehab H Youssef MD, FRCR (Presenter); Yuni K Dewaraja PhD; Hatice Savas MD; Matthew Schipper; Shen Jincheng; Mark S Kaminski *; Anca Avram MD

PURPOSE

To evaluate if initial tumor volume reduction and metabolic response predictions free survival (FPS) in patients with advanced follicular non-Hodgkin lymphoma (NHL) receiving 131-I Tositumomab therapeutic regimen.

Tumor volumes were measured on CT component of SPECIT/CT (at 6 days and 2 weeks), and of PET/CT at 2 months post-RIT; qualitative metabolic response (defined as a negative "complete metabolic response" for disease) was assessed on PET/CT at 2 months post-RIT. Clinical and imaging follow-up was continued for all patients until they progress 1-51.5 months (average 9.3).

METHOD AND MATERIALS

A group of 53 patients (37 males, 16 females), with advanced (stage III or stage IV) chemotherapy-refractory follicular B-cell lymphoma, aged 33-81 years (median age 54) received 131-I Tositumomab therapy based on whole body dosimetry calculations with the goal of delivering 75 Gy whole body radiation absorbed dose for patients with platelets > 150,000/mL, or 650Gy for patients with platelets
New Spine MR Techniques

Lawrence N Tanenbaum MD (Presenter) *

LEARNING OBJECTIVES
1) To become familiar with the role of diffusion imaging in evaluation of the spine. 2) To become familiar with the methods for optimization of diffusion of the spine. 3) To become familiar with the potential role of MR spectroscopy in evaluation of the painful disc.

The Use of Deformable External Dielectric Pad in 3T Cervical Spinal Cord MR Imaging to Enhance Image Quality

Dan T Nguyen MD (Presenter) ; Christopher Sica PhD ; Sebastian Rupprecht BS ; Jeff Veseck MS ; Gary Thomas MD, MBA * ; Qing X Yang PhD

PURPOSE
Recent development of an external deformable dielectric pad potentially allows regional image intensity enhancement and reduces center-bright artifact for MR Imaging, especially in high field magnet. The purpose of this study is to validate such theoretical advantages of the dielectric pad in applying to cervical spinal cord MR Imaging.
METHOD AND MATERIALS
In 5 clinical patients with Multiple Sclerosis, the 3T cervical MRI studies were acquired without and with the application of the dielectric pad, which surrounds the bottom and sides of the neck. Multi-slice sagittal and transverse turbo spin-echo (TSE) image sets (PD, T1W, T2W in 3mm thickness) were acquired, with some additional scans at 1mm and 1.5 mm thickness to better visualize MS lesions. A Neuroradiologist evaluated the images, and signal-to-noise (SNR) measurements were made in several discs (Cl-C4) with the TSE images and separate gradient-echo images with noise scans.

RESULTS
The images in the figure were acquired without (left) and with (right) the external dielectric pad. Images with the pad demonstrates enhanced clarity, permitting visualization of several intramedullary cord lesions, whereas the lesions are not visible in the image without pads due to insufficient SNR. The SNR enhancement among the 5 patients in C1 - C4 was in the range of 0 to 60%, with typical enhancement around 20 to 40%. The pads reduced scan power in the range of 31 to 50%, with an average reduction of 38.8%.

CONCLUSION
The use of the deformable external dielectric pad enhances the visualization of cord lesion while reduces tissue energy deposition. This ability can aid in improved and earlier diagnosis or treatment followup of spinal cord pathologies.

CLINICAL RELEVANCE/APPLICATION
The application of an external deformable dielectric pad potentially enhances image quality of the spinal cord in this cervical anatomical region that is well known to have local field inhomogeneity.

VSNR21-03 • Evaluation of Works-in-Progress Dixon Fat Suppression in Spine, Musculoskeletal and Neck Imaging Compared with Routine Imaging
Yair Safriel MBCh (Presenter) *; Brian M Dale PhD *

PURPOSE
Homogeneous fat suppression (FS) on T2 and post contrast T1 imaging is challenging in extremity, spine and neck imaging due to field heterogeneity and/or the presence of orthopedic hardware. FS may fail completely, result in paradoxical water suppression or, sometimes worse of all, generate an image with regions of successful and failed FS on the same image. Alternatives to FS are inversion recovery (IR) or gradient, however, these may have different imaging characteristics for certain anatomy or pathology compared to Turbo Spine Echo (TSE). Dixon FS (DFS) is robust to field heterogeneity and does not alter the sequence’s imaging characteristics.

METHOD AND MATERIALS
Review Board approval was obtained. DFS separately acquires images where the fat and water signals are in- and opposed-phase. Field inhomogeneity changes the overall phase, but does not change the relative phase between fat and water. Therefore, DFS uses the relative phase information to suppress fat in a manner insensitive to field inhomogeneity. Over a 6 week period the following DFS was applied to: All neck MR’s, all spinal post contrast MR’s and a random selection of noncontrast spine and musculoskeletal MR’s. In all cases the DFS was obtained in addition to routine T1 or T2 FS sequence. Sequences were performed on a variety of 1.5 and 3T (Espree, Avanto and Tim Trio, Siemens, Germany). Each sequence was scored for edge artifact, FS homogeneity, metal artifact and visualization of pathology.

RESULTS
34 DFS sequences (11 lumbar, 7 thoracic and 7 cervical spine, 3 joints, 3 pelvis and 3 necks) were scanned. T2 and T1 DFS scored better or equivalent to T2FS and T1FS in 97% and 100% of cases (P<0.05). DFS has potential to improve imaging of implanted hardware, on both 1.5T and 3T. It may also improve diagnostic confidence, possibly obviating additional or invasive procedures. Further work is needed to better define the parameters prior to commercial release.

CLINICAL RELEVANCE/APPLICATION
DFS markedly improves FS image quality in T2 and post contrast T1 sequences without altering the expected signal characteristics of anatomy or pathology.

VSNR21-04 • Iatrogenic Disorders in the Spine
Erik H Gaensler MD (Presenter)

LEARNING OBJECTIVES
This presentation will review the wide spectrum of spine imaging findings that can be due to medical intervention, including diagnostic procedures, radiation therapy, chemotherapy, therapeutic spinal injection procedures, and surgery. The pertinent findings, differential diagnosis and pitfalls of such ‘Iatrogenic Disorders’ will be discussed.

VSNR21-05 • Has Utilization of MRI of the Lumbar Spine Decreased in Response to Appropriateness Criteria for Imaging of Low Back Pain?
David C Levin MD (Presenter) *; David P Friedman MD; Laurence Parker PhD; Vijay M Rao MD

PURPOSE
The overuse of MRI for low back pain (LBP) has been a concern. Appropriateness criteria which have long been promulgated by the ACR, radiology benefits management companies, and other organizations have stated that MRI is generally not indicated in LBP without a prior trial of conservative management, unless certain “red flags” are present. It is unclear to what extent referring clinicians are aware of or have accepted these criteria. Our purpose was to determine if the utilization of lumbar spine MRI has decreased accordingly, using a large population database.

METHOD AND MATERIALS
The nationwide Medicare Physician/Supplier Procedure Summary Master Files for 1999 through 2011 were used. They cover the 36.3 million beneficiaries in the US with $5000+ in annual spending. CPT code 72148 (lumbar spine MRI without contrast) was selected and analyzed. The vast majority of these studies are done with LBP as the indication. Procedure volumes each year were determined by tabulating all global and professional component claims. Technical, component claims were excluded to avoid double counting. Utilization rates per 1000 beneficiaries were calculated for all provider specialties and all places of service.

RESULTS
In 1999, the total utilization rate of code 72148 was 14.7 exams per 1000. The rate increased progressively till it reached 32.2 in 2008, representing a compound annual growth rate of 9.1%. From 2008 through 2011, there was essentially no change in the rate. In 2011, the rate was 32.3.

CONCLUSION
Given the general consensus that early MRI of LBP is usually unnecessary, one might expect the utilization of this procedure to be declining to at least some degree. Instead, it grew rapidly through 2008, then remained unchanged through 2011. Several unrelated factors could have contributed to growth, such as patient demand, concern about malpractice liability, etc. However, even taking these into account, it appears that the appropriateness criteria have had no discernible impact on reducing MRI utilization. This represents an opportunity for radiologists to educate their clinical colleagues about the proper indications for use of this widely performed imaging test.

CLINICAL RELEVANCE/APPLICATION
Not applicable

VSNR21-06 • Does the Preoperative Trans-artery Embolism Decrease the Blood Loss during Spine Tumor Surgery?
Ningyang Jia MD, PhD (Presenter); Zhiquong Qiao; Qian He

PURPOSE
This paper aimed to evaluate the effect of pre-surgery trans-artery embolism (TAE) on the intra-operative blood loss during surgical excision of the vertebral tumor.

METHOD AND MATERIALS
RESULTS
This study showed that the pre-surgery TAE of the spinal tumor had no significant effect on the intra-operative blood loss during the surgical excision of the spinal tumor.

CLINICAL RELEVANCE/APPLICATION
View of the risk of embolism, such method should be carefully considered.

VSNR21-07 • Evaluation and Treatment of Cerebrospinal Fluid Hypotension


Treatment in Acute Non Osteoporotic Vertebral Fractures

Intracranial CSF hypotension is a disorder that presents primarily with postural headache and specific MR features. In this presentation, we will discuss the clinical presentation, common pathologic entities, diagnostic workup and therapeutic options and potential complications for these patients with spontaneous intracranial hypotension.

VSNR21-08 • Detection of Spontaneous Cerebrospinal Fluid Leak Using Dual-energy CT Myelography

Qiawei Zhang MD, PhD (Presenter); Dang Wang MD; Xiang-Yang Gong PhD

PURPOSE
To investigate the accuracy of detecting spontaneous cerebrospinal fluid (CSF) leak using dual-energy CT iodine map and virtual normal-contrast (VNC) images compared with mixed images.

METHOD AND MATERIALS
64 patients (22 men and 42 women, mean age 40.3±9 years) with suspected spontaneous CSF leak underwent dual-energy CT myelography (CTM). The tube voltages were Sn140 and 100 kVp. The images of two tubes were mixed at the ratio of 0.5 and served as simulated 120 kVp images. The iodine map and VNC images were calculated. Two radiologists independently reviewed the iodine map/VNC images and the mixed images to identify the CSF leaks along the nerve roots, high-cervical retrospinal CSF collections, and other findings.

RESULTS
Using iodine map and VNC images, 421 leaks were found in 56 patients. Using mixed images, 454 leaks were found in 56 patients. The accuracy of detecting CSF leak was 92.7% in per-leakage analysis, and was 100% in per-patient analysis. There is no difference in detecting high-cervical retrospinal CSF collections (n=17). Most of the spinal CSF leaks occurred at the lower cervical region and cervicothoracic junction (C4/5-T1/2, 55.7%).

CONCLUSION
The dual-energy CT can detect spontaneous CSF leaks using iodine map/VNC images. With dual-energy CT, the iodine leaked into the perisinal area can be confidentially identified. Multiple simultaneous leaks may occur.

CLINICAL RELEVANCE/APPLICATION
The dual-energy CT can improve the diagnostic confidence of CSF leakage detection.

VSNR21-09 • The Back Pain Outcomes Using Longitudinal Data (BOLD) Project- Baseline Data from a Prospective Cohort of ~5,000 Seniors with Back Pain

Jeffrey G Jarvik MD, MPH (Presenter)*; Brian W Bresnahan PhD*; Bryan A Comstock; Richard A Deyo MD, MPH; Janna Friedly; Patrick Heagerty; Larry G Kessler; David Rundell MS; Judith Turner; Andrew Avins; Srdjan Nedeljkovic; David Nerenz; Zoya Bauer; Katherine T James

PURPOSE
To describe how pain, functional status and health related quality-of-life vary by demographic factors among seniors presenting to primary care providers with new episodes of low back pain.

METHOD AND MATERIALS
We enrolled patients 65 years old who presented to a primary care provider with a new episode of back pain. We recruited study participants from three integrated health systems (Kaiser-P N CA, Henry Ford-Detroit and Harvard Vanguard Med Assoc -Boston). Baseline measures included: 1) Roland-Morris Disability Questionnaire (RMDQ); 2) 0-10 pain numerical rating scales (NRS); 3) Brief Pain Inventory (BPI); 4) Patient Health Questionnaire (PHQ)-4; 5) EuroQol-SD (EQ5D); 6) Pain duration; 7) Patient expectations. We examined demographic characteristics, comparing the three recruitment sites. We used the chi-square test to compare categorical variables and unpaired t-tests to compare numerical variables and the Mann-Whitney U-test when appropriate.

RESULTS
We enrolled 5,288 patients. RMDQ had a small increase with age, from a mean (SD) of 9.1(6.6) at ages 65-69 to a mean of 10.7(6.1) for those greater than 85. The average pain duration also increased with age (32% of those 65-69 having had pain of more than a year compared with 44% >85). The oldest age group had slightly lower confidence (4.9(3.7) vs. 5.6(3.7)) that they would be pain-free or substantially improved by 3 months.

African American (AA) patients were worse on most baseline measures of function and pain. Eg: the median/RMDQ scores were 12.1/13 in AAs compared with 8.6/8 for Caucasians. Because over 50% of AAs were at Detroit, confounding by site may be a factor. However, within a given site, AAs had worse scores than Caucasians by more than 1 point on the Roland scale by more than 1 point on the Roland scale by more than 1 point on the Roland scale by more than 1 point on the Roland scale.

There were substantial differences between sites with respect to potentially important prognostic demographic factors and baseline reported measures.

CONCLUSION
We observed substantial differences of our baseline measures between sites, emphasizing the need for caution when pooling results from a multicenter study. African-Americans appeared to have worse back-related health status in our cohort although confounding by site was present.

CLINICAL RELEVANCE/APPLICATION
There is great heterogeneity between sites with respect to baseline characteristics of seniors with back pain. Worse health status among African-Americans may be explained, in part, by site factors.

VSNR21-10 • Kyphoplasty vs Vertebroplasty: Economics and Evidence Base

David F Kallmes MD (Presenter) *

LEARNING OBJECTIVES
1) To update the community regarding relative costs between the procedures. 2) To update the community regarding recent changes in reimbursement for the procedures. 3) To gain insight into the current practice patterns for both procedures, including procedure volumes and practitioner specialty. 4) To review procedures. 5) To explain, in part, why site factors.

There is great heterogenity between sites with respect to baseline characteristics of seniors with back pain. Worse health status among African-Americans may be explained, in part, by site factors.

VSNR21-11 • Efficacy of Vertebroplasty for Non Osteoporotic Spinal Compression Fractures. The VOLCANO Study: Vertebroplasty vs. Conservative Treatment in Acute Non Osteoporotic Vertebral Fractures

Adrian I Kastler MD, MSc (Presenter); Eulalie Huguenot; Betty Jean MD; Jean Gabrilargues; Bruno Pereira; Emmanuel Chabert; Aurelien Coste; Beatrice Claise; Viorel Achim; Toufik Khall; Denis Sinardet; Guillaume Coll; Bernard Irthum; Jean Chazal

PURPOSE
Post Traumatic vertebral compression fractures (VCF) are commonly treated with braces. Vertebroplasty may be an alternative treatment. The aim of this prospective study is to assess the effectiveness of vertebroplasty for non osteoporotic compression fractures in the acute setting compared to conservative management.

METHOD AND MATERIALS
This prospective, randomized, non-blinded, single-center study was carried out in France between 2010 and 2012. Patients aged from 18 to 70 suffering from acute C2 fracture were included after written informed consent. Intermediate analysis performed after 100 inclusions (52 vertebroplasties and 48 bracing) showed a statistical significance in the primary outcome and lead to premature discontinuation of the study. At one month, mean RDQ was 7.56 in the vertebroplasty group and 11.1 in the brace group (p=0.004). At 6 month the difference decreased, still in favor of vertebroplasty (3.7 vs 2.61, p =0.07). A higher pain reduction at 48h post trauma was significant in the vertebroplasty group (p =0.009).

CONCLUSION
Our study showed a significant improvement in back pain related disability in patients with post traumatic vertebral fractures treated in acute phase by vertebroplasty compared to patients treated by braces. At follow up controls, vertebral height's loss was significantly higher in the bracing group.

CLINICAL RELEVANCE/APPLICATION
Acute vertebral compression fracture is a painful condition usually treated with bracing. Vertebroplasty management appears to be safe and effective and should be considered as an alternate treatment.

VSNR21-12 • Neoplastic Lytic Vertebral Lesions with Erosion of Posterior Wall and Epidural Mass: An Absolute Contraindication to Vertebroplasty?
PURPOSE
To assess technical and clinical complications of Percutaneous Vertebroplasty (PV) performed for pain palliation and/or stabilization of neoplastic lytic vertebral body lesions, with cortical erosion of the posterior wall (CE-PW), often associated with soft tissue epidural mass (EM).

METHOD AND MATERIALS
Retrospective assessment of technical and clinical complications of PV on 54 consecutive levels (8 cervical, 28 thoracic, 18 lumbar) with CE-PW, in 38 patients. EM was present in 35/54 levels. Lytic lesions were metastasis from solid tumors at 43 levels, multiple myeloma at 8, and lymphoma at 3. The procedures were variably performed before, during, or after radiation treatment and/or chemotherapy. All procedures were performed under fluoroscopic guidance, combined to CT-guidance for 8 levels. Cavity-creation was performed with plasma-field-activated radiofrequency (coablation) wands in 50/54 levels, prior to cement injection. Post-procedural CT of the treated levels was obtained in all cases. Clinical follow-up was performed at 1 and 4 weeks post-procedure.

RESULTS
In 30/54 levels the PV resulted in satisfactory PMMA filling of the lytic cavity and adjacent trabecular spaces, especially in the weight-bearing anterior half of the vertebral body. An epidural leak of PMMA occurred in 7/54 levels. This resulted in limited cement injection in 2/7 cases, resulting in technically unsatisfactory stabilization. One of these patients presented with a new compression fracture at the same level which required re-treatment. Two patients reported radicular pain after the PV, likely related to the epidural leak, spontaneously resolving within one week. No patients reported worsened pain at one week follow-up. No cases resulted in worsening of neurological function.

CONCLUSION
In our series of PV of neoplastic lytic vertebral lesions we observed an epidural leak of PMMA in only 14 % of patients despite presence of CE-PW and EM, with extremely low rate of transient clinical complication, without major or permanent complications. Our data seem to justify use of PV in such patients with intractable pain or at risk for vertebral collapse.

CLINICAL RELEVANCE/APPLICATION
Cement augmentation of neoplastic lytic spine lesions can be performed with safety also in cases with posterior wall erosion, provided adequate technique and skills level.

Pediatric Radiology Series: Fetal - Neonatal Imaging
Monday, 08:30 AM - 12:00 PM • S102AB

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Moderator
Richard A Barth, MD *

VSPD21-01 • Fetal Neuro Imaging
Beth M Kline-Fath MD (Presenter)

LEARNING OBJECTIVES
1) The participant will briefly review basic prenatal neurosonology and fetal MR imaging sequences. 2) The embryoology of the fetal brain will be correlated with important landmarks identified on MR imaging for each gestational age. 3) The learner will be able to utilize the appearance of the germinal matrix, brain parenchymal signal, sulcation and myelination to verify normal fetal brain anatomical milestones.

ABSTRACT
VSPD21-02 • Does Fetal MRI Add Clinically Important Information in Cases of Isolated Ventriculomegaly Revealed by Tertiary Antenatal Ultrasound?
Stacy K Goergen MBBS (Presenter); Tejaswi Kandula MBBS; Michael Fahey MBBS, PhD *

PURPOSE
Antenatal counselling for fetal cerebral ventriculomegaly (VM) is guided by size of the ventricles and the presence and nature of concurrent structural abnormalities. There are limited consensus guidelines regarding the role of fetal magnetic resonance imaging (FMRI) as an adjunct to ultrasound (US) in cases of isolated VM (IVM). The evidence suggests that MRI is indicated when IVM on US is severe (>15mm), but there is less agreement about its role when IVM is mild or moderate (10-15mm). Our aim was to evaluate the incidence of additional findings on FMRI when IVM is identified on tertiary level antenatal US.

METHOD AND MATERIALS
We prospectively analyzed data from a single university affiliated, tertiary referral fetal diagnostic / therapy unit. Inclusion criteria were singleton or twin pregnancies evaluated with antenatal US performed prior to FMRI with a resulting diagnosis of IVM. Aminocentesis was offered prior to FMRI but variably performed depending on maternal preference.

RESULTS
59 pregnancies studied between November 2006 and February 2013 fulfilled inclusion criteria. Median gestational age at US was 26 weeks (21-36) and timing of FMRI was 28 weeks (22-37). Median time elapsed between US and FMRI was 7 days (0-21). In 41/59 cases, there was agreement between ultrasound and MRI regarding severity of VM. Additional findings on FMRI were seen in 5/42 fetuses (11.9%) with US diagnosed mild VM, 0/10 with moderate VM, and 4/7 (57.1%) with severe VM. Of these 9 cases, 2 had amniocentesis both with a normal result. The additional findings were clinically significant in 2/5 cases with mild VM compared with 4/4 cases with severe VM. These included periventricular nodular heterotopia, foramen of Monro subependymal nodule in tuberous sclerosis, absent septum pellucidum with postnatal diagnosis of septooptic dysplasia, and agenesis of the corpus callosum.

CONCLUSION
Clinically significant cranial abnormalities on FMRI, specifically midline malformations and malformations of cortical development, were identified in 5% of fetuses with mild to moderate IVM on tertiary antenatal US. The low rate of additional findings in this group is consistent with other recently published data.

CLINICAL RELEVANCE/APPLICATION
We see the low yield of clinically important abnormalities on FMRI when VM is isolated and mild to moderate in severity on high quality antenatal US as informing antenatal counselling and referral pathways.

VSPD21-03 • Can Prenatal US Stand Alone to Diagnose Microcephaly or Is Fetal Head MRI Needed?
Gal Yaniv MD, PhD (Presenter); Eldad Katorza; Vered P Tsehmaister Abitol MD; Gilad Twig; Salim Bader; Eli Konen MD; Chen C Hoffmann MD

PURPOSE
To evaluate the agreement between ultrasound (US) and fetal head magnetic resonance imaging (feMRI) head biometry.

METHOD AND MATERIALS
A retrospective analysis was performed on 60 sequential feMRI scans obtained between 2011-2013 following US diagnosis of microcephaly w/o/severe intratertiary growth retardation (IUGR: head circumference =/= standard deviations [SD] and estimated fetal weight [EFW] =/= SD). Inclusion criteria were single fetus and fewer than 21 days between performance of US and feMRI. The mean gestational age (GA) of fetuses at US and feMRI acquisition was 33±3.3 and 34±3.3 weeks, respectively. The mean interval between US and feMRI scanning was 7.3±6 days. Biparietal diameter (BPD) and occipitofrontal diameter (OFD) results were converted to percentiles and SD by Chervenak and Hadlock normograms for US and compared to Garel normograms for feMRI. US measurements of OFD were recorded in 36/60 of the scans. Data on GA, EFW and interval between scans were also recorded.

RESULTS
Forty-two of the 60 fetuses with US-suspected microcephaly (70%) were IUGR. BPD values were =/> SD in only 5 (8.3%) according to feMRI (PP)

CONCLUSION
There is discrepancy between US and feMRI findings in the assessment of fetal head biometry. US measurements are performed only on the skull, while feMRI enables direct measurement of the brain. Abnormal anatomical findings are more predictive for true microcephaly in both US and feMRI. Thus, diagnosis of microcephaly by US alone is not sufficient and should be validated by feMRI before a final diagnosis is established and consultations with the parents are held.

CLINICAL RELEVANCE/APPLICATION
The diagnosis of microcephaly can lead to pregnancy termination, and diagnosis by US alone is insufficient and requires confirmation by a teMRI study.

VSPD21-04 • Evaluation of ADC Values of the Dead Fetus Compared to Fetal Brain Infarct and Normal Siblings in Twin Pregnancies Complicated with TTTS

Ronen Bercovitz RT, MA (Presenter); Boaz Weisz; Gal Yaniv MD, PhD; Chen C Hoffmann MD; Shlomo Lipitz; Anat Biegon; Eldad Katorza

PURPOSE
To evaluate the ADC values in the dead fetus, compared to brain infarct and to normal siblings in cases of monochorionic biamniotic (MCBA) twins, suffering from complications of twin to twin transudation syndrome (TTTS).

METHOD AND MATERIALS
A retrospective analysis was performed on 70 sequential MRI scans of fetuses in cases of MCBA pregnancies complicated with TTTS between 2009-2012. 15 women with MCBA pregnancies (mean maternal age 31 years, gestational age range 18-32, 1-4 scans/subject) were included. Follow up scans performed 1-72 days after ischemia to monitor the living remaining fetus. Whole brain ADC values (expressed in mm2/secx10^-6) were obtained at 5 weeks after ischemia. In the cases with infaracts ADC was measured in the infarcted zone. All measurements were performed using a GE workstation. The results of the dead fetuses and of the infarcted zones in the living fetuses were compared to the normal siblings.

RESULTS
The mean (SD) ADC value in the normal fetuses was 1675 (277), compared to 684 (165) in dead fetuses and 1097 (546) in infarcted brains.

CONCLUSION
The ADC value in dead fetuses increases slowly with time, and does not reach normal values even months after death, while the values in the infarcts of the living fetus normalize within 2 weeks, as was reported in early life and in adulthood. The reason for this phenomenon is unclear, and may be due to the unchanged environment of the dead fetus while the pregnancy continues with the second healthy sibling. A second factor may be lack of blood flow in the dead fetus, thus the tissue is ‘frozen’ and not liquefied.

CLINICAL RELEVANCE/APPLICATION
The time of death of a fetus cannot be determined by the low ADC value, which can stay low for more than 5 weeks.

VSPD21-05 • Congenital Diaphragmatic Hernia: Fetal and Neonatal Correlation

Christopher I Cassady MD (Presenter)

LEARNING OBJECTIVES
1) Identify the application of basic anatomic, pathologic, and physiologic principles to congenital diaphragmatic hernia. 2) Analyze imaging and therapeutic techniques and apply this knowledge to protocol development, patient management/safety, and cost in the management of CDH. 3) Demonstrate understanding of the influence of socioeconomic issues on current and future practice patterns for this referral. 4) Compare indications for specific imaging strategies in CDH.

VSPD21-06 • Correlation of the Observed-to-Expected MR Fetal Lung Volume and the Observed-to-Expected US Lung-to-Head Ratio at Different Times of Gestation in Fetuses with Congenital Diaphragmatic Hernia

Katrin Kastenholz (Presenter); Anna Walleyo; Christel Weiss; Angelika Debus MD; Claudia Hagelstein MD; Meike Weidner; Thomas Schaible; Stefan O Schoenberg MD, PhD*; Karen Busing; Sven Kehl MD; Wolfgang Neff MD, PhD

PURPOSE
Determination of the observed-to-expected fetal-lung-volume (o/e MR FLV) and observed-to-expected lung-to-head ratio (o/e US LHR) are both quantitative methods to predict clinical outcome in fetuses with congenital diaphragmatic hernia (CDH). The purpose of this study was to evaluate the potential of the o/e MR FLV and o/e US LHR to evaluate survival, need for extracorporeal membrane oxygenation (ECMO) therapy and development of chronic lung disease (CLD) at different times of gestation (32 weeks gestation (w.g.) and especially to individually compare the o/e MR FLV and the o/e US LHR for pre and postnatal diagnoses in a single institution cohort.

METHOD AND MATERIALS
In total 201 fetuses were included in this study and o/e MR FLV and o/e US LHR were calculated for 270 examinations performed within 72 hours (62 examinations 32 w.g.). Prognostic accuracy of o/e MR FLV and o/e US LHR was assessed by performing receiver operating characteristic curve (ROC) analysis and correlation was determined using linear regression analysis.

RESULTS
At all times of gestation investigated our results revealed significant differences of both o/e MR FLV and o/e US LHR for neonatal survival or no survival, need for ECMO therapy and development of CLD or not (p-values between 0.04-0.001). The o/e MR FLV and o/e US LHR are highly valuable prognostic parameters for prenatal prediction of survival, need for ECMO therapy and development of CLD in fetuses with left sided CDH for all times of gestation. No prognostic significance was obtained in cases of right sided CDH. O/e MR FLV and o/e US LHR correlate significantly for patients with left sided CDH, best when examinations are performed prior to 32 w.g.. No significant correlation of both parameters could be found in fetuses with right sided CDH.

CLINICAL RELEVANCE/APPLICATION
O/e MR FLV and o/e US LHR are reliable prognostic parameters and correlate well for prenatal prediction of survival, need for ECMO therapy and development of CLD in fetuses with left sided CDH.

VSPD21-07 • Magnetic Resonance Imaging Based Ratio of Fetal Lung Volume to Fetal Body Volume as a New Prognostic Marker in Growth Restricted Fetuses with Congenital Diaphragmatic Hernia

Meike Weidner (Presenter); Claudia Hagelstein MD; Angelika Debus MD; Anna Walleyo; Christel Weiss; Stefan O Schoenberg MD, PhD*; Thomas Schaible; Karen Busing; Wolfgang Neff MD, PhD

PURPOSE
Several prenatal prognostic parameters for fetuses with congenital diaphragmatic hernia (CDH) exist. Most of them reference to a control group, which can be problematic if individual fetal development differs from expectation. To overcome this, we evaluated the prognostic accuracy of the individually calculated magnetic resonance imaging (MRI) based ratio of fetal lung volume (FLV) to fetal body volume (FBV) concerning survival in congenital diaphragmatic hernia (CDH), especially in fetuses with growth restriction.

METHOD AND MATERIALS
RESULTS
CONCLUSION
The MRI based ratio (FLV/FBV) is a highly reliable prenatal predictor of neonatal survival in children with CDH. Unlike other prognostic parameters (e.g. observed/expected MR-FLV, ultrasound based observed/expected lung-to-head ratio) it is independent of reference to a control group and can also be used in patients whose growth development differs from expectation.

CLINICAL RELEVANCE/APPLICATION
The measurement of fetal body volume supplementary to fetal lung volume may enhance prognostic accuracy in cases of congenital diaphragmatic for individuals whose growth development is restricted.

VSPD21-08 • Congenital Bronchopulmonary Malformations (BPMs) - Prenatal Sonographic Features with Postnatal Correlations. A Single Institution Experience

Juliette Garel MD (Presenter); Laurent A Garel MD; Dorothee Dal Soglio MD; Francoise F Rypens MD; Chantale Lapierre MD; Josee Dubois MD; Andree Grignon MD

PURPOSE
BPMs include bronchogenic cysts (BC), bronchial atresias (BA) either isolated or associated with intralobar pulmonary sequestrations (ILPS), congenital pulmonary airways malformations (CPAMs) type I and II, and extralobar pulmonary sequestrations (ELPS) – (Claire Langston classification). Recent literature on congenital lung lesions emphasized the lack of correlations between imaging and pathology. Our purpose is to compare the prenatal sonograms of BPMs and postnatal diagnoses in a single institution cohort.

METHOD AND MATERIALS
Retrospective study over 10 years. Pre and postnatal imaging performed in same radiology department. Prenatal descriptors = timing of concispy, lesion echogenicity, macrocysts, vascular connections (systemic feeder, venous return), bronchocele. Postnatal diagnoses based upon pathology (surgical cases) or postnatal CT (non-operated cases).
RESULTS
115 cases, including 56 surgical cases, and 5 upcoming interventions. Postnatal diagnoses = BC (n=5), CPAM (n=33), PS (n=33) including 11 hybrid lesions (coexisting with BC, CPAM, trapping, hypoplastic pulmonary veins), trapping (n=32) including 10 BA, suprarenal PS/hybrid (n=12). Non-surgical cases (n=54): suprarenal location (n=12), spontaneous regression (n=17), embolization (n=3), lost to F.U. (n=8), expectant management (n=12), fetal demise (n=2). Prenatal ultrasound and postnatal correlations = all BPMs visible on mid 2nd trimester US; macroscopic BPMs = CPAM type I and II, or hybrid lesions (intrapulmonary BC often considered at pathology as macroscopic CPAM type I equivalent); echolic lesions with systemic vascularization = PS; echolic lesions without systemic vascularization = trapping; bronchocele seen in BA.

CONCLUSION
- Conspicuity timing = BPMs always visible on 18-22 WGA sonogram, to the contrary of fetal pulmonary tumors (3 cases in our data bank). - PS almost equally made of ELPS and ILPS (value of color Doppler ultrasound for assessing venous return). - Focal echolic lesions without systemic feeder likely to be trapping (no CPAM type I). - BA, bronchocele very suggestive of BA. Overall, excellent ultrasound pathology correlations, resulting in an improved management (investigations and treatment options) postnatally.

CLINICAL RELEVANCE/APPLICATION
Routine US has resulted in a marked increase in prenatally recognized BPMs. Salient US features allow for a reliable prenatal diagnosis of the various BPMs and for a better management postnatally.

VSPD21-09 • Pediatric Genitourinary Imaging: Fetal and Neonatal Correlation
Jeanne S Chow (MD (Presenter))

LEARNING OBJECTIVES
The purpose of this presentation is to review typical prenatal imaging findings of congenital anomalies of the genitourinary tract, the typical evaluation and appearance of these findings post-natally, and the management of these anomalies.

METHOD AND MATERIALS
This study received institutional review board approval for the use of 15 fetal specimens (gestational age: 24 - 36 weeks). The specimens were immersed in 5% formalin in a plastic container that approximated the abdominal circumference of pregnant women. CT scans were acquired with a 64-detector scanner (VCT, GE). The scanning parameters were: tube voltage 100kVp, tube current 600-,300-,150-,100-, and 50mA, rotation time 0.4 sec, pitch 1.375. Images were subjected to adaptive statistical iterative reconstruction (ASiR®, blending rate: 60%). First, we measured fetal dose in 5 specimens using 4 glass dosimeters attached on the surface of fetus, and calculated the mean of the measured dose. Furthermore, we calculated the mean of the measured dose in 5 specimens, with a radiation intensity to every tube current. In each tube image of each specimen, we generated maximum intensity projection and volume rendering images of the fetal skeleton. Two radiologists recorded the visualization of a metatarsal, metacarpal, the 12th rib, fibula, and femoral metaphysis using a visual score where 3=clear, 2=unclear, 1=not visible. We performed statistical analysis of the diagnostic ability of each scan protocol using Steel’s test. Standard image quality was considered obtainable at 600mA.

RESULTS
The fetal exposure dose was 10.2 mGy at a tube current of 600mA, 5.3 at 300mA, 2.5 at 150mA, 1.8 at 100mA, and 0.9 at 50mA. In visual evaluation of images, without ASiR there was a statistically significant difference between 50- or 100mA images and 600mA images (50mA: 0.0001).

CONCLUSION
At MDCT for the prenatal diagnosis of skeletal dysplasia, the radiation dose for images acquired with ASiR the fetal radiation dose can be reduced to 1.8mGy.

CLINICAL RELEVANCE/APPLICATION
MDCT scans obtained at 100mA, 100kVp, and ASiR are of sufficient diagnostic quality for the prenatal diagnosis of skeletal dysplasia and their radiation dose is low (1.8 mGy).

VSPD21-11 • Challenges and Controversies in Imaging Necrotizing Enterocolitis
Charles M Maxfield MD (Presenter)

LEARNING OBJECTIVES
1) Recognize imaging features of necrotizing enterocolitis. 2) Discuss imaging algorithm to the diagnosis and follow-up of necrotizing enterocolitis. 3) Review clinical features and pathophysiology of necrotizing enterocolitis.

METHOD AND MATERIALS
We retrospectively reviewed the clinical records and neuroimaging studies of forty neonates who showed SEL on neonatal cranial US. MRI was taken in 18 of them within 2 weeks after US. We evaluated the location, number, size and follow-up changes of SEL and the associated lesions to know the clinical significance of SEL.

RESULTS
The echogenic lesions were positioned around the sulci in 39 cases and considered as brain parenchymal lesions accompanying with subarachnoid hemorrhage (SAH). Only in one case, the lesion was positioned intraparenchymally. On US, the locations of the lesions were mainly frontal and parietal in 38 cases and occipitotemporal in 5 cases. The lesions were single in 13 and multiple in 27 cases. The maximal size of the lesions were 5 to 30mm(mean 15mm). There were associated other hemorrhagic lesions in subdural(SDH=12), epidural(EDH=4), intraventricular(IVH=2) location. One SDH was accompanied by skull fracture. Three EDH had associated with skull fractures. Cephalhematoma or caput succedaneum were noted in 15 cases and five(33.3%) of them was associated with EDH and fracture associated SDH. On follow up study, the SELs evolved and disappeared until 3 months on follow-up US.

CONCLUSION
The SEL in neonatal cranial US involves brain parenchyma and leptomeningeal space. Although SEL itself is usually not significant clinically, it can be one possible indicator of significant birth trauma such as EDH and SDH with skull fracture especially when it combines with cephalhematoma or caput succedaneum.

CLINICAL RELEVANCE/APPLICATION
Cranial ultrasonography can easily detect the superficial echogenic lesions of neonatal brain and if it is found and scalp hematoma is present, MRI should be recommended to detect intracranial hematoma.

VSPD21-12 • The Superficial Echogenic Lesions Detected in Neonatal Cranial Ultrasonography: A Possible Indicator of Significant Birth Trauma
Byoung Hee Han (Presenter); Sung Bin Park MD; Kyung Sang Lee; Sun Young Ko; Yeon Kyung Lee

PURPOSE
To evaluate the characteristics and the significance of the superficial echogenic lesions(SEL) in neonatal cranial ultrasonography(US).

METHOD AND MATERIALS
This study received institutional review board approval for the use of 15 fetal specimens (gestational age: 24 - 36 weeks). The specimens were immersed in 5% formalin in a plastic container that approximated the abdominal circumference of pregnant women. CT scans were acquired with a 64-detector scanner (VCT, GE). The scanning parameters were: tube voltage 100kVp, tube current 600-,300-,150-,100-, and 50mA, rotation time 0.4 sec, pitch 1.375. Images were subjected to adaptive statistical iterative reconstruction (ASiR®, blending rate: 60%). First, we measured fetal dose in 5 specimens using 4 glass dosimeters attached on the surface of fetus, and calculated the mean of the measured dose. Furthermore, we calculated the mean of the measured dose in 5 specimens, with a radiation intensity to every tube current. In each tube image of each specimen, we generated maximum intensity projection and volume rendering images of the fetal skeleton. Two radiologists recorded the visualization of a metatarsal, metacarpal, the 12th rib, fibula, and femoral metaphysis using a visual score where 3=clear, 2=unclear, 1=not visible. We performed statistical analysis of the diagnostic ability of each scan protocol using Steel’s test. Standard image quality was considered obtainable at 600mA.

RESULTS
The fetal exposure dose was 10.2 mGy at a tube current of 600mA, 5.3 at 300mA, 2.5 at 150mA, 1.8 at 100mA, and 0.9 at 50mA. In visual evaluation of images, without ASiR there was a statistically significant difference between 50- or 100mA images and 600mA images (50mA: p<0.001).

CONCLUSION
At MDCT for the prenatal diagnosis of skeletal dysplasia, the radiation dose for images acquired with ASiR the fetal radiation dose can be reduced to 1.8mGy.

CLINICAL RELEVANCE/APPLICATION
MDCT scans obtained at 100mA, 100kVp, and ASiR are of sufficient diagnostic quality for the prenatal diagnosis of skeletal dysplasia and their radiation dose is low (1.8 mGy).

VSPD21-13 • Comparison of Clinical US Measurements of the Ventricles to 3D US Ventricle Volumes in IVH Patients
Jessica E Kishimoto (Presenter); Walter M Romano MD; Aaron Fenster PhD *; David Lee MD, FRCPC; Sandrine De Ribaupierre

PURPOSE
Premature neonates with intraventricular hemorrhage (IVH) are followed with serial 2D US, head circumference (HC) measurement, as well as clinical examination to determine if they require treatment for hydrocephalus. However, accurate volume measurements are impossible with 2D images, and one relies on ratios and width of ventricles to estimate the changes in ventricular volume. 3D ultrasound (US) has been proven feasible in a clinical setting in this population. We compared the ventricle volumes from those images have been comparable to those made in MRI. Since 2D US and HC measurements have historically been used clinically, we aimed to compare those clinical standard measurements against 3D US ventricular volumes.

METHOD AND MATERIALS
A Philips HDI 5000 US machine with a C8-5 transducer was used for all 2D US exams. 3D US images were acquired, using the same probe, attached to a system that generated 3D images by mechanically moving the transducer. HC measurements were recorded on the days US images were acquired. Five IVH patients were scanned 1-2 times/week for the duration of their stay in the NICU, for a total of 7-11 scans per patient. Total of 47 scans for all patients investigated.

Levane’s index (LI), axial horn width (AHW), third ventricle width (3rd) and the thalamo-occipital distance (TOD) were measured on the 2D US images, and ventricle volumes were manually segmented from 3D US images. Pearson correlation between each index and volume as well as the correlations between the
change in each index between adjacent time points and corresponding change in volume were performed.

RESULTS
Strong, significant correlations ($r=0.80$, $p<0.02$) were found for all correlations comparing the change in volumes and the change in 2D measurements. Change in Hc was the lowest of all the correlations ($r=0.085$).

CONCLUSION
Neither changes in 2D US measurements, nor changes in Hc appear to be related to actual ventricle volume changes. This should be taken into account when reviewing standard cranial US exam.

VSPD21-14 • Doppler Evaluation of Anterior Cerebral Artery in Children on ECMO and Age-matched Controls: Predictive Value in Cerebrovascular Complications

Eman N Alqahtani MBBS (Presenter); Carlos A Zamora MD, PhD; Melanie Bembea; Ivor Berkowitz; Kathryn A Carson; Thierry Huisman MD; Aylin Yekes MD

PURPOSE
Patients on extracorporeal membrane oxygenation (ECMO) are at high risk of cerebrovascular complications (CVC) due to serious underlying diseases, systemic heparinization and sepsis. Our aims were: 1) To evaluate resistive index (RI) measurements in the anterior cerebral artery (ACA) to predict CVC such as intracranial hemorrhage (ICH) and ischemic events in children on ECMO, and 2) To evaluate the differences in RI measurements between children on ECMO and age-matched controls, 3) To evaluate clinical variables to predict CVC.

METHOD AND MATERIALS
The institutional review board approved this study. A retrospective chart review of patients

RESULTS
There were a total of 98 children (ECMO n=36, age matched controls n=62). Nine (25%) of the 36 developed CVC (ICH n=6, ischemia n=3). The difference between baseline and compression RI values and percent change on the first day of ECMO was statistically significantly higher for children with CVC compared to no CVC ($p=0.03$ and $p=0.02$, respectively). Median percentage change in the RI value was 5.59% in controls. The median percent change was -20% to -78% during the period on ECMO in the no CVC group, while the ICH group showed the widest range of RI percent change until the day of CVC (Fig. 1). Of the clinical variables, only age at initiation of ECMO was statistically significantly associated with increased risk of CVC ($p=0.02$).

CONCLUSION
Children who had ICH had the widest range of percent RI change during the course of ECMO. Minimal RI change can be reassuring for no CVC in children with ECMO. Younger children than 3 days of age at the time of ECMO cannulation are at higher risk for CVC. These results should be validated in larger prospective studies.

CLINICAL RELEVANCE/APPLICATION
We want to understand the role of cerebral autoregulation in patients on ECMO aiming to predict CVC that affect 30-50% of patients on ECMO.
Creating, Storing, and Sharing Teaching Files Using RSNA’s MIRC®: A Hands On Course

**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.

Global Health: Dose Reduction is Our Business (Sponsored by the Associated Sciences Consortium) (An Interactive Session)

**LEARNING OBJECTIVES**
1) Identify inefficiencies in radiology departmental workflow. 2) Provide examples of how the Radiology Information System can be used help to improve efficiency in the Radiology Department.

**ABSTRACT**
The radiology information system (RIS) is the central information system of many radiology departments. It was initially built as a system to schedule appointments and bill patients; however, it has grown to encompass all aspects of departmental workflow from the time an examination is ordered through the time a bill is sent and beyond. While certain elements of the RIS have been built for efficiency, others have lagged behind. The purpose of this talk is to describe methods by which the RIS can improve departmental efficiency. Case examples will be used to illustrate these methods and will include using the RIS to identify critical examinations at the time they are ordered, using the RIS to correct incorrect orders, and using the RIS to drive departmental initiatives such as structured reporting.

ICII21C • Making the Case for Business Intelligence in Radiology

Matthew B Morgan MD (Presenter)

**LEARNING OBJECTIVES**
You are starting to hear about ‘big data’ and you wonder how this will play a role in your radiology practice? What is Business Intelligence and Analytics? How will it help you, and how do you get started? You will learn the answers to these questions and more when you attend this presentation.

**ABSTRACT**

You are starting to hear about 'big data' and you wonder how this will play a role in your radiology practice? What is Business Intelligence and Analytics? How will it help you, and how do you get started? You will learn the answers to these questions and more when you attend this presentation.

**Global Health: Dose Reduction is Our Business (Sponsored by the Associated Sciences Consortium) (An Interactive Session)**

**LEARNING OBJECTIVES**
1) To comprehend the importance of European Union (EU) Projects for promoting a Radiation Protection safety culture. 2) To understand the structure of the European Radiation Protection Organizations. 3) To critically analyze the results of some of the EU projects. 4) To know the Role and structure of European Federation of Radiographer Societies (EFRS). 5) To understand the contribution of EFRS in EU projects.

**ABSTRACT**
In the past years there have been several European Union (EU) projects dedicated to Radiation Protection area, mostly promoted by the Directorate General of Energy (DG ENER) from the European Commission (EC). The majority of these projects were related to topics from the EURATOM 97/43 Directive (known as the MED), that constitutes an European Law that all Member States are obliged to transpose to their National legislation system. During this presentation a special focus will be given to: (a) Clinical Audit Guidelines (a tool developed to facilitate the implementation of clinical audit programs in medical imaging and radiotherapy departments); (b) EMAN (European Medical ALARA Network - dedicated to optimization in medical field); (c) MEDRAPET (Medical Radiation Protection Education and Training - dedicated to develop guidelines for E&T in RP for Health Professionals); (d) DOSEDATAMED II (dedicated to collect dose distributions from medical radiodiagnostic procedures from EU member states); One of the main relevant point of all these EU projects is the fact that they were made on a multi stakeholders model, based on the contribution of Organizations representing EU regulators, Radiologists, Radiographers, Medical Physicists, Research Centers, amongst others. In conclusion this presentation will give an overview of all these projects, the respective results and the importance that they have in promoting a Radiation Protection Culture in Europe.

**MSA22A • Promoting Radiation Safety in Imaging Worldwide**

Donna E Newman (Presenter)

**LEARNING OBJECTIVES**
1) You will learn about the ISRT involvement in global initiatives that promote best radiography practice, education and standards in developing countries. We will review several Partnerships with WHO, PAHO and Local associations that helped facilitate dose reduction this past year at workshop and conferences. 2) You will learn how the ISRT involvement in global initiatives and international standards serves as the voice for technologists internationally; The ISRT cooperates and communicates with international organization that address medical imaging, health care, patient safety, radiation protection. 3) You will learn how the ISRT participates as a member state in projects relating to radiological protection in medical exposure for the IAEA and WH.

**ABSTRACT**
Promoting Radiation Safety in the Imaging Worldwide You will learn about the ISRT involvement in global initiatives help facilitate global dose reduction threw the use of Workshops and conferences in developing countries. Also about the ISRT’s Campaign for safe use of radiation in developing countries through the use of workshops. You will learn how the ISRT promotes radiography practice, education and standards in developing countries to help ensure dose reduction with the use of workshops and conferences. We will review several Partnerships with WHO, PAHO and Local associations that helped facilitate dose reduction in various areas of radiology this past year: Caribbean/ Jamaica/mammography partnership with PAHO, Cameroon/ Partnership with French Local Organization, Lithuanian partnership with EPRS European organization Malawi/ QA and Pattern Recognition and Zambia/Image interpretation. You will learn how the ISRT involvement in global initiative and international standards help promote radiation reduction by acting as a stakeholder and the voice for technologists internationally. ISRT cooperates and communicates with international organization that address medical imaging, health care, patient safety, radiation protection for example, Smart Card/Smart RAD Track and the IAEA WHO/IRON Referral Guidelines project. You will learn how the ISRT participates as a member state in projects relating to radiological protection of patient and protection in medical exposure for the IAEA and WHO. We will discuss several of the project and documents that have been developed and review by our organization. Several example of this are the WHO/Radiation risk communication in pediatric imaging IAEA’s Training material on Radiation protection in diagnostic and interventional radiology, digital Radiology Annals Reports of the ICRP, Basic Safety Standards Review and Safety guides and Justification of medical exposures IAEA Technical meeting.
LEARNING OBJECTIVES
1) Understand the latest brain imaging techniques and how they can be used in routine clinical practice. 2) Generate appropriate differential diagnoses based on imaging findings and clinical presentation. 3) Recognize imaging features of various brain pathologic entities, such as neoplastic, infectious, inflammatory, and vascular diseases. 4) Help guide clinical colleagues along the path to the appropriate diagnosis.

ABSTRACT
Magnetic Resonance Imaging continues to be the workhorse technique in brain imaging. The brain imaging capabilities of MRI continue to make MRI a more sensitive and specific diagnostic tool compared with CT for most clinical entities. The past 15 years has ushered in the era of "Physiologic MRI techniques," such as diffusion-weighted imaging, diffusion tensor imaging, gadolinium-based and arterial spin labeled perfusion imaging, spectroscopy, functional MRI (fMRI), and, most recently, connectivity/network-based imaging. This presentation will cover the MR imaging features of several brain pathologic entities, and some of the latest brain MR imaging techniques will be introduced.

MSCM22B • Head and Neck
Ilona M Schmalfuss MD (Presenter) *

LEARNING OBJECTIVES
1) Generate appropriate differential diagnoses based on imaging findings and patient's clinical presentation. 2) Demonstrate understanding of pertinent anatomy and imaging findings relevant to commonly overlooked disease processes in the head and neck area. 3) Recognize imaging features of different head and neck malignancies and apply this knowledge to cancer staging and treatment plan. 4) Practice interpretation of new imaging techniques.

ABSTRACT
Learning objectives: 1. Generate appropriate differential diagnoses based on imaging findings and patient’s clinical presentation 2. Demonstrate understanding of pertinent anatomy and imaging findings relevant to commonly overlooked disease processes in the head and neck area 3. Recognize imaging features of different head and neck malignancies and apply this knowledge to cancer staging and treatment plan 4. Practice interpretation of new imaging techniques.

MSCM22C • Peds Neuro
A. James Barkovich MD (Presenter) *

LEARNING OBJECTIVES
1) Determine the appropriate imaging study based upon the clinical history supplied. 2) Generate appropriate differential diagnoses of Pediatric Brain Imaging studies based upon the clinical presentation and the imaging findings. 3) Recognize imaging features of malformations, neurocutaneous disorders, metabolic disorders, and brain injuries that cause neurologic dysfunction in childhood. 4) Guide clinical colleagues in their pursuit of diagnosis.

ABSTRACT
Imaging of children with neurological dysfunction is difficult for most radiologists. The immature child's brain looks different from the adult brain because, especially in young children, development is not complete: sulcation has not completely finished, myelination is ongoing, the cerebellum is still immature. This presentation will explain features of normal development, discuss the best imaging strategies in immature and mature pediatric brains, and show examples of some of the most common and important disorders that are seen in children with perinatal and postnatal brain injury, developmental delay, epilepsy, and new neurological impairment. In addition to normal brain development as assessed by imaging, this talk will cover perinatal and postnatal brain injury, common malformations, and causes of epilepsy including neurocutaneous disorders. Some new concepts will be discussed that make these disorders easier to understand.

Molecular Imaging Symposium: Radiogenomics - The Next Logical Step in 'Rad-Path' Correlation for Clinical Imaging?

LEARNING OBJECTIVES
1) Understand the latest brain imaging techniques and how they can be used in routine clinical practice. 2) Generate appropriate differential diagnoses based on imaging findings and clinical presentation. 3) Recognize imaging features of various brain pathologic entities, such as neoplastic, infectious, inflammatory, and vascular diseases. 4) Help guide clinical colleagues along the path to the appropriate diagnosis.

ABSTRACT
Magnetic Resonance Imaging continues to be the workhorse technique in brain imaging. The brain imaging capabilities of MRI continue to make MRI a more sensitive and specific diagnostic tool compared with CT for most clinical entities. The past 15 years has ushered in the era of "Physiologic MRI techniques," such as diffusion-weighted imaging, diffusion tensor imaging, gadolinium-based and arterial spin labeled perfusion imaging, spectroscopy, functional MRI (fMRI), and, most recently, connectivity/network-based imaging. This presentation will cover the MR imaging features of several brain pathologic entities, and some of the latest brain MR imaging techniques will be introduced.

MSCM22B • Head and Neck
Ilona M Schmalfuss MD (Presenter) *

LEARNING OBJECTIVES
1) Generate appropriate differential diagnoses based on imaging findings and patient's clinical presentation. 2) Demonstrate understanding of pertinent anatomy and imaging findings relevant to commonly overlooked disease processes in the head and neck area. 3) Recognize imaging features of different head and neck malignancies and apply this knowledge to cancer staging and treatment plan. 4) Practice interpretation of new imaging techniques.

ABSTRACT
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MSCM22C • Peds Neuro
A. James Barkovich MD (Presenter) *

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Imaging of children with neurological dysfunction is difficult for most radiologists. The immature child's brain looks different from the adult brain because, especially in young children, development is not complete: sulcation has not completely finished, myelination is ongoing, the cerebellum is still immature. This presentation will explain features of normal development, discuss the best imaging strategies in immature and mature pediatric brains, and show examples of some of the most common and important disorders that are seen in children with perinatal and postnatal brain injury, developmental delay, epilepsy, and new neurological impairment. In addition to normal brain development as assessed by imaging, this talk will cover perinatal and postnatal brain injury, common malformations, and causes of epilepsy including neurocutaneous disorders. Some new concepts will be discussed that make these disorders easier to understand.

Cardiac CT Mentored Case Review: Part II (In Conjunction with the North American Society for Cardiac Imaging) (An Interactive Session)

Monday, 10:30 AM - 12:15 PM • S406A

MSCM22C • Coronary Artery Disease I: Native Vessel Disease
Geoffrey D Rubin MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

MSCM22B • Coronary Artery Disease II: Native Vessel Disease
Smita Patel MBBS (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

MSCM22C • Coronary Artery Disease II: Native Vessel Disease
Smita Patel MBBS (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

ABSTRACT
Cardiac CT can provide information on valves and function when retrospective ECG gating is used in the acquisition. These studies require extensive image post-processing to accurately depict the moving structures. This presentation will highlight basic image acquisition as well as the evaluation of normal and abnormal patients.

Molecular Imaging Symposium: Radiogenomics - The Next Logical Step in 'Rad-Path' Correlation for Clinical Imaging?

Monday, 10:30 AM - 12:00 PM • S406B

MSCM22A • Coronary Artery Disease I: Native Vessel Disease
Geoffrey D Rubin MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

MSCM22B • Coronary Artery Disease II: Native Vessel Disease
Smita Patel MBBS (Presenter)

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MSCM22C • Coronary Artery Disease II: Native Vessel Disease
Smita Patel MBBS (Presenter)

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Cardiac CT can provide information on valves and function when retrospective ECG gating is used in the acquisition. These studies require extensive image post-processing to accurately depict the moving structures. This presentation will highlight basic image acquisition as well as the evaluation of normal and abnormal patients.
**ABSTRACT**
Radiogenomics is an emerging field that attempts to correlate and integrate radiological information from medical images and molecular data from tissue. Typically medical image features are extracted from a wide range of imaging modalities such as MRI, CT or PET images. Similarly, recent developments in molecular technologies have unleashed a myriad of technologies data types such as gene expression, microRNA expression, DNA methylation, and DNA mutation data. 

**PURPOSE**
To assess the prognostic value of the PTV dimension in patients affected by locally advanced oropharyngeal carcinoma (OPC) treated with induction chemotherapy (CT) followed by radical IMRT.

**METHODS AND MATERIALS**
Patients and methods: 38 consecutive stage III-IV OPC patients who underwent induction CT followed by SIB-IMRT were analyzed. CT consisted of TPF (docetaxel, platinum and 5-FU) delivered for 3 cycles before radiotherapy in all patients. The maximum radiation dose, consisting of 66Gy-70.95Gy in 30-33 fractions, was prescribed to the PTV70, that included the initial extent of disease (pre-CT GTV plus 0.5-0.8 mm margin). The node-negative neck received a total dose of 54-62.70 Gy in 30-33 fractions. Patients were divided into two groups according to the PTV70 dimensions: 97.5cc.

**RESULTS**
Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume. Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume. Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume. Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume. Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume. Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume. Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume. Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume. Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume. Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume. Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume. Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume. Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume. Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume. Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume. Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume. Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume. Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume. Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume. Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume. Kaplan-Meier analysis was used to calculate disease free survival (DFS) and overall survival (OS). Log-rank test was used to test potential risk factors including PTV70 volume.
ABSTRACT

Abstract

Background: To investigate the therapeutic efficacy of computed tomography (CT)-guided permanent percutaneous implantation of iodine-125(125I) for treating recurrent head and neck cancer.

Methods: Thirteen patients with recurrent head and neck cancer (previously treated with a total cumulative dose exceeding 100 Gy) were included in this study. 125I seeds were implanted into recurrent head and neck lesions by CT-guided needle puncture. Treatment responses were evaluated during follow-up by contrast-enhanced CT and MR imaging using the Kaplan-Meier method.

Results: The tumor response rate was 84.0%. The overall median control time was 24.0 months. The local control rate was 57.8% and 34.5% at 1 and 2 years, respectively. The overall 1- and 2-year survival rates were 61.9% and 38.1%, respectively. No serious complications were observed postoperatively and during the follow-up period.

Conclusion: Ultrasonic-guided brachytherapy using 125I seed implantation is safe and effective for treating recurrent head and neck cancer.

MSRO22-06 • Development of a Standardized Method for Contouring the Larynx and Its Substructures

Mehee Choi MD (Presenter); Tamer Refaat Abdelrahman MD,PhD; Ian Bacchus PhD; Malisa S Lester MD; Alfred W Rademaker PhD; Bharat B Mittal MD *

Purpose

Limiting radiation dose to the larynx can diminish effects of laryngeal dysfunction. However, no clear guidelines exist for defining the larynx and its substructures on cross-sectional imaging. This study presents computed tomography (CT)- and magnetic resonance imaging (MRI)-based guidelines for contouring laryngeal organs-at-risk (OARs).

Methods

Using published anatomic information and radiologic data, standardized guidelines for delineating the larynx and its suborgan structures at risk (OARs) on 3-mm axial CT images were devised. Based on the guidelines, the OARs were delineated on CT and MRI for five consecutive patients with non-laryngeal head and neck cancer. Volumetric comparisons between CT and MRI contours were performed to validate that the guidelines could be applied consistently to radiation therapy planning. CT scans as well as MRI scans in a reproducible manner. The guidelines were then used to delineate the OARs on radiation therapy-planning CT scans of 44 additional patients treated with chemoradiation for head and neck cancer. Further volumetric comparisons were made to establish the consistency of guideline-based contours.

Results

The larynx and its substructures were successfully created on CT and MRI datasets for five patients, using the proposed guidelines. Differences in OAR volumes were not statistically different between CT and MRI. Comparisons of 44 additional CT-based contours with the five initial CT-based contours and MRI-based contours showed no significant differences in OAR volumes.

Conclusion

The contouring guidelines developed provide a precise, reproducible method for delineating the larynx and its substructures on treatment-planning CT scans. Similar guidelines could be used for MRI-based planning. Clinical implementation of the guidelines should reduce observer variability, leading to an improved understanding of the relationship between radiation dose–volume effects on laryngeal substructures and toxicity outcomes.

Clinical Relevance/Application

This study presents guidelines for contouring the larynx and its substructures on axial CT and MR images for use in future investigations of radiation dose-volume effects on larynx dysfunction.

MSRO22-07 • Single Fraction Spine Stereotactic Body Radiation Therapy for Treatment of Chordoma

Edward W Jung MD (Presenter)

ABSTRACT

Purpose/Objective(s): Chordoma is a rare, slow growing locally aggressive bone tumor arising from embryologic notochord that affects 300 new patients each year in the United States. Only 10% to 20% of tumors arise in the cervical, thoracic, or lumbar spine. Because chordomas are radioresistant, involvement of the spine presents a therapeutic challenge due to the high doses of radiation needed for local control along with proximity to the spinal cord, a dose-limiting organ. There are currently no published reports in the literature exclusively looking at outcomes of spine Stereotactic Body Radiation Therapy (SBRT) treatment of chordoma. The purpose of this study is to determine the efficacy and safety of treatment with single fraction SBRT for chordoma of the spine.

Materials/Methods: A retrospective review of our IRB approved registry from 2007 to 2012 identified 6 patients with chordoma of the spine who were treated with single fraction SBRT. Fourteen underwent concurrent chemoradiation, typically with platinum based regiments. Fourteen underwent concurrent chemoradiation, typically with platinum based regiments. Fourteen underwent concurrent chemoradiation, typically with platinum based regiments. Fourteen underwent concurrent chemoradiation, typically with platinum based regiments. Fourteen underwent concurrent chemoradiation, typically with platinum based regiments. Fourteen underwent concurrent chemoradiation, typically with platinum based regiments. Fourteen underwent concurrent chemoradiation, typically with platinum based regiments. Fourteen underwent concurrent chemoradiation, typically with platinum based regiments. Fourteen underwent concurrent chemoradiation, typically with platinum based regiments. Fourteen underwent concurrent chemoradiation, typically with platinum based regiments. Fourteen underwent concurrent chemoradiation, typically with platinum based regiments. Fourteen underwent concurrent chemoradiation, typically with platinum based regiments. Fourteen underwent concurrent chemoradiation, typically with platinum based regiments. Fourteen underwent concurrent chemoradiation, typically with platinum based regimens.

Results: Median age was 58 years (22 - 83). Median KPS was 70 (40 - 90). Median target volume was 19 cm$^3$ (1 - 304). Median prescription dose was 16 Gy (11 - 16). Median conformity index was 1.35 (1.15 - 3.21). Median homogeneity was 1.12 (1.05 - 1.19). Median follow-up time was 10 months (0.5 - 34). Local control at 12 months was 88.8% with one local failure. All patients presented with spinal pain, and pain was improved in 50% of patients treated. One patient developed limited cord myelopathy that resolved with steroids. There were no other treatment toxicities from SBRT.

Conclusion: Spine SBRT can be safely and effectively delivered to treat chordoma of the spine with the potential to improve pain symptoms. Single fraction SBRT compares favorably with other treatment platforms and techniques based on this early data. Longer follow-up with more patients is necessary to determine the exact role of SBRT in the treatment of chordomas of the spine.

MSRO22-08 • Re-irradiation of the Head and Neck Using High Conformal Tomotherapy IMRT

Daniel A Jones MD (Presenter)

ABSTRACT

Purpose/Objective(s): There is no standard of care regarding re-irradiation of the head and neck. The difficulty of balancing the benefit of tumor control with that of increased normal tissue toxicity may be partially negated with proper patient selection and highly conformal radiation therapy. The purpose of this study was to analyze the outcomes of patients with a second primary and/or recurrent head and neck cancer treated at our institution and to identify patients who are most likely to benefit.

Materials/Methods: We retrospectively reviewed 24 patients treated with re-irradiation to the head and neck, between March 2008 and July 2012. There were 17 patients with recurrent tumors, 5 with second primaries, and 2 with both second primaries and recurrences. Tumor factors included volume of recurrence (median 12.5 cm$^3$, range 1.3-400), and recurrence location (local only (12), neck only (5), local + neck (3), and local + distant (3)). Patient factors included age, median 62 (27-77), and performance status, (20 with ECOG 0-1, 4 with ECOG 2-3).

Results: Three patients were unrespectable and underwent biopsy only. Four underwent subtotal resection or debulking. Seventeen underwent gross total resection, with margins: negative in 14 patients, positive in 3 patients. All but two patients were treated with conventionally fractionated tomotherapy IMRT. Fourteen underwent concurrent chemoradiation, typically with platinum based regimens. Results: Patients were followed for a median of 10 months, minimum of 8 months among survivors. Patients were treated with a median dose of 60 Gy (44-70). Kaplan-Meier estimates for 1 year local control, recurrence free survival, and overall survival was 58% (95% CI 36-75), 40% (95% CI 20-59), and 68% (95% CI 44-83). Kaplan-Meier estimates for 2 year local control, recurrence free survival, and overall survival was 41% (95% CI 6-64), 30% (95% CI 6-41), and 25% (95% CI 1-46). Median survival was 15 months (95% CI 10-20). There were 3 long term survivors, at 24, 24, and 32 months, all of which are disease free. Toxicity was significant with twelve patients permanently dependent on a feeding tube and two dying of carotid artery bleeds.

Conclusion: Spine SBRT was mostly treated with highly conformal conventionally fractionated Tomotherapy IMRT. Outcomes are similar to those achieved in other published series. Local control at one and two years was encouraging at 58% and 41% and re-irradiation likely reduced morbidity associated with local progression. The heterogeneous small sample size with only 6 patients precluded a true genomically driven study to guide patient selection. This study results to future patient management. Likely, treatment with highly conformal techniques such as with Tomotherapy IMRT, improve the ability to control disease and reduce toxicity.

MSRO22-09 • Metastatic Carcinoma of Unknown Primary to Cervical Lymph Nodes: Treatment Patterns, Outcomes, and Patterns of Failure

Varun K Chowdhry MD (Presenter); Michael Farris MD; Seung S Hahn MD; Jack M Hsu MD; Michael A Lacombe MD
Stepwise Implementation of Imaging Changes for Cervical Cancer Brachytherapy Planning Using Existing Infrastructure: A Multidisciplinary Approach to Advancing Patient Care

Theodora A Koulis MD, PhD (Presenter); Derek W Brown; Deepak Bhayana; Karen Long; Maree Patrick; and for the Multidisciplinary Cervical Cancer Brachytherapy Planning Group (New York, NY)

PURPOSE

To identify microRNAs (miRNAs) that correlate with clinical outcome in patients with locally advanced cervical cancer after chemoradiotherapy.

METHOD AND MATERIALS

This study included a total of 81 patients with locally advanced squamous cell cervical cancer who underwent definitive chemoradiotherapy between February 2006 and September 2011. We compared the expression level of miRNAs in 45 no evidence of disease [NED] and 36 cancer-caused death [CD] patient's serum before treatment using miRCURY LNA™ Universal RT microRNA PCR. The amplification was performed in a LightCycler® 480 Real-Time PCR System (Roche) in 384 well plates. The raw data was extracted from the Lightcycler 480 software. Data was internally calibrated by UniSp3 IPC using GenEx software (ver.5). The significance of the expression changes between patient characteristics and disease-free and overall survival rates determined by multivariate Cox proportional-hazard model analysis.

RESULTS

Among 384 miRNAs analyzed, miR-214* was most significantly overexpressed in the CD group than in the NED group (p=0.03), whereas miR-493* was most significantly overexpressed in the CD group than in the NED group (p=0.03). The results of multivariate analysis showed that miR-214* is a significant predictor of disease-free survival [RR=2.01, p=0.03], while miR-493* is a significant predictor of poor overall survival [RR=1.32, p=0.02].

CONCLUSION

Two miRNAs identified in this study, miR-214* and miR-493* can be used as prognostic biomarker to improve clinical strategies for treatment of locally advanced cervical cancer after chemoradiotherapy.

CLINICAL RELEVANCE/APPLICATION

Two miRNAs identified in this study, miR-214* and miR-493* can be used as prognostic biomarker to improve clinical strategies for treatment of advanced cervical cancer after chemoradiotherapy.
Our data showed that the CCRT with nedaplatin for FIGO stage IB-IVA carcinoma of the cervix uteri was efficacious and safe, especially in view of less renal toxicity. Histologic type, lymph node metastases, maximum diameter of the tumor and pretreatment hemoglobin level were independent risk factors for PFS, (hazard ratio (HR) 3.40, 95% confidence interval (95%CI) 1.03-9.81), (HR 2.89, 95%CI 1.12-7.72), (HR 1.42, 95%CI 1.11-1.79) and (HR 0.63, 95%CI 0.46-0.85), respectively. In terms of adverse effects, 27 patients (49.1 %) had acute grade 3-4 leukopenia. Seven patients (12.7 %) had late grade 3 intestinal complications. There was no renal toxicity during CCRT.

CONCLUSION
Our data showed that the CCRT with nedaplatin for FIGO stage IB-IVA carcinoma of the cervix uteri was efficacious and safe, especially in view of less renal toxicity. Histologic type, lymph node metastases, maximum diameter of tumor and pretreatment hemoglobin level were statistically significant prognostic factors.

CLINICAL RELEVANCE/APPLICATION
Chemoradiotherapy with nedaplatin for carcinoma of the cervix uteri was efficacious and safe, especially in view of less renal toxicity.

ABSTRACT
The main objectives of this study are to determine the three dimensional dose volume parameters for a Point A plan and a CTV-based plan and to compare these values using statistical tools.

Results: With regards to the dose volume parameters evaluated in this study, all mean values generated from all cases were higher when CTV based planning was done rather than Point A based planning. But the results generated were only significant for those that belong in Group 2 or those having a large CTV (> 100cm^3). This shows a better coverage of the target volume in terms of the D90, V100 and Coverage Index which can be correlated with an increase in terms of the success of treatment outcome for the CTV based planning. But for the organs at risk, namely the bladder and rectum, having higher radiation doses can result to increase risk of early and late complications.

Conclusions: The evidence of this study showed that CTV based treatment planning has more advantage compared to Point A planning if implemented in a CT-based brachytherapy because the method depends highly on the anatomy of the patient (i.e. patient specific). But the organs at risk must be considered in the evaluation of the plan because of the tendency over dosing the bladder and rectum specially when dealing with a large cervix (>100cm^3). Thus, the dose to the target volume and organs at risk must be noted and be optimized to be able to meet the goals of brachytherapy treatment.

MSRO25-07 • Treatment Outcome and Prognostic Factors of Concurrent Chemoradiotherapy with Nedaplatin for FIGO Stage IB-IVA Carcinoma of the Cervix Uteri
Fujiiwara Masateru MD (Presenter); Isoshishi Fumiaki; Yoshioka Yasuo; Mabuchi Seiji; Kimura Tadashi; Ogawa Kazuhiko

METHOD AND MATERIALS
We retrospectively reviewed the medical records of 55 patients with FIGO stage IB-IVA cervical cancer treated with CCRT using nedaplatin 35 mg/m^2 weekly from 2000 and 2009. The treatment consisted of external beam radiotherapy 46.5-66 Gy (in 24-33 fractions) followed by 13.6-28.8 Gy (in 2-4 fractions) of high-dose-rate intracavitary brachytherapy (ICBT) or 34-35 Gy (in 4 fractions) of medium-dose-rate ICBT. Overall survival (OS) and progression-free survival (PFS) were estimated by the Kaplan-Meier method. The Cox proportional hazard model was used for multivariate analysis. Acute and late toxicities were evaluated by CTCAE ver.4.

RESULTS
The median follow-up was 48 months (range 3-121 months). The median age was 62 years old (range 25-73 years old). The 5-year OS and PFS were 78.9 and 55.6 %, respectively. The 5-year local control was 71.6 %. Multivariate analysis showed that histologic type (adenoma / squamous cell carcinoma), regional lymph node metastases, maximum diameter of the tumor and pretreatment hemoglobin level were independent risk factors for PFS, (hazard ratio (HR) 3.40, 95% confidence interval (95%CI) 1.03-9.81), (HR 2.89, 95%CI 1.12-7.72), (HR 1.42, 95%CI 1.11-1.79) and (HR 0.63, 95%CI 0.46-0.85), respectively. In terms of adverse effects, 27 patients (49.1 %) had acute grade 3-4 leukopenia. Seven patients (12.7 %) had late grade 3 intestinal complications. There was no renal toxicity during CCRT.

CONCLUSION
Our data showed that the CCRT with nedaplatin for FIGO stage IB-IVA carcinoma of the cervix uteri was efficacious and safe, especially in view of less renal toxicity. Histologic type, lymph node metastases, maximum diameter of tumor and pretreatment hemoglobin level were statistically significant prognostic factors.

CLINICAL RELEVANCE/APPLICATION
Chemoradiotherapy with nedaplatin for carcinoma of the cervix uteri was efficacious and safe, especially in view of less renal toxicity.

ABSTRACT
The main objectives of this study are to determine the three dimensional dose volume parameters for a Point A plan and a CTV-based plan and to compare these values using statistical tools.

Materials/Methods: A total of 22 cases of cervical cancer who were subjected to CT-based Intracavitary Brachytherapy were enrolled in this retrospective study. After the DICOM files were loaded, the critical organs (i.e. bladder and rectum) and target volumes were delineated. Treatment planning was undertaken using 2 methods: (1) Manchester of Patterson and Parker and (2) optimization of radiation dose to assigned calculation points which highly depends on the target volume. A prescribed dose of 7 Gy was used for the two methods. 44 plans were generated using the Oncentra version 4 treatment planning system. Patients were divided according to the total volume of the CTV. Patients with CTV less than or equal to 100 cm^3 were assigned as Group 1, those with more than 100 cm^3 were assigned as Group 2. The following 3D dose volume parameters were determined using relative and absolute values from graph of the plotted DVH: Coverage Index, V100 of the CTV, D90 of the CTV and D2cc of the bladder and rectum.

Results: With regards to the dose volume parameters evaluated in this study, all mean values generated from all cases were higher when CTV based planning was done rather than Point A based planning. But the results generated were only significant for those that belong in Group 2 or those having a large CTV (>100cm^3). This shows a better coverage of the target volume in terms of the D90, V100 and Coverage Index which can be correlated with an increase in terms of the success of treatment outcome for the CTV based planning. But for the organs at risk, namely the bladder and rectum, having higher radiation doses can result to increase risk of early and late complications.

Conclusions: The evidence of this study showed that CTV based treatment planning has more advantage compared to Point A planning if implemented in a CT-based brachytherapy because the method depends highly on the anatomy of the patient (i.e. patient specific). But the organs at risk must be considered in the evaluation of the plan because of the tendency over dosing the bladder and rectum specially when dealing with a large cervix (>100cm^3). Thus, the dose to the target volume and organs at risk must be noted and be optimized to be able to meet the goals of brachytherapy treatment.
We assessed Snapshot Freeze Motion Correction algorithm for its effect on image quality of coronary CT angiography (CCTA) with retrospective ECG-triggered.

**PURPOSE**
Lijuan Fan
Specific method.

**RESULTS**
Dual-source CTCA showed comparable diagnostic accuracy for selecting CABG candidates compared with CCA. Combining CT-based SYNTAX score with CTCA can be highly specific method for selecting CABG candidates.

**CONCLUSION**
Combining CT-based SYNTAX score with CTCA can be highly specific method for selecting CABG candidates.

**CLINICAL RELEVANCE/APPLICATION**
Successful motion correction of coronary CTA images may expand the use of this non-traumatic method to more suspected CAD patients.

**SSC01-02 • The Feasibility of Half-cycle Reconstruction Improve Image Quality of Free-breathing 320-detector Multidetector CT Angiography**
Zhen Wang BMedsC, RT (Presenter); Jianhua Yuan MD; Xiang Zhong Ding MD

**PURPOSE**
In patients with heart rates above 65 beats per minute, 320-detector multidetector CT uses multi-cycle reconstruction to improve the effective temporal resolution by using data from more than one R-R interval of the cardiac cycle to reconstruct an image. Sometimes the heart does not follow the same pattern of motion with every beat (e.g. some patients cannot hold their breath). In the situation, the multi-cycle reconstruction might not improve image quality of coronary computed tomography angiography (CCTA) due to respiration artifacts. Our aim was to investigate the feasibility of Half-cycle reconstruction improve image quality of free-breathing CCTA in patients with heart rates above 65 beats per minute using with a 320-detector multidetector CT.

**METHOD AND MATERIALS**
A total of 1489 coronary computed tomography angiography were performed in patients with heart rates above 65 beats per minute during the study period from October 2010 to February 2013. All CCTA examinations were produced with the standard breath-holding method, but the images in 22 patients existed respiration artifacts. Half-cycle reconstruction image and multi-cycle reconstruction image were reconstructed for each patient. The quality scores for 15 segments of all coronary arteries were analyzed and defined as: 1 (excellent), 2 (good), and 3 (poor). The signal-to-noise ratio (SNR), contrast-to-noise ratio (CNR), and effective radiation dose of each were compared between the two methods.

**RESULTS**
In patients with half-cycle reconstruction, diagnostic quality images (scores of 1 or 2) were obtained in 97.9% of the analyzed segments, compared with 69.5% in the group with multi-cycle reconstruction (p < 0.001). The SNR and CNR were not significantly different between the two methods. The median effective radiation dose was 1.2 mSv for the group with multi-beat acquisition and simulative effective radiation dose was 8.9 mSv for the group with half-cycle reconstruction (p < 0.001).

**CONCLUSION**
Half-cycle reconstruction can improve image quality of free-breathing CCTA in patients with heart rates above 65 beats per minute using with a 320-detector multidetector CT. For patients with difficulties of breath-holding, free-breathing CCTA with single beat acquisition can be an alternative solution for coronary artery evaluation.

**CLINICAL RELEVANCE/APPLICATION**
320-detector MDCT offers new opportunities for the breathless patient by using half-cycle reconstruction.

**SSC01-03 • Diagnostic Accuracy of Dual-source Computed Tomography for Selecting Coronary Artery Bypass Graft Surgery Candidates**
Young Joo Suh MD (Presenter); Young Jin Kim MD; Sae Rom Hong MD; Yoo Jin Hong MD; Hye-Jeong Lee MD; Jin Hur MD; Byung Wook Choi MD

**PURPOSE**
To investigate the diagnostic performance of dual-source computed tomography coronary angiography (CTCA) in terms of selecting coronary artery bypass graft surgery (CABG) candidates according to the 2011 American College of Cardiology/American Heart Association practice guidelines for CABG and to assess the added value of Syntax score for selecting CABG candidates.

**METHOD AND MATERIALS**
Institutional review board approval was obtained. We included 250 patients (mean age, 63.9 years; 150 men and 100 women) with a suspicion of coronary artery disease who underwent both dual source CTCA and conventional coronary angiography (CCA). We established eligible criteria for CABG based on 2011 American College of Cardiology/American Heart Association guidelines for CABG and to assess the added value of Syntax score for selecting CABG candidates were calculated, with CCA as the reference standard.

**RESULTS**
Dual-source CTCA showed comparable diagnostic accuracy for selecting CABG candidates compared with CCA. Combining CT-based SYNTAX score with CTCA can be highly specific method for selecting CABG candidates.

**CONCLUSION**
Dual-source CTCA showed comparable diagnostic accuracy for selecting CABG candidates and combining CT-based SYNTAX score with CCA can be highly specific method.

**CLINICAL RELEVANCE/APPLICATION**
Dual-source CTCA showed comparable diagnostic accuracy for selecting CABG candidates and combining CT-based SYNTAX score with CCA can be highly specific method.

**SSC01-04 • Effect of Snapshot Freeze Motion Correction Algorithm on Image Quality of Retrospective ECG-triggered Coronary CT Angiography**
Lijuan Fan (Presenter); Jiwang Zhang; Donghai Fu; Liren Zhang MD

**PURPOSE**
We assessed Snapshot Freeze Motion Correction algorithm for its effect on image quality of coronary CT angiography (CCTA) with retrospective ECG-triggered.

**RESULTS**
Successful motion correction of coronary CTA images may expand the use of this non-traumatic method to more suspected CAD patients.
Thirty consecutive patients undergoing CCTA with retrospective ECG- triggered. Two types of reconstruction methods of standard (STD) and snapshot freeze motion correction (SSF) were used to produce the 75% and 45% R-R interval images. We compared image quality and interpretability between STD and SSF reconstructions of each heart cycle. CCTA images were interpreted with Likert 5-points score by two experienced radiologists. The image quality and interpretability were respectively assessed on per-patient, per-artery and per-segment levels. Comparisons of variables were performed with Wilcoxon rank sum test and McNemar test.

RESULTS

CONCLUSION

The use of SSF improves image quality and interpretability of coronary CTA. The image quality of the 45% R-R interval was best.

CLINICAL RELEVANCE/APPLICATION

The use of SSF improves image quality and interpretability of coronary CTA.

SSC01-05 • Improved Non-calcified Plaque Delineation on Coronary CT Angiography by Sonogram-affirmed Iterative Reconstruction with Different Strength and Relationship with BMI

Lei Zhao MD (Presenter) ; Fabian Plank ; Andrea Klauser MD ; Florian Wolf MD ; Werner R Jaschke MD, PhD ; Gudrun Feuchtner MD *

PURPOSE

To prospectively compare non-calcified plaque delineation and image quality of coronary artery computed tomography angiograms (CCTA) obtained with sonogram-affirmed iterative reconstruction (SAIR) with different strengths and filtered back projection (FBP).

METHOD AND MATERIALS

A total of 53 patients (body weight 90.4±21.6 kg, BMI 29.5±6.6) were investigated. CCTA was performed using 128-slice dual-source CT. Images were reconstructed with standard FBP and sonogram-affirmed iterative reconstruction using different strength (12f, 13f, 14f). Image quality score (IQS) of overall CCTA exam and a non-calcified plaque outer border delineation scores (PDS) were evaluated respectively by using a 5-scale score: from 1= non-diagnostic to 5=excellent. Image noise, contrast-to-noise ratio (CNR) of aorta root, left main and right coronary artery proximal part, and the non-calcified plaques were quantified and compared among the 4 image reconstructions. IQS and PDS were compared between different BMI groups (BMI 50%

CONCLUSION

SAIR offers improved image quality and non-calcifying plaque delineation as compared with FBP, especially if BMI is increasing. Importantly, 18.3% of non-calcifying plaques were missed with FBP but detected by SAIR. 14f shows the best IQS and PDS among the different SAIR strength.

CLINICAL RELEVANCE/APPLICATION

SAIR improves non-calcifying plaque delineation and detection, and image quality in CCTA. In high BMI patients, highest SAIR strength 14f is most beneficial.

SSC01-06 • Enhanced Diagnostic Accuracy of In-stent Patency in Low-dose High-pitch Dual-source CT Angiography with Iterative Image Reconstruction

Jun-Jie Yang (Presenter)

PURPOSE

Recent studies demonstrated that sinogram affirmed iterative reconstructions can produce higher-resolution images with greater robustness for the reduction of various imaging artifacts. The aim of this study was to assess the diagnostic accuracy of in-stent restenosis (>50% luminal narrowing) using low-dose high-pitch dual-source CT coronary angiography (Flash CTCA) with sinogram affirmed iterative reconstructions (SAFIRE) in symptomatic patients referred for conventional coronary angiography (CCA).

METHOD AND MATERIALS

137 stents in 70 patients (average heart rate was 57±8 bpm), were prospectively evaluated. The interval between stenting and inclusion in the study was 21±12 months. Before scheduled CCA, Flash CTCA was performed between September 2011 and December 2012. In-stent noise, signal-to-noise ratio (SNR) and stent-lumen attenuation increase ratio (SNR) were measured and compared between SAFIRE reconstruction (group A) and traditional filtered back projection (FBP) reconstruction (group B). CCA was served as the standard of reference to further analyze accuracy of both groups on detecting in-stent restenosis.

RESULTS

Of the 137 stents, group A were superior to group B on in-stent noise (22.5±8.6 vs. 36.1±13.9; P<0.05). However, in subgroup of smaller stent (0.05). CCA average effective dose was (1.41±0.45) mSv.

CONCLUSION

Low-dose high-pitch dual-source CT angiography can be performed well in the detection of in-stent patency. Iterative image reconstruction significantly improve diagnostic accuracy of in-stent restenosis even in smaller stents.

CLINICAL RELEVANCE/APPLICATION

Iterative image reconstruction significantly improve diagnostic accuracy of in-stent restenosis even in smaller stents.

SSC01-07 • Use of 80kV, 100kV and 120kV in Coronary CT Angiography with Prospectively Electrocardiogram (ECG)-triggered Spiral Acquisition by Dual-source CT: Image Quality and Radiation Dose

Shuo Li MD (Presenter) ; Yining Wang MD ; Lingyan Kong MD ; Zhengyu Jin MD

PURPOSE

To compare the image quality (IQ) and radiation exposure using of 80kV, 100kV and 120kV tube voltage with prospectively electrocardiogram (ECG)-triggered spiral acquisition in coronary CT angiography.

METHOD AND MATERIALS

Totally ninety consecutive patients with irregular heart rate ( RESULTS

There was no difference in age, heart rate, mean scan time and body mass among the three groups (P>0.05). The mean tube current was 269.75±40.30 mAs.

CONCLUSION

In patients with a low and stable heart rate (< 70bpm), use of low tube voltage reduces radiation dose and may result in improved image quality.

CLINICAL RELEVANCE/APPLICATION

As increased applications of CCTA continue to emerge, concerns exist in regards to patient radiation exposure. lowering the tube voltage, have been developed for lowering radiation dose with CCTA.

SSC01-08 • Sub-millisievert CT Coronary Angiography (CTCA) Using Adaptive Iterative Dose Reduction

Masoud Shariat MD (Presenter) ; Aparna Deshpande MBBS ; Vikram M Raju MBBS, FRCR ; Bahiyah Alnafisi MD ; Narinder S Paul MD *

PURPOSE

To determine whether Adaptive Iterative Dose Reduction (AIDR) increases the proportion of patients with diagnostic quality submillisievert CTCA studies compared to Filtered Back Projection (FBP).

METHOD AND MATERIALS

Retrospective analysis of 80 consecutive patients referred for CTCA. Group A (FBP) = 40 patients; (25 M), aged 60.2± 9.0 years, BMI 28.0± 5.1, and group B (AIDR) = 40 patients; (20 M), aged 59.4 ± 12.9 years, BMI 27.8±6.6. All patients had the same preparation with oral/IV metoprolol 75-150mg/0-40mg to achieve a target heart rate (HR) of =60bpm and s/l NTG 300mcg. CTCA was performed using 320 x 140-160mm detector rows (Aquilion One, TMS, Otawara, Japan), gantry rotation of 350ms and power injection of 80cc iodinated CM at 6cc/s. In both groups, the X-ray tube settings (kVp, mAs) were optimized to pre-defined levels of image noise using proprietary software (SureExposure, Toshiba Medical Systems). Assessment of image quality was performed by 2 level III trained cardiac radiologists independently, blinded to the scan parameters. Qualitative assessment used a 4 point visual score (1=excellent, 2=good, 3=adequate, 4=poor). Quantitative assessment compared the signal to noise ratio (SNR) in the ascending aorta. The console readout (CTDI, DLP) provided the
American Heart Association guidelines. We evaluated myocardial strain using Intag-Software. Volume) were calculated to determine the pattern of ventricular remodeling. Evaluation of LGE was performed according to the 17-segment model of the myocardium. Positive findings were consistent with a diagnosis of PH.

METHOD AND MATERIALS

To establish a relationship between mean pulmonary arterial pressure (mPAP) and period of existence of vortical blood flow in the main pulmonary artery, we analyzed data from MR-PCI performed on 54 patients (29 males, 25 females, mean age 60.9 ± 11.6 years). Patients were scheduled for MR-PCI and had PH diagnosed on clinical grounds and/or the presence of PH on echocardiography. The period of existence of vortical blood flow was calculated from MR-PCI images using dedicated software. The relationship between mPAP and vortex was analyzed using the following statistical methods: linear regression, correlation analysis, and visual assessment.

RESULTS

A linear relationship was observed between mPAP and period of existence of vortical blood flow with a coefficient of determination of 0.99 (p < 0.001). The slope of the relationship was 1.6% per mmHg. Employing this relation to estimate mPAP from vortex allowed for accurate diagnosis of PH. A cut-off value of t vortex = 0.95 described as increasing linearly from 0.95 to 0.90% (mPAP = 25 mmHg) was validated in a subsequent cohort of patients.

CONCLUSION

MR-PCI vortex enables detection and evaluation of the abnormal origin of the coronary artery, including its high risk anatomy features.

Cardiac (Anatomy and Function I)

SSC01-09 • Anomalous Origin of the Coronary Artery from the Wrong Coronary Sinus Evaluated with Computed Tomography

Maciej Krupinski (Presenter) ; Malgorzata Urbanyczka Zawadzka ; Malgorzata Irzyk ; Bartosz Laskowicz ; Tomasz Miszalski-Jamka ; Robert Pawel Banys ; Jan Baron

PURPOSE

Anomalous origin of coronary artery is an abnormality occurring in around 1% of patients. The aim of the study was to perform cardiac computed tomography (CT) evaluation of the coronary arteries originating from the wrong coronary sinus, including their anatomy.

METHOD AND MATERIALS

7115 patients, who were scheduled for 64-slice or dual source cardiac CT were screened for the presence of isolated anomalous origin of the coronary artery from the wrong coronary sinus. Those, who revealed abnormal origin of coronary artery were evaluated for: high risk anatomy features (acute angle of takeoff, slitlike orifice, intramural course and course between aorta and pulmonary artery), presence and type of clinical symptoms and occurrence of cardiac events during follow up.

RESULTS

Anomalous origin of coronary artery was found in 54 (0.76 %) patients (29 males, 25 females, mean age 60.9 ± 11.6 years). 22 (41%) patients presented circumflex artery originating from the right coronary artery sinus (ALCx), 13 (24%) patients left coronary artery originating from the right coronary artery sinus (ALCA) and 3 (5%) patients left coronary artery originating from the noncoronary artery sinus. The mean value of angle of takeoff was lower (p < 0.001) compared to normal.

CONCLUSION

Anomalous origin of the coronary artery from the wrong coronary sinus is a rare occurring anomaly in cardiac CT. High risk anatomy features are the most common in patients with right coronary artery originating from the wrong coronary sinus. Patients with ARCA also reveal higher prevalence of chest pain and cardiac events in the follow up than individuals with ALCA and ALCx.

Clinical Relevance/Application

Cardiac CT enables detection and evaluation of the anomalous origin of the coronary artery, including its high risk anatomy features.

SSC02-01 • Assessment of Mean Pulmonary Arterial Pressure and Diagnosis of Pulmonary Hypertension Based on Vertical Blood Flow in the Main Pulmonary Artery

Gert Reiter (Presenter) ; Ursula Reiter ; Gabor Kovacs MD ; Horst Olschewski MD ; Michael H Fuchsjaeger MD

PURPOSE

To establish a relationship between mean pulmonary arterial pressure (mPAP) and period of existence of vortical blood flow in the main pulmonary artery derived from magnetic resonance phase-contrast imaging (MR-PCI) to 1) evaluate accuracy of non-invasive vortex-based estimation of mPAP and 2) define cut-off values for the diagnosis of manifest pulmonary hypertension (PH).

METHOD AND MATERIALS

The prospective study was approved by the local ethical review board. 145 patients with suspected PH (69 patients with and 76 without manifest PH) underwent right heart catheterization (RHC) and ECG-gated, time resolved three-dimensional MR-PCI of the main pulmonary artery. Velocity fields derived from MR-PCI were visualized with dedicated software and evaluated for period of existence of vertical blood flow (t vortext) in percent of the cardiac interval in the main pulmonary artery. Relationship between mPAP and t vortext was analyzed by means of regression, Bland-Altman and receiver operating characteristic curve analysis.

RESULTS

Relationship between mPAP and t vortext was excellently (goodness-of-the-fit parameter R² = 0.95) described as increasing linearly from t vortext = 0% (mPAP = 16 mmHg) with a slope of 1.6% per mmHg. Employing this relation to estimate elevated mPAP from t vortext in patients with manifest PH resulted in a standard deviation of 4 mmHg between MR-PCI vortex-based and RHC-derived mPAP values. Manifest PH, defined as mPAP = 25 mmHg, corresponded to t vortext = 14% of cardiac interval.

CONCLUSION

MR-PCI vortex based determination of periods of existence of vertical blood flow in main pulmonary artery allows for both, accurate diagnosis of PH and accurate estimation of elevated mPAP.

Clinical Relevance/Application

Vortex based assessment of mPAP has the potential to become the non-invasive, non-ionizing method of choice for early recognition and longitudinal follow up of patients with PH.

SSC02-02 • Myocardial Adaptation in Previously Untrained Men after Four Months of High-intensity Running Training (HIT): A Comprehensive Longitudinal Cardiac MR Imaging Study

Michael Scharf MD (Presenter) ; Axel Schmid MD ; Michael Uder MD ; Michael M Leil MD

PURPOSE

To prospectively evaluate whether short term endurance high intensity training (HIT) induces detectable morphologic cardiac changes in previously untrained men, as assessed with magnetic resonance imaging (MRI), and to compare findings to inactive control subjects.

METHOD AND MATERIALS

84 untrained volunteers were randomly assigned to a HIT-group (n=42; 44±4.7 years; range 33-51 years) or an inactive control group (n=42; 42±5.6 years; range 31-51 years). Before and after 4 months of HIT subjects underwent cardiac MRI cine, late gadolinium enhancement, tagging) to assess myocardial morphology and function of the left and right ventricle. In addition, a stepwise progressive-intensity treadmill test with continuous assessment of ventilation parameters and determination of heart rate at the anaerobic threshold was performed. Ejection fraction, end-diastolic volume, end-systolic-volume, stroke-volume, myocardial mass and cardiac index were measured for the left and right ventricle. LV and RV remodeling index (myocardial mass/end-diastolic volume) were calculated to determine the pattern of ventricular remodeling. Evaluation of LGE was performed according to the 17-segment model of the American Heart Association guidelines. We evaluated myocardial strain using Intag-Software.

RESULTS
Indexed volume and mass for the left and right ventricle were significantly greater after HIT whereas values in control subjects remained unchanged. Changes in ventricular EDV and MM were significantly correlated with changes in indexed VQmax (Pearson correlation, 0.609 and 0.588).

**CONCLUSION**
A relatively short period of HIT in previously untrained men leads to significant changes in left and right ventricular morphologic characteristics and function. These findings are not associated with pathologic features predisposing for sudden cardiac death.

**CLINICAL RELEVANCE/APPLICATION**
A short period of HIT leads to significant changes in cardiac morphologic characteristics and function which are not associated with pathologic features predisposing for sudden cardiac death.

**SSC02-03 • MRI Based Non-invasive Measures Correlates with Invasive Measurements of Left Atrial Diastolic Function in Atrial Fibrillation Patients**

Irfan M Khurram MD (Presenter) ; Farhan Maqbool MBBS ; Roy Beinart MD ; Hugh Calkins ; Saman Nazarian MD * ; Stefan L Zimmerman MD

**PURPOSE**
Atrial fibrillation (AF) is the most common cardiac arrhythmia and is a major source of morbidity due to diminished cardiac function. This study describes a novel methodology for non-invasive measurement of left atrial (LA) function in patients with AF.

**METHOD AND MATERIALS**
A total of 55 patients (81% male, 55% paroxysmal, age 60.4±10.2 years) underwent cardiac MRI prior to AF ablation. LA pressure was measured during sinus rhythm following trans-septal puncture for AF ablation. LA pressure (invasive) and volume (MRI derived) loops were prepared for all patients. LA diastolic function was assessed using a diastolic dysfunction score, defined as the ratio of the change in LA pressure to the change in LA volume during passive LA filling. Additionally, the ratio of pulmonary vein flow velocities during ventricular systole and diastole were obtained using phase contrast MRI (Figure, top panel, S/D ratio). LA volumes from 30 phases of the cardiac cycle were obtained from cine-MRI. LA systolic functions were calculated from the active emptying fraction during atrial contraction. Diastolic dysfunction scores greater than the 90th percentile (>1.6mmHg/ml) were considered to signify severe diastolic dysfunction.

**RESULTS**
The mean diastolic dysfunction score was 0.76±0.7 mmHg/ml. The score was higher (worst) in patients with persistent versus paroxysmal AF (1.0±0.9 versus 0.6±0.5, p<0.02). The mean S/D ratio was 1.04±0.6; and was lower in patients with persistent versus paroxysmal AF (0.5±0.5 versus 1.2±0.5, p=0.04).

There was a negative linear association between diastolic dysfunction scores and S/D ratio measures (Figure, bottom panel, R2 0.262, p<0.01). The non-invasive MRI derived ratio of pulmonary vein flow velocities during systole and diastole are associated with the MRI/invasive derived diastolic dysfunction score, and appear to be a reasonable surrogate of LA diastolic function.

**CLINICAL RELEVANCE/APPLICATION**
Non-invasive PV flow characteristics by MRI yield comparable results to pressure/volume loops and may ease the assessment of LA diastolic function. More studies are needed to validate this association.

**SSC02-04 • A Quantitative and Qualitative Assessment of Unaged Free-breathing Cardiac Imaging Using Through-time Radial GRAPPA for Left Ventricular Functional Evaluation**

Gunhild E Aandal MD (Presenter) ; Vidya Nadig MD ; Victoria Yeh ; Prabhakar Rajiah MD, FRCR ; Trevor Jenkins ; Abdus Sattar PhD ; Mark A Griswold PhD * ; Robert C Gilkeson MD * ; Vikas Gulani MD, PhD * ; Nicole Seiberlich PhD *

**PURPOSE**
To determine whether LV functional parameters and image quality of free-breathing, ungated scans reconstructed with through-time radial GRAPPA are comparable to those of gold-standard breathhold cine techniques.

**METHOD AND MATERIALS**
Volumetric data was collected in 78 subjects (14 volunteers, 64 patients) on a 1.5T MRI scanner. Both gold-standard breathheld cardiac functional scans with ECG gating (tailored to the patient with spatial resolutions between 1.4-2.6 mm² and temporal resolutions of 31-62ms) and free-breathing, ungated highly undersampled radial GRAPPA scans (spatial temporal resolution of 42.2ms) were acquired. Reconstruction of the radial data was performed with through-time radial GRAPPA. ESV, EDV, and EF were assessed for both methods, and correlation coefficients and Bland-Altman plots were generated. The images were rated by two cardiothoracic radiologists for specific features on a scale of excellent, good, poor, no visibility; obvious visual differences precluded blinding. Ordinal logistic regression analysis (corrected for clustering) of the radiologists’ ratings was performed.

**RESULTS**
Correlation coefficients indicated significant correlation between the methods (EF R=0.97, EDV R=0.99, and ESV R=0.99). Bland-Altman analysis showed that 72 of the 78 of the EF measurements were within the 95% limits of agreement (mean difference=-0.93%, SD=2.49%). Similar results were found for the EDV and ESV values. Radiologist ratings showed that the free-breathing method was preferred for depiction of end systolic borders (p<0.05), and mitral valve visualization and blood pool contrast with the breathhold method were preferred (p<0.05). Differences in EF, EDV, and ESV between the gold-standard and free-breathing, ungated images generated using through-time radial GRAPPA are not clinically significant. Radiologist review demonstrated that some features including endocardial borders are better visualized with the free-breathing scan due to their reduced motion artifacts, while the breathhold method was preferred for valve visualization and blood pool contrast.

**CLINICAL RELEVANCE/APPLICATION**
Free-breathing ungated scans with through-time radial GRAPPA can be used to find LV functional parameters quickly and cost-effectively even for patients with difficulty breathholding or arrhythmia.

**SSC02-05 • Fat Accumulation in Skeletal Muscle Quantified by MRS: Relationship to Global Myocardial Function**

Radwa A Noureldin MD, MSc (Presenter) ; Ronald Ouwerkerk PhD ; Roderic I Pettigrew MD, PhD ; Ahmed M Gharib MChB

**PURPOSE**
Obesity has a detrimental effect on cardiac function, we aimed to evaluate relationship between musculoskeletal fat deposition and myocardial function.

**METHOD AND MATERIALS**
Seventy-seven HIPPA-compliant subjects, without history of cardiac disease, were scanned after IRB approval and signing a written informed consent. We used a Siemens Verio 70cm bore 3T-MRI. Short axis (SA) and 4-chamber SSFP cine were obtained for evaluation of global myocardial function; EF, EDV, ESV, and LV mass, variables were indexed to BSA. Pericardial fat volume was quantified on SA images at end systole, extended from level of mitral valve to the apex. MRS was performed using PRESS technique, TR/TE = 4000/24ms. PRESS voxel was targeting the vastus lateralis (VL), anterior tibial (AT) and soleus (SV) muscles. Musculoskeletal fat fraction (FF) was quantified using Amares/MRUI. IMCL was also calculated. Axial T1 weighted images at L4-L5 level were acquired for abdominal fat measurement.

**RESULTS**
Correlation coefficients indicated significant correlation between the methods (EF R=0.97, EDV R=0.99, and ESV R=0.99). Bland-Altman analysis showed that 72 of the 78 of the EF measurements were within the 95% limits of agreement (mean difference=-0.93%, SD=2.49%). Similar results were found for the EDV and ESV values. Radiologist ratings showed that the free-breathing method was preferred for depiction of end systolic borders (p<0.05), and mitral valve visualization and blood pool contrast with the breathhold method were preferred (p<0.05). Differences in EF, EDV, and ESV between the gold-standard and free-breathing, ungated images generated using through-time radial GRAPPA are not clinically significant. Radiologist review demonstrated that some features including endocardial borders are better visualized with the free-breathing scan due to their reduced motion artifacts, while the breathhold method was preferred for valve visualization and blood pool contrast.

**CLINICAL RELEVANCE/APPLICATION**
Free-breathing ungated scans with through-time radial GRAPPA can be used to find LV functional parameters quickly and cost-effectively even for patients with difficulty breathholding or arrhythmia.

**SSC02-06 • Caffeine and Taurine Containing Energy Drink Improves Systolic Left-ventricular Contractility in Healthy Volunteers Assessed by Strain Analysis Using Cardiac Magnetic Resonance Tagging (CSPAMM)**

Jonas Doerner (Presenter) ; Daniel Kuettling ; Claas P Naehle MD * ; Hans H Schild MD ; Daniel K Thomas MD, PhD

**PURPOSE**
Energy drinks (ED) usually contain a high amount of caffeine, taurine, and sugar as their main ingredients. Although their consumption appears not critical, there is little or no regulation on ED sales so far. Concerns about adverse side effects especially focus on heart function in adolescents and young adults. In this study, we investigated the effect of ED consumption on myocardial function in healthy volunteers using MRI tagging and strain analysis.

**METHOD AND MATERIALS**
18 healthy volunteers (15 male, 3 female, mean age: 27.5 years) were investigated using cardiac magnetic resonance imaging (CMR). CMR was performed on a 1.5-Tesla Siemens scanner (Siemens Medical Solutions, Erlangen, Germany). Each volunteer consumed 32 mg caffeine (168 ml/m² body surface area) and 400 mg taurine (168 ml/m² body surface area). For left-ventricular (LV) myocardial tagging, complementary spatial modulation of magnetization (CSPAMM) was used. Strain was calculated for peak systolic (PS), peak systolic strain rate (PSSR) and peak diastolic strain rate (PDSR) using TagTrack (Gyrotools, Zurich, Switzerland). Steady state free precision (SSFP) cine imaging was used for determination of LV-function. Additionally vital parameters such as heart rate (HR) and blood pressure...
RESULTS
PS and PSSR as parameters for systolic LV-contractility were significantly increased 1h after ED consumption compared to baseline (PS: w/o ED -22.33 ± 1.7; w ED -24.15 ± 2.4; p=0.01; PSSR: w/o ED -1.18 1/s ± 0.08; w ED -1.30 1/s ± 0.16, p=0.01). PDSR as a parameter for diastolic LV-relaxation was slightly, but not significantly higher compared to baseline (PDSR: w/o ED 1.90 l/s ± 0.33; w ED 2.09 l/s ± 0.44, p=ns). No significant changes were found for LV-function (LV-EDV: w/o ED 141 ml ± 31; w ED 145 ml ± 32; LV-EF: w/o ED 64 % ± 4; w ED 66 % ± 8) and vital parameters (HR: w/o ED 63 l/min ± 9; w ED 62 l/min ± 7; BP: w/o ED 113/62 mmHg; w ED 117/64 mmHg).

CONCLUSION
This work reveals that ED consumption has a short-term impact on cardiac contractility, therefore further studies have to evaluate the impact of long-term ED consumption and the effect of ED on patients with heart disease to determine potential risks or benefits of ED consumption.

CLINICAL RELEVANCE/APPLICATION
ED consumption lead to changes in LV-contractility, which can be assessed by CMR tagging and strain analysis.

SSC02-07 • Left Ventricular Strain Analysis by Cardiac MR Using Deformation Field Analysis at Bright Blood Cine SSFP Imaging: A Comparison with Speckle Tracking Echocardiography
Kevin Kalisz (Presenter); Edouard Semaan; Daniel H Katz; Xiaoming Bi PhD; Marius Cordts; Christoph Guetter PhD; Marie-Pierre Jolly; Benjamin Freed; Daniel Lee; Preeti Kansal; Sanjiv Shah MD; Michael Markl PhD; James C Carr MD; Jeremy D Collins MD

PURPOSE
To demonstrate the feasibility of strain analysis using deformation field analysis on steady state free precession (SSFP) cardiac MR images with speckle tracking echocardiography (STE) as the reference standard.

METHOD AND MATERIALS
44 patients (29 males, average age 52 years) referred to CMR for scar assessment or evaluation of infiltrative disease were imaged on a 1.5T scanner (Magnetom Avanto or Aera, Siemens Healthcare, Erlangen, Germany). Bright blood cine short axis images (TR/TE 42/1.2, FA 79 degrees, frame rate 25, BW 930) were analyzed using prototype software (Siemens Corp., Corporate Technology, Princeton, NJ). Similar to speckle tracking, the spatio-temporal deformation of the LV muscle on cine images was used to derive deformation fields and quantify in-plane strain indices. A subset of images (15 patients) were analyzed again by the first reviewer and independently by a second reviewer. Global peak radial and circumferential strains were compared to values obtained at STE using the Pearson coefficient. The intraclass correlation coefficient (ICC) was used as a measure of inter-observer and intraobserver variability.

RESULTS
CMR peak radial and circumferential strains demonstrated fair and good correlation with STE (r=0.36 and 0.63, respectively). CMR underestimated (p < 0.05) strain compared to STE in radial and circumferential strain respectively. Fair to good agreement was noted between LV global strain by CMR and STE, however. Work is ongoing to determine optimal cine SSFP acquisition parameters, to improve the deformation field algorithm for strain calculation, and to correlate CMR strain values with patient symptoms.

CLINICAL RELEVANCE/APPLICATION
Myocardial strain has been applied to predicting changes in cardiac function is a variety of disease processes. We describe the use of a novel algorithm to compute strain at cinegraphic cardiac MR.

SSC02-08 • Cardiac Computed Tomography (CCT) for Predicting Left Atrial Appendage Occluder Device Size
Orly Goitein (Presenter); Grupper Avishay; Elio Di Segni MD; Eli Konen MD; Ashraf Hamdan MD; Victor Guetta *; Ilan Hai; David Luria MD; Michael Glikson MD

PURPOSE
Atrial fibrillation (AF) may cause thromboembolic stroke. The left atrial appendage (LAA) is the thrombi source in more than 90% of strokes. Several devices have been developed to occlude the LAA. Inaccurate LAA orifice sizing may lead to utilization of more than one device per procedure, or inadequate LAA occlusion.

The purpose of this study was to assess the contribution of cardiac Computed Tomography (CCT) measurements for LAA device sizing with.

METHOD AND MATERIALS
All subjects underwent ECG gated CT scans prior to LAA closure device insertion. CCT scans were performed using a 256-slice scanner with retrospective electrocardiographic gating.

Assessed parameters included: LAA maximal and minimal diameters (mm), LAA depth (mm). These values were compared with final implanted device size.

Echocardiographic follow up at six weeks was performed in order to document the presence of regurgitation, as evidence for incomplete LAA occlusion.

RESULTS
This study cohort included 22 chronic AF patients (9 males, average age 76 years). Two procedures failed, the maximal LAA diameter was 39 mm in both. The total number of devices used was 24 in 20 patients (1.2 devices per patient). Mean maximal LAA diameter was 22±4 mm. Mean device size was 24±4. Good correlation was found between maximal CCT diameter and device size (Pearson correlation=0.45; p=0.04). No correlation was found between minimal LAA diameter, LAA depth and device size (Pearson correlation=-0.008; p=0.7 respectively). Mean LAA depth was 22±4 mm. Mean device size was 24±4. Good correlation was found between maximal CCT diameter and device size (Pearson correlation=0.45; p=0.04). No correlation was found between minimal LAA diameter, LAA depth and device size (Pearson correlation=-0.008; p=0.7 respectively). Mean LAA depth was 22±4 mm. Mean device size was 24±4. Good correlation was found between maximal CCT diameter and device size (Pearson correlation=0.45; p=0.04). No correlation was found between minimal LAA diameter, LAA depth and device size (Pearson correlation=-0.008; p=0.7 respectively). Mean LAA depth was 22±4 mm.

CONCLUSION
CCT should be considered as an important adjunct modality for device sizing. LAA maximal diameter > 30 mm was predictive of unfavorable procedure outcome including procedure failure and incomplete LAA occlusion in 80% of cases with large LAA ostia.

CLINICAL RELEVANCE/APPLICATION
Cardiac CT is an important imaging modality before LAA occluder insertion. It allows accurate LAA size evaluation and can identify potential problematic cases prior to device implantation.

SSC02-09 • Characterisation of Myocardial Function and Structure in Patients with Rheumatoid Arthritis: A Cardiovascular Magnetic Resonance Study
Ntobeko A Ntusi MBCh, MD (Presenter); Jane M Francis; Paul M Matthews MD, DPhil; Paul B Wordsworth MBBS, FRCP; Stefan Neubauer; Theodoros D Karamitsos

PURPOSE
To assess global and regional left ventricular (LV) function and myocardial fibrosis in patients with rheumatoid arthritis (RA), using cardiovascular magnetic resonance (CMR) and examine the additional effect of traditional cardiovascular risk factors (CVRFs) in RA patients.

METHOD AND MATERIALS

RESULTS

CONCLUSION
CMR demonstrates impaired myocardial strain and a high incidence of non-ischaemic fibrosis in RA patients. The cardiac abnormalities in RA appear to be incremental to those due to traditional CVRFs.

CLINICAL RELEVANCE/APPLICATION
Cardiovascular disease is common in asymptomatic RA patients and traditional CVRFs need to be aggressively controlled as they appear to confer incremental risk in this cohort.
RESULTS

The repeated measuring test and the Steel-Dwass test for multiple comparisons of values and the difference ratio among different SAFIRE groups, using the

In 70 consecutive patients, who underwent CAC imaging by 128-slice dual-source 128-slice CT, CAC volume, mass and Agatston score were calculated from

Coronary artery calcium (CAC) score by computed tomography (CT) is widely used for cardiovascular risk stratification. Iterative reconstruction algorithms

METHOD AND MATERIALS

Purposes of the study were to evaluate the differences in coronary calcium scores between state-of-the-art CT scanners from four different vendors using fifteen ex-vivo human hearts placed in a commercially available anthropomorphic chest phantom. These hearts were scanned with unenhanced prospectively ECG-triggered step-and-shoot protocols at equal radiation dose settings. Thickness and increment of slices were 3mm. Agatston scores, calcification volume and mass scores were quantified

Coronary artery calcifications expressed as Agatston scores with state-of-the-art CT scanners from the four major vendors.

Our study suggests that elevated levels of MMP-8 are associated with greater atherosclerotic plaque volume at cCTA. Moreover, IL-8 and TNF-α may indicate

We evaluated the differences in coronary calcium scores between state-of-the-art CT scanners from four different vendors using fifteen ex-vivo human hearts placed in a commercially available anthropomorphic chest phantom. These hearts were scanned with unenhanced prospectively ECG-triggered step-and-shoot protocols at equal radiation dose settings. Thickness and increment of slices were 3mm. Agatston scores, calcification volume and mass scores were quantified with clinically used semi-automatic software from the same vendor as the CT system. Differences were analyzed by the Friedman test (significance level P

RESULTS

Fourteen hearts had coronary calcifications. Agatston scores, calcification volume and mass scores differed significantly (P3, respectively. Median (interquartile range) calcification mass scores were 70 (27-245), 84 (42-326), 85 (43-337), and 69 (35-246) mg, respectively.

CONCLUSION

CT scanners from different vendors result in significantly different Agatston scores, calcification volume scores and mass scores.

CLINICAL RELEVANCE/APPLICATION

Integration of quantitative cardiac CT imaging with novel serum biomarkers of atherosclerosis and myocardial remodeling may enhance insights into the patho-mechanisms of coronary heart disease.

SCS03-03 • Coronary Artery Calcification Scoring with CT Scanners from Four Different Vendors Results in Different Scores

Martin J Willemink MD (Presenter) ; Richard A Takx MD ; Mathias Prokop MD, PhD * ; Johan De Mey * ; Marco Das MD * ; Pim A De Jong MD, PhD ; Ricardo P Budde MD, PhD ; Arnold Schilham PhD ; Ronald L Bleys MD, PhD ; Nico Bults DSc, PhD * ; Joachim E Wildberger MD, PhD ; Tim Leiner MD, PhD *

PURPOSE

Coronary artery calcifications have emerged as an important biomarker for cardiovascular risk stratification. New guidelines recommend evaluation of these calcifications using cardiac computed tomography (CT) in asymptomatic adults with low-to-intermediate and intermediate cardiovascular risk, concerning approximately 40% of the United States adult population. Treatment strategies depend on coronary artery calcification scores on CT. However, it is unknown whether different new generation CT scanners result in similar Agatston scores. Therefore, the purpose was to determine the inter-vendor variability of coronary artery calcifications expressed as Agatston scores with state-of-the-art CT scanners from the four major vendors.

METHOD AND MATERIALS

We evaluated the differences in coronary calcium scores between state-of-the-art CT scanners from four different vendors using fifteen ex-vivo human hearts placed in a commercially available anthropomorphic chest phantom. These hearts were scanned with unenhanced prospectively ECG-triggered step-and-shoot protocols at equal radiation dose settings. Thickness and increment of slices were 3mm. Agatston scores, calcification volume and mass scores were quantified with clinically used semi-automatic software from the same vendor as the CT system. Differences were analyzed by the Friedman test (significance level P

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CONCLUSION

CT scanners from different vendors result in significantly different Agatston scores, calcification volume scores and mass scores.

CLINICAL RELEVANCE/APPLICATION

Integration of quantitative cardiac CT imaging with novel serum biomarkers of atherosclerosis and myocardial remodeling may enhance insights into the patho-mechanisms of coronary heart disease.

SCS03-04 • Impact of Iterative Reconstruction on CT Coronary Calcium Quantification

Akira Kurata (Presenter) ; Anoeshka S Dharampal MD ; Admir Dedic MD ; Pim Feyter MD, PhD ; Marcel L Dijkshoorn RT * ; Gabriel P Krestin MD, PhD * ; Koen Nieman MD

PURPOSE

Coronary artery calcium (CAC) score by computed tomography (CT) is widely used for cardiovascular risk stratification. Iterative reconstruction algorithms reduce image noise and potentially decrease radiation exposure. We evaluated the influence of sonogram-affirmed iterative reconstruction (SAFIRE) on the CCS score.

METHOD AND MATERIALS

In 70 consecutive patients, who underwent CAC imaging by 128-slice dual-source 128-slice CT, CAC volume, mass and Agatston score were calculated from images reconstructed by filtered back projection (FBP) without and with incremental degrees of iterative reconstruction (SAFIRE algorithm: 10-50%). We used the repeated measuring test and the Steel-Dwass test for multiple comparisons of values and the difference ratio among different SAFIRE groups, using the

RESULTS

The repeated measuring test and the Steel-Dwass test for multiple comparisons of values and the difference ratio among different SAFIRE groups, using the
In normal myocardium, diastolic and systolic myocardial T1 times significantly differ but strongly correlate with each other. Besides elimination of gender myocardial T1 level. Blood normalized diastolic and systolic myocardial T1 values strongly correlated with each other on segmental (r = 0.72) as well as mean and 13 ms in systole in case of mean myocardial T1 times) and significant differences in segmental and mean myocardial T1 times with gender completely disappeared. Mean myocardial T1 times (984 ± 28 ms in diastole, 959 ± 21 ms in systole) as well as all segmental T1 values in diastole and systole differed significantly (p < 0.05). The images were analyzed with use of the research software prototype CAIPI. After an initial segmentation of the aortic vessel wall, the vessel contour is automatically propagated to all frames using a registration based on a quadrature filter. The results of the automatic analysis were compared to the manual results of three experts. The segmentation results of the three observers and the automatic segmentation (duration 39 ± 4 s) were compared pair-wise. The average dice coefficient between observer 1 and the algorithm was 0.86 ± 0.04, the observer comparison was 0.92 ± 0.03. The average symmetric absolute surface distance error was 1.09 ± 0.4 mm for the algorithm and 0.71 ± 0.22 mm for the observers. The mean absolute error of the stroke volume was 4.67 ± 2.28 ml for the algorithm and 6.14 ± 3.5 ml for the observers. The average dice coefficient between the two sexes groups on both per-segment and per-person basis.

RESULTS

The median Agatston score (range) decreased with incremental IR: 163 (0.1 ~ 3393.3), 158.4 (0.1 ~ 3079.3), 137.7 (0.1 ~ 2978.0), 120.6 (0 ~ 2783.6), and 84.1 (0 ~ 2186.9) for 0% (FBP), 10%, 20%, 30%, 40%, and 50% SAFIRE, respectively (Figure 1; P = 0.52 for systole): After blood normalization variances of segmental and mean myocardial T1 times decreased (to 17 ms in diastole and 13 ms in systole) and significant differences in segmental and mean myocardial T1 times with gender completely disappeared; Blood normalized diastolic and systolic myocardial T1 values strongly correlated with each other on segmental (r = 0.72) as well as mean myocardial T1 (r = 0.89) level. The comparison of the manual and automatic quantification shows good agreement. Because no manual correction is needed, the proposed method is suited for the automatic analysis of the temporal evolution of flow velocities, peak velocities, stroke volumes and flow rates over multiple cardiac cycles.

CONCLUSION

Patients with aperiodic heartbeats (e.g. arrhythmias) and monitoring of hemodynamic responses to stress or physiologic manoevers.

CONCLUSION

Women’s myocardial extracellular volume fraction is higher than men’s in healthy population.

CLINICAL RELEVANCE/APPLICATION

The higher myocardial ECV in healthy women than men indicates studies ideally consist of subgroups of each gender may help to interpret the research and clinical results involving myocardial ECV.

SSC03-06 • Higher Myocardial Extracellular Volume Fraction in Women than Men: Study by Contrast Enhanced Cardiac Magnetic Resonance Imaging

Shi-Jun Zhang (Presenter) ; Sheng Hong Ju MD, PhD

PURPOSE

To investigate whether the myocardial extracellular volume fraction (ECV) of women differs from that of men in healthy population.

METHOD AND MATERIALS

Institutional review board approval and informed consent were obtained. Twenty-eight healthy volunteers (11 men and 17 women, aged 19 to 63 years) were recruited. A contrast agent MRI scan was performed at a dose of 0.15 mmol/kg intravenous bolus of Gd-DTPA. A mid-cavity short-axis plane was selected for T1 mapping precontrast and repetitively after contrast injection, using the modified Look-Locker inversion recovery (MOLLI) sequence. Regions of interest (ROIs) were selected from four segments (the septal, anterior, lateral and inferior wall of the left ventricle) within the myocardium for ECV calculating in each person. The ECV was calculated as: ECV = ? • (1 - hematocrit), where ? is the myocardial contrast partition coefficient, and was calculated by relating change in longitudinal relaxation rate (R1 = 1/T1) of myocardium (R1m) versus that of left ventricular blood pool (R1b). Independent-samples t tests were applied to compare ECV between the two sexes groups on both per-segment and per-person basis.

RESULTS

Three out of the 112 segments were excluded from two men due to sever artifact, remaining 41 segments in men and 68 segments in women. The mean values (standard deviation) of ECV within the septal, anterior, lateral and inferior left ventricular wall were 0.238±0.023, 0.235±0.024, 0.248±0.032 and 0.240±0.022 in the 11 men, while in the 17 women, the values were 0.273±0.023, 0.275±0.033, 0.279±0.025 and 0.276±0.034. The mean difference (95% confident interval, 95%CI) for the four segments between the two sexes groups were 0.034 (0.016-0.053), 0.040 (0.016-0.063), 0.034 (0.012-0.057) and 0.036 (0.010-0.063). The overall mean ECV values of these two groups on per-segment basis were 0.239 ± 0.025 and 0.275 ± 0.029, P < 0.001. The per-person ECV were calculated as the arithmetic mean value of the ROIs from the 4 segments, and the mean values of the two groups were 0.239 ± 0.024 and 0.275 ± 0.024, P = 0.001.

CONCLUSION

Women’s myocardial extracellular volume fraction is higher than men’s in healthy population.

CLINICAL RELEVANCE/APPLICATION

The comparison of the manual and automatic quantification shows good agreement. Because no manual correction is needed, the proposed method is suited for the automatic analysis of the temporal evolution of flow velocities, peak velocities, stroke volumes and flow rates over multiple cardiac cycles.

CONCLUSION

Patients with aperiodic heartbeats (e.g. arrhythmias) and monitoring of hemodynamic responses to stress or physiologic manoevers.

SSC03-07 • Normal Diastolic and Systolic Myocardial T1 Times at 1.5 T: Correlations and Blood Normalization

Ursula Reiter (Presenter) ; Gert Reiter * ; Katrin Dor MD ; Andreas Greiser PhD * ; Ralph Madertheran MD ; Michael H Fuchsjaeger MD

PURPOSE

To evaluate regional differences between systolic and diastolic myocardial longitudinal relaxation time (T1), and to investigate variances of myocardial T1 values associated with T1 time of blood to derive relations between blood normalized systolic and diastolic myocardial T1 times in healthy subjects.

METHOD AND MATERIALS

In the current prospective study, approved by the local ethical review board, 40 healthy subjects (20 female, 20 male; age range 20-35 years) underwent ECg-gated 1.5 T magnetic resonance imaging. A modified Look-Locker inversion recovery (MOLLI) sequence was used to acquire baseline, mid-ventricular and apical short-axis T1 images. A mid-ventricular and apical short-axis T1 times were evaluated in systole and diastole. Regional myocardial T1 times were evaluated in 16 AHA-segments, blood T1 values were derived from blood pool in the center of the left ventricular cavity. Linear regression slopes between myocardial and blood T1 values were employed to normalize measured myocardial T1 values to the mean blood T1 time of the study population. Mean of T1 values were compared by t-test, considering P < 0.05 as significant.

RESULTS

Mean myocardial T1 times (984 ± 28 ms in diastole, 959 ± 21 ms in systole) as well as all segmental T1 times in diastole and systole differed significantly (p2 = 0.53 for diastole, R2 = 0.52 for systole): After blood normalization variances of segmental and mean myocardial T1 times decreased (to 17 ms in diastole and 13 ms in systole) and significant differences in segmental and mean myocardial T1 times with gender completely disappeared; Blood normalized diastolic and systolic myocardial T1 values strongly correlated with each other on segmental (r = 0.72) as well as mean myocardial T1 (r = 0.89) level.

CONCLUSION

In normal myocardium, diastolic and systolic myocardial T1 times significantly differ but strongly correlate with each other. Besides elimination of gender differences in myocardial T1 values, blood normalization reduces variability of myocardial T1 times.

CLINICAL RELEVANCE/APPLICATION

Blood normalization allows improving the definition of threshold values to distinguish normal from pathologically affected myocardium in diastole and systole.

SSC03-08 • 4-Dimensional Magnetic Resonance Velocity Mapping Based Evaluation of Elevated Mean Pulmonary Arterial Pressure: Comparison of Vector, Streamline and Particle Trace Flow Visualization

Ursula Reiter (Presenter) ; Gert Reiter * ; Gabor Kovacs MD ; Aurelien F Stalder * ; Mehmet A Gulsun * ; Andreas Greiser PhD * ; Horst Olschewski MD ; Michael H Fuchsjaeger MD

PURPOSE

To compare relative period of existence of vortical blood flow in the main pulmonary artery in patients with pulmonary hypertension (PH) from velocity vector...
METHOD AND MATERIALS
This prospective study was approved by the local ethical review board. 23 patients with manifest PH underwent right heart catheterization (RHC) and 4D MR-PCI of the main pulmonary artery. Blood flow patterns were visualized as 3D velocity vector fields projected on 2D anatomical images (3D-vector visualization), and as 3D particle traces and evaluated for period of existence of vortical blood flow (vortex in percent of the cardiac interval) in the main pulmonary artery. Dependence of vortex on visualization and relation to mPAP were analyzed by means of correlation, linear regression and Bland-Altman analysis.

RESULTS
Vortex derived from different visualizations strongly correlated ($r = 0.94$ for 3D-vector versus streamline and $r = 0.92$ for 3D-vector versus particle trace visualization). Bias and 95% limits-of-agreement were $-4\%$ and $\pm 14\%$ for comparison 3D-vector versus streamline visualization and were $-3\%$ and $\pm 15\%$ for 3D-vector versus particle trace visualization. In all techniques vortex showed strong correlation with mPAP with small standard errors from regression lines ($r = 0.96$, $SE = 3.4$ mmHg for 3D-vector, $r = 0.95$, $SE = 3.6$ mmHg for streamline, and $r = 0.92$, $SE = 4.4$ mmHg for particle trace visualization).

CONCLUSION
Although periods of existence of vortical blood flow determined from 3D-vector visualization correlated best with mPAP, visualization of streamlines and particle traces provide similar results.

CLINICAL RELEVANCE/APPLICATION
4D velocity mapping represents an emerging tool in the analysis of PH hemodynamics and enables estimation of elevated mPAP irrespectively of flow visualization technique.

SSC03-09 • 3T 1H-MR Spectroscopy of Myocardial Steatosis: Relationship to Fat Depots throughout the Body
Radwa A Noureldin MD, MSc (Presenter) ; Ronald Ouwerkerk PhD ; Roderic J Pettigrew MD, PhD ; Ahmed M Gharib MBChB

PURPOSE
To quantify amount of fat accumulated in the heart using high field MRH1 and to determine its relationship to metabolic lipid profile and other fat depots in the human body.

METHOD AND MATERIALS
After IRB approval, ninety HIPPA-compliant subjects, not known to have cardiac disease, underwent 1H-MRS using wide bore 3T scanner. B0 shimming parameters were optimized with a rapid B0 mapping method. MRS of heart was performed using ECG gated PRESS breath navigated technique, TR/TE $= 1.5k/30ms$. PRESS voxel was located in the septum at isovolumic phase of diastole planned on a 4-chamber SSFP with saturation slabs across subcutaneous and pericardial fat. The same sequence was used for musculoskeletal 1H-MR; PRESS voxel targeting the vastus lateralis, tibialis anterior and soleus muscles. Fat was quantified with Amrakes/MRUI and related to water in unsuppressed spectra. Axial images of the heart were obtained at end systole for pericardial fat quantification. Axial T1 weighted images at L4-L5 level were acquired for abdominal fat measurement. All subjects had lipid profile assessment including serum cholesterol, HDL, LDL and serum triglycerides and were obtained within one month of the scan.

RESULTS

CONCLUSION
1H-MR spectroscopy quantifies ectopic fat deposition in the heart. In population with no cardiac disease, myocardial steatosis is correlated with high circulating triglycerides, musculoskeletal fat other fat depots in the human body.

CLINICAL RELEVANCE/APPLICATION
1H-MR spectroscopy is an important tool to investigate and monitor the effects of circulating serum lipids on fat metabolism and its accumulation within cardiac muscle and other ectopic fat depots.
ULDS with AIDR3D has a sufficient potential to be used for lung cancer screening.

**RESULTS**

It was demonstrated that ULDS with AIDR3D could have comparable LND to LDS with AIDR3D except for smaller non-solid nodules.

**CONCLUSION**

It was demonstrated that ULDS with AIDR3D could have comparable LND to LDS with AIDR3D except for smaller non-solid nodules.
Washout on the Portal Venous and Equilibrium Phases

RESULTS

On comparison of each parameter between malignant and benign SPNs, both LSRs had significant difference between two groups (p < 0.05).

CONCLUSION

In the positive predictive value (PPV) (from 100% to 96.8%).

detecting hypovascular HCCs. Combining 'delayed WO' with WI/WO raises the sensitivity of HCC characterisation from 46.9% to 62.8%, with a minor decrease.

RESULTS

was only observed in 3 other nodules (2 cholangiocarcinomas, 1 regenerative nodule). Hypointensity on the hepatospecific phase was not sensitive in (n=22;15.2%). The WI/WO pattern was observed only in HCC. 23 of the 55 arterially-enhancing HCCs lacking WO (41.8%) showed 'delayed WO'.

RESULTS

receiver-operating characteristics curve (ROC) analysis was performed.

manually-segmented from the surrounding lung parenchyma on axial CT images and 3D shape features of each nodule were calculated using an in-house software program. To evaluate the differentiating value of these 3D shape features between benign and malignant nodules, comparison statistics and receiver-operating characteristics curve (ROC) analysis was performed.

RESULTS

Between benign and malignant nodules, there were significant differences in nodule's sphericity, discrete compactness and 3D roundness. Compared with malignant nodules, benign nodules showed significantly higher sphericity (0.767 vs. 0.653, p < 0.05).

Clinical relevance/application

Over 1/3 of benign nodules referred to community pulmonologists undergo an invasive procedure for diagnosis. Better pathways are needed to avoid invasive diagnosis of benign lesions.

Gastrointestinal (Hepatocellular Carcinoma Imaging)

Monday, 10:30 AM - 12:00 PM • E353A

SCC05-01 • ‘Delayed Washout’ on the Hepatospecific Phase of Gd-BOPTA MRI in the Characterisation of Arterial-enhancing HCCs Lacking Washout on the Portal Venous and Equilibrium Phases

Kelvin Curtis MD, MRCS, FRCR (Presenter) ; Rosa Liotta ; Roberto Miraglia MD ; Settimo Caruso ; Vincenzo Carollo MD ; Angelo Luca MD

PURPOSE

The current cornerstone of HCC diagnosis is the wash-in(WI)/wash-out(WO) enhancement pattern. However, there remain a significant proportion of hypervascular HCCs lacking WO on the portal venous and/or equilibrium phases. We investigated the possible role of the hepatospecific phase on gadobenate dimeglumine-enhanced MR imaging (Gd-BOPTA-MRI) in further characterising HCCs lacking the typical WI/WO pattern.

METHOD AND MATERIALS

Ninety-seven consecutive patients who underwent liver transplantation between 2004 and 2012 and Gd-BOPTA-MRI within three months of surgery were enrolled. Two experienced radiologists performed a nodule by nodule analysis, which was followed by liver explant correlation. 'Delayed WO' was defined as hypointensity on the hepatospecific phase in arterial-enhancing nodules lacking WO on the portal venous and/or equilibrium phases.

RESULTS

Imaging was performed 41.7±25.4 days prior to transplantation. 295 lesions were identified on histopathology, of which 240 were HCCs. 47 HCCs with massive necrosis after percutaneous treatment were eliminated. Of the remaining 193 HCCs, 48 were not detectable on imaging (24.9%). The 145 HCCs seen on imaging showed WO (n=68;46.9%), arterial enhancement without WO (n=55;37.9%), and hypovascularity on arterial and venous sequences (n=22;15.2%). The Wl/wo pattern was observed only in HCC. 23 of the 55 arterially-enhancing HCCs lacking WO (41.8%) showed ‘delayed WO’. This pattern was only observed in 3 other nodules (2 cholangiocarcinomas, 1 regenerative nodule). Hypointensity on the hepatospecific phase was not sensitive in detecting hypovascular HCCs. Combining ‘delayed WO’ with WI/wo raises the sensitivity of HCC characterisation from 46.9% to 62.8%, with a minor decrease in the positive predictive value (PPV) (from 100% to 96.8%).

CONCLUSION

A significant proportion of arterial-enhancing nodules lacking WO demonstrate ‘delayed WO’ on the hepatospecific phase of Gd-BOPTA-MRI. When coupled with...
Differentiation of Small (≤2 cm) Hepatocellular Carcinoma from Small (≤2 cm) Benign Nodule in Cirrhotic Liver on Gadoxetic Acid-enhanced and Diffusion-weighted MR Images

Gil-Sun Hong MD (Presenter); Jae Ho Byun MD; Heon-Ju Kwon MD; So Yeon Kim; Kyoung Won Kim MD; Hyung Jin Won MD; Yong Moon Shin; Pyo Nyun Kim MD

PURPOSE
To identify characteristic imaging features that differentiate small (=2 cm) hepatocellular carcinoma (HCC) from small (=2 cm) benign nodule in the cirrhotic liver on gadoxetic acid-enhanced and diffusion-weighted (DW) magnetic resonance (MR) images.

METHOD AND MATERIALS
This retrospective study was approved by our institutional review board, and informed consent was waived. We included 230 cirrhotic patients with 222 pathology-confirmed small HCCs and 61 benign nodules including 28 pathology-confirmed dysplastic nodules (diameter, 0.5–2 cm), who underwent gadoxetic acid-enhanced and DW MR imaging. In consensus, two radiologists analyzed signal intensity of the HCCs and benign nodules at each MR sequence and rim enhancement during the arterial or equilibrium phases. The findings relevant as predictors of small HCCs were identified using univariate and multivariate logistic regression analyses. The combinations of significant MR findings in multivariate analysis were compared with American Association for the Study of Liver Disease (AASLD) practice guideline (a combination of arterial enhancement and portal or delayed washout) using McNemar test.

RESULTS
On multivariate analysis, arterial enhancement (adjusted odds ratio [OR], 8.7), T2 hyperintensity (adjusted OR, 6.2), and hyperintensity on DW images (adjusted OR, 2.6) were significant for differentiating small HCCs from benign nodules (P=0.04). When two or all three findings of them were applied as diagnostic criteria for differentiating small HCCs from benign nodules, sensitivity and accuracy were significantly higher than those of AASLD practice guideline (91% vs. 81% and 89% vs. 83%, respectively; each P=0.006).

CONCLUSION
On gadoxetic acid-enhanced and DW MR images, arterial enhancement and hyperintensity on T2-weighted image and on DW images are helpful for differentiating small HCCs from benign nodules in patients with liver cirrhosis.

Clinical Features of Hepatocellular Carcinoma Showing Isointense or Hyperintense on Hepatocyte-phase of Gadoxetic Acid-enhanced Magnetic Resonance Imaging; Radiologic-pathologic Correlation in Surgically Resected Cases

Katsuhiro Sano MD (Presenter); Utaor Motosugi MD; Hiroyuki Morisaka MD; Shintaro Ichikawa MD; Tomoaki Ichikawa MD, PhD *

PURPOSE
Hepatocellular carcinoma (HCC) commonly demonstrates hypointense on hepatocyte-phase of gadoxetic acid-enhanced magnetic resonance (EOB-MR) imaging. However, some cases of hepatocellular carcinoma show isointense or hyperintense on hepatocyte-phase of EOB-MR images, which is a pitfall for diagnosis of HCC. The purpose of this study was to elucidate the radiological and histopathological features of HCC that appear isointense or hyperintense on hepatocyte-phase of EOB-MR images.

METHOD AND MATERIALS
In this study, 24 HCCs in 23 patients (mean age; 71.1, 18 males and 5 females, mean tumor size; 32.4mm) who were surgically resected from January 2008 to March 2012 were included. Inclusion criteria of HCC were more than 0.9 of EOB enhancement ratio (tumor to liver contrast on hepatocyte-phase / tumor to liver contrast on precontrast phase). All tumors were retrospectively reviewed of enhancement of arterial-phase, bile juice production, histopathological grading, 1 and 3 year survival rate, and 1 and 3 year recurrence-free survival rate.

RESULTS
Twenty-one nodules (88%) showed hypervascular on arterial-phase of EOB-MR images. In gross pathologically, 13 (54%) cases showed green hepatoma producing bile juice. In histopathological findings, all cases were diagnosed as well to moderately-differentiated HCC with no case of poorly-differentiated HCC. The survival rate of 1 and 3 years are 100%. Recurrence-free survival rate of 1 and 3 years are 67% and 56%, respectively.

CONCLUSION
This study demonstrated that poorly-differentiated HCC was not included in the HCC showing isointense or hyperintense on hepatocyte-phase of EOB-MR images. HCC showing isointense or hyperintense on hepatocyte-phase of EOB-MR images tend to show good survival rate.

Diagnostic Performance of Delayed Hepatobiliary Imaging Post Gadoxetic Acid Combined with DWI vs. Dynamic Contrast-enhanced Imaging for HCC Detection

Cecilia Besa MD (Presenter); Nancy A Cooper MD; Sara Lewis MD; Amita Kamath MD; Sasan Roayaie; Bachir Taouli MD *

PURPOSE
To compare the diagnostic performance of hepatobiliary phase imaging (HBP) post gadoxetic acid combined with diffusion-weighted imaging (DWI) vs. dynamic contrast-enhanced (CE) T1-weighted imaging (T1WI) for hepatocellular carcinoma (HCC) detection.

METHOD AND MATERIALS
203 consecutive patients at risk of HCC who underwent gadoxetic acid-enhanced MRI from 01/2011 to 12/2011 were included in this IRB approved retrospective study. Two sets of images were analyzed independently by 2 readers: HBP/DWI-set (HBP + DWI using b 0-50-500-1000) and dynamic CE-set (pre-contrast, arterial, portal venous and late venous 3D T1WI after administration of 10 mL of gadoxetic acid). Reference standard was represented by consensus interpretation of 2 separate readers using combination of imaging, clinical and pathologic data. HCCs were defined as lesions > 1 cm with hypointensity on HBP and/or restricted diffusion (hypointensity on b500/1000 and low ADC) on HBP/DWI-set and typical wash-in/wash-out on the CE-set (AASLD criteria). Per lesion and per patient sensitivity, specificity, PPV and NPV were calculated for each image.

RESULTS
On multivariate analysis, arterial enhancement (adjusted odds ratio [OR], 8.7), T2 hyperintensity (adjusted OR, 6.2), and hyperintensity on DW images (adjusted OR, 2.6) were significant for differentiating small HCCs from benign nodules (P=0.04). When two or all three findings of them were applied as diagnostic criteria for differentiating small HCCs from benign nodules, sensitivity and accuracy were significantly higher than those of AASLD practice guideline (91% vs. 81% and 89% vs. 83%, respectively; each P=0.006).

CONCLUSION
On gadoxetic acid-enhanced and DW MR images, arterial enhancement and hyperintensity on T2-weighted image and on DW images are helpful for differentiating small HCCs from benign nodules in patients with liver cirrhosis.

Differentiation of Small (≤2 cm) Hepatocellular Carcinoma from Small (≤2 cm) Benign Nodule in Cirrhotic Liver on Gadoxetic Acid-enhanced and Diffusion-weighted MR Images

SSC05-03 • Clinical Features of Hepatocellular Carcinoma Showing Isointense or Hyperintense on Hepatocyte-phase of Gadoxetic Acid-enhanced Magnetic Resonance Imaging; Radiologic-pathologic Correlation in Surgically Resected Cases

SSC05-04 • Diagnostic Performance of Delayed Hepatobiliary Imaging Post Gadoxetic Acid Combined with DWI vs. Dynamic Contrast-enhanced Imaging for HCC Detection

SSC05-05 • Pilot Study to Evaluate the Diagnostic Per-patient Accuracy of a Limited Hepatobiliary Phase-gadoxetate Enhanced MRI for Hepatocellular Carcinoma Surveillance

Robert M Marks MD (Presenter); Andrew Ryan MD; Elhamy R Heba BMBCH; An Tang MD; Claude B Sirlin MD *; Mustafa R Bashir MD *

PURPOSE
To evaluate the diagnostic performance of an abbreviated gadoxetate-enhanced MRI protocol as a potentially low-cost alternative to conventional MRI for hepatocellular carcinoma surveillance in the setting of chronic liver disease.

METHOD AND MATERIALS
This pilot dual center retrospective cross-sectional study was IRB approved at both institutions where informed consent was waived. 299 consecutive patients at risk for HCC that were in an MRI-based HCC surveillance program between October 28, 2008 and January 31, 2010 were included in the study. For each patient, their first gadoxetate-enhanced MRI was evaluated as the index study. Two readers, blinded to the history and clinical interpretation of the study, independently read two image sets per patient: set 1 included T1w 20-minute hepatobiliary phase images and a T2w SSPSE sequence; set 2 included diffusion-weighted imaging and set 1. For each image set per patient, each nodule larger than 10mm was scored using a 5 point predetermined scoring grid and the highest scoring nodule was then used to give the image set a final score. Image sets with a score of 1-3 were classified as negative, and 4 and 5 were classified as positive. The composite reference standard included pathologic proof after transplantation, hepatocytosis, biopsy, empirical treatment based on the
RESULTS
There were a total of 49 lesions considered positive for HCC. Inter-reader agreement was substantial for both image sets (κ = 0.72 for both). Intra-reader agreement was excellent (κ = 0.97 and 0.99). Reader performance for image set 1 (given as reader A/reader B) was: sensitivity 85.7%/79.6%; specificity 91.2%/95.2%; positive predictive value 65.6%/76.5%; negative predictive value 97.0%/96.0%; accuracy 90.3%/92.6%. Only one examination (out of 299) was scored differently on image set 2 compared with set 1, leading to nearly identical performance.

CONCLUSION
Due to its high negative predictive value, an abbreviated MRI protocol with T2-weighted SSFSE and hepatobiliary phase sequences may be an acceptable, low cost alternative to a complete MRI in the setting of chronic liver disease at centers that rely on MRI for HCC surveillance.

CLINICAL RELEVANCE/APPLICATION
This limited MRI may be an acceptable alternative to dynamic conventional MRI’s and could potentially reduce costs and improve throughput for patients in an MRI surveillance program for HCC.

SSC05-06 • Radiopathological Correlation of Hepatocellular Carcinoma in Transplant Patients. MR Evaluation with Gadoxetic Acid
Yuko Nakamura MD (Presenter) ; Tomoki Kimura ; Toru Higaki PhD ; Fuminarui Tatsugami ; Yasushi Nagata MD ; Kazuo Awai MD

PURPOSE
To evaluate the clinical performance of MRI using Gadoxetic acid in the detection of patients with hepatocellular carcinoma (HCC) and the disease burden within a transplant population.

METHOD AND MATERIALS
A retrospective analysis was performed of the MRI and explant histology reports of patients receiving liver transplants between January 2011 and April 2013. MRI and histologically detected HCC were recorded and correlated as were the indications for transplantation. Comparison was made with an initial cohort of patients and the total study population.

RESULTS
166 adult patients received a liver transplant over the study period. The indications included acute liver failure (6), alcoholic liver disease (45), Primary biliary cirrhosis (16), primary sclerosing cholangitis (20), viral hepatitis (34), alcoholic liver disease and hepatitis (7) and miscellaneous (38). 131 patients had an MRI scan performed prospectively for evaluation of HCC and 40 patients had image positive hepatocellular carcinoma. With histological correlation on a per patient basis, MRI was 100% sensitive and 98.9% specific in detecting HCC. One patient was diagnosed with multifocal HCC on MRI but only had multiple dysplastic nodules. A total of 83 histological HCCs were detected with 76 true positives, 7 false negatives and 9 false positives on imaging. This equates to a sensitivity of 91.6% on a per lesion basis. No patients were diagnosed with marginally suspicious tumour burdens within Milan criteria on explant histology. There was no difference in the diagnostic performance between the early and total population.

CONCLUSION
Concerns in changing practice from a dual contrast technique using superparamagnetic iron oxide and gadolinium to a gadoteric acid technique were unfounded. Performance in identifying patients with HCC within transplant criteria was high as was the length of resection correlation.

SSC05-07 • Detection of Hepatocellular Carcinoma (HCC) in Liver Transplant Candidates: Intraindividual Comparison of Gadobenate Dimeglumine (Gd-BOPTA) Enhanced MR Imaging and Multiphasic 64-slice CT
Min Ju Kim MD (Presenter) ; Rameen Albazaz MBCh ; Andrew F Scarsbrook FRCR ; Maria B Sheridan MD ; James A Guthrie MBBCh

PURPOSE
To intraindividually compare gadobenate dimeglumine (Gd-BOPTA) enhanced MRI and 64-slice CT for detection of HCC in patients with cirrhosis.

METHOD AND MATERIALS
Informed consent and ethical approval were obtained. Eighty-five consecutive patients with 104 HCC nodules underwent MRI at 1.5T (Avanto, Siemens) and 64-slice CT (Sensation 64, Siemens) at a mean interval of 14 days (range, 10–20 days). All patients underwent transplantation within 60 days. MR acquisitions comprised unenhanced breath-hold T2W images and volumetric 3D Gd-BOPTA-enhanced (0.1 mL/kg; MultiHance®, Bracco) T1W GRE images acquired at 25s, 60s, 180s (dynamic phase) and 90 min (hepatobiliary phase). 64-slice CT was performed with 0.6 x 64 mm collimation, 3-mm section thickness, 250 mAs, 120 kVp. A triple-phase protocol was started at 18s, 60s and 180s after reaching a trigger threshold of 150 HU above baseline CT number in the aorta. Image analysis was independently performed by three observers in two sessions separated by 4 weeks. Findings were compared directly with explanted liver pathology results. Diagnostic accuracy was evaluated using the receiver operating characteristic (ROC) method. Sensitivity, specificity, PPV and NPV with corresponding 95% confidence intervals were determined.

RESULTS
The mean area under the ROC curve for Gd-BOPTA MRI (0.78) was higher than that of CT (0.76). On a lesion-by-lesion basis, the mean sensitivity (73%) of Gd-BOPTA MRI was significantly higher than that of CT (63.4%) (P < 0.05). Gd-BOPTA-enhanced MRI is significantly more accurate and sensitive than 64-slice CT for the diagnosis of HCC in patients with cirrhosis prior to liver transplantation.

CLINICAL RELEVANCE/APPLICATION
MR imaging with hepatobiliary contrast agent may improve the diagnostic accuracy of MR in the detection of focal liver lesions in cirrhotic patients.

SSC05-08 • Retrospective Comparison of MRI Sequences for Prediction of Size of Hepatocellular Carcinoma Based on Explant Evaluation
Claudia R Seuss MD (Presenter) ; Min Ju Kim ; Michael J Triolo MD ; Cristina H Hajdu MD ; Andrew B Rosenkrantz MD

PURPOSE
Size of hepatocellular carcinoma (HCC) is a critical feature in determining liver transplant allocation. The purpose of this study was to compare measurements of size of HCC on different MRI sequences with pathologic size of HCC determined from evaluation of liver explantation specimens.

METHOD AND MATERIALS
92 patients with HCC who underwent contrast-enhanced liver MRI between July 2005 and June 2012 within 90 days before liver transplantation were included in this retrospective study. One radiologist reviewed the imaging in conjunction with pathologic findings and created a map depicting the location of the dominant lesion in each case. Then, two separate abdominal radiologists (R1 and R2) used these maps to independently measure the size of the dominant HCC on the following sequences in different sessions: T2-weighted imaging (T2WI); b-500 diffusion weighted imaging (DWI); and arterial (AR), portal venous (PV) and equilibrium (EQ) post-contrast phases. Size measurements on the various MRI sequences were compared with explant measurements using Pearson’s correlation coefficients, paired T-tests, and Bland-Altman plots.

RESULTS
For R1, correlation with pathology was highest for PV (r = 0.89) and EQ (r = 0.83); for R2, correlation was highest for AR, PV, and EQ (r = 0.85-0.86). Absolute error was lowest for R1 on PV (4.3 mm, p

CONCLUSION
When considering absolute and systematic error, we suggest use of portal venous phase images to obtain the most reliable measurements of size of HCC on MRI. Measurements on arterial phase images systematically over-estimated lesion size for both readers in our study.

CLINICAL RELEVANCE/APPLICATION
HCC size is critical for determining transplant eligibility and allocation. Our findings regarding the utility of size measurements in the portal venous phase may help standardize such measurements.

SSC05-09 • Clinical Utility of Weighted Liver Spleen Contrast Using Gadoxetate Disodium-enhanced Hepatic MRI: Pre-evaluation of Stereotactic Body Radiotherapy for Hepatocellular Carcinoma
Yuko Nakamura MD (Presenter) ; Tomoki Kimura ; Toru Higaki PhD ; Fuminarui Tatsugami ; Yasushi Nagata MD ; Kazuo Awai MD

PURPOSE
Stereotactic body radiotherapy (SBRT) is a loco-regional therapy for hepatocellular carcinoma (HCC). Radiotherapy to the liver must be planned carefully because of poor hepatic radiation tolerance especially in HCC patients with liver dysfunction and their eligibility for SBRT for HCC must be assessed carefully because radiation-induced liver disease can be fatal. At SBRT for HCC, V20, defined as the percentage of the liver volume exposed to >20 Gy, is usually planned to be
Acoustic Radiation Force Impulse Elastography for the Prediction of Chemotherapeutic Response in the Patients with Liver Metastases

**PURPOSE**
To investigate if and when acoustic radiation force impulse (ARFI) elastography can predict chemotherapeutic response in patients with liver metastasis from colorectal cancer.

**METHOD AND MATERIALS**
The institutional review board approved this prospective study and informed consents were obtained in all patients. 45 untreated metastatic liver tumors from colon cancer (mean, 3.6 ± 1.9 cm; =3 nodules per patient) of 26 patients (M:F=16:10; mean age, 58.6 ± 9.6 years) were included in this study. ARFI elastography was performed before chemotherapy and 48 hours, 1 week, 2 weeks and 4 weeks after chemotherapy for the same liver tumors along with measurement of tumor diameter. Shear wave velocities were obtained from the center, 12 o’clock, 3 o’clock, 6 o’clock and 9 o’clock direction within a tumor, two times per measurement point (total, 10). Responders and nonresponders were determined by RECIST 1.1 criteria on CT taken 2 month after the start of chemotherapy. Paired t-test was used for statistical analysis.

**RESULTS**
Responders (n=10) showed significant interval drop in elasticity of metastatic liver tumors between pre-chemotherapy and post-48hr (mean difference, -0.23 MPa, P<0.05). Nonresponders (n=15) showed no significant change.

**CONCLUSION**
ARFI elastography may be a useful method to predict chemotherapeutic response in patients with liver metastasis from colorectal cancer.
Noninvasive imaging biomarkers that can quantitatively monitor physiologic changes in tumor microenvironment in response to antiangiogenic therapies will be an alternative tool as it is more accurate than CT.

** SSC06-04  ▪ Diagnosis of Complete Response in the Colorectal Cancer Liver Metastasis (CRCLM) after Chemotherapy: Which Imaging Modality Should Be Used?**

Min Jung Park (Presenter); Mi-Suk Park MD; Seong Ho Park MD *; Won Jae Lee MD; Min Ju Kim; Sung Eun Rha MD; Chang Hee Lee MD; Yoon Jin Lee MD; Sumi Park; Yang Shin Park MD; Nurhee Hong MD

**PURPOSE**

To determine the performance of CT and MRI with liver-specific contrast agent for the evaluation of complete response in CRCLM after chemotherapy in a retrospective multicenter setting and to find out alternative role of non-contrast enhanced MRI (NE-MR) with Diffusion-weighted imaging (DWI) for the evaluation of complete response in CRCLM after chemotherapy.

**METHOD AND MATERIALS**

Among patients treated for CRCLM between 2008 and 2011 at eight hospitals in Korea, 90 patients (63 men, 27 women; mean age, 57 years; age range, 36–77 years) with the following criteria were retrospectively included: fewer than 10 liver metastases (LM) before chemotherapy; neoadjuvant chemotherapy followed by liver resection; disappearance of at least one LM on post-chemotherapy multidetector CT portal venous phase images with slice thickness=5mm; post-chemotherapy gadobenate diodium-enhanced MRI including DWI b-value=500sec/mm2; time interval=4 weeks between post-chemotherapy CT and MRI; follow-up at least 1 year after surgery. We retrospectively evaluated 445 LM in these patients on CT and MRI. Pathologic report of surgical specimen, sonographic finding on radiofrequency ablation and follow-up CT or MRI were served as reference standard. The diagnostic accuracies of MRI and CT were determined and compared using the McNemar test.

**RESULTS**

In diagnosing complete response after chemotherapy, gadoxetic acid-enhanced MRI showed significantly higher accuracy (89%), sensitivity (75%), and specificity (94%) compared to CT (95%; 91%; 45%); respectively (P<0.001). For the evaluation of HCC viability comparing between the MK and ADC, the sensitivity, specificity, and area under the ROC curve for the MK were 89.3% (95% CI, 0.59–0.89), 99.2% (95% CI, 0.99–1.0) and 0.96 (95% CI, 0.93–0.99); respectively (P<0.001). The duration of this imaging acquisition was five minutes. We computed the mean kurtosis (MK) and mean diffusivity (MD) values (0, 100, 500, 1000, 1500, and 2000 sec/mm2) over regions of interest encompassing the entire tumor using MATLAB software (Mathworks, Natick, Mass). The diagnostic performance of MK and ADC values for the evaluation of HCC viability were compared.

**CONCLUSION**

Our study findings suggest that DWI and MK could be an alternative tool as it is more accurate than CT.

**CLINICAL RELEVANCE/APPLICATION**

Formula-based volumetric software is available. Volumetric tumor information, in particular relative changes in volume during therapy, can be approximated using the proposed WHO-based formula if no volumetric software is available.

** SSC06-05  ▪ Formula-based Lesion Volume Estimation: Evaluation of the Agreement with Software-based Volumetry**

Melvin D’Anastasi MD (Presenter) *; Ruediger P Laubender MA, MPH *; Julia Lynghjem *; Volker Heinemann MD *; Maximilian F Reiser MD; Anno Graesser MD *

**PURPOSE**

To evaluate the agreement between true tumor volume and tumor volume derived from (i) a new formula based on longest lesion (RECISt) diameter, (ii) a new formula based on longest diameter and longest orthogonal (WHO) diameter.

**METHOD AND MATERIALS**

89 baseline and follow-up CTs were available in 20 patients with metastatic colorectal cancer from the randomized phase II multicenter CIOX trial. Target lesions were semi-automated and followed over time. Lesions were evaluated at (i) semi-automated volumetry using Siemens Syngo.via and (ii) volumetric assessment using a newly developed formula based on manual measurement of the longest diameter and the longest orthogonal diameter. True, WHO- and RECIST-based volumes were calculated. We compared the agreement of the true volume to the WHO-based volume and RECIST-based volume. We also compared the agreement between ‘true’ and WHO-based volume relative changes by means of the intraclass correlation.

**RESULTS**

A total of 151 lesions were evaluated. Using a variance components model it was shown that the difference between true and RECIST-based volume is statistically significant (p < 0.001) indicating a substantial constant bias. The same model showed a difference between true and WHO-based volume, which was not statistically significant (p = 0.50), indicating no substantial constant bias. Scatter-plots show that the RECIST-based volume overestimates lesion volume. The intraclass correlation between ‘true’ and WHO-based volume relative changes was 0.95, showing nearly perfect agreement between methods.

**CONCLUSION**

Our proposed formula, if based on WHO-measurements, allows for a very good estimate of relative volume changes (the RECIST-based formula overestimates the true volume).
RESULTS

Accuracy of mRECIST versus RECIST 1.1 in Predicting Outcome in Hepatocellular Carcinoma Treated with Sorafenib
Giulia Gallusi; Rossella Di Miscio; Michele Di Martino (Presenter); Concetta V Lombardo; Adolfo Attili; Carlo Catalano MD

PURPOSE
To retrospectively determine the frequency and clinical significance of the findings and recommendations derived from pelvic CT performed as part of multiphasic CT surveillance imaging for hepatocellular carcinoma (HCC) in patients at risk for the development of HCC.

METHOD AND MATERIALS
The study was HIPAA-compliant and approved by the institutional review board with waiver of informed consent. The cohort was comprised of 602 patients with either cirrhosis and/or hepatitis B who were referred for routine HCC surveillance by hepatologists from an academic medical center in southern California. Multiphasic acquisitions were performed using a multidetector 16-slice or 64-slice helical CT scanner (GE Lightspeed) to obtain non-contrast, arterial, portal venous, and delayed phase images. Reports from the initial abdominopelvic CT scan for each patient obtained between 2002-2007 were retrospectively reviewed for extrarenal findings in the pelvis.

RESULTS
Screening was performed in 602 patients (mean age 54 years). Of these patients, 389 (65%) were male and 213 (35%) were female. Logistic regression indicated a lower likelihood of pelvic findings in patients that were young.

CONCLUSION
Pelvic CT included at the time of HCC surveillance does not uncover a statistically significant number of incidental pelvic findings that impact patient care. In light of the increased ionizing radiation dose to patients and unnecessary healthcare costs associated with pelvic CT imaging in this context, routine surveillance of patients with known risk factors for HCC should be performed with multiphasic abdominal CT only.

CLINICAL RELEVANCE/APPLICATION
Pelvic CT does not detect clinically meaningful pelvic pathology with sufficient frequency to warrant its routine inclusion in HCC surveillance protocols.

SSC06-09 • Significance of Pelvic Imaging in Computed Tomographic Surveillance of Hepatocellular Carcinoma
Kazim Narsinh MD (Presenter); Iris M Otni MD; Cynthia S Santillan MD; Claude B Sirlin MD *

PURPOSE
To retrospectively determine the frequency and clinical significance of the findings and recommendations derived from pelvic CT performed as part of multiphasic CT surveillance imaging for hepatocellular carcinoma (HCC) in patients at risk for the development of HCC.

METHOD AND MATERIALS
The study was HIPAA-compliant and approved by the institutional review board with waiver of informed consent. The cohort was comprised of 602 patients with either cirrhosis and/or hepatitis B who were referred for routine HCC surveillance by hepatologists from an academic medical center in southern California. Multiphasic acquisitions were performed using a multidetector 16-slice or 64-slice helical CT scanner (GE Lightspeed) to obtain non-contrast, arterial, portal venous, and delayed phase images. Reports from the initial abdominopelvic CT scan for each patient obtained between 2002-2007 were retrospectively reviewed for extrarenal findings in the pelvis.

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Screening was performed in 602 patients (mean age 54 years). Of these patients, 389 (65%) were male and 213 (35%) were female. Logistic regression indicated a lower likelihood of pelvic findings in patients that were young.

CONCLUSION
Pelvic CT included at the time of HCC surveillance does not uncover a statistically significant number of incidental pelvic findings that impact patient care. In light of the increased ionizing radiation dose to patients and unnecessary healthcare costs associated with pelvic CT imaging in this context, routine surveillance of patients with known risk factors for HCC should be performed with multiphasic abdominal CT only.

CLINICAL RELEVANCE/APPLICATION
Pelvic CT does not detect clinically meaningful pelvic pathology with sufficient frequency to warrant its routine inclusion in HCC surveillance protocols.

SSC07 • Accuracy of mRECIST versus RECIST 1.1 in Predicting Outcome in Hepatocellular Carcinoma Treated with Sorafenib
Giulia Gallusi; Rossella Di Miscio; Michele Di Martino (Presenter); Concetta V Lombardo; Adolfo Attili; Carlo Catalano MD

PURPOSE
To compare RECIST1.1 and mRECIST ability in the estimation of the response to therapy in patients with advanced HCC treated with Sorafenib.

METHOD AND MATERIALS
From August 2008 to July 2012, 58 cirrhotic patients with advanced HCC received Sorafenib at starting dose of 400 mg bid and were followed until death occurred. Using RECIST1.1 and mRECIST, 27 patients who had undergone a 4-phase CT scan/dynamic MR before and after (30-100 days) the start of treatment were retrospectively analysed. RRR was evaluated according to RECIST1.1 and mRECIST, to determine the ability of each method in predicting the response of HCC to Sorafenib, taking OS as an end-point.

RESULTS
The objective response (OR= complete response (CR) + partial response (PR)), stable disease (SD) and progressive disease (PD) rates according to RECIST1.1 and mRECIST were 14%, 25%, 59% and 25%, 18%, 55%, respectively. In CR+PR versus SD+PD patients, median OS was 24.3 months (both with RECIST1.1 and mRECIST) versus 10.9 (with RECIST1.1) and 10.1 months (with mRECIST). OR was significantly associated with OS only according to mRECIST (p=0.007).

CONCLUSION
RRR according to mRECIST, but not to RECIST1.1, sensibly correlates to outcome in cirrhotic patients with HCC treated with Sorafenib.

CLINICAL RELEVANCE/APPLICATION
mRECIST evaluation may help to select patient who try benefit from Sorafenib treatment.

ISP: Genitourinary (New Methods for Characterization of Renal Masses)
Monday, 10:30 AM - 12:00 PM • N228
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SSC07 • ANA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Richard G Abramson , MD *
Moderator
Cary L Siegel , MD

SSC07-01 • Genitourinary Keynote Speaker: Targeted Therapies for Renal Cell Carcinoma:Imaging of Treatment Response and Complications
Richard G Abramson MD (Presenter) *

PURPOSE
The ascendency of targeted anticancer agents has broad implications for clinical imaging. This short presentation discusses targeted therapies for renal cell carcinoma, highlighting important challenges for assessing response and identifying treatment-related complications. An understanding of targeted agents and their mechanisms of action can enhance the radiological interpretation and improve patient care.

SSC07-02 • Radiogenomics of Clear-cell Renal Cell Carcinoma: Associations between CT Imaging Features and Mutations
Christoph A Karle MD (Presenter); Pier Luigi Di Paolo MD; Joshua L Chaim DO; A Ari Hakimi MD; James J Hsieh MD, PhD; Oguz Akin MD; Hedvig Hricak MD, PhD

PURPOSE
To investigate associations between computed tomography (CT) features of clear-cell renal cell carcinoma (ccRCC) and mutations in VHL, PBRM1, SETD2, KDM5C or BAP1 genes.

METHOD AND MATERIALS
The institutional review board approved this retrospective, hypotheses-generating study of 233 patients with ccRCC and waived the informed consent requirement. The study was HIPAA compliant. Three radiologists independently reviewed pre-treatment CT images of all ccRCC without knowledge of their genomic profile. One radiologist measured largest diameter and enhancement parameters of each ccRCC. Associations between CT features and mutations in VHL, PBRM1, SETD2, KDM5C and BAP1 genes were tested using Fisher’s exact tests. Associations between mutations and size/enhancement were assessed using independent t-tests. Interreader agreements were calculated using Fleiss’ Kappa.

RESULTS
Mutation frequencies among ccRCC were: VHL, 53.2% (124/233); PBRM1, 28.8% (67/233); SETD2, 7.3% (17/233); KDM5C, 6.9% (16/233); BAP1, 6%
SSC07-03 • Biopty Proven Oncocytoma and Oncocytic Neoplasms: In Situ Natural History and Clinical Outcomes of 139 lesions

Manish Dhyani MBBS (Presenter) ; Sameer M Deshmukh MD ; Adam S Feldman MD ; Rosemary Tambouret MD ; Debra A Gervais MD * ; Ronald S Arellano MD ; Anthony E Samir MD

PURPOSE Renal oncocytes (oncocytic adenoma/oxyphilic adenoma/proximal tubular adenoma) account for 3-7% of all renal neoplasms and are the most common benign, solid renal neoplasms. Oncocytomas (OC) have a distinctive pathological appearance but other neoplasms such as chromophobe RCC and oncocytic papillary RCC can mimic this pattern, precluding tumor classification as “Oncocytoma” and instead classifying it as an "Oncocytic Neoplasm (ON)". OC are thought likely benign, but their long-term outcome has not been established with certainty. The purpose of this study was to review the in-situ natural history and clinical outcomes of biopty proven OC and ON at our institution.

METHOD AND MATERIALS We performed a retrospective review of patients who underwent percutaneous biopsy of a suspicious renal mass at our institution between 1998-2011. Lesions with a pathological diagnosis of (1) OC, (2) "ON favoring a diagnosis of OC" and (3) ON on percutaneous biopty were identified. Surveillance follow-up and treatment outcomes were assessed.

RESULTS A total of 1254 image-guided percutaneous renal bioptyes were performed between 1998-2011. A total of 139 lesions (11%) in 135 patients (M:F = 86:49) with a mean age of 70 years (range: 24-91 years) were identified to have a pathological diagnosis of OC (n=90, 7%), ON favoring OC (n=20, 1.6%) and ON (n=29, 2.2%) on image-guided (US/CT = 81.3%) percutaneous biopty. The majority of lesions were solid (n=135, 97%) with a mean size of 2.7 cm (range: 0.8-10.0 cm).

110 lesions were followed with a minimum of one imaging study. 57 lesions were either stable or decreased in size during a mean 1.5±1.2 years of follow-up and have been summarized in Table 2. Of the 53 lesions that grew in size the mean rate of growth was 0.39±0.38 cm/year (follow-up interval = 2.7±1.2 years).

Overall repeat pathology was available for 11/110 (10%) lesions that were followed. One pathological diagnosis of RCC -- chromophobe on re-biopsy prompted resection in a lesion that was stable while all others were categorized as OC.

CONCLUSION Renal lesions diagnosed as ON, ON favoring OC and OC usually remain stable or are slow growing. Our data suggests that lesions of this type can be safely followed with periodic imaging.

CLINICAL RELEVANCE/APPLICATION Extremely little is known about Oncocytoma’s with the largest series in the literature describing 33 lesions. This larger series provides a better understanding of their in situ natural history.

SSC07-04 • Characterization of Focal Renal Masses Using Post-contrast-Enhanced Images Alone from a Dual Energy CT Data Set Acquired with Fast kilovoltage-switching

Drew E Davis MD (Presenter) ; Daniele Marin MD ; Achille Mileto MD ; Kingshuk Roychoudhury ; Rendon C Nelson MD *

PURPOSE To evaluate the diagnostic performance of quantitative methods for characterization of focal renal masses using post-contrast enhanced images alone from a fast kilovoltage-switching single source dual energy CT (ssDECT) dataset.

METHOD AND MATERIALS IRB approved study comprised of 58 patients (43 men, 15 women; age range: 43-82 years) with 63 focal renal masses measuring 1.5-cm (mean diameter, 3.5 cm; range, 1.5-8.0 cm), who underwent noncontrast (NCCT) and contrast-enhanced fast kilovoltage switching ssDECT from 11/2011-2/2013. Lesions were classified as: (a) simple cysts (≤20 HU on NCCT and ≤15 HU enhancement)(n=42), (b) complex cysts (>20 HU on NCCT and ≤15 HU enhancement)(n=9) and (c) enhancing masses (>15 HU enhancement)(n=12). Synthesized monochromatic datasets were reconstructed at selected x-ray energies of 40 keV, 50 keV, 59 keV (mean energy for 120-kVp beam) and 140 keV. Material density reconstructions were also generated for iodine, calcium and water. All reconstructed datasets were analyzed using a region-of-interest drawn in the center of each renal lesion. Linear discriminant analysis was used for lesion classification using profiles of values obtained at different keV (spectral analysis) and material density reconstructions from post-contrast DECT images.

RESULTS Material density analysis demonstrated characteristic features: (a) simple cysts: low iodine, low water; (b) complex cysts: low iodine, high water; and (c) enhancing masses: high iodine, high water. High diagnostic accuracy was achieved in differentiating enhancing renal masses from simple and complex renal cysts using: (i) spectral analysis at 40 and 140 keV (sensitivity/specificity 92%/100%) and (ii) iodine and water material density reconstructions (sensitivity/specificity 96%/100%). One enhancing renal lesion was misclassified as a complex cyst using both methods. Additionally, one complex renal cyst was misclassified as an enhancing lesion using the material density reconstruction only.

CONCLUSION Focal enhancing renal masses may be accurately differentiated from simple and complex renal cysts using single-phase contrast-enhanced DECT alone. However, our data suggest a slight but important risk of misclassifying small enhancing renal masses.

CLINICAL RELEVANCE/APPLICATION It is possible to accurately characterize focal renal masses using only post-contrast images from a fast kilovoltage-switching single source dual energy CT dataset.

SSC07-05 • Dual-energy CT in Renal Lesions. Which Are the Best Approaches and Thresholds to Evaluate the Iodine-uptake?

Achille Mileto MD (Presenter) ; Daniele Marin MD ; Bernhard Krauss PhD *; Alfredo Blandino ; Emanuele Scrobaino ; Silvio Mazzotti ; Giorgio Ascenti MD

PURPOSE To compare the accuracy of different dual-energy CT approaches in evaluating the iodine-uptake in renal lesions using a single-phase nephrographic acquisition.

METHOD AND MATERIALS IRB approval and waiver of informed consent were obtained for this HIPAA-compliant study. Fifty-nine patients (41 men, 18 women; mean age, 57.7 years) with 80 renal lesions underwent contrast-enhanced dual-energy CT during the nephrographic phase of enhancement. Renal lesions were characterized as enhancing or non-enhancing, using contrast-enhancement with thresholds of 15-HU and 20-HU and iodine quantification with threshold of 0.5 mg/ml. Accuracy of contrast-enhancement and iodine quantification was calculated, using histopathology or CT follow-up as reference standard. Differences in sensitivity and specificity were assessed by means of McNemar test and ROC analysis.

RESULTS A significant difference was found between contrast-enhancement with thresholds of 15-HU (sensitivity, 91.4%; specificity, 93.3%; PPV, 91.4%; NPV, 93.3%) and 20-HU (sensitivity, 77.1%; specificity, 100%; PPV, 100%; NPV, 84.9%) (P = .008). Iodine quantification (sensitivity, 100%; specificity, 97.7%; PPV, 97.2%; NPV,100%) was significantly more accurate (P = .004) than contrast-enhancement with threshold of 20-HU. No significant difference in accuracy was found between iodine quantification and contrast-enhancement with threshold of 15-HU. Contrast-enhancement and iodine quantification showed an area under the ROC curve of 0.98 (95% CI: 0.92, 0.99) and of 1.00 (95% CI: 0.95, 1.00), respectively (P = .31).

CONCLUSION Contrast-enhancement with threshold of 15-HU and iodine quantification are the most accurate dual-energy CT approaches to assess the iodine-uptake in renal lesions, using a single-phase nephrographic acquisition.

CLINICAL RELEVANCE/APPLICATION Dual-energy CT may reduce radiation exposure, increases cost and patient’s anxiety from further tests, most frequently CT, that are usually needed when an unenhanced acquisition is not available.
Intimate Contact: CT Evaluation of Tumor Contact Surface Area and Its Role in Peri Operative Outcome Prediction

Scott Leslie MBBS ; Inderbir S Gill MBCh B ; Andre L Abreu MD ; Mihir Desai ; Vinay A Duddalwar MD, FRCR (Presenter) ; Darryl Hwang PhD

PURPOSE
The surface area of contact that a tumor has with the adjacent renal parenchyma considerably determines the extent of resection of kidney tissue during partial nephrectomy (PN), and thus may impact on peri-operative outcomes. We present a novel method of calculating renal tumor contact surface area (CSA) using image-processing technology and correlate it with peri-operative variables in patients undergoing PN.

METHOD AND MATERIALS
From 01/2010-08/2011, 162 patients underwent minimally invasive PN for tumor, and had CSA data available using image rendering software (3D Synapse – Fuji film©). CSA was correlated with baseline demographics and peri-operative outcomes.

RESULTS
Mean tumor size was 3.1 cm and mean CSA was 18.3 cm². Univariate analysis demonstrated that CSA significantly correlated with blood loss (p=0.0001), operative time (p=0.003), length of hospital stay (p=0.0028), and post-operative eGFR (0.0124). On multivariable logistic regression CSA was an independent predictor of the above outcomes as well as overall complications.

CONCLUSION
In patients undergoing partial nephrectomy, tumors with greater contact surface area with surrounding renal parenchyma require a more extensive resection, thus impacting on peri-operative outcomes including blood loss, operative duration, complications and renal function. If these findings are validated in larger cohorts, future nephrometry systems could incorporate CSA measurements to objectively quantify renal tumor complexity and predict peri-operative outcomes of partial nephrectomy surgery.

CLINICAL RELEVANCE/APPLICATION
The contact surface area of a renal mass is a predictor of the amount of dissection needed during surgery and may predict operative outcomes In patients undergoing partial nephrectomy.

Dual Energy CT (DECT) for Assessment of Response to Antiangiogenic Treatment in Patients with Metastatic Renal Cell Cancer (mRCC)

Katharina Hellbach MD (Presenter) ; Raju Sharma MD ; Ashu Seth Bhalla MBBS, MD ; Shivanand R Gamanagatti MBBS, MD ; Amlesh Seth MBBS, MChir ; Ajay K Yadav MBBS ; Prasenjit Das ; Arun K Gupta MBBS, MD

PURPOSE
• To assess which renal lesions demonstrate diffusion restriction and evaluate the utility of Diffusion-weighted MRI (DW-MRI) in their differentiation.

METHOD AND MATERIALS
The institutional ethics committee waived the requirement of informed consent for this retrospective study. 120 adult patients with 225 focal renal lesions underwent MRI with DW Imaging (at b-values of 0 and 500 s/mm²) from September 2008 – December 2012. In all, there were 65 malignant neoplasms (44 renal cell carcinomas (RCC) 10 transitional cell carcinomas TCCs, 11 miscellaneous) and 25 benign neoplasms (20 angiomyolipomas AMLs, 4 oncocytomas). In addition, there were 25 inflammatory lesions (including 19 abscesses), 45 pseudotumors (40 in diseased and 5 in normal kidneys), 15 hemorrhagic cysts and 50 benign cysts (Bosniak category I, II and IIIF). Lesion ADC values were determined, compared and receiver operating characteristic (ROC) curves were drawn to establish cut-off values.

RESULTS
Both benign and malignant renal neoplasms showed restricted diffusion with mean ADC values: RCC [1.56 ± 0.40 (x 10-3 mm²/s)], TCC [1.26 ± 0.12 (x 10-3 mm²/s)] and AML [1.32 ± 0.19 (x 10-3 mm²/s)]. Inflammatory renal lesions demonstrated lowest ADCs [1.1 ± 0.21(x 10-3 mm²/s)] while hemorrhagic cysts showed wide range of ADC values [1.47 ± 0.81 (x 10-3 mm²/s)]. Pseudotumors and benign cysts showed unrestricted diffusion. Individually, AMLs and TCCs showed significantly lower ADC values compared to RCCs (p=0.0133 and 0.0236 respectively). ROC analysis revealed an area under curve of 0.730 in differentiating RCC from AML and 0.890 in differentiating TCC from RCC.

CONCLUSION
The difference between the ADC values of different focal renal lesions was statistically significant and ROC analysis yielded cut-off values with high accuracy in making correct relevant distinctions. Restricted diffusion in a renal mass does not always imply malignancy; rather benign neoplasms cause greater diffusion restriction. Renal abscesses depict lowest ADC values. Despite overlapping ranges, ADC values provide an additional paradigm for distinguishing AMLs and TCCs from RCCs.

CLINICAL RELEVANCE/APPLICATION
Diffusion restriction is not specific for malignancy; rather inflammatory renal lesions cause most marked diffusion restriction, followed by benign neoplasms and RCCs in ascending order of ADC values.

Dual Energy CT (DECT) for Assessment of Response to Antiangiogenic Treatment in Patients with Metastatic Renal Cell Cancer (mRCC)

Katharina Hellbach MD (Presenter) ; Alexander Sterzik ; Wieland H Sommer MD ; Martina Karlitschka MD ; Jozefina Casuscelli ; Michael Ingrisch ; Michael Staehler MD ; Anno Grazer MD *

PURPOSE
To evaluate whether dual energy CT (DECT) allows for better assessment of response to antiangiogenic treatment with multi-kinase inhibitors (MKI) than standard contrast-enhanced CT.

METHOD AND MATERIALS
17 patients with mRCC (14 males, 62.1±10.9 years; 3 females, 64.3±5.1 years) underwent baseline and follow-up single-phase abdominal contrast enhanced DECT (100 kVp/Sn140 kVp) on a dual source scanner (Somatom Definition Flash, Siemens). DECT scans were performed immediately before and 10 weeks after start of treatment with MKI. Virtual non-enhanced and color coded iodine images were generated. 31 metastases were measured at the two timepoints. We determined Hounsfield unit (HU) values for VNE and iodine density (ID) as well as iodine content (IC) in mg/ml of tissue. These values were compared to the standard venous phase CT number of the lesions. Values before and after treatment were compared using t test.

RESULTS
Between baseline and follow up, standard CT density ID showed a significant reduction (CT: 76.3±20.7 HU vs 52.4±19.1 HU; p=0.0001; ID: 40.4±19.0 HU vs 19.5±16.0 HU; p. CONCLUSION
Dual energy CT-based quantification of iodine content of mRCC metastases allows for significantly more sensitive detection of antiangiogenic treatment effects.

Further research is warranted to correlate these findings to outcome measures of patients.

CLINICAL RELEVANCE/APPLICATION
Dual energy CT improves detection of antiangiogenic effectsof MKI in patients with mRCC.

Dual-energy CT: Evaluation of Hyperdense Renal Masses Incidentally Detected on Single-phase Postcontrast CT

Ji Ye Son (Presenter) ; Chan Kyo Kim MD, PhD ; Dong Ik Cha MD ; Sung Yoon Park ; Byung Kwan Park MD

PURPOSE
To determine whether dual-energy CT (DECT) can help characterize hyperdense (> 30 HU) renal masses incidentally detected on single-phase postcontrast CT.

METHOD AND MATERIALS
In 80 patients, 90 hyperdense renal masses (median size, 1.3 cm) that were incidentally detected on single-phase postcontrast CT were further evaluated with DECT. DECT protocols included true noncontrast (TNC), DE corticomedullary and DE late nephrographic phase imaging. Virtual noncontrast (VNC) and iodine overlay (IO) images were derived from DE corticomedullary and DE late nephrographic phases, respectively. The CT numbers of hyperdense renal masses were calculated on linearly blended and IO images from DE corticomedullary and DE late nephrographic phases and the results were compared. A minimum size of hyperdense renal masses was also investigated to accurately differentiate solid masses from benign cystic lesions.

RESULTS
47 benign cystic lesions (25 hemorrhagic cysts and 22 simple cysts) and 43 solid masses (24 renal cell carcinomas and 19 angiomyolipomas) were analyzed. The mean CT numbers of the renal masses calculated on IO images from DE corticomedullary and DE late nephrographic phases were statistically not different from those on the corresponding linearly blended images (P> 0.05). For differentiating solid masses from benign cyst lesions, the sensitivities of IO images from DE corticomedullary and DE late nephrographic phases were 77.6 % and 55.5%, compared with on the corresponding linearly blended images (95.7% and 80.1%), respectively (P=0.004 and P= 0.001, respectively); the specificities of IO images from the two phases were 97.7% and 100%, compared with on the corresponding linearly blended images (97.7% and 100%), respectively (P> 0.05). The minimum size of the renal masses to accurately differentiate solid
A large proportion of residents are unaware of the adverse effects of ionizing radiation, especially during pregnancy and childhood.

CLINICAL RELEVANCE/APPLICATION
Increased education of non-radiology residents by Radiology faculties on radiation safety may lead to more informed ordering of imaging tests and commitment to use of radio-protective equipment.

Arguing Your Way to an Education: An Effective Method of Teaching Residents Health Economics

Stephen J Hunt (Presenter); Saurabh Jha MD

PURPOSE
To investigate residents' knowledge and perception of ionizing radiation adverse effects, frequency of their education on radiation safety and their use of radio-protective equipment.

METHOD AND MATERIALS
Residents from 15 residency programs at Emory University received an invitation email to complete Resident Radiation Safety Survey through SurveyMonkey in September 2012. The associations between residents' knowledge and use of radio-protective equipment with residents' specialty and year of training were investigated.

RESULTS
173/532 residents responded to the survey (response rate of 32%). 39% reported radiation safety is discussed in their residency curriculum at least every six months. This rate was significantly higher among Radiology residents (84% vs. 20% in Medicine, 19% in Surgery and 30% in OB/GYN); P

CONCLUSION
A large proportion of residents are unaware of the adverse effects of ionizing radiation, especially during pregnancy and childhood.

Clinical Relevance/Application
Increased education of non-radiology residents by Radiology faculties on radiation safety may lead to more informed ordering of imaging tests and commitment to use of radio-protective equipment.

SSC08-03 • Arguing Your Way to an Education: An Effective Method of Teaching Residents Health Economics

Arguing Your Way to an Education: An Effective Method of Teaching Residents Health Economics

Stephen J Hunt (Presenter); Saurabh Jha MD

PURPOSE
The study compares a new method of teaching residents health policy and economics, using faculty-moderated point-counterpoint resident debates, with traditional didactic lectures.

METHOD AND MATERIALS
A new method of resident-driven conference comprising an Oxford-style debate moderated by faculty was employed for the curriculum in economics and health policy. The debate involves a motion that highlights a basic principle of economics with one resident arguing for the motion and the other against, with questions thrown to the wider audience. The residents then vote for or against the motion. In concluding, the moderator summarizes the key issues of economics and policy and the points of tension. The study compares the resident ratings of the debates to traditional lectures in the economics and policy curriculum. Residents assign a score for all lectures on a point scale ranging from (1) to (5) with a score of 5 expressing maximum effectiveness and a score of 1 the least.

RESULTS
In 2012, 285 lectures received mean rating of 4.49 +/- 0.02. Each lecture was, on average, rated by 16 residents. Amongst the nine subspecialties, there was essentially a bimodal distribution with the highest garnering mean ratings of 4.64 +/- 0.06 and the lowest a mean of 4.26 +/- 0.12. The mean score of the didactic economics and health policy lectures in 2011 was 4.0 +/- 0.38, placing it below the lowest of the subspecialty. In 2012 there were ten lectures in the economics and health policy curriculum, with six delivered in the traditional didactic format, and four utilizing debates.. The didactic lectures in 2012 received a mean rating of 3.94 +/- 0.12 (N=90). The moderated debates demonstrated a 20% higher mean rating, with an average of 4.71 +/- 0.07 (N=60), scoring higher on average than any of the nine clinical subspecialty. There was statistical significance in the difference in ratings between the new format and both the concurrent 2012 didactic lectures and historic 2011 lectures.

CONCLUSION
The moderated point-counterpoint debate is an effective adjunct to didactic lectures in teaching radiology residents issues in health economics and health policy. We make a case for this model to be adopted by other residency programs.

CLINICAL RELEVANCE/APPLICATION
Literacy in economics, often dubbed as the dismal science, is becoming increasingly important to optimally manage finite healthcare resources to increase net health benefits.

SSC08-04 • Emergency Department Musculoskeletal Study Interpretation: Can Performance on a Musculoskeletal Curriculum Predict Error Frequency When on Call?

Kevin B Hoover MD, PhD (Presenter) *

PURPOSE
Errors in initial radiologic interpretation can significantly affect patient management in the emergency department (ED). This retrospective study investigated test results and work parameters that could be helpful in predicting resident errors.

METHOD AND MATERIALS
A curriculum for residents during their first and second musculoskeletal radiology (MSK) rotations was began in July 2010. During both rotations, textbook reading, chapter specific slide presentations and chapter specific quizzes were assigned. The quiz results for each resident were placed into quartiles, based on the results so far obtained. The number of studies interpreted by a resident on service was also calculated and compared to like postgraduate year (PGY) residents and placed in a quartile. ABR written exam results and ACR inservice results for MSK were also tabulated for the residents in quartiles. Correlation between the percentage of minor and significant discrepancies on MSK studies when on call and the quartile of the above parameters was interrogated. Significant discrepancies were defined as those that could cause an important change in patient management.

RESULTS
A total of 13,296 adult MSK studies were reviewed by 23 PGY3-5 residents out of which there were 458 discrepancies (3.4%), 380 of which were minor (2.8%) and 78 significant (0.6%). Out of these 23 residents, 15 completed the ABR written exam, 22 completed the ACR inservice at least once, 17 completed the curriculum and the number of cases per interpreted per day on service was calculated in 21 residents. Out of these variables, the only result to correlate with the minor and significant discrepancies was the quartile score on the curriculum. The quartiles for the first and second rotation curriculum together were negatively correlated with minor discrepancies (Spearman's rho coefficient -.511, p

CONCLUSION
Residents rotating through MSK have an assigned curriculum that guides them through the basics of orthopedic radiology including MRI. The resident performance on the curriculum was the only parameter investigated that correlated retrospectively with the number of errors in the emergency department on
SSC08-05 • What Makes a Great Radiology Review Course Lecture? The Ottawa Radiology Resident Review Course Experience
Lily Cao MD, PhD (Presenter) ; Matthew D McInnes MD, FRCPC ; John G Ryan MD

Purpose
To objectively determine qualities of radiology review course lectures that are associated with positive audience evaluation.

Method and Materials
57 presentations from the Ottawa Resident Review Course (2012) were analyzed by a PGY4 radiology resident blinded to the result of audience evaluation. Objective data extracted were: slides per minute, lines of text per text slide, words per text slide, cases per minute, images per minute, images per case, number of audience laughs, number of questions posed to the audience, number of summaries, inclusion of learning objectives, ending on time, use of pre/post-test and use of special effects. Subjective data extracted were: speaker spontaneity, speaker tone and image quality. Mean audience evaluation scores for each talk from daily audience evaluations (up to 60 per talk) were standardized out of 100. Correlation coefficient was calculated between continuous variables and audience evaluation scores. Student T test was performed on categorical variables and audience evaluation scores.

Results
Strongest positive association with audience evaluation scores was for image quality ($r=0.57$), followed by the speaker tone ($r=0.47$) and number of times the audience sounded out. Strongest negative association was between images per case and audience scores ($r=-0.25$). Talks with special effects were rated better (mean score 94.3 vs. 87.1).

Conclusion
Many factors go into making a great review course lecture. At the University of Ottawa Resident Review Course, high quality images, dynamic speaker tone, use of special effects, use of pre/post-test and humor were most strongly associated with high audience evaluation scores. High image volume per case may be negatively associated with audience evaluation scores.

CLINICAL RELEVANCE/APPLICATION
Resident review course lectures are challenging to give; this study identifies several strategies to improve these lectures and better educate residents.

SSC08-06 • The Role of Radiologists in Breast Cancer Medical Education: A Systematic Review of the Literature
Faezeh Sodagari MD ; Pedram Golnari MD (Presenter) ; Hamid R Baradaran MD, PhD

Purpose
To determine the role of radiologists in medical education research in the field of breast cancer

Method and Materials
A systematic search in bibliographic databases was performed using a sensitive search strategy with "breast cancer" and "medical education" as key words (from January 1 2000 to May 20 2011) without any language and/or methodological limitation. Medical education research was defined as any research study pertaining to education of students, residents, fellows, faculty members, curriculum development, or program evaluation. Information regarding type of study, outcomes, and sample size (if applicable) were extracted using a checklist designed according to the coding sheet of Best Evidence in Medical Education (BEME) Collaboration. All citations stored and managed by EndNote X3. Descriptive data were produced by SPSS ver. 17 and also were qualitatively synthesized and reported.

Results
The search strategy yielded 691 citations that 394 citations published after 2000 were reviewed. By title and abstract reviewing by two independent reviewers, 183 citations were excluded. Full-text articles for 211 citations were reviewed. Out of 161 studies in the field of breast cancer medical education, only 19 articles had radiologists as their subjects and were included in the review. The majority of the included studies (17 out of 19 studies), aimed to assess the capability of residents and radiologists in reading mammograms. Sample size of studies ranged from 3 to 364 with the median of 207 subjects. Only one study had an interventional design and most of studies (16 out of 19) were prospective cross-sectional studies. The majority of studies (15 out of 19 studies) assessed knowledge or skill of the participants. None of the studies considered a clinical outcome as an outcome of the medical education research.

Conclusion
Despite the paramount importance of radiology in screening, diagnosis and follow up of breast cancer, and different existing modalities and technologies, educational effort and evidence in the field of breast cancer seems lacking and is limited to interpreting mammography. Larger studies and experiments using controlled designs, and clinically relevant outcomes are needed.

CLINICAL RELEVANCE/APPLICATION
Radiologists should actively participate in improving medical education research activities in the field of breast cancer to play an active role in the future of diagnosis and management of this disease.

SSC08-07 • Prevalence of Flawed Multiple-choice Questions in Major Radiology Journals’ Continuing Medical Education
Andres R Ayoob MD ; Lindsay E Williams MD (Presenter) ; David J Disantis MD

Purpose
Maintenance of Certification (MOC) requirements, the advent of all-computer-based Board examinations, and the ubiquity of CME-offering platforms make multiple choice questions (MCQs) an inescapable part of contemporary radiology, and indeed all medical disciplines. The result has been a burgeoning demand for well-constructed MCQs. The purpose of this study was to determine whether the CME MCQs in 3 major radiology journals comport with standard question-writing principles.

Method and Materials
CME questions from the January 2013 editions of the American Journal of Roentgenology (AJR), RadioGraphics, and Radiology were evaluated. The month was chosen at random, based solely on the current CME offerings at the time of manuscript preparation. The journals offered 181 print or on-line multiple choice items for their 22 CME-designated articles. Each question was analyzed by three radiologists to assess its adherence to question writing guidelines; disagreements were settled by consensus. From 31 validated MCQ-writing guidelines, we chose the seven previously identified as frequent flaws in medical CME questions. Example flaws included unfocused questions, negatively worded questions and options, and heterogeneous options.

Results
78 of the 181 questions contained flaws (43%). 45 questions had one flaw, while 24 questions had two, eight questions had three, and one had four. Specific flaws varied widely in prevalence, but an unfocused question and heterogeneous options were the two most frequently violated writing principles.

Conclusion
Nearly half of CME questions from three major radiology journals violated standard MCQ item writing principles.

CLINICAL RELEVANCE/APPLICATION
The high prevalence of flawed CME questions in three major radiology journals puts learners at risk of failing for reasons unrelated to their knowledge of the topic.

SSC08-08 • Potential Impact the American Board of Radiology’s New Core Examination Will Have on Resident Training: Resident and Faculty Perspectives
Brian J Clark MD (Presenter) ; Himma Prabhakar MD

Purpose
Assess radiology resident and faculty perspectives on the potential impact the ABR’s new core exam will have on resident training. Factors assessed include resident call schedule, protected time, fourth year focused training, and entering fellowship.

Method and Materials
A 5-point Likert scale survey was given to radiology residents and faculty at an academically-affiliated hospital radiology residency program. Question responses were: 5=strongly agree, 4=agree, 3=undecided, 2=disagree, and 1=strongly disagree. Faculty and resident responses were compared using the student’s t-test and summary statistics were generated.

Results
Most surveyed were undecided or disagreed if the new exam format would better prepare residents for practice (89%, rating =4) and all thought it would shift to the third year (100%, rating =4). Most surveyed agreed third year residents should have protected study time (94%, rating =4) and 69% thought 6 to 8 weeks or more was adequate. All surveyed agreed that residents should be relieved from call duties before the core exam (100%, rating =4) and
Effect of Computerized Evidence-based Clinical Decision Support (CDS) on the Use and Yield of Computed Tomography Pulmonary Angiography (CTPA) in the Inpatient Setting

Rasu B Shrestha, MD, MBA (Presenter) *

POURSE

To determine the effect of evidence-based CDS on the use and yield of inpatient CTPA for acute pulmonary embolism (PE).

METHOD AND MATERIALS

This HIPAA-compliant study included all adult inpatients at a 793-bed quaternary care hospital between April 1, 2007, and June 30, 2012. The intervention was a computerized evidence-based CDS implemented in the electronic medical record. The intervention consisted of a computer-generated order set that recommended the use of CTPA in patients with a high clinical suspicion for PE. The recommendation was based on a combination of the clinical probability of PE and the results of a decision rule algorithm. The decision rule algorithm was based on a previously validated clinical decision rule for PE.

RESULTS

Of the 136,652 inpatient CTPA examinations performed, 121,542 were included in the analysis (95%). The CTPA order rate decreased significantly from 25% pre-implementation to 7% post-implementation (p < 0.001). The CTPA yield increased from 31% pre-implementation to 47% post-implementation (p < 0.001). The overall mortality rate decreased from 3% pre-implementation to 2% post-implementation (p < 0.001).

CONCLUSION

Computerized evidence-based CDS significantly decreased the use of inpatient CTPA for PE and increased the yield of CTPA. This is the first study to demonstrate the effectiveness of computerized CDS in reducing the overuse of CTPA for PE.

CLINICAL RELEVANCE/APPLICATION

Computerized CDS can be used to reduce the overuse of CTPA for PE and improve patient outcomes. Further research is needed to evaluate the long-term impact of computerized CDS on patient outcomes and costs.
Discussion
Prior to implementation of the numeric system, our 9 most commonly used alphabetic order priorities and their average (OTPT) in hours (std dev) for all modalities were: ASAP 4.4 (7.6), PRIOR1 0.9 (2.15), PRIOR2 0.5 (0.76), PRIOR3 0.9 (1.4), PRIOR4 1.9 (2.5), PRIORITY 0.4 (2.59), ROUTINE 6.7 (11.9), STAT 1.1 (1.6) and BLANK (i.e., no selection) 6.5 (12.3) (Fig. — left side). The hierarchical options of PRIOR1-4 were extra options for radiographers only. After implementation of the numeric order priority system of 1-9 with defined descriptions, OTPTs for all modalities by priority were 1.4 (4.1), 1.7 (3.4), 5.8 (17.1), and 8.3 (33.8) hrs (Fig. — right side). Similar improvements were reflected by each modality. There was desirable stratification of OTPTs after implementation of the numeric system while there was less dependable stratification with the alphabetic system. Smaller STD DEV values for high priority studies indicated greater uniformity in performance times.

SSC09-04 • Implementation of a Numerical READING PRIORITY System as a Distinct Step beyond Conventional Use of ORDER PRIORITY for the Prioritization of Radiology Exam Interpretation: Impact on STRATIFIED REPORT TURNAROUND TIME in a Large Academic Medical Center

Dustin Boatman MD (Presenter) ; Ryan P McWey ; Michael Hanshew MS ; Cree M Gaskin MD *

CONCLUSION
Addition of a numeric reading priority system as a step beyond order priority for prioritizing radiology exam interpretation was associated with more desirable stratification of RTAT, as well as improved (reduced) variability in RTAT for high priority exams.

Background
The prioritization of radiology exam interpretation is conventionally based upon the order priority set by the ordering provider. This may not allow for revision of priority based upon new information (e.g. pending clinic appointment or concerning imaging finding noted by the tech). It also yields competing priorities between inpt, outpt, and ED exams when folded into a common reading work list.

Evaluation
This QI project was not human subject research. Our institution implemented a numeric reading priority (1-9, with defined criteria) set by the tech at end exam in addition to the provider’s order priority. We sought to determine the impact of this additional priority score on stratified report turnaround time (RTAT) (i.e. time between end exam and release of first report). We retrospectively reviewed RTAT for all exams, excluding fluoroscopy, (n=309,331) parsed by read priority for the same 6 mos (Mar-Aug) at 2 points: immediately following implementation (when radiologists continued existing patterns of prioritization, largely ignoring the new data) and 1 yr later (after they had adopted prioritizing interpretations with the new read priority score).

Discussion
With existing patterns of priority for interpretation, RTAT was not well stratified by hierarchical reading priority and demonstrated wider variation. Avg RTATs in hours (STD DEV) for all combined modalities, in order from most urgent (score 1) to least (score 9) were 11.9 (6.1), 4.7 (6.9), 13.6 (31.4), 11.8 (59.7), 17.4 (21.5), 14.9 (42.9), 28.8 (13.8), 26.2 (47.1), and 21.7 (27.7). After radiologists adopted use of the read priority score, RTATs for the same priorities were 7.1 (4.2), 1.7 (2.5), 6.5 (15.6), 6.6 (17.1), 13.4 (20.6), 10.1 (11.9), 19.9 (16.2), 18.8 (28.9), and 18.4 (27.5). The high priority studies had the greatest improvements with reduced and more uniform RTAT. Included FIGURE demonstrates improvement across all priorities but most notably among high priority studies.

SSC09-05 • Truly Meaningful Use

Kambrie Kato MD (Presenter) ; Joshua J Reicher MD * ; Alberto Kywi MS ; Michael A Trambert MD *

CONCLUSION
11 radiologists qualified attesting to the EHR Incentive Program in 2012, possibly making this group the first community hospital-based outpatient radiology practice in the U.S. to do so. Compliance was achieved using a complete cloud-based EHR. Benefits extend beyond the incentive payment, including real time access to clinical data by the radiologist and increased patient engagement.

Background
The Center for Medicare and Medicaid Services EHR Incentive Program provides financial incentives to providers who “meaningfully use” a certified EHR. Although temporary exemptions to penalties, which begin in 2015 are available, failure to comply threatens to isolate radiologists from physicians, patients, and hospitals that have rapidly adopted the specified technologies. With over 350,000 eligible providers participating as of 12/31/2012, the ability to exchange information according to these standards may soon be a “must have” feature of any successful radiology practice, though a minority of radiologists have attested to date.

Evaluation
Successful implementation of a complete cloud-based certified EHR in a community hospital-based outpatient radiology practice is reported, with shown benefits of greater clinical relevancy and direct patient engagement.

Discussion
The medical group discussed herein uses a cloud-based EHR system (DR Systems, Inc., San Diego, CA) that can be incorporated into any third party RIS or PACS. Cloud-based architecture results in rapid deployment of updates and the ability to communicate with patients via a personal health record (PHR) (Health Companion, Inc., San Diego, CA). As a result, patients can provide required data prior to the appointment and can automatically access required information via the web. An upstream electronic interface enables automated input of some data. Patients can pre-register using the PHR over the web, and data is collected and sent to the imaging center. The upstream system sends the relevant EHR data is single-click accessible to the radiologist during the exam interpretation. An unanticipated benefit was leveraging the EHR to satisfy a joint commission request for access to outpatient medication and allergy data.

SSC09-06 • Patient Access to Radiology Report Via an Internet Portal: Low Rate of Patient Utilization and Concerns about Delayed Care

Nogah Shabshin MD, MBA (Presenter) * ; Sahar Darawshi ; Ifat Abadi-Korek PhD ; Martine Szyper-Kravitz MD ; Joshua Shemer MD, MPH

PURPOSE
In recent years communicating radiology reports to patients directly through an internet portal is becoming more popular. Patients log into a portal with a personal password and can view the radiology report. Although online access is the fastest way to get the report, in our institution, after 5 years of using this technology, only 30% of patients log in to the portal. The purpose of this study was to investigate whether patients with abnormal studies who didn’t access their reports online received the results, and to examine whether they returned to the referring physicians for further work-up and treatment.

METHOD AND MATERIALS
A telephone survey was conducted with 1594 patients who had an abnormal CT or MRI between April and October 2012, and whom received a password for the internet portal but did not log in. Patients were asked the following questions: ‘Did you receive the report?’ If answered yes: ‘Did you return to your referring physician after receiving the report?’

RESULTS
Two hundred and ninety four (14%) patients with abnormal studies that did not log into the portal did not receive the results although these were available to them. Of the 1374 patient who did get the results 190 (14%) patients did not return to their referring physician.

CONCLUSION
Despite the availability of the reports online, and despite studies reporting that patients prefer to receive results fast, preferably online, the utilization of this technology is surprisingly low and most patients receive the results in an alternative way. When patients receive abnormal reports not through their physician, the compliance for further work-up and treatment is concerning and may lead to delay in diagnosis and treatment.

CLINICAL RELEVANCE/APPLICATION
Even when patients receive results directly it is of high importance to deliver the results to the referring physician as well to minimize delayed patient care.

SSC09-07 • Impact of a Point-of-Care Electronic Clinical Decision Support (CDS) Tool on Adherence to Departmental Guidelines for Follow-up of Incidental Pulmonary Nodules on Abdominal CT

Michael T Lu MD (Presenter) ; David A Rosman MD ; Carol C Wu MD ; Tarik K Alkasab MD, PhD ; Jo-Anne O Shepard MD ; Giles W Boland MD ; Matthew D Gilman MD

PURPOSE
The indeterminate pulmonary nodule is a common incidental finding on abdominal CT. While the abdominal radiologist plays a critical role in recommending appropriate follow-up, we have previously demonstrated that the majority of recommendations deviate from best practice guidelines. We implemented an automated decision support tool to provide evidence- and consensus-based recommendations at the point-of-care for further imaging based upon the Fleischner Society guidelines. The goal of this study was to evaluate the effect of the CDS tool on adherence to guidelines for follow-up of incidental pulmonary nodules.

METHOD AND MATERIALS
The RIS was mined for abdominal CT reports from 10/22/12 – 4/4/13 with a solid, noncalcified, pulmonary nodule that did not have a prior abdominal CT or prior or concurrent chest CT. History of smoking or malignancy, whether follow-up chest CT was recommended, and the time interval for follow-up were recorded. Concordance between the radiologist’s recommendation for follow-up and departmental guidelines was compared between three groups: reports
where the CDS tool was used, those where it was not used, and z68 historical controls prior to the implementation of the CDS tool.

RESULTS
Out of 7,713 consecutive abdominal CT reports, 243 described a pulmonary nodule. Manual review of these reports yielded 141 consecutive patients who met inclusion criteria. The CDS tool was used in 40% (57/141). When used, 95% (54/57) of the recommendations were concordant with guidelines. In the remaining 5% of cases (3/57), the radiologist overrode the CDS tool and recommended more aggressive follow-up. Concordance with guidelines was significantly greater for the CDS group than the non-CDS group (45%, 38/84, p < 0.01) and historical pre-intervention controls (50%, 133/268, p < 0.01).

CONCLUSION
A point-of-care CDS tool improved adherence to departmental guidelines for follow-up of incidentally detected pulmonary nodules.

CLINICAL RELEVANCE/APPLICATION
Real time, point-of-care CDS tools can decrease the variability of radiologist recommendations, which may impact patient outcomes and cost.

SSC09-08 • Impact of a Multi-screen Decision Support Alert on Repeat Use of CT

Stacy D O’Connor MD (Presenter); Aaron D Sodickson MD, PhD; Ivan Ip MD, MPH; Ali Raja MD, MBA; Luciano M Prevedello MD,MPH; Wendy Mar; Michael J Healey MD; Louise I Schneider MD; Ramin Khorasani MD

PURPOSE
Evaluate the impact of a multi-screen decision support alert on repeat use of CT.

METHOD AND MATERIALS
This institutional review board-approved, pre-post study was conducted at a 776-bed academic medical center with computerized physician order entry and decision support systems. Previously, a single-screen alert notified orderers in real-time if the patient’s same body part had been imaged with the same modality within 90 days. Providers could ignore the alert and proceed, or drop the order. The intervention was a multi-screen repeat decision support alert. Orderers ignoring the single-screen alert received a second screen requiring selecting a clinical justification from a predetermined menu to complete the order, otherwise it was dropped. All 28,420 CT orders triggering a repeat alert in 2010, excluding those for malignancy restaging (n=11,862), were included. Primary outcome was proportion of dropped orders, evaluated with the Chi-square statistic. Multiple logistic regression assessed effect of care setting, orderer role, patient age and gender.

RESULTS
682/6,542 (10.4%) of CT orders triggering single-screen alerts were dropped; the multi-screen alert resulted in a 12.9% (1,290/10,016) drop rate (23% relative decrease; p < 0.01).

CONCLUSION
A multi-screen decision support alert requiring clinical justification to proceed with a repeat CT order prevented 1 in 10 repeat CT orders.

CLINICAL RELEVANCE/APPLICATION
Multi-screen decision support (DS) significantly reduces repeat CT orders; some proportion of dropped orders are likely unnecessary exams. Our study helps inform optimum DS design and implementation.

SSC09-09 • An Enterprise Class Computer Aided Detection Platform Scalable from Laptop to Cloud

Mark Hinton (Presenter); Olga A Kubassova PhD, MSc; Mikael Boesen MD, PhD

CONCLUSION
The challenges of handling large image datasets and real-time overlay calculations have been addressed through a novel architecture. Our validation in real clinical practice has shown that our cloud based architecture gives the same or better performance than a workstation. Further, it supports multi-center collaboration and seamless data sharing. There are low costs to deploy the software. Development of new functionality is faster and automatically deployed to all users.

Background
To achieve efficiency in analysing medical images many radiology units use cloud based computer aided detection (CAD). The problem is to keep calculations and image overlays up to date whilst providing good user experience across bandwidths and latencies that are not controlled. Further, to support new developments, the architecture of the software must support easy integration of algorithms without compromising performance. We present a novel approach to multi-tier architecture, Dynamika, which has successfully addressed the problems and been validated in radiology practices.

Evaluation
The architecture of Dynamika makes use of a classic back end framework of Spring and Hibernate to give robust server side scaling and performance. It uses Spring Webflow to control the path through the application. Webflow has been enhanced to allow for tightly controlled batch processing, which is utilized in clinical trials or routine analysis. The front end is based on Google Web Toolkit to give high performance in the client, desktop like behavior through AJAX and the power of HTML5. 3D visualization and animation is achieved through WebGL.

Discussion
Software using the new architecture has been bench marked against a conventional workstation solution for user experience and development efficiency. The performance of the cloud is comparable or better than the workstation in scrolling images with complex overlays and making calculations such as image registration, saving clinician time. To implement new algorithms, which was measured by recording time of code and test, was up to 10 times less in the cloud performance.

Musculoskeletal (Interventional I)

Monday, 10:30 AM - 12:00 PM • E450B

SSC10 • AUA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

Moderator
Cree M Gaskin , MD *

Moderator
Brian D Petersen , MD

SSC10-01 • MR-guided High-intensity Focused Ultrasound Ablation of the Femoral Bone: MRI and CT Evaluation of Structural Changes

Matthew D Bucknor MD (Presenter); Viola Rieke PhD; Thomas M Link MD, PhD; Mark W Wilson MD; Sharmila Majumdar PhD; Maythem Saeed DVM, PhD

PURPOSE
To evaluate hyperacute structural changes.

METHOD AND MATERIALS
Experimental procedures received approval from the institutional committee on animal research. MRgHIFU was used to create two thermal lesions (distal and proximal) in the right femur of 8 pigs, while the left femur was used as a control. Each target was subjected to either 4 (n=4) or 6 (n=4) sonications within similar treatment volumes. The energy dosed to the distal target was higher than the proximal target (419±19 J versus 324±17 J). On real-time MR thermometry, the temperature rise adjacent to target bone was quantified. HIFU lesions were imaged using multiple MRI sequences (3.0T) and 64-slice CT, with and without contrast, before and after treatment.

RESULTS
MRgHIFU created focal hyperenhanced lesions measuring on average 2.1 cm in maximum cranio-caudal dimension. Interestingly, within similar prescribed treatment volumes, the use of 6 as opposed to 4 sonications increased the depth of the transverse intramedullary hyperenhanced zone, measuring up to 6.5 mm versus 2.9 mm, respectively (p<0.05). CT imaging failed to demonstrate morphological abnormalities with and without contrast media.

CONCLUSION
The number of focal sonications plays a crucial role in the depth of treatment within the targeted bone. MR thermometry provided precise thermal dose maps. Unlike CT, T2-weighted and contrast enhanced MR demonstrated the hyperacute structural changes in the femur and surrounding soft tissue.

CLINICAL RELEVANCE/APPLICATION
Sonication number and energy dose during MRgHIFU of bone can be selected to precisely control ablation zone size, allowing for more effective and better-tolerated treatment of focal bone lesions.
SSC10-02 • Thermal Ablation Techniques for Curative Treatment of Bone Metastases
Frederic Deschamps (Presenter) ; Geoffrey Faraouli ; Lambros C Tselikas MD ; Thierry J De Baere MD *

PURPOSE
To determine prognostic factor(s) for complete thermal ablation (TA) of bone metastases

METHOD AND MATERIALS
The medical records of all the patients who had undergone curative-intent TA of bone metastases in our Institution between September 2001 and February 2012 were prospectively reviewed. The goal of the TA was to achieve a local tumor control in order to cure all bone metastases in oligometastatic patients or to prevent the occurrence of skeletal-related events in long life expectancy cancer patients.

We have analyzed the rate of complete treatment at 1 year according to the patients’ details -gender, age, site of the primary tumor- and the bone metastases’ characteristics -synchronicity with the primary tumor, already treated by external radiotherapy, local evolution within 3 months before the procedure (RECIST criteria), location (axial vs. appendicular), maximal diameter at baseline CT, condensation aspect at CT (lytic vs. sclerotic), bone cortical erosion, critical neurological structures in the vicinity (less than 10mm), TA technique used (radiofrequency ablation vs. cryoablation).-

RESULTS
Eighty-nine consecutive patients underwent TA in a curative-intent of 124 bone metastases. The median follow-up was 22.8 months (12.2 to 44.4 months).

We report a 67% of complete treatment at 1 year. In multivariate analysis the good prognostic factors for complete treatment were: metastatic bone metastasis (p=0.004), no progression within 3 months before (p=0.004), no cortical erosion (p=0.01), maximal diameter

CONCLUSION
Thermal ablation techniques are effective to cure small (clinical relevance/application)

Thermal ablation techniques must be considered in oligometastatic patients or in long life expectancy cancer patients with bone metastases.

SSC10-03 • Radiofrequency Thermoablation versus Magnetic Resonance Guided Focalized Ultrasound Surgery (MRgFUS) in the Treatment of Osteoid Osteoma: Experience on 27 Consecutive Cases
Francesco Arrigoni (Presenter) ; Armando Conchiglia ; Lorenzo Maria Gregori ; Luigi Zugaro ; Antonio Barile ; Carlo Masciocchi

PURPOSE
To compare the clinical and morphological results, two years after the procedure, of the treatment of 27 osteoid ostomas with Magnetic Resonance guided Focus Ultrasound Surgery (MRgFUS) versus the treatment with Radiofrequency thermoablation (RF).

METHOD AND MATERIALS
From March 2011 we treated 27 osteoid osteomas, 12 using MRgFUS (ExAblate InSightech, Israel) and 15 using RF (LeVeen Needle Electrode Boston Scientific - USA). The osteoid osteomas treated with MRgFUS were located in the femur (n.8), tibia (n.3) and in the talus (n.1). The lesions treated with RFs were located in the femur (n.9), talus (n.2), vertebreal body (L3 and L5) and tibial plateaun (n.2). All the lesions were diagnosed by plain films, CT and MRI and controlled after the procedure by MRI and CT. The clinical evaluation was performed by VAS scale.

RESULTS
All the patients treated with RF thermoablation showed a regression in painful symptomatology with a mean VAS decreasing from 8 to 1.2 two years after the treatment. The treatment with MRgFUS was successful in 10 out of 12 patients (mean VAS dropped from 8.1 to 1.3 two years after the treatment). The two cases unresponsive were re-treated successfully with RF. The MRgFUS evaluation showed a disappearance of bone edema already to the first controls at 6 months after the treatment in all the patients treated successfully. In the CT controls no substantial changes were found, except for the disappearance of the central calcification of the nidus in the 40% of cases treated with MRgFUS.

CONCLUSION
Although further studies with a longer term and a larger number of cases are needed, our experience demonstrates the effectiveness of the treatment of osteoid osteomas with MRgFUS. In particular this treatment is successful in 83% of cases. The main limit is today represented by the accessibility of the lesion by the ultrasound. However the treatment is repeatable and does not preclude treatments with other techniques (with the RFs, the percentage of success is of 100%).

CLINICAL RELEVANCE/APPLICATION
This study explain an innovative and non-bloody technique to treat osteoid ostema of bone.

SSC10-04 • MR-guided Focused Ultrasound (MRgFUS) For Treatment of Painful Bone Metastases: Can ADC Be Used to Predict Clinical Outcome?
Fabrizio Boni (Presenter) ; Alessandro Napoli MD ; Michele Anzidei MD ; Vincenzo Noce MD ; Daniel R De Oliveira ; Carlo Catalano MD

PURPOSE
To evaluate potential of diffusion-weighted magnetic resonance imaging (DWI) with apparent diffusion coefficient (ADC) maps in the assessment of molecular changes in bone metastasis micro-environment caused by MR guided Focused Ultrasound (MRgFUS), and to correlate these modifications with clinical outcomes

METHOD AND MATERIALS
23 patients with bone metastases underwent MRgFUS with the ExAblate 2100 system (InSightech). Minimal required imaging work-up consisted of CT and MR imaging to determine size and location of the lesions. Skeletal metastasis imaging was performed with a 3-T MR imaging unit (Discovery 750, GE; gd-BOPTA, Bracco). After treatment, all patients were scheduled to undergo clinical follow-up examinations at 1, 3 and 6 months post-treatment. To evaluate treatment efficacy in terms of symptoms palliation, pain severity and pain interference scores were determined using Visual Analogue Scale (VAS) score. Additionally, all patients underwent MR imaging at 1, 3 and 6 months after treatment. The margins of metastatic lesions were tracked manually on the baseline ADC as quantitative parameter of treatment response, we calculated percentage of increase in ADC (ADC%)

RESULTS
No adverse events were recorded. We found an effective pain relief, with mean VAS score drop from an average baseline of 7.09±1.8, to 2.65±1.36 at first month follow-up to 1.04±1.91 at third month and to 1.09±1.99 at sixth month. Furthermore, patients treated with MRgFUS showed a mean increase in ADC value of +46.9% at first month follow-up (p<0.001).

CONCLUSION
Our preliminary data showed that incremental ADC values positively correlated with MRgFUS clinically successful outcome in patients with bone metastases; a different percentage increase in ADC was evident among our population (partial vs complete responders). ADC value might play as an important early marker surrogate for clinical outcome in patients undergoing MRgFUS for painful bone metastasis

CLINICAL RELEVANCE/APPLICATION
MRgFUS treatment determines bone metastasis cell damage, correlate with clinical outcomes, as demonstrated by local ADC modification

SSC10-05 • MR-guided Focused Ultrasound (MRgFUS) Ablation for Non-spinal Osteoid Osteoma Treatment: A Prospective Multi-centric Cohort Study
Daniel Geiger MD (Presenter) ; Alessandro Napoli MD ; Armando Conchiglia ; Alberto Bazzocchi MD ; Ugo Albisinni MD ; Carlo Masciocchi ; Carlo Catalano MD

PURPOSE
Purpose of this study was to evaluate MR-guided focused ultrasound (MRgFUS), in terms of success rate, for painful non-spinal osteoid osteoma treatment.

METHOD AND MATERIALS
This IRB approved prospective multi-centric cohort study, performed at three university hospitals, included thirty patients (M:21;Mean age:24±11). Between May 2010 and October 2012 thirty painful non-spinal osteoid ostomas, diagnosed at imaging (including ce-dynamic MR [Gd-BOPTA, Bracco]) have been treated using MRgFUS (3.0-T/1.5-T GE Discovery 750/450 + InSightec ExAblate 2000). Treatment success in terms of pain reduction was has evaluated using visual analog scale (VAS). Sonication number and mean acoustic energy (J) have been recorded. One year clinical and imaging follow-up was performed to evaluate success rate, recurrence and complications.

RESULTS
Thirty osteoid ostomas (26 lower limbs and 4 upper limbs) have been treated using MRgFUS. Complete clinical success rate was 90% (27/30), with a pain score =2 after treatment and at twelve months evaluation. Partial treatment was observed in 10% (3/30) and CTgRFA (2/30) or open surgery (1/30) was then performed. A single session treatment was sufficient in 93% (28/30) of cases to achieve clinical success. Two cases required MRgFUS retreatment. Types of anesthesias were spinal (21), peripheral (5) and general (4;in pts. =16yo). Mean sonication number was 6±3; mean energy 1080±727 J. No complications were observed immediately after treatment or during follow-up.

CONCLUSION
This multi-centric prospective cohort study demonstrated that MRgFUS has a high success rate (90%) and a relatively short learning curve for non-spinal osteoid osteoma treatment. Our results suggest that MRgFUS may be considered as an effective, totally non-invasive and safe alternative approach in osteoid osteoma interventional management.
SSC10-06  •  Cryoablation of Perineural Musculoskeletal Tumors: Use of Intraprocedural Motor Evoked Potential (MEP) Monitoring to Improve Safety

Anil N Kurup MD (Presenter); Jonathan M Morris MD; Grant D Schmitz MD; Thomas D Atwell MD; Adam J Weisbrod MD; Matthew R Callstrom MD, PhD*; Andrea J Boon; Rickey Carter PhD; C. T Wass MD; Peter Rose MD

PURPOSE
To describe the use of MEP monitoring to minimize risk of neural injury during image-guided cryoablation of perineural musculoskeletal tumors.

METHOD AND MATERIALS
Between May 2011 and March 2013, 59 cryoablation procedures were performed to treat 64 perineural musculoskeletal tumors, defined as those within 2 cm of the spinal cord or major motor nerve, in 52 unique patients. Total intravenous general anesthesia, CT guidance, and MEP monitoring were employed. Patient demographics, tumor characteristics, MEP findings, and clinical outcomes were assessed.

RESULTS
The cohort included 26 males and 26 females with median age of 61 years (range, 4-82). Tumors were located in the spine (27; 3 cervical, 14 thoracic, 10 lumbar), sacrum (23), peripheral skeleton (6), peripheral soft tissue (5), and extremities (5; 5 upper, 3 lower). Among the 64 tumors, 50 (78%) were metastases. 21 different tumor histologies were presented, most commonly renal cell carcinoma (17 tumors, 27%), colorectal carcinoma (6 tumors, 9%), and multiple myeloma/ plasmacytoma (5 tumors, 8%). Median tumor size was 4.0 cm (range, 0.8-15.0). 19 (32%) of 59 procedures resulted in decreased intraprocedural MEPs, including 15 (25%) with transient decreases and 4 (7%) with persistent decreases. Two (5%) of the 4 patients with persistent MEP decreases had motor deficits following ablation, one permanent and one which resolved over 5 months. No patient with transient MEP decreases or no MEP change developed a functional motor change. The risk of major motor injury with persistent MEP changes was significantly increased compared to transient or no change (p=0.0045, RR 69.8, 95% CI: 5.9 to >100). Excluding neural injury, there were 3 major complications (Clavien-Dindo grade >= 3): acute renal failure due to tumor lysis requiring temporary hemodialysis, cerebrospinal fluid leak requiring blood patch, and extruded cement from concomitant cementoplasty requiring surgical cement resection.

CONCLUSION
In this initial series of cryoablation procedures using intraprocedural MEP monitoring, persistent MEP decreases correlated with post-procedural major motor deficits.

SSC10-07  •  Palliation of Pain and Prevention of Fracture for Acetabular Metastases Using Combined Cryoablation and Cementoplasty

Erik B Sviggum MD (Presenter); Anil N Kurup MD; Matthew R Callstrom MD, PhD*; Peter Rose MD; Franklin Sim MD

PURPOSE
To assess the viability of combined cryoablation and cementoplasty in palliating pain and preventing fracture in patients with lytic metastatic disease of the acetabulum.

METHOD AND MATERIALS
39 combined cryoablation and cementoplasty procedures were performed on 37 patients with lytic acetabular metastatic disease from January 2004 through September 2012. Cryoablation was performed initially, with cementoplasty performed subsequently, usually the following day. Patient age ranged from 48 to 83 years (median 65, range 48-83). Patients included were known to have lytic periacetabular metastases that were painful, or nonpainful but extensive enough to cause concern of imminent fracture. Nonpainful lesions were evaluated by orthopedic surgeons and deemed at risk for fracture prior to procedure. Pre-procedural pain rating, using a visual analog scale (VAS), was obtained by referring clinicians or the interventional radiologist. Lesion location, pain levels pre- and post-procedure, periacetabular fracture (defined as cortical discontinuity or fracture on CT or MRI) pre- and post-procedure, completeness of the ablation procedure, and pre- or post-ablative therapies (surgery, radiation) to the specific location were documented.

RESULTS
27 of the 39 procedures were done for palliation of pain and had complete pre- and post-procedural VAS pain scores. Of these patients, 23 (85%) had improved post-procedural pain scores. Patients who had complete cryoablation of their periacetabular metastases (defined as the ice ball completely encompassing the tumor as seen on intermittent CT fluoroscopy) had improved pain compared with patients who had incomplete cryoablations. Of the patients who received follow-up imaging of their pelvis, 69% had no progression of pre-existing fracture or development of new fracture. Lesion stability was slightly higher in patients who had complete cryoablations vs incomplete cryoablations (73% vs 57%). Only 4 of the 39 patients required a post-procedural intervention, including one patient who required sciatic neuritis due to leakage of cement during the procedure.

CONCLUSION
Combined cryoablation and cementoplasty is a useful tool in the treatment of lytic acetabular metastatic disease for both palliation of pain as well as stabilization and prevention of fracture.

SSC10-08  •  Selective Arterial Embolization of Aneurysmal Bone Cyst (ABC) of the Skeleton with N-2 Butyl Cyanoacrylate: Revisited Results, Recurrences and Outcomes in 75 Patients

Giuseppe Rossi MD; Eugenio Rimondi MD (Presenter); Giancarlo Facchini; Paolo Spinnato MD; Patrizia Pelotti; Teresa Calabro; Pietro Ruggieri; Daniel Vanel MD; Alberto Bazzocchi MD

PURPOSE
To emphasize the role of arterial embolization with N-2 butyl cyanoacrylate as single and resolving treatment for ABC. We evaluated the effectiveness and complications of the procedure in 75 patients at the “Rizzolo Institute”.

METHOD AND MATERIALS
From April 2003 until April 2013, 75 patients with ABC were treated (41 males and 34 females, range 3 - 40 years). Each case was histologically proven. Twenty-four were sited in the appendicular skeleton (5 in the superior and 19 in the inferior limb), 8 affecting the thoracic cage (1 rib, 3 clavicle and 4 scapula), 28 in the pelvis and 15 in the spine (8 sacral, 4 lumbar, 3 thoracic). In 50 patients (66%) only one embolization was performed, two embolization in 18 patients (24%) and three in the remaining 7 cases (16%), for a total of 107 procedures.

RESULTS
Regardless of the number of the embolizations, the treatment was effective in 69 patients (92%): medium follow-up 59 months ± 12 months. In four patients the procedure was not finalised for anatomical concerns. In two patients needing integrative embolization therapy the procedure was shifted to surgery because of skin necrosis (clinical decision) or patient’s choice. In the 107 procedures, there were three complications (3%): two skin necrosis and one transient pharesis. However all the complications were solved one after surgical support.

CONCLUSION
Arterial embolization is the treatment of choice for aneurysmal bone cysts. The use of cyanoacrylate seems to be determinant for the excellent outcome of embolization following permanent effect and well-controlled procedure. Embolization is less invasive, cheaper, simpler, faster, more secure for skilled operators and it is easily repeatable.

SSC10-09  •  Clinic Efficacy of CT-guided Iodine-125 Seed Implantation Therapy in Patients with Advanced Vertebrae Metastatic Tumor

Zhijin Chen (Presenter); Zhongmin Wang; Ju Gong

PURPOSE
The purpose of this study was to examine the safety and clinical efficacy of CT-guided radioactive iodine-125 seeds implantation treatment in patients with vertebrae metastatic tumor.

METHOD AND MATERIALS
We retrospectively analyzed 20 cases with vertebrae metastatic tumor, including 9 men and 11 women aged 50-79 years (mean age, 61.1 years). We used TPS to reconstruct the 3D image of vertebrae metastatic tumor and work out the number and the dose rate distribution of 125I seeds. The MPD of 125I seed was calculated.
RESULTS
20 cases were followed up for a median of 12 months (4-26 months). The rate of pain relief was 95%. The 6 months and 12 months local control rates were 80% and 30%, respectively. The median local control time was 9 months. Overall survival rates for 6 months and 12 months were 95% and 45%. The median survival time was 10 months.

CONCLUSION
CT-guided radioactive iodine-125 seeds implantation treatment in patients with vertebrae metastatic tumor is a safe, effective, and minimally invasive method.

CLINICAL RELEVANCE/APPLICATION
CT-guided radioactive iodine-125 seeds implantation treatment in patients with vertebrae metastatic tumor is a safe, effective, and minimally invasive method.
SSC11-04  •  2-hydroxyglutarate (2HG) Level Is Associated to Tumor Progression in Gliomas Carrying IDH Mutations

Liya Wang MD (Presenter) ; Juliya Kalinina ; Shaoxiong Wu PhD ; Chad A Holder MD ; Erwin G Van Meir ; Hui Mao PhD

PURPOSE

Mutation in the isocitrate dehydrogenase (IDH) is a common feature of a major subset of primary low grade gliomas. The IDH mutation specific metabolite 2-hydroxyglutarate (2HG) can be detected and quantified by magnetic resonance spectroscopy (MRS). This study investigates whether the 2HG concentration, a possible marker for IDH mutant activity, is related to tumor progressions.

METHOD AND MATERIALS

2HG in 28 gliomas carrying IDH1/2 mutations were detected and quantified using 2D correlation MRS. Tumor volumes were determined from routine clinical MRI exams performed on each patient based on the enhancing portion of mass in post-contrast T1 weighted imaging. Tumor grade and Ki-67 proliferation index (MIK) data were obtained from histopathology analysis. Two-tailed Spearman (P

RESULTS

Higher 2HG concentrations were found in tumors with higher grades. Higher 2HG level appears associated with the increased tumor volume and MIK index. However, 2HG levels in Grade IV tumor, which is considered as the secondary glioblastom multifforme (GBM) and different from low grade gliomas, is lower than those of Grade III gliomas. In all four cases with follow-up MRI and repeated biopsy, 2HG concentrations were increased when tumor progression took place from grade II to grade III two years later. In all four cases, routine MRI exams showed increased tumor volume and more pronounced contrast enhancement effects in tumor after effects. In comparison, 2HG levels obtained from MRS showed more than 2-fold of increase. These results provided patient specific examples demonstrating that the 2HG level is increasing with the elevated tumor grade in low grade gliomas carrying IDH mutations.

CONCLUSION

Findings of this study provide the evidence that IDH mutation specific 2HG level has a strong correlation with several clinically important prognostic measurements, such as tumor size and MIK index value. Excess 2HG accumulated in tumors may contribute to formation and malignant progression of glioma.

CLINICAL RELEVANCE/APPLICATION

Association of increased 2HG level and tumor progression features suggests 2HG as a MRS detectable marker for predicting glioma prognosis.

SSC11-05  •  Development of an Unbiased, Semi-automated Method of Tumor Volume Segmentation Using Imaging Processing Software in Glioblastoma before and after Resection

Chad A Holder MD (Presenter) ; James S Cordova BS ; Eduard Schreibmann PhD * ; Constantinos G Hadjipanayis MD, PhD ; Ying Guo PhD ; Hyunsuk Shin PhD

PURPOSE

This work aims to standardize and evaluate an MR signal-based approach for tumor segmentation using an FDA 510k-approved software package (Velocity AI) that allows the rendering, fusion, and analysis of multi-modality 3D medical images.

METHOD AND MATERIALS

Currently, glioblastoma (GBM) volume measurements rely on the product of orthogonal tumor diameters on post-contrast T1w MRI; however, it is difficult to measure post-resection tumor in this manner, especially when hyperintense, nonneoplastic lesions are present. Though the need for objective volumetric analysis was highlighted by the NeuroOncology Working Group (Wen, PY et al. JCO 2010; 28,11 1963-1972), a standardized image display, processing, and analysis platform has not been developed for a clinically-utilized volume rendering software. We applied our volume determination method to compare the extent of resection (EOR) using 5-ALA-guided resection to EOR of standard resections. Datasets consisted of high-resolution pre- and post-op MR images (T1w images pre- and post-enhancement) from 13 randomized patients in an Emory ALA study and 13 controls matched for tumor location. To tabulate preop tumor volume, a 3D ROI was drawn around the tumor and the software was used to segment volumes of hyper- and hypointensity on T1w MRI in the ROI in a semi-automated fashion. To estimate residual post-op tumor, image difference maps were produced by subtracting co-registered, pre- and postcontrast T1w MRI to correct for postop blood.

RESULTS

The average EOR without ALA-guidance—expressed as percent residual tumor—was 10.69 ± 7.45%, while that of ALA-guidance was 4.85 ± 3.98%. These values were found to be significantly different at p

CONCLUSION

These results support the use of this semi-automated method for the unbiased and reproducible generation of contrast-enhancing tumor volumes in GBM pre- and post-resection. In addition, this technology allows the selection of voxels in discrete tumor regions on T1w MRI for the quantitative analysis of treatment-induced metabolic changes in spatially-coregistered, high-resolution MR spectroscopic images.

CLINICAL RELEVANCE/APPLICATION

This method allows quantitative analysis of brain tumor response to chemo-, radiation, and surgical therapies, offering a precise tool for the longitudinal monitoring of patients in clinical trials.

SSC11-06  •  Imaging Genomic Mapping Using Perfusion Uncovers Potential Genomic Targets Involved in Angiogenesis and Invasion

Rivka R Colen MD (Presenter) ; Tapan Abrol MD ; 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 perfusion radiophenotype to possibly find new genomic targets for GBM treatment. Increases in angiogenesis demonstrate increases on MRI perfusion with the enhancing effect in tumors after two years. In comparison, 2HG levels obtained from MRS showed more than 2-fold of increase. These results provided patient specific examples demonstrating that the 2HG level is increasing with the elevated tumor grade in low grade gliomas carrying IDH mutations.

METHOD AND MATERIALS

We identified 30 GBM patients from The Cancer Genome Atlas (TCGA) who had both genetic-expression profiles and neuroimaging. All morphological image analyses were done using slicer 3.6 (slicer.org) and functional analysis using NordicICE, and reviewed in consensus by 2 neuroradiologists. Quantitative perfusion parameters where obtained using the region of interest (ROI) method. ROIs were placed in the previously segmented regions of contrast enhancement, necrosis, and non-enhancing perilesional FLAIR hyperintensity- the latter reflecting a mixture of edema/tumor infiltration. Biostatistics analysis was performed for gene and miRNA sets whereas the median CBV values of each of the segmented regions were taken as the cutoff to define high and low groups. These groups were then analyzed by Comparative Marker Selection (Broad Inst.). Among the whole gene set the most upregulated miRNAs/miRNAs, were analyzed with ingenuity pathway analysis (IPA).

RESULTS

IPA identified molecular networks, as well as canonical and functional pathways highly associated with cancer, angiogenesis, and invasion in those patients with high tumor CBV.

CONCLUSION

The perfusion radiophenotype identified genes and miRNAs and corresponding molecular networks that were highly associated with angiogenesis and 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 specific examples demonstrating that the 2HG level is increasing with the elevated tumor grade in low grade gliomas carrying IDH mutations.

CLINICAL RELEVANCE/APPLICATION

The discovery of imaging biomarkers reflecting specific genomic tumor compositions in necrosis is clinically relevant as they can determine aggressiveness and tumor growth.

SSC11-07  •  Validating MRI as a Screening Tool for Genomic Target Discovery for Therapeutic Drug Development

Rivka R Colen MD (Presenter) ; Prateesh Sathyan ; Ashok J Kumar MD ; Pascal O Zinn MD

PURPOSE

The search for an effective therapy of Glioblastoma Multiforme (GBM) continues. Imaging Genomics, a newly emerged field, links gene expression profiles with MRI phenotypes (Zinn et al. 2011). MRI-FLAIR was found to correlate with cellular invasion in GBM; thus, whole genome quantitative imaging analysis can reveal functional microRNA-gene regulatory networks as novel targets for cellular invasion in GBM. We sought to validate MRI as a screening tool for genomic target discovery.

METHOD AND MATERIALS

We performed radiogenomic mapping of MRI- and corresponding genomic data in 78 TCGA patients. The top microRNA-gene regulatory network was biologically validated by functional and mechanistic in-vitro and in vivo orthotopic xenograft model studies using gain and loss of function. Small animal 7T
RESULTS
The top up-regulated gene in high invasion MRI phenotypes was PERIOSTIN (POSTN). The top down-regulated microRNA (miR-219) was validated to bind to POSTN. MRT2/FLAIR signal highly correlated with POSTN levels and the degree of cellular invasion in orthotropic xenograft models. Furthermore, high POSTN and a high POSTN/miR-219 signature resulted in decreased survival and shorter time to progression (P < 0.05).

In this study, we validated a novel noninvasive diagnostic method to screen for functional networks of cellular invasion. POSTN inhibition can be a novel therapeutic approach to target invasion in GBM. Furthermore, targeted individualized molecular therapies can be based on diagnostic imaging-genomics and can be monitored throughout the treatment period.

CLINICAL RELEVANCE/APPLICATION
Imaging, specifically MRI, can be used as a screening method in order to identify genomic targets that are clinically meaningful and can potentially go on to develop genomic based therapeutics.

**SCCC1-08 • MRI and PET Measurement of Oxygen Extraction Fraction in Patients with Brain Tumors**

Parinaz Massoumzadeh PhD (Presenter); Dhanasree Rajderkar MD; Hongyu An DSc; Jonathan E McNicholy MD, PhD *; Joshua S Shimony MD, PhD; Abraham Z Snyder PhD; Yi Su PhD; Andrei Vlassenko MD, PhD; Xiaodong Zhang PhD; Jon J Christensen; Sarah C Jost MD; Daniel S Marcus PhD *; Keith M Rich MD; Tammie S Benzinger MD, PhD *

PURPOSE
To quantify and compare the cerebral oxygen extraction fraction (OEF) measurement in the normal brain and brain tumors using 15O positron emission tomography (PET) and oxygen sensitive magnetic resonance (MR)1.2 imaging.

METHOD AND MATERIALS
30 patients (20 with brain tumors) were recruited. MRI included standard clinical sequences plus OEF-MRI1: a two-dimensional multi-echo gradient spin echo sequence. Concurrent with the MR acquisition, subjects with brain tumors underwent PET scanning, which included 2 sets of 3 scans with serial inhalation of air with 40-75 mCi radiolabeled carbon monoxide (C15O), 40-75 mCi radiolabeled oxygen (15O2), and injection of 25-50 mCi radiolabeled water (H215O). MR and PET data were post-processed off line and registered to the anatomic T1 pre- and post-contrast images. Regions of interest were drawn based upon contrast-enhancing tumor areas, contra-lateral normal white matter (NWM), and normal gray matter (NGM) Ratios of OEF (rOEF) were obtained for lesions compared to normal tissue.

RESULTS
There is very good correlation between two OEF-PET measurements for tumor (R2=0.90 with slope of 0.82), and for rOEF (R2=0.93 and slope of 1.14). The OEF values of NWM are not significantly different between the OEF-PET measurements. OEF-MR and OEF-PET correlates well when subjects with SWI abnormalities (blood clot, hemorrhage, calcification) are excluded (R=0.73).

CONCLUSION
Both MR and [15O] PET can measure OEF in brain tumors and in peritumoral edema. Variable OEF measurements for tumor and edema may be implications for tumor grade and prognosis. BOLD MR fails in regions with signal loss on SWI or T2*. Both techniques have tremendous potential and may offer new insight into the underlying physiology of brain tumors and their response to therapy without requiring radiation or injected contrast.

**REFERENCES**

**CLINICAL RELEVANCE/APPLICATION**
Both MR and [15O] PET can measure OEF in brain tumors and in peritumoral edema and have potential to predict treatment response. BOLD MR fails in regions with signal loss on SWI or T2*.

**SCCC1-09 • Creating a Radiogenomics Map of Multi-omics and Quantitative Image Features in Glioblastoma Multiforme**

Olivier Gevaert PhD (Presenter); Lex A Mitchell MD; Achal Achrol; Jiaying Xu MS; Gary K Steinberg MD, PhD; Samuel H Cheshier; Sandy Napel PhD *; Greg Zaharchuk MD, PhD *; Sylvia K Plevritis PhD

PURPOSE
To create mappings between quantitative image and genomic features for glioblastoma multiforme (GBM) and to assess the prognostic association of significant correlations.

METHOD AND MATERIALS
We obtained multi-omics data from 251 patients and MR image data from a subset of 55 patients in the Cancer Genome Atlas (TCGA) and The Cancer Imaging Archive (TCIA) GBM databases. A board certified neuroradiologist traced 2D regions of interest (ROI) around necrotic and enhanced parts of the largest lesion in a selected slice from a T1 post-contrast MR, and around the region of hyperintensity obtained from the enhancement on the matched T2 FLAIR slice. These ROIs were used to compute quantitative image features from their shapes and pixel values. We used a module network algorithm that integrates copy number, DNA methylation and gene expression data into 100 co-expressed gene modules, modeled by sparse linear regression of driver genes, which were selected based on a significant correlation of copy number or DNA methylation with their respective gene expression. We established a radiogenomics map by correlating the modules with the quantitative image features, and correlated the image features from this map with significant correlations with survival using Cox proportional hazards modeling.

RESULTS
A total of 28 quantitative image features were extracted for each of the necrosis, enhancement and edema ROIs in each patient. The radiogenomics map between modules and quantitative image features revealed 14, 10 and 16 significant gene-module associations with necrosis, enhancement and edema ROIs respectively. For example, we found a significant correlation between Module 64, enriched with genes in neuronal differentiation, and the compactness of the necrosis (p = 0.0145). Also, we found that the amount of necrosis vs. enhancement or edema is correlated with Module 74, enriched in metabolism related genes (p < 0.05).

CONCLUSION
Creating radiogenomics maps provides multi-scale insight by associating image features with molecular function. Moreover, these maps may provide additional insight for image features with prognostic correlations.

**CLINICAL RELEVANCE/APPLICATION**
Associating activation of molecular pathways with image features has the potential of allowing non-invasive assessment of the molecular properties of a tumor at the time of diagnosis.

**Neuroradiology/Head and Neck (Traumatic Brain Injury)**

**Monday, 10:30 AM - 12:00 PM • N229**

**SCCC12 • AMA PRA Category 1 Credit ™: 1.5 • ARRT Category A+ Credit: 1.5**

**Moderator**

Pratik Mukherjee, MD, PhD *

**Moderator**

Gerard Riedy, PhD, MD

**SCCC12-01 • Six Hour Repeat Head CT for Trauma Patients on Antiplatelets and/or Anticoagulation**

Jackson Chung MD (Presenter); Armando S Herradura MD; Stephen R Baker MD *

PURPOSE
To determine the efficacy of repeat six-hour head CTs for trauma patients on antiplatelets and/or anticoagulation for delayed intracranial hemorrhage (ICH)

METHOD AND MATERIALS
Retrospective analysis was conducted on all head CTs performed at our institution from the years 2007-2012. Inclusion criteria included availability of initial, repeat head CTs within a six hour period, and data on the type of antiplatelet and/or anticoagulation. Data were obtained from electronic medical records, PACS, and radiology reports. Cases which identified a new ICH on the repeat study were examined for changes in patient management, hospital course, and outcomes.
RESULTS
Preliminary analysis of the 11,562 head CTs performed at our institution during the year 2012 yielded 128 cases meeting inclusion criteria. Incidence of ICH on repeat examination was 1.5% regardless of antiplatelet/anticoagulation type, consistent with previously published studies. Further evaluation of these cases demonstrated that the repeat study did not alter patients’ management and outcomes.

CONCLUSION
Repeat six hour head CTs for patients on antiplatelet and/or anticoagulation therapy was low-yield for delayed ICH and did not affect patient outcomes. More comprehensive analyses are required to determine the cost-benefit analysis of a repeat head CT and to identify certain populations which can benefit from a repeat scan.

CLINICAL RELEVANCE/APPLICATION
Our analysis demonstrates these repeat head CTs are unnecessary and only result in increased radiation exposure and costs.

SSC12-02 • The Use of Coronal and Sagittal Reforms in the Evaluation of Post-traumatic Intracranial Hemorrhage
Anil Syal MD (Presenter)

PURPOSE
Evaluate if coronal and sagittal reconstructions are helpful in the evaluation of post-traumatic intra-cranial hemorrhage.

METHOD AND MATERIALS
Approximately 317 cases of acute, post-traumatic intracranial hemorrhage from a level II trauma center over a 16-month period were reviewed. These positive cases were interspersed with an equal number of negative controls. A board-certified neuro-radiologist, a body radiologist and two residents, a PGY-3 and a PGY-4, evaluated each case without any history other than “post-traumatic.” Evaluators were told to read each study using only axial 5mm slices. After completing the studies, the interpretations were compared to the original readings (which were re-evaluated prior to this study by a separate neuro-radiologist), which were designated as the “control report.” Any cases of missed post-traumatic intra-cranial hemorrhage were then re-evaluated by the test subject one month later, with the additional aid of coronal and sagittal reforms. Any discrepancies with their original reads were documented. As well, any missed post-traumatic intracranial findings were then viewed in light of their “clinical significance,” via documented follow-up studies and clinical course.

RESULTS
Preliminary results indicate only a small difference between the rate of positive post-traumatic intracranial bleeds when using only axial images, versus with the aid of coronal and sagittal reforms.

CONCLUSION
The industry standard protocol for a post-traumatic head CT typically includes 2.5 or 5mm axial cuts; where protocols differ is in the use or absence of digital coronal and sagittal reforms. In a review of approximately 600 cases from a level II trauma center, there was minimal difference in the number of positive reported cases. Furthermore, the clinical relevance of these missed findings seen only in one, reformatted plane is of questionable significance, based upon patient outcomes.

CLINICAL RELEVANCE/APPLICATION
Axial images alone are satisfactory in diagnosing clinically relevant post-traumatic intracranial hemorrhage.

SSC12-03 • Utility Assessment of Repeat Head CT in the Setting of Mild Traumatic Brain Injury Using a Natural Language Processing Tool
Jason M Johnson MD (Presenter) ; Tarik K Alkasab MD, PhD ; Daniel Yeh MD ; Pamela W Schaefer MD

PURPOSE
To assess the rate of which repeat head CT following mild traumatic brain injury revealed worsening of imaging findings using a natural language processing tool.

METHOD AND MATERIALS
Utilizing our institutional trauma registry, 824 adults with blunt TBI who arrived within 24 hours of injury, with arrival GCS of >12 with initial head imaging positive for TBI were evaluated. Each patient with positive findings were identified. Each exam was evaluated using a natural language processing (NLP) tool designed for high sensitivity to identify reports describing worsening findings. Imaging reports for 114 patients were manually assessed by an experienced neuroradiologist and a Kappa score was calculated for agreement between the NLP tool and a human reader.

RESULTS
Of the 819 patients identified, 164 were removed for additional review for having less than 2 CT scans. An additional 30 patients were removed due to initial operative management. Of the remaining 625 patients, 287 had 2 CTs, 172 had 3 CTs and 166 had >3 CTs. Review of the NLP revealed 86% (98/114) algorithm concordance with neuroradiologist review. The majority of the errors (81.3%; 13/16) were NLP overcalls based on the report. Of the 626 patients with at least two CT scans, the second CT scan contained language suggesting worsening in 263 cases (42.0%).

CONCLUSION
A supervised NLP tool can be used in conjunction with a patient registry to identify language associated with worsening head CT findings. We expect to use this tool to further explore clinical factors associated with worsening imaging findings to improve imaging utilization patterns.

CLINICAL RELEVANCE/APPLICATION
This tool may be important for exploring image utilization patterns and outcomes for large populations.

SSC12-04 • Quantitative DTI for Prediction of Neurocognitive Outcome in Severe Traumatic Brain Injury: A Five-year Prospective Cohort
Omid Khalilzadeh MD, MPH (Presenter) ; Julien Dinkel MD ; Vincent Perlberg PhD ; Louis Puybasset MD, PhD ; Damien P Galanaud MD, PhD * ; Rajiv Gupta PhD, MD

PURPOSE
Prediction of long-term neurocognitive outcome in patients with traumatic brain injury (TBI) is challenging. In this study, we evaluated the prognostic value of DTI, performed in acute-phase after TBI, for prediction of long-term neurocognitive sequelae. For this purpose, we tracked the changes in quantitative DTI parameters over a span of 5 years after the injury.

METHOD AND MATERIALS
Sixteen patients with severe TBI who were admitted to the intensive care unit were enrolled in this prospective study. A baseline MRI was acquired as soon as clinically feasible (within 6 weeks). The MRI scans were repeated at 2 and 5 years after the injury. Patients underwent a neuropsychological evaluation and we assessed the cognitive sequelae and the level of disability based on Glasgow outcome scale, the disability rating scale and the modified Rankin scale. Healthy controls (n=8) were scanned at baseline and at 2-year intervals. Automated segmentation software calculated axial/radial diffusivity and fractional anisotropy in 20 predefined white matter regions. The DTI parameters were normalized using a large set of DTI data from healthy controls. The association of DTI changes with patients’ clinical outcome was evaluated.

RESULTS
TBI patients had significantly lower fractional anisotropy and higher radial diffusivity in selected white matter tracts compared with healthy controls. Baseline changes in fractional anisotropy and radial diffusivity in the brain stem, corpus callosum and coronal radiata were significantly (p < 0.05) different from healthy controls. Acute changes in fractional anisotropy and radial diffusivity after severe TBI can predict long-term neurological sequelae with high confidence. DTI changes in the body/genu of the corpus callosum provide the best long-term prognostic value for severe TBI.

CONCLUSION
Quantitative DTI can be used as a prognostic tool for prediction of long-term neurocognitive outcome in severe traumatic brain injury.

SSC12-05 • Diffusion Tensor Imaging and Neuropsychological Performance in Post-acute Blast-induced Traumatic Brain Injury among U.S. Military Veterans
Thomas M Malone BA (Presenter) ; Jacob Bolzenius BA ; Mark Colijn MS ; Evan Schulze BA ; P. T Roskos PhD ; Richard R Bucholz ; Jeffrey D Stout PhD

PURPOSE
Operations Iraqi Freedom and Enduring Freedom have resulted in a returning veterans with an approximately 20% exposure rate to blast-induced mild traumatic brain injury (mTBI).[1] Standard neuroimaging (MRI/CT) lacks sensitivity to mTBI; however, some research has shown evidence that Diffusion Tensor Imaging (DTI) can identify white matter injury.[2,3] DTI measures the local diffusion profile of tissue and can characterize the microstructural integrity of white matter. In this study, we compared DTI derived fractional anisotropy (FA) values in veterans with post-acute blast mTBI versus healthy controls (HCS) and examined the association between FA and neuropsychological measures.

CLINICAL RELEVANCE/APPLICATION
Current methods for assessing neurocognitive outcomes in blast-related mTBI have limitations. DTI can provide additional information on structural integrity of the brain and may be useful in assessment of neurocognitive outcomes in these patients.
RESULTS
Comparison of FA values using independent sample t-tests showed significant differences between groups in the posterior limb of the internal capsule, bilaterally (p<0.05).

RESULTS indicate that DTI is sensitive to group differences in blast-related mTBI, even in the post-acute phase. This suggests presence of a long-term impact of blast injury on the brain. Paradoxically, higher FA values and lower neuropsychological scores were found among veterans with mTBI.

CONCLUSION
To characterize brain network alterations related to prefrontal traumatic axonal injury (TAI) in mTBI patients. We hypothesized that prefrontal resting network connectivity is related to left dorsolateral prefrontal cortex, previously associated with TAI and executive dysfunction in this patient group, would be abnormal in comparison to uninjured controls.

METHOD AND MATERIALS
Infirmed consent was obtained from 11 mTBI patients (ages 21-62) within 2 weeks of injury and 9 healthy control subjects, in compliance with HIPAA. Using a GE-EPI time series (TE=40; voxel size 8ul), resting fMRI was performed on a Philips Achieva TX 3.0 T MR scanner. Preprocessing was performed in FSL, including motion and slice timing correction, nuisance vector (noise and CSF) regression, FLM prewhitening and registration to the Johns Hopkins University template. Mean signal timecourses from right- and left-dorsolateral prefrontal cortex (DLPFC; BA 9/46) and rostral prefrontal cortex (RPF; BA10) were used as seed regions (predictors) in voxelwise correlation analyses for each subject. Comparison between mTBI patients and controls was performed using unpaired, uncorrected t-tests, with Bonferroni correction.

RESULTS
We have previously demonstrated low left DLPFC fractional anisotropy and impaired executive function (Austin maze and CPT) in this patient group. Using resting fMRI, left DLPFC was significantly more highly correlated with both right and left RPF (t-stat -5.67 and -5.61, p<0.05). We demonstrate enhanced correlation of resting state fMRI activity within left prefrontal networks implicated in executive function. Enhanced correlation among resting networks has been described in pathologic states, including TBI, as evidence of reduced network functional efficiency. The spatial and functional relationship between resting fMRI findings (DLPFC-RPF network), previously demonstrated DTI evidence of TAI (DLPFC) and functional impairment (executive dysfunction), reveals physiologic consequences that can link microstructural pathology to functional consequences in mTBI patients.

CONCLUSION
We demonstrate a link between thalamic iron metrics and frontal white matter microstructural changes. These data suggest iron may contribute to secondary injury after mTBI.

SSC12-06 • Association of Thalamic Iron and Frontal White Matter Diffusion Changes: Longitudinal Findings after Mild Traumatic Brain Injury (mTBI)

Martin Kopec MD (Presenter) ; Yulin Ge MD ; Robert I Grossman MD ; Yvonne W Lui MD

PURPOSE
Thalamic iron has been shown to be elevated after a single concussive episode. The thalamus is a hub for numerous cortical connections, particularly of interest in mTBI are frontocortical connections to areas responsible for executive function. Fractional anisotropy (FA) is a sensitive measure of white matter microstructural integrity after concussion. It is not known whether iron accumulating from secondary injury is related to degree of white matter structural change. The purpose of this study is to correlate thalamic iron using magnetic field correlation imaging (MFC) and frontal white matter microstructure changes using Diffusion Tensor Imaging (DTI) in a cohort of mTBI patients over the first year after injury.

METHOD AND MATERIALS
27 patients with documented mTBI treated by the University of Rochester Medicine criteria were prospectively enrolled with longitudinal data available in 14 subjects. Evaluation included 3 Tesla MRI performed at 1 month and 1 year after injury. Microscopic MFC, an iron marker, and DTI were performed. Thalamic microscopic MFC values using region of interest analysis and frontal white matter FA (FWM-FA) were obtained at both time points. Pearson correlation coefficient was calculated.

RESULTS
27 subjects studied at the first time point (21 males, 6 females; mean age of 33.2 years) and 14 followed at both time points (11 males, 3 females; mean age of 34.6 years) were imaged at a mean of 27 and 422 days after injury. Average thalamic microscopic MFC was 123.5 and 126.2 at 1 month and 1 year, respectively. Average FA was 0.378 and 0.381. At 1 month, no correlation was found between thalamic microscopic MFC and FW-FA; however, at 1 year, thalamic microscopic MFC values were highly correlated with a reduction in FW-FA (r=-0.7, p=0.0007).

CONCLUSION
1 year after injury an association emerges between higher thalamic iron measures and frontal white matter microstructural changes. This demonstrates the first reported connection between white matter injury and iron accumulation in mTBI.

CLINICAL RELEVANCE/APPLICATION
We demonstrate a link between thalamic iron and frontal white matter microstructural changes. These data suggest iron may contribute to secondary injury after mTBI.

SSC12-07 • Linking Microstructural Injury and Functional Outcome in Mild Traumatic Brain Injury (mTBI): A Role for Resting fMRI

Susan Sotardi MD, MS (Presenter) ; Jeremy Smith PhD ; Michael L Lipton MD, PhD

PURPOSE
To characterize brain network alterations related to prefrontal traumatic axonal injury (TAI) in mTBI patients. We hypothesized that prefrontal resting network connectivity is related to left dorsolateral prefrontal cortex, previously associated with TAI and executive dysfunction in this patient group, would be abnormal in comparison to uninjured controls.

METHOD AND MATERIALS
Infirmed consent was obtained from 11 mTBI patients (ages 21-62) within 2 weeks of injury and 9 healthy control subjects, in compliance with HIPAA. Using a GE-EPI time series (TE=40; voxel size 8ul), resting fMRI was performed on a Philips Achieva TX 3.0 T MR scanner. Preprocessing was performed in FSL, including motion and slice timing correction, nuisance vector (noise and CSF) regression, FLM prewhitening and registration to the Johns Hopkins University template. Mean signal timecourses from right- and left-dorsolateral prefrontal cortex (DLPFC; BA 9/46) and rostral prefrontal cortex (RPF; BA10) were used as seed regions (predictors) in voxelwise correlation analyses for each subject. Comparison between mTBI patients and controls was performed using unpaired, uncorrected t-tests, with Bonferroni correction.

RESULTS
We have previously demonstrated low left DLPFC fractional anisotropy and impaired executive function (Austin maze and CPT) in this patient group. Using resting fMRI, left DLPFC was significantly more highly correlated with both right and left RPF (t-stat -5.67 and -5.61, p<0.05). We demonstrate enhanced correlation of resting state fMRI activity within left prefrontal networks implicated in executive function. Enhanced correlation among resting networks has been described in pathologic states, including TBI, as evidence of reduced network functional efficiency. The spatial and functional relationship between resting fMRI findings (DLPFC-RPF network), previously demonstrated DTI evidence of TAI (DLPFC) and functional impairment (executive dysfunction), reveals physiologic consequences that can link microstructural pathology to functional consequences in mTBI patients.

CONCLUSION
We demonstrate a link between thalamic iron metrics and frontal white matter microstructural changes. These data suggest iron may contribute to secondary injury after mTBI.

SSC12-08 • Altered White Matter Microstructure as Vulnerability Factors and Acquired Signs of Traffic Accident-induced PTSD Altered White Matter Microstructure as Vulnerability Factors and Acquired Signs of Traffic Accident-induced PTSD

Yawen Sun (Presenter) ; Yan Zhou PhD ; Zhen Wang ; Weina Ding ; Zhi Guo Zhuang ; Yong Zhang ; Yijun Liu ; Jianrong Xu

PURPOSE
White matter (WM) microstructural changes have been found in patients with chronic and new onset posttraumatic stress disorder (PTSD). Whether such WM changes are stress-induced or not, precursors for this vulnerability remain unclear. The aim of the current study was to identify susceptibility factors relating to the development of PTSD and to examine the ability of these factors to predict the course of longitudinal PTSD.

METHOD AND MATERIALS
A total of 62 participants who experienced traffic accidents underwent diffusion-weighted imaging using a 3.0T MRI system within 2 days after their accidents. Among them, 21 participants were diagnosed with PTSD, at 1 month or 6 months using the Clinician-Administered PTSD Scale (CAPS), and 10 patients with PTSD underwent the second MRI scanning up diagnosis. Voxel-based analysis (VBA) was performed on fractional anisotropy (FA) images to assess the differences in the WM microstructures across the whole brain between the groups. Assessing the relationship between PTSD symptom severity and WM microstructures, the correlation between the CAPS at diagnosis and the FA values in the brain regions of interest was also examined.

RESULTS
Compared with the trauma-exposed control group, the PTSD group showed lower FA values in the right anterior cingulate cortex, right middle temporal gyrus, right middle frontal gyrus and left gyrus rectus/media orbital frontal cortex within 2 days after trauma. Importantly, the reduced FA values in the left gyrus rectus at the acute phase predicted greater future CAPS scores. In addition, we found decreased FA values in the left insula in the follow-up scan in the patients with PTSD, which correlated with the decrease in FA values in the left gyrus rectus in their first scan.

CONCLUSION
These results suggested that the WM microstructure has already changed within 2 days after the initial trauma in the individuals who would later on develop PTSD. Furthermore, the reduced FA values in the ventromedial prefrontal cortex region could be established as a vulnerability neuroimaging marker that predicts future development of PTSD symptoms and might also provide an outcome prediction of the acquired signs of PTSD, focusing on reduced FA values in the insula.

CLINICAL RELEVANCE/APPLICATION
Identify the susceptibility factors relating to the development of PTSD and examine the ability of these factors to predict the course of longitudinal PTSD.
An Automated Method to Estimate Organ Dose from Tube Current Modulated (TCM) CT Scans Using Software to Extract Regional Tube Current Values

Maryam Khatonabadi (Presenter) *; Tim O’Connell MD, MEng *; Aaron D Sodickson MD, PhD; Michael F McNitt-Gray PhD *

PURPOSE
Regional CTDIvol has proven to be a valuable metric for estimating dose from TCM CT scans; however, its practicality has not been established. The purpose of this study was to evaluate an automated landmark recognition software which can be used to extract basic landmarks within a CT exam to calculate both regional CTDIvol, and regional water equivalent diameter (WED) metrics to enable automated organ dose estimates.

METHOD AND MATERIALS
Image data and tube current modulation data were collected from 10 patients who underwent either an abdomen/pelvis (N=4) or thorax (N=6) exams. An automated software program was used to analyze each patients’ image data and identify the type of exam and to extract image numbers corresponding to important landmarks of regional anatomy: for thorax, locations of the lung apices and the top of the diaphragm were extracted; for A/P, locations of the top of the lung apices and the diaphragm were extracted. The extracted image numbers were used to calculate a regional CTDIvol based on DICOM header-reported mAs values as well as the WED of each image. Regional CTDIvol and WED were used to estimate dose to lungs and breasts from thorax and dose to liver, kidneys, and spleen from abdomen/pelvis exams, using a predictive model capable of estimating organ dose using regional information. For these same patients, the image data was used to create voxelized models used in Monte Carlo simulations in which dose to each of the relevant organs was estimated. Estimated organ doses from automated method were compared with those obtained through simulations and a Root Mean Square error between methods was calculated.

RESULTS
Estimated doses using the automated method resulted in RMS error of 33%, whereas estimates using the manual approach resulted in lower RMS error of 15% across all organs.

CONCLUSION
This work has demonstrated that automated methods to estimate organ dose for CT scans performed with tube current modulation yield reasonable results in a small number of patients having either A/P or thorax exams. Further work is needed to improve automated extraction of regions, especially for extraction of regional data to estimate thoracic organ doses (particularly breast dose), where tighter organ-specific regions would be preferable.

CLINICAL RELEVANCE/APPLICATION
Automated body landmark recognition can facilitate the calculation of multiple regional CTDIvol values from a single TCM exam for use in organ dose estimation.

Phase Based Dose Modulation for Improved Dose Efficiency in Cardiac CT

Skeppholm, PhD (Presenter) *; Benjamin Voelkel; Sarmidi, PhD *; Willi A Kalender PhD *

PURPOSE
A new approach to the optimization of cardiac CT dose has been developed that exploits temporal motion of cardiac structures. This non-traditional cardiac CT dose modulation (CMD) technique uses a phase detection algorithm to acquire only relevant cardiac images at the optimal phase of systole and diastole. In this study we evaluate the potential of this dose optimization technique using phasing of coronary arteries during the cardiac cycle.

METHOD AND MATERIALS
A custom-made phase detection algorithm was implemented in a commercial cardiac CT scanner. Nineteen volunteers and 14 patients with clinical indications for cardiac CT were examined. One patient had 3 separate examinations to assess the effect of the phase selection on dose estimates. For each examination, a region of interest was drawn around the coronary arteries and dose was measured using a calibrated ionization chamber at the center and in the periphery of the phantom.

RESULTS
The mean phase-based dose reduction ranged from 2% to 36% (2/19) with the mean dose difference of 19% (17/19) for all volunteers and patients. Two patients had dose reduction of 36% and 30% where the coronary arteries were clearly visible. However, in the remaining 17 patients, the coronary arteries were only occasionally captured and the dose reduction was limited to 2% to 15%. The phase-based dose reduction was statistically significant (p<0.05).

CONCLUSION
The phase-based dose reduction observed in this study is in good agreement with the dose reduction observed in a previous study. The phase-based dose modulation technique shows potential for dose reduction in cardiac CT. Further work is needed to improve the accuracy of the phase detection algorithm and to assess the clinical implications of the phase selection on image quality.

CLINICAL RELEVANCE/APPLICATION
The phase-based dose modulation technique has the potential to reduce patient dose in cardiac CT while maintaining image quality. This approach can be particularly useful in patients with small coronary arteries or in cases where the coronary arteries are only occasionally visible.

An Automated Method to Estimate Organ Dose from Tube Current Modulated (TCM) CT Scans Using Software to Extract Regional Tube Current Values

Maryam Khatonabadi (Presenter) *; Tim O’Connell MD, MEng *; Aaron D Sodickson MD, PhD; Michael F McNitt-Gray PhD *

PURPOSE
Regional CTDIvol has proven to be a valuable metric for estimating dose from TCM CT scans; however, its practicality has not been established. The purpose of this study was to evaluate an automated landmark recognition software which can be used to extract basic landmarks within a CT exam to calculate both regional CTDIvol, and regional water equivalent diameter (WED) metrics to enable automated organ dose estimates.

METHOD AND MATERIALS
Image data and tube current modulation data were collected from 10 patients who underwent either an abdomen/pelvis (N=4) or thorax (N=6) exams. An automated software program was used to analyze each patients’ image data and identify the type of exam and to extract image numbers corresponding to important landmarks of regional anatomy: for thorax, locations of the lung apices and the top of the diaphragm were extracted; for A/P, locations of the top of the lung apices and the diaphragm were extracted. The extracted image numbers were used to calculate a regional CTDIvol based on DICOM header-reported mAs values as well as the WED of each image. Regional CTDIvol and WED were used to estimate dose to lungs and breasts from thorax and dose to liver, kidneys, and spleen from abdomen/pelvis exams, using a predictive model capable of estimating organ dose using regional information. For these same patients, the image data was used to create voxelized models used in Monte Carlo simulations in which dose to each of the relevant organs was estimated. Estimated organ doses from automated method were compared with those obtained through simulations and a Root Mean Square error between methods was calculated.

RESULTS
Estimated doses using the automated method resulted in RMS error of 33%, whereas estimates using the manual approach resulted in lower RMS error of 15% across all organs.

CONCLUSION
This work has demonstrated that automated methods to estimate organ dose for CT scans performed with tube current modulation yield reasonable results in a small number of patients having either A/P or thorax exams. Further work is needed to improve automated extraction of regions, especially for extraction of regional data to estimate thoracic organ doses (particularly breast dose), where tighter organ-specific regions would be preferable.

CLINICAL RELEVANCE/APPLICATION
Automated body landmark recognition can facilitate the calculation of multiple regional CTDIvol values from a single TCM exam for use in organ dose estimation.

Clinical Implication of Early 3T-MR with Susceptibility Weighted (SWI) and Blood Flow (ASL) Imaging in Collegiate Athletes with Mild Traumatic Brain Injury: Preliminary Report

Anna Ellermeier MD (Presenter) *; Heather Spader; Zahid Jethani; Jason T Machan PhD; William C Lafrance; Michael Worden; Kaspr De Jongh; Michael J Hulsyn; Neha Raukar; Jeffrey M Rogg MD

PURPOSE
Mild traumatic brain injury (mTBI) in young adults accounts for the 2nd highest rate of brain injury in RI State, with increasing emphasis placed on the immediate and long-term effects of these injuries. We report the results of 3T-MR susceptibility weighted (SWI) and cerebral blood flow (CBF) pulsed arterial spin labeled (ASL) imaging for diagnosis and prognosis assessment in mTBI.

METHOD AND MATERIALS
Following IRB approval, prospective consent was obtained from right-handed college football and rugby athletes. Fourteen (14) athletes with sports-related concussions (GCS 13-15) were enrolled. 3T-MR imaging (Siemens Trio) performed 1-month clinical follow-up; 8 had >3-month clinical and MR follow-up. T1/FLAIR and SWI MR reviewed blindly by a CAQ Neuroradiologist. ASL vascular territory ROI analysis performed using Osirix software, with a general linear model treating MR parameters as multivariate-Gaussian distributed for statistical analysis.

RESULTS
All subjects had headache, memory/concentration difficulty and/or decreased energy, 36% (5/14) severe; 21% (3/14) had persistent symptoms at 1-month, 14% (2/14) severe. None had abnormal T1 or FLAIR. Two out of 14 had SWI hemorrhage (punctate peri-genu and peri-splenium CC) and severe presentation with clinical and imaging resolution at 1-month. ASL showed significantly increased minimum and decreased standard deviation in hippocampus (HIP) CBF post-injury as compared to >3-month delayed intra-subject control (Fig. 1).

CONCLUSION
Our mTBI subjects clinically parallel existing literature. Standard T1 and FLAIR 3T-MR had no relevant findings in the 14 athletes. Thoguth both subjects with SWI blood had severe symptoms, their full recovery suggests prognosis is not affected by SWI findings. ASL showed statistically increased HIP CBF in the acute stage. Our results, as existing literature shows elevated filter was designed as existing literature shows elevated filter was designed to correlate with symptom severity. Clinical significance is considered by implication of HIP dysfunction on memory, concentration and mood stability, all associated with mTBI.

CLINICAL RELEVANCE/APPLICATION
In mTBI, 3T-MR SWI may show hemorrhage but does not predict prognosis. We use ASL to show increased hippocampal CBF, supporting literature that suggests this may be clinically relevant.
Adam Budde  MS (Presenter) * ;  Brian E Nett PhD *

PURPOSE

In cardiac half-scan reconstruction a smooth weighting function is typically used to weight the sinogram data. We assess if knowledge of this weighting function and the prescribed cardiac phase can be used to improve dose efficiency.

METHOD AND MATERIALS

In prospectively triggered cardiac CT, data is typically acquired such that a prescribed phase and some adjacent phases can be reconstructed (e.g. prescribed phase and nominal phases (SDD)). During the reconstruction process of any given phase a smooth temporal weighting is applied to reduce motion artifacts. In this work a phase based mA modulation is proposed, such that less dose is delivered to the views which will receive a down weighting during the reconstruction process. The base protocol for comparison was a half scan acquisition with a gantry rotation period of 280ms with 50ms of phase padding on each side. A comparison, using numerical simulations of a 20cm water phantom, was performed between the standard and the phase based dose modulation, where the integral of the mA was conserved between the two acquisitions.

RESULTS

The image noise at the center of the phantom was assessed through region of interest measurements of the variance of voxel values, as this metric varies inversely with dose. Modulating the mA while keeping the total dose constant reduced the image variance by 12.2% at the center reconstructed phase, 12.0% at the reconstructed phase 25ms from center, and by 6.2% at the reconstructed phase 50ms away from the prescribed phase.

CONCLUSION

Prospective phase based dose modulation enables improved dose efficiency for cardiac CT scanning.

CLINICAL RELEVANCE/APPLICATION

Radiation dose reduction in cardiac CT can be achieved while maintaining the same level of image noise through phase based modulation.

SSC13-04 • Method to Achieve Specific Image Quality and Dose Targets over a Range of Patient Sizes by Optimizing CT Tube Current Modulation Parameters

David B Larson MD (Presenter) * ;  Daniel J Podberesky MD *

PURPOSE

Automated tube current modulation (ATCM) can reduce CT radiation dose by adjusting the tube current according to patient size. However, ATCM does not establish image quality or dose targets nor does it ensure that those targets are met. Our purpose was to develop a method for achieving specific image quality targets over a range of patient sizes by adjusting the ATCM parameters of standard deviation of noise (“SD”) and minimum and maximum mA values.

METHOD AND MATERIALS

A mathematical optimization model, based on a 320-detector row scanner (Aquilion ONE, Toshiba, Otawara, Japan), was developed to predict noise and size-specific dose equivalent (SSDE) based on scanner settings, including ATCM parameters (SDD), which has been presented previously. The model was applied to a quantitative noise target curve as a function of patient size, which has also been presented previously. The three ATCM variables (SD and minimum and maximum mA) were adjusted in the model to enable explicit matching of predicted image noise with target image noise over a range of patient sizes. Mean deviation and mean absolute deviation (MAD) of the predicted from the target noise and SSDE were obtained for water-equivalent diameters corresponding to weight ranges of 0-15 kg, 16-30 kg, 31-45 kg, 46-70 kg, 71-100 kg, and 100+ kg. Values obtained using mA limits were compared to those not using mA limits.

RESULTS

The ATCM noise curve without mA limits resulted in excessive noise (insufficient dose) for smaller patient diameters and lower-than-necessary noise (excessive dose) for larger patient diameters (Fig. 1). MAD for noise and SSDE not using mA limits were 1.88 HU and 1.57 mGy, respectively. Values obtained using mA limits were 0.32 HU and 0.30 mGy, respectively. Use of mA limits decreased MAD for noise and SSDE by 83% and 81%, respectively.

CONCLUSION

Predicted CT image noise and SSDE can be closely matched to target noise and SSDE curves over a specified size range by adjusting the SD and minimum and maximum mA settings using a mathematical optimization model. Without setting minimum and maximum mA limits according to the model, the ATCM algorithm tends to use insufficient dose for smaller patients and excessive dose for larger patients.

CLINICAL RELEVANCE/APPLICATION

Using the model, ATCM parameters can achieve target noise and SSDE over a range of patient sizes, enabling reliable image quality and dose based on imprecise patient size estimates such as weight.

SSC13-05 • Towards Accurate Monte Carlo Simulations of Tube Current Modulation CT Dosimetry: Model Validation and Technical Considerations

Kyle McMillan (Presenter) * ;  Maryam Khatonabadi * ;  Christopher H Cagnon PhD ;  John J Demarco PhD ;  Michael F McNitt-Gray PhD *

PURPOSE

The purpose of this study is to establish the appropriate level of detail needed within Monte Carlo models to accurately simulate dose from tube current modulation (TCM) CT scans of patients.

METHOD AND MATERIALS

A Monte Carlo model was developed in MCNPX for use in CT dose quantification. In order to validate the suitability of this model to accurately simulate patient dose from a TCM scan, a two-part validation scheme was devised. In the first phase, relatively simple geometries requiring varying levels of x-, y- and z-modulation were investigated, including a cylindrical CTDI phantom, an elliptical body phantom and a rectangular water equivalent phantom. In the next phase, a more complex anthropomorphic phantom was investigated. Each phantom was scanned in a Siemens Sensation 64 scanner under the conditions of fixed tube current (FTC) and TCM. Dose measurements were made at various surface and depth positions within each phantom. Simulations using each phantom were performed for FTC, full x-y-z TCM and z-axis (along patient length) only TCM, and dose was tallied at the same locations where measurements were obtained.

RESULTS

For simple geometries, the average absolute difference between the FTC measurements and simulations was 4.6%. The difference between TCM measurements and FTC, and full TCM and z-axis only simulations was 4.1% and 9.7%, respectively. Dose differences in the water equivalent phantom, whose rectangular shape contains considerably more x-y modulation than the other phantoms, were as high as 37.2% when z-axis only TCM was simulated. For the water equivalent phantom, the difference between TCM measurements and full TCM and z-axis only TCM simulations was 4.1% and 9.7%, respectively. Dose differences in the water equivalent phantom, whose rectangular shape contains considerably more x-y modulation than the other phantoms, were as high as 37.2% when z-axis only TCM was simulated. For the water equivalent phantom, the difference between TCM measurements and full TCM and z-axis only TCM simulations was 1.2% and 8.9%, respectively. For FTC measurements and simulations, the difference was 1.6%.

CONCLUSION

This work exhibited good agreement between measured and simulated values under both simple and complex geometries including an anthropomorphic phantom. This work also showed the increased dose differences for z-axis only TCM simulations, which demonstrates the importance of using full TCM data for Monte Carlo simulations.

CLINICAL RELEVANCE/APPLICATION

Results from this investigation highlight details that need to be included in Monte Carlo simulations of TCM CT scans in order to yield accurate, clinically viable assessments of patient dosimetry.

SSC13-06 • Monte Carlo Patient Dosimetry for Computed Tomography Examinations with Automatic Tube Current Modulation Using Precalculated Organ Dose Databases

Daniel J Long PhD (Presenter) ;  Elliott J Stepusin BS ;  Lindsay Sinclair PhD ;  Wesley E Bolch PhD

PURPOSE

The demand for accurate, easily-accessible patient dosimetry for computed tomography examinations has been on the rise in recent years. Programs utilizing precalculated organ dose databases such as CT Dosimetry and CT Expo have seen widespread use for their ease-of-use; however, they fail to inherently account for modern examinations which use automatic tube current modulation (ATCM). This work seeks to develop a methodology by which to account for ATCM in patient dosimetry within the framework of a precalculated organ dose database program.

METHOD AND MATERIALS

Organ dose measurements using OSL detectors were made at Shands Hospital at the University of Florida on three female cadavers of varying BMI (17.4, 35.2, and 43.9) for four standardized CT protocols (CAP, chest, abdomen, and pelvis) utilizing ATCM. Voxel phantoms were then created for each cadaver by segmenting anatomy from the CAP exam image sets, and slice-by-slice organ dose databases were created for each through the use of a Monte Carlo model of a Toshiba Aquilion ONE CT scanner. In addition to doses, average photon attenuation was calculated for each slice of anatomy in the databases, which was then used to create weighting factors by which the doses for each slice in the desired exam range were scaled. By using the reported average effective mAs delivered for each exam, simulated in-field organ doses for each cadaver were calculated and compared to those experimentally measured.
RESULTS
Simulated and measured in-field average organ doses for each cadaver and CT exam type were compared by percent difference calculations using the measured doses as the accepted standard. Average magnitudes of percent differences over all exam types were 10.6 ± 2.5%, 9.2 ± 0.4%, and 11.5 ± 2.7% for the cadavers of BMI 17.4, 35.2, and 43.9, respectively.

CONCLUSION
This work establishes the feasibility of a methodology by which to account for automatic tube current modulation in Toshiba patient CT examination dosimetry within the bounds of a precalculated organ dose database program. This study lays the foundation for additional work to create a more robust methodology spanning various CT makes and models.

CLINICAL RELEVANCE/APPLICATION
The tools and methodology outlined in this work are a step closer to providing accurate and clinically-feasible patient organ doses in computed tomography exams with automatic tube current modulation.

SSC13-07 • Realistic Dose Distribution in Helical Abdominal/Pelvis Scans - Fixed mA vs. Z-directional and Angular mA Modulation
Da Zhang PhD (Presenter) ; Xinhua Li PhD ; Wendi Cai PhD ; Bob Liu PhD

CONCLUSION
Direct dose measurements inside the Abd/Pelvis region of an anthropomorphic phantom provided realistic dose distributions, and demonstrated the significant difference between scans with fixed mA and with mA modulation.

Background
Helical CT scans with automatic tube current modulation are widely utilized clinically. However, in the regions where the preset maximum mA is reached, the scan is conducted with constant mA. Due to the complex nature of scanning motion, mA modulation, and patient shape and composition, the dose distribution inside the scanned volume is not well understood. We want to investigate and compare the dose distribution under a scan with fixed mA and a scan with both z-directional and angular mA modulation.

Evaluation
We sampled the doses experimentally inside an anthropomorphic phantom (CIRS 701 ATOM) by embedding an array of optically stimulated luminescence dosimeters in it. We scanned the abdominal/pelvis region of the phantom at a GE LS 16 Pro scanner, using the routine protocol for our institution for this region (at 120 kVp, 0.5s rotation time, 16x1.25 mm beam collimation, and pitch of 1.375). The first scan employed Auto-mA and Smart-mA with a noise index of 15 and the widest available mA range, and the second scan was with a fixed 170 mA. For each scan, we acquired 16 readings along the central z-axis of the phantom, 13 readings along the peripheral z-axis near the anterior surface, and 22 readings on each of the two selected axial planes where many radio-sensitive organs are located.

Discussion
With both fixed mA and mA modulation, large fluctuations were observed on the peripheral doses along the z-direction, which was attributed to the ripple effect resulting from x-ray attenuation and beam divergence. With fixed mA, the central doses of all sizes showed small fluctuation around about 63% of the reported CTDIvol. The central dose changed significantly when Auto-mA is used for compensating the change of cross-sectional shape and size of the subject. The doses on the same axial plane in both scans ranged from 70% to 160% of the reported CTDIvol's, and were asymmetrically distributed.

SSC13-08 • Evaluating the Complex Relationship of Automated Tube Current Modulation, Noise Index, Image Noise and Phantom Size
Xiujiang J Rong PhD (Presenter) ; Eric P Tamm MD ; Vesna Gershan PhD ; Dianna D Cody PhD * ; Xinning Liu PhD ; Erik K Paulson MD ; Vikas Kundra MD, PhD *

PURPOSE
To determine the influence of phantom size on automated tube current modulation (ATCM) performance.

METHOD AND MATERIALS
Four tissue equivalent abdominal CT dose phantoms (CIRS 007TE) were scanned using a GE HD750 scanner. To simulate an extra-large size patient, a 5th phantom was created by wrapping a fat-ring around the Large Adult phantom. Abdominal CT protocol: 120kVp, 0.8s rotation time, 40mm beam width, 0.984 pitch, 2.5 mm image thickness and Large Scan Field-of-View. With Auto-mA and Smart-mA enabled, Noise Index (NI) was varied resulting in various levels of image quality. Images were reconstructed using Standard algorithm. For each phantom size/NI combination, ROI (n=3/image) and noise measurements (standard deviation of ROI) in 10 consecutive images of the central portion of the phantom were performed. The relationship of average noise versus NI was plotted for each phantom size.

RESULTS
For each phantom size, noise increased linearly as NI value increased (R² = 0.9898-0.9996). However, the slopes (ranged 0.47-1.26) differed among phantom of different sizes. Using a constant NI value, and hence the same scan protocol, noise levels decreased with phantom size. For the 15 year old to medium phantom sizes (circumference of 71, 86, and 96cm), the differences in noise index were smaller compared to the small-medium-size phantoms, and also quite different from each other, resulting in three distinct sets of lines on the noise vs NI plot. Accordingly, for large and extra-large phantoms at a given NI, image noise is less than anticipated. Counter intuitively, this suggests that for large and very large phantoms, a higher NI could be used for maintaining adequate image quality while achieving lower radiation dose.

CONCLUSION
ATCM was limited in obtaining the same noise across phantoms of different size when using the same NI. Utilization of ATCM requires NI value be optimized based on patient size for optimal performance.

CLINICAL RELEVANCE/APPLICATION
Using a fixed NI across the entire range of patient sizes will likely result in great variability in image noise. Choice of an appropriate NI therefore must take into account patient size.

SSC13-09 • Dose to Radiosensitive Organs during Routine Chest CT: Effects of Standard and Organ-based Tube Current Modulation
Federica Zanca PhD (Presenter) ; Xochitl Lopez-Rendon MSc ; Walter Coudyzer ; Raymond H Oyen MD, PhD

PURPOSE
To quantify the effect of standard and organ-based tube current modulation (TDM) on dose to radiosensitive organs (breasts, lungs, heart, thyroid gland) and on image quality in adult female patients of various sizes undergoing chest CT examinations.

METHOD AND MATERIALS
Four (underweight, normal, overweight and obese BMI index) female cadavers (45) were scanned using a GE LS 16 Pro scanner, using the routine protocol for this region (at 120 kVp, 0.8s rotation time, 40mm beam width, 0.984 pitch, 2.5 mm image thickness and Large Scan Field-of-View). We scoured the abdominal/pelvis region of the phantom at a GE LS 16 Pro scanner, using the routine protocol for our institution for this region (at 120 kVp, 0.5s rotation time, 16x1.25 mm beam collimation, and pitch of 1.375). The first scan employed Auto-mA and Smart-mA with a noise index of 15 and the widest available mA range, and the second scan was with a fixed 170 mA. For each scan, we acquired 16 readings along the central z-axis of the phantom, 13 readings along the peripheral z-axis near the anterior surface, and 22 readings on each of the two selected axial planes where many radio-sensitive organs are located.

RESULTS
For each phantom size, noise increased linearly as NI value increased (R² = 0.9898-0.9996). However, the slopes (ranged 0.47-1.26) differed among phantom of different sizes. Using a constant NI value, and hence the same scan protocol, noise levels decreased with phantom size. For the 15 year old to medium phantom sizes (circumference of 71, 86, and 96cm), the differences in noise index were smaller compared to the small-medium-size phantoms, and also quite different from each other, resulting in three distinct sets of lines on the noise vs NI plot. Accordingly, for large and extra-large phantoms at a given NI, image noise is less than anticipated. Counter intuitively, this suggests that for large and very large phantoms, a higher NI could be used for maintaining adequate image quality while achieving lower radiation dose.

CONCLUSION
Auto-mA and Smart-mA with a noise index of 15 and the widest available mA range, and the second scan was with a fixed 170 mA. For each scan, we acquired 16 readings along the central z-axis of the phantom, 13 readings along the peripheral z-axis near the anterior surface, and 22 readings on each of the two selected axial planes where many radio-sensitive organs are located.

Discussion
With both fixed mA and mA modulation, large fluctuations were observed on the peripheral doses along the z-direction, which was attributed to the ripple effect resulting from x-ray attenuation and beam divergence. With fixed mA, the central doses of all sizes showed small fluctuation around about 63% of the reported CTDIvol. The central dose changed significantly when Auto-mA is used for compensating the change of cross-sectional shape and size of the subject. The doses on the same axial plane in both scans ranged from 70% to 160% of the reported CTDIvol's, and were asymmetrically distributed.

CLINICAL RELEVANCE/APPLICATION
Using a fixed NI across the entire range of patient sizes will likely result in great variability in image noise. Choice of an appropriate NI therefore must take into account patient size.
SSC14-04 • Development of a Novel Multi-Atlas Method to Derive Pseudo CT from MR Image Independent of MR Sequences for PET/MR Application

June-Goo Lee PhD (Presenter); Bruce R Whiting PhD; Chan Hong Moon PhD; H. Michael Gach MD; Jin Hong Wang MD; Kyongtae T Bae MD, PhD *

PURPOSE
To develop a multi-atlas method for deriving pseudo CT (pCT) from MR images independent of MR sequences and to evaluate the compatibility of pCT images against the reference CT (rCT) images

METHOD AND MATERIALS
We retrieved head CT images from 20 patients and used them as CT atlases. Ten of these patients also had matching MR images of the head. The CT atlases were registered to each test MR image. The registration scheme was in two steps, initial alignment with affine transform and refinement with B-spline non-rigid transform. The registered atlases were sorted on basis of a Hessian analysis on MR and atlas images. After selecting the registered atlases showing more than 80% of maximum Hessian response score, the median based merging process was applied to derive pCT for each test MR image. For

SSC14-03 • Reduction of Susceptibility Artifacts in R2' Measurements Using Z-shimming Based Multi-echo Asymmetric Spin-Echo (Z-MASE) Sequence at High Fields

Xiaodong Zhang PhD (Presenter); Yuai Hua PhD; Hongtu Zhu PhD; Yasheng Chen PhD; Jue Zhang; Xiaoying Wang MD; Weili Lin PhD; Hongyu An DSc

PURPOSE
In this study, we proposed a rapid method, dubbed as Z-shimming based Multi-echo Asymmetric Spin-Echo (Z-MASE), to estimate and correct the ?B effects for an accurate estimation of R2'.

METHOD AND MATERIALS
In this method, three Z-shimming tables were applied sequentially prior to echo 1, 2 and 3 of a triple-echo ASE EPI sequence, respectively [1]. And the Z-shimming tables were only applied once for a specific 180° pulse offset t. Then a sinc function is usually assumed to characterize signal loss induced by [2]. Finally, an estimate of R2' was obtained without the effects of macroscopic field variation [3]. A small testing tube containing contrast agent was attached to a large phantom to induce ?B effect. In addition, ten normal volunteers were studied and written informed consent was obtained from all subjects. A multiple slice triple-echo ASE-EPI with Z-shimming gradients was utilized. The imaging parameters were as follows: TR=3s; TE1=43ms, TE2 = 61ms, TE3 = 79ms; Slice Thickness = 3mm, voxel size=3*3*3mm3; number of ASE offset time =23, Maximum ?TE = 26ms, 44ms, and 62ms; number of Z-Shimming gradients steps = 8, the maximum strength of Gz = 32pm/m, the Z-Shimming-related data scan time is 24s and the total scan time is 5min 6 sec.

RESULTS
In the Phantom studies, the signal loss in the ASE images has been fully recovered as demonstrated by the almost identical line profile between the spin echo and the corrected ASE. In the volunteer studies, absolute measurements of R2' from the ten volunteers were obtained. A R2' of 12.12±4.47Hz was obtained without the ?B correction for the frontal regions of the brain. In contrast, with the ?B correction, a R2' of 2.84±0.75Hz was obtained for the frontal regions of the brain.

CONCLUSION
Unlike the conventional z-shimming method, this method can reverse ?B effects without perfectly matching one of the Z-shimming gradients to ?B. Our approach can also be adapted as a rapid (24 sec) standalone ?B mapping method if ?B maps are needed for other DTI or fMRI studies.

REFERENCE

CLINICAL RELEVANCE/APPLICATION
The ability to simultaneous measurements of R2' and reduction of susceptibility artifacts may have the profound clinical application for studies of disordered brain oxygen metabolism.

SSC14-02 • MR-compatibility of Stents: Measuring RF Induced Heating and MR-artifact according to ASTM Standard F2182-11a and F2119-07

Felix V Guettler (Presenter); Andreas Heinrich; Ina Kaufhold; Florian Schliesies; Maximilian De Bucourt MD; Ulf K Teichgraeber MD

PURPOSE
Up to date MR-based in-stent lumen measurement is limited to a small number of systems and field-strength of 1.5 T. It does not allow accurate measures. According to ASTM RF-induced heating, depending on the antenna effect, is within acceptable ranges for the measured stent lengths.

Background
The background of this study is to measure radio frequency (RF) induced heating and artifact in MR-images at 1.5T and 3T for commonly used stents in angiography according to standardized test methods of ASTM. Furthermore the MRI-based measurability of the in-stent lumen was assessed.

Evaluation
Currently nine stents (IDev Supra 8x100mm, Cook Medical Zilver PTX 7x80mm, Gore Tigris 6x30mm, 6x40mm, 7x30mm, 7x100mm, TERUMO Misago 8x60mm, 8x80mm, 8x100mm, 8x120mm) were compared on a 1.5T and 3T MRI (Magnetom Avanto and Trio, Siemens, Erlangen, Germany). The signal loss was measured according to ASTM F2119 for a TSE (TR/TE 500/26ms) and Flash (TR/TE 100/15ms) sequence. The artifact border is defined as grey value shift if a pixel differs more than 30% of the reference value (solvent) to the next pixel. The visualization of in-stent lumen (inside-diameter) was determined the same way. The stents were placed parallel and antiparallel to the static magnetic field (B0). The largest external diameters and in-stent lumen were measured at five points. For safety aspects the RF induced heating was measured according to ASTM F2182 with a TrueFISP (TR/TE 3.04/1.52ms, scan time 15min).

Discussion
With none or very limited MR-artifacts MR-based stent-lumen measurement might become feasible for a broad spectrum of clinically used MR sequences. Compared to other MR-compatible implants or instruments made from NiTi-based alloys modern stent systems show potential for further improvement.

SSC14-01 • Accurate Quantitative DCE-MRI of Prostate at 3T Using High-order B1 Field Correction

Kyunghyun Sung PhD (Presenter); Daniel J Margolis MD *; Holden H Wu PhD; Yutaka Natsukita *; Steven S Raman MD

PURPOSE
In the quantitative analysis of dynamic contrast-enhanced MRI (DCE-MRI), a critical step is to convert dynamic MR signal into contrast agent concentration, based on knowledge of the pre-contrast T1 value. We demonstrate improved T1 measurements by using a novel B1 field correction method and show more accurate quantitative DCE-MRI analysis of prostate cancer at 3T.

METHOD AND MATERIALS
Variable flip angle (VFA) imaging is commonly used for T1 mapping but known to be highly sensitive to transmit B1 field variation. We have recently developed a novel method that can simultaneously measure T1 and B1 maps, reference region VFA (RR-VFA), assuming that the fat T1 value is well characterized, and the B1 variation at the prostate is sufficiently approximated by high-order polynomials. The RR-VFA method computes B1 maps using conventional VFA images without additional scanning. Experiments were performed on 3OT Siemens MRI systems in a total of 11 prostate cancer patients and one healthy volunteer. We used 4 flip angles (2°, 5°, 10°, and 15°) for VFA imaging and compared T1 maps with and without compensating for B1 variation. Quantitative DCE-MRI analysis was performed on OsiriX using our previously developed DCE-MRI plug-in.

RESULTS
In 11 subjects, the average T1 in the prostate was 1985.8 (± 363.8) ms without B1 correction and 1557.6 (± 110.3) ms with B1 correction. The uncorrected T1 values are overestimations of the prostate T1 and vary with different subjects and MRI systems, while the corrected T1 values are consistently in a good agreement with previous observations from the literature. Figure 1 shows a representative example of the overestimation of the prostate T1 without B1 correction. The average B1 variation in the prostate was 123%. Without B1 correction, the T1 overestimations can cause underestimations of contrast agent concentration result in a ktrans map that was unsuccessful in depicting the prostate cancer (see the arrows), while the ktrans map with B1 correction nicely depicts two cancer regions (see the arrows). Gleason scores are 3+3 (Region 1) and 3+4 (Region 2) based on the whole mount pathology.

CONCLUSION
We have demonstrated that B1 compensation using a novel RR-VFA technique can improve the accuracy of quantitative DCE-MRI analysis of prostate cancer at 3T.

CLINICAL RELEVANCE/APPLICATION
Quantitative DCE-MRI with B1 correction at 3T can improve detection and characterization of prostate cancer.

REFERENCES

ACCR       0.638 CCR  0.638 R  0.638
There is increasing need for using FA mapping for improving qMRI accuracy and for correcting B1 inhomogeneity artifacts. At the same time, because of no image deformation and less inconvenience compared to an endorectal coil. The endorectal coil is not recommended very soon after radiation therapy, is not feasible after rectum resection. The major goal of the study is to compare the performance of 3T endorectal coil 'receive' MR spectroscopic imaging (MRSI) of prostate with that using an external 'receive' body array coil.

BACKGROUND
A self-consistent FA mapping technique has been developed that is based on image processing only. It could be useful for increasing qMRI accuracy, streamlining MRI examinations, and improving image quality at ultrahigh field strengths. 1. Wade T, McKenzie CA, Rutt BK. Flip angle mapping with the accelerated 3D look-locker sequence. Magnetic Resonance in Medicine 2013.

CLINICAL RELEVANCE/APPLICATION
A method of characteristic response curves (CRC): An accelerated computational method for accurate quantitative magnetic resonance imaging. 2. We have developed a multi-atlas method to derive pCT images from MR images independent of MR sequences. The pCT images of the head were in good agreement with the real CT images.

RESULTS
pCT images were successfully generated from all test MR images at different MR sequences. The mean of the ratio of correction values of pCT and rCT was close to 1 and standard deviation was small (mean, std.): (0.993±0.012, 0.062±0.016) for 10 FLAIR MRI; (0.999±0.010, 0.054±0.014) for 6 MPRAGE MRI; (0.991±0.045, 0.046±0.009) for 6 T1 MRI; and (0.987±0.012, 0.053±0.013) for 8 T2 MRI.

CONCLUSION
We have developed a multi-atlas method to derive pCT images from MR images independent of MR sequences. The pCT images of the head were in good agreement with the real CT images.

CLINICAL RELEVANCE/APPLICATION
A method of characteristic response curves (CRC): An accelerated computational method for accurate quantitative magnetic resonance imaging.

REFERENCES
1. We used images of the head (1.5T Achieva, Philips Healthcare) with the mixed turbo spin echo sequence, which begins with an inversion pulse. The DA images are recorded as a function of varying FA for every pixel, the actual FA will correspond to the minimum pixel value difference between the synthesized minus the true DA image.

2. Several FA mapping techniques have been described in the literature (1): these involve a separate scan. We hypothesize that FA can be mapped as an application of multi-spectral Synthetic MRI without needing a separate scan. Because Synthetic-MRI allows for the generation of images of arbitrary content.

3. Hernan Jara PhD (Presenter) *; Stephan W Anderson MD; Jorge A Soto MD *; Osamu Sakai MD, PhD *; Robert E Reiter MD, PhD; Hajime Sakuma MD *; Mio Uno MD; Yoshitaka Goto MD

METHOD AND MATERIALS
Twenty patients (mean age 63.1yo) with prostate cancer (PCas) who underwent endorectal MRI imaging and proton MR spectroscopic imaging were included in this study in 3T MRI. After the endorectal scan, patients were scanned with the external body array coil for the comparison study. MRSI parameters of endorectal and external body array were as follows: TR 750ms, TE 145ms, acquisition bandwidth 1250 Hz, 6 averages, and 512 spectral data points with the voxel resolution of 0.3ml. For the external body array, the voxel resolution was 0.35ml.

RESULTS
Peak areas for Ch, Cr, and Cit were calculated by using numeric integration. Metabolic maps of (Ch + Cr)/Cit were generated. Voxels were considered suitable if they contained at least 75% detectable voxels. Both endorectal coil and external body array metabolites ratios were significantly higher in cancer locations compared to non-cancer locations. Also the coefficient of variance was higher in external body array than the endorectal coil due to larger size of the coil and increased distance from the prostate. The sensitivity and accuracy of endorectal coil is higher than (82% and 79%) the external body array (70% and 75%).

CONCLUSION
These preliminary findings confirmed that the use of endorectal coil significantly improves spectral line width and coefficient of variance of metabolite ratios when compared with external body array.

CLINICAL RELEVANCE/APPLICATION
In patients with rectal diseases or patients who could not tolerate the discomfort with insertion of an endorectal surface coil, use of the phased array coil may be recommended.
CONCLUSION
A twofold accelerated T1 qMRI processing algorithm based on the CRC method was developed and tested with a large imaging dataset. The methodology is very general and can be used for the computation of other qMRI parameters. CRC could be instrumental for incorporating computationally intensive qMRI algorithms into clinical practice.

Background
Relaxometry is often performed with intricate qMRI pulse sequences, which can lead to complicated magnetization dynamics. In some cases the magnetization dynamics is such that the Bloch equations may not have closed-form analytical solutions, and consequently the resulting qMRI relaxometry algorithms may be solvable only by iterative numerical methods, which can be very slow. For multislice high spatial resolution applications this can lead to long computational times, which may be clinically impractical. The purpose of this work was to develop a faster qMRI processing algorithm methodology whereby the most time consuming operation is performed only once for generating the Characteristic Response Curve (CRC) of the qMRI pulse sequence and this CRC model is then used as the common solution applicable by interpolation to all pixels in the imaging dataset.

Evaluation
The CRC method is very general and in principle applicable to any Bloch equation solution, nevertheless we describe here its application to T1 relaxometry with the mixed turbo spin echo (mixed-TSE) pulse sequence. A computer program was developed in MathCad (PTC, Needham, MA) and applied to MR images obtained with the mixed turbo spin echo pulse sequence using a 1.5T MR scanner (Intera, Philips Healthcare, Cleveland, Ohio). The head scan of a research subject: 80 slices, 256x256 matrix, and voxel size 0.9375x0.9375x3mm^

Discussion
T1 maps generated with the exact pixel by pixel and the CRC algorithms are shown in Fig. 1 below. Both maps are visually indistinguishable. The processing times of the standard and CRC algorithms for all 80 slices were 86s and 43s, respectively. The accuracy of the CRC algorithm relative to the standard algorithm is compared in Fig. 2 in terms of whole brain histograms revealing the same overall bimodal shape with minor differences.

SSC14-09 • A Controllable and Stable Denoising Filter for Magnetic Resonance Imaging
Xin Zhou PhD (Presenter); Yanli Song; Miaofei Han; Qiang Li PhD *

CONCLUSION
The TWE is an excellent method to control the noise reduction levels in NLM filter.

Background
Non-local means (NLM) filter is considered as one of state-of-the-art denoising methods. A big issue in NLM is that it is nearly impossible to automatically set its parameters for removing noise to a specific level, as the denoising level of NLM depends heavily on multiple parameters. We embedded a total-weight equalization technique in NLM filter (TWE-NLM) to adaptively control the denoising level by use of a single parameter of total weight. With this technique, we can automatically reduce noise standard deviation of the output image to any specific level of that of input noisy image.

Evaluation
A total of 146 magnetic resonance (MR) scans in 12 major body parts were obtained from a 1.5T MR scanner with various imaging sequences. For each body part, 4 representative images were selected for objective and subjective evaluation of image quality in the study. Standard NLM was used as a baseline method for comparison with TWE-NLM. Three denoising levels of sharp, medium, and smooth (roughly corresponding to percent noise reduction of 33%, 50%, and 66%, respectively) were specified by a radiologist. In TWE-NLM, the only adjustable parameter of total weight was automatically determined to be 1.5, 2.0, and 3.0 for the denoising levels. For standard NLM, multiple parameters were manually adjusted by a physicist with a trial-and-error method in order to achieve the denoising levels. Statistical analysis results show that the consistency and robustness of denoising levels achieved in TWE-NLM was markedly higher than that of NLM with manual parameter selection. A blinded subjective evaluation with more radiologists from multiple hospitals will be conducted in the coming months.

Discussion
A key issue in denoising is the easy selection of parameters and the robustness of selected parameters. We embedded a TWE approach into NLM to automatically control the denoising level through a single parameter. In addition to its simplicity for parameter selection, the TWE method also achieved a higher uniformity in noise reduction inside an images and a higher consistency across different images.
SSC15-04 • Rate of 18FDG-PET Parameter Decline Early During Radiotherapy Predicts Clinical Outcomes in Locally-advanced Non-small Cell Lung Cancer (LA-NSCLC)

Victor Mangona MD (Presenter); Larry J. Estin MD; Dan Ionascu PhD; Ovidiu Marina; Bor-Tau Hung; Mackenzie C McGee MD; Ching-Yee O Wong MD; Di Yan; Inga Grills MD

Purpose
To determine on-treatment (OT) 18FDG PET-CT parameters predictive of clinical outcomes for response-based adaptive radiotherapy (RT).

METHOD AND MATERIALS
16 consecutive patients from 2009-11 with node+ cstage IIIA (n=9) and IIIB (n=7) NSCLC received 1.5 Gy BID RT with concurrent chemotherapy on a prospective phase II/II protocol. RT dose was 60-72 Gy (N=12) (54 Gy if neoadjuvant, n=4) using IMRT with daily onlyne CBCT. 4D dual-phase PET-CTs were obtained at 50% and 90% of the total dose. Actual and fibulabase max dimension (cm), 3D volumetric product (BDP, cm^2), SUVmean, SUVmax, PET volume (vol), and total glycolytic activity (TGA=SUVMAX x PETvol) were assessed. Rate of change was estimated with slope of linear regression. All PET vols were measured with the PET edge tool (MIM softwareTM) = 25 times (average reported) attempting coverage of 50% SUVmax. Clinical outcome groupings were compared with the Mann-Whitney U test (medians listed) and Cox proportional hazards.

CLINICAL RELEVANCE/APPLICATION
Early PET response parameters during RT, particularly total glycolytic activity (TGA), predict long-term clinical outcomes. Such parameters may facilitate a treatment response-based dose modification.

SSC15-05 • SUVmax and GLUT-1 Expression Correlate with Treatment Failure in Stage I Lung Adenocarcinoma

Todd Aguilera MD, PhD (Presenter) ; Maximilian Diehn MD, PhD * ; David Shultz MD, PhD ; Nicholas Trakul MD, PhD ; Viswam S Nair MD ; Robert West MD, PhD ; Billy W Lou MD, PhD *

Purpose
Stage I non-small cell lung cancer (NSCLC) can be treated with surgery or stereotactic ablative radiotherapy (SABR) and predictors of treatment failure may enable selection of patients for adjuvant treatment. Glycolytic metabolism, as assessed by SUVmax in 18F-Fluorodeoxyglucose PET, glucose transporter type I (GLUT-1) or SLCA2 expression may correlate with outcome. In Stage I NSCLC patients, we set out to explore if SUVmax, GLUT-1 expression and/or SLCA2 expression correlate with outcomes in Stage I NSCLC patients treated with SABR or surgery.

METHOD AND MATERIALS
To determine disease-free survival (DFS) We examined the records of 100 adenocarcinoma (AC) and 78 squamous cell carcinoma (SCC) Stage I NSCLC patients treated at Stanford. Thirty-five AC and 16 SCC tumors received SABR and 65 AC and 62 SCC received surgery. SUVmax was determined for SABR patients, and GLUT-1 and SLCA2 expression was evaluated in surgical patients. Lasty, we examined the association of SLCA2 expression with outcomes in 778 NSCLC surgically treated patients.

RESULTS
Among radiotherapy patients, 11 AC and 3 SCC, failed treatment locally, regionally or distantly. The median SUVmax for AC of 7.8 (range 1.4-31.8) was significantly associated with 5-year DFS (HR=1.12, 95% CP 1.01-1.24) while the median SUVmax for SCC of 14.3 (range 3.1-25.4) did not associate with 5-year DFS (HR=1.06, 95% CI 0.87-1.29). In surgical patients GLUT-1 was high in 23% and 62%, intermediate in 37% and 24%, and low in 4% and 5% in AC and SCC patients respectively. There were 10 AC and 15 SCC failures and GLUT-1 staining significantly associated with 5-year DFS for AC (HR=2.39, CI 1.25-4.66) but not for SCC patients (HR=0.74, CI 0.39-1.91). SLCA2 expression in 778 NSCLC patients profiled using DNA microarrays confirmed association of SLCA2 expression with outcome in AC and non-SCC patients (HR=1.12, CI 1.01-1.24) but not for SCC patients (HR=1.07, CI 0.84-1.37).

CONCLUSION
SUVmax in SABR patients, and SLCA2 expression in surgical patients strongly associate with outcomes in stage I lung AC but not SCC. Therefore, SUVmax and/or SLCA2 expression may be useful biomarkers for identifying stage I AC patients at highest risk for disease recurrence.

CLINICAL RELEVANCE/APPLICATION
In the assessment of curable early stage lung cancer risk stratification based on imaging characteristics can guide clinical management. FDG-PET will play an important role in this assessment.

SSC15-06 • Comparison of Auto-segmented PET Volumes in Lung Tumors with CT Based Manual Contours: Implications in Radiotherapy Planning

Madhava Kanakamedala MD (Presenter); Shankar P Giri MD; William N Duggar; Srinivasan Vijayakumar MD

ABSTRACT
Purpose/Objectives:
The aim of this study was to compare GTV volume data manually on CT scans with GTV delineation on FDG PET scans utilizing an automatic threshold (SUV 3) and gradient-based (PET Edge) auto-segmentation methods in lung radiating radiation planning.

Materials/Methods:
Nineteen patients with lung carcinoma treated with radiation therapy, whose PET scans were done within 30 days of simulation CT were enrolled. FDG-PET/CT planning and CT CTs were transferred to the Mim software (MIM Vista Corp,Cleveland,OH) and fused using a deformable registration algorithm. For each patient, three GTVs were defined. GTV for CT was manually contoured on CT scans using lung window for lesions well within the lung parenchyma and a mediastinal window when it was adjacent to mediastinum or chest wall. For PET SUV3, a circle of interest was created with a margin around the lesion, excluding blood pool-heart) and auto segmented with SUV value of 3. The GTV-PET Edge was auto segmented using a PET Edge tool centered on the hyper metabolic area. Statistical Methods: Spearman correlation coefficients were computed to view relationships between variables, and sign tests were used for inference.

RESULTS:
Among 19 patients 3 were small cell, 16 were non-small cell carcinomas (9 squamous cell and 6 adenocarcinoma). As per the AJCC 7th Ed, 7- they had 3 stage 1, 5 stage II and 11 stage IIIA. Only two patients had histological tumor and atelectasis. Median CT volume for all lesions was 18.96 (range 0.82-630.9), PET Edge median 8.9 (range 0.74-507.610), SUVs 3 median 26.93 (058-723.15). Correlation between CT and SUV 3, SUV 3 and PET edge, CT and PET edge were 0.9474, 0.9526 and 0.9211 respectively. No significant differences between CT and SUV 3 volumes (p=0.043). On average PET edge volumes were 10.66 cc less than the CT volumes.

Conclusions:
CT overestimates GTV volume in lung tumors with no additional or negative marginal requirements to create CTV (Chan et al). Surgical pathologic studies determined CTV volumes of 6mm for SCC and 8mm for ADC, beyond gross pathological tumor. In phantom studies auto segmentation using PET edge tool was shown to be superior to other methods and better correlated with pathology. In our study on CT and IIIA, only two patients had the GTV based on PET edge was consistently smaller. PET SUV 3 is valuable when contouring a GTV using PET/CT fusion as it could include tumor and microscopic extensions. The use of PET edge tool needs to be studied clinically to assess if the smaller volume may be useful in small low risk tumors suitable for SBRT.

Surgical pathological studies with larger number of patients are required to further confirm the CTV margins based on the GTV volumes generated on CT and PET auto segmented tools.

SSC15-07 • Investigate 4D CT Images in Defining Contours Using QUASUR Programmable Respiratory Motion Simulation Platform and Lung Phantom

Changsheng Ma MS (Presenter)

Purpose
To analyze 4D CT images in defining contours of lung phantom using Programmable Respiratory Motion Platform.

METHOD AND MATERIALS
Acquiring 4D CT images of the respiratory motion lung phantom using varian Real-time Position Management (PRM) system. The lung portion from the Computerized Imaging Reference Systems (CIRS) phantom (Computerized Imaging Reference Systems, Inc., Norfolk, VA), was scanned using a CT scanner (Phillips Big core CT) to obtain a CT HU-density table as for baseline dose calculation and stability comparison The Quality Assurance System for Advanced
RESULTS

 Compared to the actual movement, lung density phantom geometry center displacement for X axis is 1mm, 2mm for Y axis and 1mm for Z axis in 4D CT reconstruction image.

CONCLUSION

4D CT of PRM system in ascertaining the respiratory motion images is accurate, easy to use, and fast. It allows for clean imaging and treatment of lung sites which affected by the respiratory motion.

CLINICAL RELEVANCE/APPLICATION

No

SSC15-08 • Radiation-induced Fibrosis after Lung Stereotactic Body Radiation Therapy (SBRT) Is Correlated with Radiation Treatment Parameters: A Timeline of Computed Tomography (CT) Changes

Mary M Salvatore MD (Presenter); Miriam Knoll MD; Ren-Dih Sheu PhD; Sarah L. Kerns PhD, MPH; Abraham Knoll MD; Yeh-Chi Lo PhD; Kenneth E Rosenzweig MD *

PURPOSE

Patients treated with stereotactic body radiation therapy (SBRT) for lung cancer are followed by computed tomography (CT) and most patients are found to have evidence of radiation-induced fibrosis (RIF) surrounding the treated tumor. There is no consensus regarding the size and anatomic pattern of RIF and we investigated whether treatment isodose levels could predict RIF.

METHOD AND MATERIALS

We selected 37 lung lesions in 32 patients who were treated with SBRT and had received post-treatment follow up CTs (FU-CT). Each FU-CT was fused with the patient's original simulation CT, and treatment isodose levels were overlaid onto the CT. The RIF surrounding the treated lesion was contoured. The fibrosis extension index (FEI) was defined as the volume of RIF extending outside a given isodose level relative to the total volume of RIF on FU-CT and was expressed as a percentage.

RESULTS

32 patients underwent SBRT to the planned target volume (PTV) to a total dose of 45-54 Gy in 3-5 fractions. The 1st, 2nd, and 3rd FU-CT were at a median of 6 (n=36), 10 (n=26), and 16.8 (n=6) months. The mean RIF volume at 1st, 2nd, and 3rd FU-CT was 69, 47, and 42 cc. Univariate analysis using Pearson's correlation revealed that the PTV was positively correlated with RIF volume (correlation coefficient [CC]=0.628 and p < 0.001 at 1st FU; CC=0.401 and p=0.021 at 2nd FU; CC=0.265 and p=0.306 at 3rd FU). FEI40 Gy at 1st FU was significantly positively correlated with FEI40 Gy at subsequent FU's (CC=0.689 and p=0.01 and 2nd FU; 0.901 and p=0.020 comparing 2nd and 3rd FU). A similar trend was seen for FEI20 Gy, FEI30 Gy and FEI35 Gy, where 1st FU positively correlated with 2nd FU and 2nd FU positively correlated with 3rd FU. 96% and 94% of the RIF was found within the 20 Gy isodose line at the 1st and 2nd FU, respectively. 65% of patients were found to have a decrease in RIF at 2nd FU.

CONCLUSION

We have shown that radiation-induced fibrosis evolves over time and 1st FU-CT correlates well with subsequent CTs. 96% of the RIF can be found to occur within the 20 Gy isodose line, which may prove beneficial to radiologists attempting to distinguish recurrence vs. RIF.

CLINICAL RELEVANCE/APPLICATION

Communication of treatment isodose information to radiologists may improve the accuracy of reporting CTs after SBRT, and may aid with distinguishing recurrence vs. RIF.

SSC15-09 • Application of Bone Suppression Technique to Real-time Tracking Radiotherapy

Rie Tanaka PhD (Presenter); Shigeru Sanada PhD *; Makoto Oda; Mitsutaka Suzuki; Keita Sakuta RT; Hiroki Kawashima MS

PURPOSE

A recently developed image processing methodology, the bone suppression technique, can suppress the conspicuity of bones on chest radiographs, creating sort of soft-tissue images obtained by the dual-energy subtraction technique. This study was performed to evaluate the usefulness of bone suppression fluoroscopy in real-time tracking radiation therapy.

METHOD AND MATERIALS

Dynamic chest radiographs of 9 patients with lung nodules during respiration were obtained using a flat panel detector (FPD) system (CXDI-50RF; Canon Inc.) (120 kV, 0.1 mAs/pulse, 5 fps, SID = 1.0 m). Commercial bone suppression image-processing software (SofView version 2.0; Riverain Medical) was applied to the dynamic chest radiographs to create corresponding bone suppression images. Region of interest (ROI) of the treated lung lesion was contoured automatically and automatic target tracking was conducted with in-house software based on template matching technique (MATLAB ver. 2012b; MathWorks). The size of the ROI and its search area were determined to achieve the greatest accuracy. To evaluate the accuracy of target tracking, the maximum tracking error in bone suppression and conventional fluoroscopic images was measured. The average maximum tracking errors in bone suppression and conventional fluoroscopic images were 1.3 ± 1.0 mm and 3.3 ± 3.3 mm, respectively. The bone suppression technique was especially effective in the lower lung area where pulmonary vessels, bronchi, and ribs showed complex movements (Fig. 1). In contrast, there was no significant improvement in a patient with severe interstitial pattern that resulted in a faint shadow of ribs on the original images.

RESULTS

The accuracy of target tracking was significantly improved in 8 of 9 cases. For better accuracy, the ROIs and search area were set to a larger size than for conventional images. The average maximum tracking errors in bone suppression and conventional fluoroscopic images were 1.3 ± 1.0 mm and 3.3 ± 3.3 mm, respectively. The bone suppression technique was especially effective in the lower lung area where pulmonary vessels, bronchi, and ribs showed complex movements (Fig. 1). In contrast, there was no significant improvement in a patient with severe interstitial pattern that resulted in a faint shadow of ribs on the original images.

CONCLUSION

The bone suppression technique improves tracking accuracy without special equipment and additional patient dose in real-time tracking radiation therapy. Our results indicated its usefulness especially in the lower lung area with complex movements of lung structures and ribs.

CLINICAL RELEVANCE/APPLICATION

Bone suppression fluoroscopy is a useful new technique for respiratory displacement of the target. Automatic target tracking can be conducted without rib shadows.

Vascular/Interventional (Chemoembolization)

Monday, 10:30 AM - 12:00 PM • E351

SSC16 • AMA PRA Category 1 Credit ™ • ARRT Category A+ Credit:1.5

Moderator

S. William Stavropoulos, MD *
Moderator

Kenneth J Kolbeck, MD, PhD

SSC16-01 • Influence of Hepatic Artery Embolization on Tumor Growth and Metastatic Potential in a Rat Orthotopic Hepatoma Model

Guang Zhi Wang PhD, MD (Presenter); Zhu Ting Fang; Wei Zhang; Jianhua Wang

PURPOSE

To examine if transarterial embolization (TAE) enhance the metastatic potential of the residual HCC, and investigate the mechanisms underlying the effects of embolization with a rat model of orthotopic hepatocellular carcinoma.

METHOD AND MATERIALS

All protocols were approved by the animal research committee of Fudan University and met NIH guidelines. In vitro study, the hepatoma cell line McA-RH7777 marked by GFP (Green Fluorescent Protein) were cultured under hypoxic and normoxic conditions. Forty male buffalo rats were implanted with McA-RH7777 tumor in the left lateral lobe of liver. After laparotomy and retrograde placement of catheter into the gastroduodenal artery (14 days after implantation), TAE used with Lipiodol and 0.2 ml/kg were performed. Tumor volumes were measured before (on day 14) and after (on day 28) treatment with magnetic resonance imaging (MRI). Tumor growth and lung metastases were further observed using fluorescence imaging and the macroscopic characteristics were correlated with histological findings. The migration and invasion of HCC was observed by invasion assays in vitro. The molecular changes of hypoxia-inducible factor (HIF)-17, VEGF, E-cadherin, N-cadherin, and vimentin in residual tumor cells were evaluated by western blot, PCR, or immunohistochemistry in vitro and in vivo.
Carcinoma

**SSC16-05 • Advanced Stage Hepatocellular Carcinoma (HCC): Retrospective Study at Three German Liver Centers**

**SSC16-03 • Treatment of N1-S1 Hepatocellular Mouse Model**

**Clinical Relevance/Application**

Metastases are present. However, further prospective or randomized studies are necessary. The combined treatment of Sorafenib and TACE seems to be a promising treatment option in patients with HCC in BCLC stage C, especially if extrahepatic infiltration, extrahepatic metastases, time-to-progression and overall survival were evaluated. For patients of group A adverse events were also documented.

**Conclusion**

Bimodal embolic treatment of hepatocellular cancer is more effective than embolic Rx alone. Further study of these propriety agents is warranted because agents target enzymes specific to cancer. Optimization of drug form, dose and route administration (IV, oral) are needed. Safety studies must be completed before human use.

**Clinical Relevance/Application**

Clinical relevance is enormous. Agents should be effective against all cancers with little effect on normal tissues. Mode of delivery can be arterial, intravenous and/or oral. Challenge is funding.

**SSC16-02 • Bimodal Treatment of Aerobic and Glycolytic Metabolism by Particle Embolization Combined with Anti-glycolytic Compound Improves Treatment of N1-S1 Hepatocellular Mouse Model**

**John R Haaga MD (Presenter); Hanping Wu MD, PhD**

**Purpose**

To determine if combination treatment of aerobic metabolism by embolization and antiglycolytic drugs compared to embolization alone provides better treatment of N1-S1 hepatocellular carcinoma in a rat model.

**Method and Materials**

Two separate laparotomies were performed, one for subcapsular tumor implant and the second for retrograde placement of catheter into the gastroduodenal artery for 5 different treatments. Treatments were: 1) Control (n=5, 1 ml NS); 2) TAE (n=4, 10 mg 50-150μm PVA particle in 1ml NS), 3) TAE+AG-B (n=5, 10mg PVA in 1ml AG-B); 4) TAE+AG-F (n=5, 10mg PVA+30mg AG-F in 1ml NS); 5) TAE+AG-C (n=5, 10mg PVA+30mg AG-C in 1ml normal saline). Tumor length (L), width (W), and height (H) was measured by 2D-ultrasound before treatment and twice a week till 4 weeks after treatment. Tumor volume (V) was calculated by the formula: \( V = \frac{4}{3} \pi LW^2 \). Relative tumor volume after treatment was calculated as the percentage of pre-treatment tumor volume. Kruskal-Wallis test was used to compare the difference of relative tumor volume between 5 groups on each observation time point.

**Results**

The initial tumor sizes in each group were statistically not significantly different. Three animals in the control group were euthanized before the end of observation due to rapid tumor growth and anorexia. In TAE group, one kept growing after treatment. In other 3 animals, the tumor volume increased in the early observation time points (1 within 1 week, 2 within 2 weeks) and then shrank. In other 3 TAE+AG+ groups, the tumor volumes decreased after treatment with significant differences between control group and 3 TAE+AG groups on all observation time points except TAE+F group from 3.5 days and 4 weeks. At 4 weeks after treatment, the median relative tumor volumes were 3.174±0.5% in control group, 58.2% in TAE group, 9.6% in TAE+AG-B group, 23.8% in TAE+AG-F group, and 13.4% in TAE+AG-C group.

**Conclusion**

Bimodal embolic treatment of hepatocellular cancer is more effective than embolic Rx alone. Further study of these propriety agents is warranted because agents target enzymes specific to cancer. Optimization of drug form, dose and route administration (IV, oral) are needed. Safety studies must be completed before human use.

**Clinical Relevance/Application**

Clinical relevance is enormous. Agents should be effective against all cancers with little effect on normal tissues. Mode of delivery can be arterial, intravenous and/or oral. Challenge is funding.

**SSC16-03 • Effects on Apoptosis in Rabbit Hepatic VX2 Carcinoma after Transcatheter Arterial Chemoembolization Using Alginate Microspheres-Adriamycin (ADM): Experimental Study**

**Kaiyuan Xu (Presenter)**

**Purpose**

To evaluate effects on the apoptosis of transcatheter arterial chemoembolization (TACE) with alginate microsphere-ADM in experimentally induced liver tumor.

**Method and Materials**

Thirty New Zealand White rabbits were randomly divided into five groups and VX2 carcinoma was grown in the left lobes of the livers. TACE was performed with normal saline (Group A), alginate microsphere (Group B), alginate microsphere-adriamycin (Group C), Lipiodol (Group D), and Lipiodol-adriamycin (Group E). Three weeks later, the animals were killed and apoptotic index were calculated on the basis of findings. Effects on intrahepatic and distal metastasis in all groups were examined.

**Results**

Apoptine microspheres can potentially serve as embolizing agents and drug delivery vehicles for local slow-release. With embolization and chemotherapy effect on VX2 liver tumor, the recurrence rate and metastasis was reduced after treatment, the median relative tumor volumes were 3.174.5% in control group, 58.2% in TAE group, 9.6% in TAE+AG-B group, 23.8% in TAE+AG-F group, and 13.4% in TAE+AG-C group.

**Conclusion**

Apoptine microspheres can potentially serve as embolizing agents and drug delivery vehicles for local slow-release. With embolization and chemotherapy effect on VX2 liver tumor, the recurrence rate and metastasis was reduced after treatment, the median relative tumor volumes were 3.174.5% in control group, 58.2% in TAE group, 9.6% in TAE+AG-B group, 23.8% in TAE+AG-F group, and 13.4% in TAE+AG-C group.

**Clinical Relevance/Application**

Microembolization with alginate microsphere-ADM is an effective antitumor treatment of hepatic carcinoma.

**SSC16-04 • Evaluation of a Combined Protocol of Sorafenib and Transarterial Chemoembolization (TACE) vs. TACE vs. Sorafenib Protocol Alone in Advanced Stage Hepatocellular Carcinoma (HCC): Retrospective Study at Three German Liver Centers**

**Thomas J Vogl MD, PhD (Presenter); Jorg Trojan MD; Markus Goller; Mark Op Den Winkel; Eckart Schott; Martin W Welker; Stefan Zhangos MD; Wolf-Otto Bechstein; Stefan Zeuzem MD; Frank T Kolligs MD**

**Purpose**

To compare combined Sorafenib and transarterial chemoembolization (TACE) for treatment of patients with advanced hepatocellular carcinoma (HCC) according to the Barcelona Clinic Liver Cancer (BCLC) stage C.

**Method and Materials**

In this retrospective multicenter cohort study 185 patients with BCLC stage C who were treated with Sorafenib and TACE (group A, n=50), with TACE alone (group B, n=59) or with Sorafenib alone (group C, n=76) were retrospectively analyzed for comparison from January 2002 to 2010. Portal vein infiltration, extrahepatic metastases, time-to-progression and overall survival were evaluated. For patients of group A adverse events were also documented.

**Results**

Portal vein infiltration was documented in 32% of patients in group A, 36% in group B, and 37% in group C. Extrahepatic metastases were present in 60% (group A), 34% (group B), and 49% (group C). Median time-to-progression was 6.3 months in group A (95%-confidence interval (CI): 4.3-8.3) 5.4 months in group B (95%-CI: 3.5-7.3) and 3.5 months in group C (95%-CI: 3.1-3.9). Median overall survival was 17.0 months in group A (95%-CI: 13.5-20.5), 11.0 months in group B (95%-CI: 8.1-13.9) and 9.0 months in group C (95%-CI: 7.0-11.0). The most common adverse events in the combined treatment of Sorafenib and TACE were diarrhea (34%), hand-foot-skin-reactions (40%) and fatigue (36%). Due to adverse events the Sorafenib dose was reduced in 86% of patients in group A and stopped in 6%. The Mann-Whitney U-test or \( \chi^2 \) was used for statistical comparisons.

**Conclusion**

The combined treatment of Sorafenib and TACE seems to be a promising treatment option in patients with HCC in BCLC stage C, especially if extrahepatic metastases are present. However, further prospective or randomized studies are necessary.

**Clinical Relevance/Application**

The combined therapy of Sorafenib and TACE is a relevant therapy option for patients in advanced stages of HCC.

**SSC16-05 • Quantitative Measurement of the Hepatic Blood Flow before and after Transcatheter Arterial Chemoembolization of Hepatocellular Carcinoma**

**Yi-Yang Lin MD (Presenter); Rheun-Chuan Lee MD; Hsiu-Shan Tseng; Chien An Liu MD; Wan-Yuo Guo MD, PhD *; Cheng-Yen Chang MD**

**Evaluation of a Combined Protocol of Sorafenib and Transarterial Chemoembolization (TACE) vs. TACE vs. Sorafenib Protocol Alone in Advanced Stage Hepatocellular Carcinoma (HCC): Retrospective Study at Three German Liver Centers**

**Wolf-Otto Bechstein**

**Jorg Trojan**

**Markus Goller**

**Mark Op Den Winkel**

**Eckart Schott**

**Martin W Welker**

**Stefan Zhangos**

**Wolf-Otto Bechstein**

**Stefan Zeuzem**

**Frank T Kolligs**

**Evaluation of a Combined Protocol of Sorafenib and Transarterial Chemoembolization (TACE) vs. TACE vs. Sorafenib Protocol Alone in Advanced Stage Hepatocellular Carcinoma (HCC): Retrospective Study at Three German Liver Centers**

**Thomas J Vogl MD, PhD (Presenter); Jorg Trojan MD; Markus Goller; Mark Op Den Winkel; Eckart Schott; Martin W Welker; Stefan Zhangos MD; Wolf-Otto Bechstein; Stefan Zeuzem MD; Frank T Kolligs MD**

**Purpose**

To compare combined Sorafenib and transarterial chemoembolization (TACE) for treatment of patients with advanced hepatocellular carcinoma (HCC) according to the Barcelona Clinic Liver Cancer (BCLC) stage C.
**RESULTS**

The median follow-up time was 26.4 months (range, 1-46.1 months). 37 nodules in 33 patients showed local recurrence, 1- and 2-year cumulative local recurrence rates were 61.9% and 81%, 9.3% and 20.2% for nodules with defect (n=21) and for nodules without defect (n=75), respectively (p=0.000). Among the 73 nodules without defect, 1- and 2-year cumulative local recurrence rates were 11.1% and 22.2%, 7.7% and 17.9% and for nodules with complete safety margin (n=36) and for nodules with incomplete safety margin (n=39), respectively (p=0.901). In multivariate analyses using Cox proportional hazard model, lipiodol uptake homogeneity (HR = 0.266; 95% CI: 0.11, 0.65; P < .05), lipiodol uptake defect (HR =3.76; 95% CI: 1.53, 9.27; P < .05) remained significant in local recurrence.

**CONCLUSION**

In case of complete lipiodol uptake in the tumor, safety margin did not affect local recurrence rate in C-arm CT assisted chemoembolization for HCC.

**CLINICAL RELEVANCE/APPLICATION**

In case of complete lipiodol uptake in the tumor, additional effort to ensure complete safety margin as in RF ablation is not justified in superselective chemoembolization for small nodular HCC.

**Succ16-07 • Volumetric Tumor Assessment Predicts Survival in Patients Treated with Transarterial Chemoembolization for Hepatocellular Carcinoma**

**Purpose**

Tumor response in patients with hepatocellular(HCC) treated by transarterial chemoembolization(TACE) can be measured quantitatively using 3D volumetric European Association for the Study of the Liver(qEASL) and volumetric Response Evaluation Criteria in Solid Tumor (vRECIST). The purpose of this study was to demonstrate that qEASL and vRECIST can be used to predict patient survival.

**Method and Materials**

Tumor response using pre- and post-TACE MRI was assessed on 84 consecutive patients treated with a first session of TACE for HCC. The entire tumor volume was used for vRECIST and the enhancing portion of the tumor volume for qEASL analysis. Targeted tumor response (TTR) and overall tumor response (OR) revealed two distinctive groups of patients: responder (R) and non-responder (NR). For TTR using vRECIST, R was defined as patients with a decrease in sum of target tumors (TT) volumes beyond 30%. For TTR using qEASL analysis, R was defined as patients with a decrease, beyond 50%, of the sum of TT qEASL volume. qEASL and vRECIST OR were determined based on TTR, non-TTR and on potential new lesion on post-TACE MRI. Survival difference between R and NR for TTR and OR as defined by vRECIST and qEASL were explored by Kaplan Meier survival analysis.

**Results**

131 TT, 32 non-NT and 9 new lesions were evaluated from 84 HCC patients. Mean tumor volume and mean enhancing volume decreased from 235±475 cm³ and 206±414 cm³ to 120±250 cm³ and 97±215 cm³, respectively. Using vRECIST, both TTR and OR showed n=8(10%) R with a mean survival time of 45±18 months, and n=76(90%) NR with a mean survival time of 27±3 months. There was no statistical survival difference between R and NR for vRECIST TTR and OR (p=0.177). According to qEASL analysis, both TTR and OR showed n=30(36%) R and n=54(64%) NR. Mean survival times based on qEASL TTR was 42±4 months for R and 23±3 months for NR and on qEASL OR was 42±8 months for R and 23±3 months for NR. qEASL TTR and OR analysis showed that survival times between R and NR were statistically different with p=0.014 and p=0.018, respectively.

**Conclusion**

The 3D tumor enhancement assessment, qEASL can be used to assess target tumor response and overall tumor response and can predict survival in HCC patients after the first TACE session.

**Succ16-08 • Assessing Viable Tissue within Hepatocellular Carcinoma (HCC) Lesions after Locoregional Therapy: A Comparison between Modified RECIST (mRECIST) and Volumetric Quantification**

**Purpose**

mRECIST is used to assess HCC response to locoregional therapy. We compared the accuracy of mRECIST to volumetric tissue quantification in HCC after locoregional therapy.

**Method and Materials**

This HIPAA compliant retrospective study was IRB approved. Twenty-four HCCs were evaluated in 24 patients by triphasic MDCT scans performed before and three months after 90Y-radioembolization. The percentage of change in viable tissue within the tumor, defined as enhancing areas on arterial phase, was quantified based on mRECIST and volumetrically using segmentation software. Results were compared using the paired t-test, Bland-Altman plots and concordance correlation coefficient. The agreement between the methods in the assessment of treatment response was examined by kappa (κ) statistics.

**Results**

A significant difference in percentage of residual viable tissue was observed between the two methods (P=0.008). There was wide difference in measurements between the methods with a bias of 49.0% (95%CI: -96.9% to 194.9%). Correlation between mRECIST and volumetric measurement was poor, p=0.54. Poor agreement was demonstrated between the two techniques when assessing response based on percentage of change in viable tissue (κ = 0.34, 95% CI: 0.148-0.543).

**Conclusion**

There is poor agreement between mRECIST and volumetric quantification when assessing response to locoregional therapy in HCC.
SCC16-09 • Estimation of the Prognosis of Hepatocellular Carcinoma Treated with Hepatic Arterial Chemoembolization: Comparison of Nine Prognostic Staging Systems

Yasutaka Baba MD (Presenter) ; Sadao Hayashi MD ; Shunichiro Ikeda BS ; Masayuki Nakajo PhD

PURPOSE
To examine various prognostic staging systems estimating the prognosis of patients with hepatocellular carcinoma (HCC) treated with hepatic arterial chemoembolization (HACE).

METHOD AND MATERIALS
The subjects were 1040 patients (Male:714 , Female:326 ) with the mean age of 67.5 (range, 17 – 93 years) treated with HACE for HCC from January 1990 to December 2009. HACE was principally done selectively using anticancer drugs mixing with iodized-oil and gelatin sponge. Factors determining survival were analyzed by univariate and multivariate analyses using the Kaplan-Meier method and Cox proportional hazard regression models. Nine prognostic staging systems (Child Pugh classification[CPC], UICC TNM, Japanese Integrated Staging score [JIS], Okuda score [Okuda], Cancer of the Liver Italian Program [CLIP], Barcelona Clinic Liver Cancer [Barcelona], Japanese TNM [JTNM], Japanese Liver Damage[JLD], Tokyo score[Tokyo]) were compared about the discriminatory capacity, which was tested by the linear trend. Moreover, the likelihood ratio test was used to investigate the additional homogeneity of survival within scores.

RESULTS
The mean survival period was 33 months. In a multivariate analysis, tumor number (>=4), tumor diameter(>=3cm), vascular invasion (+), ascites (+), albumin( < 3.5 g/dL) was a significant bad factor. CLIP was the most informative prognostic staging system for estimating the long term survival of patients with HCC treated with HACE.

CLINICAL RELEVANCE/APPLICATION
Among 9 prognostic staging systems, CLIP may be the most important prognostic system for estimating the prognosis of patients with HCC treated with HACE.
carcinoma (HCC) include hepatic arterial hepatic infusion chemotherapy (HAIC), trans arterial chemoembolization (TACE), and radioembolization. The high concentration of the active compounds delivered via hepatic artery is able to increase response rates when compared with the same therapy used intravenously.

For CRLM, HAIC is used as an induction therapy in patients with unresectable liver metastases, with the goal of high morphologic response in order to render patient surgical candidate. Interventional radiology can place percutaneously the indwelling catheters/ports to permit HIAC with a technical success rate close to 100%, and equivalent or superior patency when compared to surgically implanted catheters [1]. 49 patients with unresectable CRLM (>5 CRLM in >9% of patients, bilobar disease in 98%, >6 segments involved in 86%) received HAIC with FUDR and doxorubicin, plus systemic chemotherapy with oxaplatin and irinotecan allows a 92% response rate with 47% of the patients able to undergo resection with a median survival of 50.8 and 35 months for naive and previously treated patients, respectively [2]. HAIC with oxaplatinum combined with cetuximab in first-line results in overall response rate was 90% (95%-CI, 70-99) and disease control rate was 100% (95%-CI, 94-100) with 48% of patients were downstaged enough to undergo R0 resection and/or radiofrequency ablation. [3].

TACE is the standard of care for intermediate stage HCC and is used in neuroendocrine liver metastases (NELM). Recent technical improvement in TACE includes recent advances in delivery platform and imaging guidance. Drug eluting beads have been demonstrated in a experimental models to increase concentration of drug in tumor [4], and have a potential benefit over drug alone. The ideal size of beads and the ideal agent to load on beads are still under investigation. It is noteworthy that the survival reported for HCC and NELM patient treated with TACE is improved in recent publication, probably as a consequence of this technical improvement and better patient selection. Further randomised trials are needed to evaluate the real potential of intra-arterial therapies to patient survival and to define what is the best technique of HAIC or TACE.

REFERENCES

SSC17-05 • Colorectal Liver Metastases: Role of the Radiologist in the Multidisciplinary Team
Valerie Vilgrain, MD (Presenter); Mohamed Abdel-Rehim, MD; Maxime Ronot, MD; Magaly Zappa, MD; Annie Sibert, MD
Abstract France Presents
There are various treatments for liver metastases from primary colorectal cancer including surgical resection, non surgical ablative treatments, and chemotherapies. Yet, surgical resection with peripheorical chemotherapy has been shown to be the best treatment option for cure in these patients. Therefore the role of the Radiologist in the Multidisciplinary Team is key and can be splitted in four topics: 1) diagnosis of liver lesions as liver metastases, 2) extrhepatic staging including nodal metastases, peritoneal implants, regional or local recurrent or residual disease, and pulmonary metastases, 3) intrahepatic staging which aims to define number and extent of liver metastases in the segmental and lobar distribution in order to evaluate surgical resectability or feasibility of non surgical ablative treatments, 4) and eventually response to chemotherapy with or without targeted therapy. Multimodal imaging is needed to answer all these questions. The most important imaging modalities are CT, MR imaging and PET. Multidetector CT is particularly helpful for whole body investigation and anatomic information for surgical planning. MR imaging is better than CT for lesion detection and lesion characterization in the liver in particular with diffusion-weighted images and sequences using liver-specific agents. Pertherapeutic and intraoperative contrast-enhanced ultrasound may complete the work-up.

SSC17-06 • Closing Remarks
Richard L Baron, MD (Presenter); Jean-Pierre Pruvo, MD, PhD (Presenter); Nicolas Grenier, MD (Presenter)

PET-MRI in Alzheimer Disease
Monday, 12:15 PM - 12:45 PM • S503AB

CL-MIE-MOSA
Hemant T Patel, MD
Ankur Shah, MD
Megha Sanhvi, MD
Manas Mayank, MD
Laxmi V Bhobe, DMRD
Jay V Shah, MBBS
PURPOSE/AIM
The purpose of this exhibit is:
1. To review limitations of CT and MRI in detection of Alzheimer disease
2. To outline the advantages and limitations of PET-MRI
3. To demonstrate various appearances of PET MRI in Alzheimer disease and its impact on management

CONTENT ORGANIZATION
• Classification of dementia and etiopathogenesis of Alzheimer disease
• Corelation of PET imaging with structural images of MRI for evaluation of functional changes in presenile and advanced cases of Alzheimer disease
• Discuss PET MRI findings in Alzheimer disease: Sample cases and images
• Overlapping appearances and limitations of PET-MRI
• Future directions and summary: Role of PET MRI in diagnosis of other causes of dementia

SUMMARY
The major teaching points of this exhibit are:
1. PET MRI is an excellent tool for imaging work up of dementia with Alzheimer disease in particular which requires functional metabolic evaluation
2. This exhibit will help for recognition of Alzheimer disease in its early form which eventually helps for better management

Molecular Imaging - Monday Posters and Exhibits (12:15pm - 12:45pm)
Monday, 12:15 PM - 12:45 PM • S503AB

CL-MIE-MOA • AMA PRA Category 1 Credit ™:0.5
Host Vikas Kundra, MD, PhD *

CL-MIS-MOA1 • CT Imaging Biomarker for Evaluation of Emodin as a Potential Drugs on LPS-induced Osteoporosis Mice
Han Ah Lee (Presenter); Kwon-Ha Yoon MD, PhD; Dong Min Kang MD; Ju-Young N Kim; Jae Min Oh; Myung Soo Lee; Seong Tae Jung; Seon Yaran Juhng; Young Hwan Lee MD
PURPOSE
This study was designed to identify CT imaging biomarker for evaluation of the effect of emodin as a potential drugs to treat osteoporosis on lipopolysaccharide (LPS)-mediated bone resorption mice model

METHOD AND MATERIALS
We examined TRAP staining, or alkaline phosphatase (ALP) and Alizarin Red staining to analyze the role of emodin on osteoblasts or osteoclasts differentiation in vitro. Twenty male DBA/1j mice were induced bone osteoporosis by intraperitoneal injection of LPS (5 mg/kg) on days 1 and 4. Of the twenty mice, ten were administered emodin (50 mg/kg) 1 day prior to LPS injection and every other day for 8 days. Five were administered emodin only, and other five mice were injected saline as a control group. After 8 days, the mice were sacrificed, and micro-CT images were obtained in the proximal femur. The images were analyzed using a software to calculate the bone parameters such as BV/TV(%) and trabecular number as CT imaging biomarkers. Histomorphometric analysis was performed using hematoxylin and eosin and TRAP immunohistochemistry methods.

RESULTS
In vitro results, emodin inhibited RANKL-induced osteoclast differentiation in bone marrow macrophages and bone resorbing activity of mature osteoclasts. Emodin also increased osteoblastic differentiation marker, ALP and Alizarin Red-mineralization activity on osteoblasts. Mice treated with emodin demonstrated marked suppressive effect of lipopolysaccharide-induced bone resorption (BV/TV: 29.7% vs 39.5%, Tb.Sp: 0.283 μm vs 0.227 μm, Tb.Th 0.098 μm vs 0.099 μm, Tb. N: 2.673 vs 3.314). On TRAP immunohistologic analysis of femurs, the number of osteoclasts per field of tissue were revealed as 43 vs 25. The imaging biomarker of BV/TV(%) and trabecular number were well correlated to histomorphometric analysis

CONCLUSION
This findings reveal a novel effect of emodin in bone remodeling in LPS-induced mice model. CT imaging biomarkers can offer as a promising tool for assessment of therapeutic effect of a potential drugs in osteoporosis.
CL-MIS-MOA • Assessment of 11C-Acetate PET for Response Monitoring of Indirect Modulators of Fatty Acid Synthase in Prostate Cancer

Pedram Heidari MD (Presenter) ; Umar Mahmood MD, PhD ; Giorgia Zadra PhD ; Massimo Loda MD

PURPOSE
It has been previously shown that the uptake of 11C-acetate in PET strongly correlates with the expression of fatty acid synthase (FASN) in the native prostate cancer (PCA) tumor models and following treatment with direct FASN inhibitors such as C75. We performed a study to evaluate the utility of 11C-acetate PET for monitoring of the response to therapy in indirect FASN modulators specifically AMPK activators.

METHOD AND MATERIALS
In this study we imaged nu/nu mice bearing subcutaneous LNCaP tumors using 11C-acetate PET at baseline and following treatment with vehicle, MT 63-78 (30 mg/kg), AICAR (400 mg/kg) and C75 (30 mg/kg), at 24h and 1h before follow-up imaging. MT 63-78 and AICAR are AMPK activator and C75 is FASN inhibitor. We performed western blotting for measuring FASN expression on cells following treatment with vehicle, MT 63-78, and AICAR. Moreover we measured 14C incorporation in lipids and 14C-CO2 release from cells following incubation with 14C-acetate and treatment with vehicle, MT 63-78 and AICAR.

RESULTS
We observed that the mean SUVmean of tumors in 11C-acetate PET minimally changed following treatment with vehicle and MT 63-78, increased 16% with AICAR and decreased 20% with C75 treatment. Western blots showed a pronounced decrease in FASN expression in MT 63-78 and to a smaller extent in AICAR. There was a significant decrease in 14C incorporation in cell lipids following treatment with MT 63-78 while there was a significant increase in 14C-CO2 release from cells with MT 63-78 and to a higher extent with AICAR treatment.

CONCLUSION
Acetate is used as a substrate precursor during FA and cholesterol synthesis in cancer cells with increased lipogenesis (e.g. PCa) but can also be metabolized through the tricarboxylic acid (TCA) cycle. These results suggest that AMPK activation (with MT 63-78 and AICAR) not only causes the inhibition of FASN, but also increases catalytic activity of enzymes of TCA cycle and mitochondrial biogenesis, which compensates/overcompensates for the reduction in 11C-acetate uptake observed with the FASN inhibitors such as C75. Thus, 11C-acetate may not be an adequate marker for monitoring the response to therapy with indirect inhibitors of FASN such as AMPK activators in PCa.

CLINICAL RELEVANCE/APPLICATION
This study helps clarify when 11C-acetate PET imaging is useful for monitoring response of prostate cancer to new targeted therapeutics that modulate FASN directly or indirectly.

CL-MIS-MOA • Decision Modelling in the Identification of Potential Clinical Applications for Prognostic Imaging Biomarkers in Oncology: Methods and Preliminary Results

Kenneth Miles (Presenter) * ; Thida Win ; Balaji Ganeshan PhD * ; Ashley M Groves MBBS *

PURPOSE
To describe a decision modeling approach for the identification of potential clinical applications for prognostic imaging biomarkers in oncology.

METHOD AND MATERIALS
An approach that uses decision modeling to identify potential applications for prognostic imaging biomarkers was defined. The approach requires cross-validated data indicating the hazard ratio and proportion of high risk patients identified by the imaging biomarker along with the 95% confidence intervals (CI). The biomarker also needs to be prognostic independent of tumor stage and other potential imaging biomarkers. Decision modeling is then used to assess potential health outcomes and costs from proposed biomarker deployments with Monte Carlo analysis quantifying the likelihood of realizing beneficial outcomes. The approach was used to assess potential applications of CT texture analysis (CTTA) for the personalization of chemotherapy for patients with advanced non-small cell lung cancer.

RESULTS
The cross-validated mortality hazard ratio (95% confidence interval) for CTTA was 1.99 (1.14 – 3.44) with 52.5% (95% CI: 43.2 – 61.7%) categorized as high risk. Decision modeling identified CTTA-based strategies with high, intermediate and low likelihoods of clinical benefit and/or cost-effectiveness. Two strategies that used CTTA to identify sub-sets of patients with EGFR-negative tumors for 2-agent platinum based chemotherapy increased the survival benefit of this treatment to 5.3 months (95% CI:3.3 -7.3 months ) and were most likely to be cost-effective (Net monetary benefit $540; 95% CI: $369-702 and $762; 95% CI: $351-1154 respectively).

CONCLUSION
Decision modeling can be useful in the identification of potential clinical applications for prognostic imaging biomarkers in oncology.

CLINICAL RELEVANCE/APPLICATION
Methods that aid the identification of clinical applications for prognostic imaging biomarkers will promote their translation to personalized medicine.

Nuclear Medicine - Monday Posters and Exhibits (12:15pm - 12:45pm)

Monday, 12:15 PM - 12:45 PM • SS03AB

CL-NMS-MOA • AMA PRA Category 1 Credit ™:0.5
Host
Amir H Khandani, MD

CL-NME-MOA1A • Three-dimensional Reformatted PET/CT for Assessing Therapy Response in Lung Cancer

Seoung-Oh Yang MD, PhD (Presenter) ; Hong Je Lee MD ; Sang Ho Lee

PURPOSE/AIM
Three-dimensional (3-D) displays for medical imaging are now emerging field and very promising tools for diagnosis, therapeutic response monitoring and detection of tumor recurrence. Morphological criteria for defining therapy response (CR, PR, SD, PD) have been established with RECIST (Response evaluation criteria in solid tumors). Furthermore, 3-D imaging taken from PET/CT can be an excellent approach to assess the tumor response after appropriate therapy. In this educational presentation, we will discuss the TrueD application of F-18-FDG PET/CT for both initial staging and post-therapeutic follow-up in patients with lung cancers.

CONTENT ORGANIZATION
Over five hundred lung cancer patients with more than two PET/CT images enrolled in this study. A. Methods of producing 3-D PET/CT images using TrueD software with appropriate palettes. B. Among many galleries, the most optimal palette will be recommended according to various metastatic lesions. C. Monitoring of tumor response to therapy was assessed using these 3-D PET/CT images.

SUMMARY
The development of three- and four-dimensional image processing will lead medical imaging to full definition volumetric display for clinician as well as patients themselves. VOIs (volume of interests) of 2 or 3 time points display can be saved and exported as a comprehensive images through the PACS systems.

CL-NMS-MOA2 • Scintigraphic Assessments of Reparative Process in Osteonecrosis of the Femoral Head Using Bone SPECT/CT Fused Imaging

Goro Motomura (Presenter) ; Takuaki Yamamoto MD, PhD ; Koichiro Abe MD ; Yasuhiro Nakashima ; Masanobu Ohishi ; Satoshi Hamai ; Hiroshi Honda MD ; Yukihide Iwamoto

PURPOSE
The purpose of this study was to assess the fused imaging of SPECT/CT with 99mTc-HMDP in early-stage osteonecrosis of the femoral head for the better understanding of the reparative process of the disease.

METHOD AND MATERIALS
We retrospectively evaluated the SPECT/CT imaging, which were performed after femoral osteotomy to confirm the viability of the proximal bone fragment. Consecutively 22 hips with untreated osteonecrosis of the femoral head contralateral to the osteotomied hips were the subjects of this study. Patients included 16 males and seven females with a mean age of 40.4 years. According to the classification system, 12 hips were classified as stage1 (defined as no radiographic abnormality), six hips were stage2 (demarcating sclerosis is seen without femoral head collapse), and five hips were stage3A (less than 3mm femoral head collapse). All SPECT/CT images were processed on a workstation and analyzed by a single experienced nuclear medicine physicians, who was
blind to all patients’ information including staging. The lesion which shows the highest uptake count within the femoral head on SPECT/CT imaging was recorded. The degree of uptake in each case was assessed by the count ratio, which was defined as the highest count within the femoral head divided by the average uptake count of ipsilateral femur at the level of the distal end of lesser trochanter.

RESULTS
In stage-1 hips, the highest uptake count tended to be seen at the anterior region of the femoral head (11 of 12 hips). Meanwhile, in both stage-2 and 3A hips, the highest uptake count was located at the lateral region of the femoral head (five of six hips and all five hips, respectively). The count ratios of stage-2 and 3A were significantly higher than those of stage-1. Based on the analysis of Spearman rank correlation coefficient, a count ratio was positively correlated with progression of the ONFH stages.

CONCLUSION
The current study indicated that, during the time before collapse, there may be a gradual increase in osteoblastic activity around the necrotic lesion, shifting the main lesion from anterior to laterally. SPECT/CT imaging will be helpful for the better understanding of the repair mechanisms as well as the pathophysiology of ONFH.

CLINICAL RELEVANCE/APPLICATION
SPECT/CT clearly demonstrated the osteoblastic activity in the early stages of osteonecrosis of the femoral head.

CL-NMS-MOA3 • The Role of 99mTc-MDP Bone Scintigraphy in the Workup of Patients with Hepatocellular Carcinoma
Khun Visith Keu MD,FRCP(C) (Presenter) ; Glen Lutchman ; Andrew Quon MD ; Erik S Mittra MD, PhD ; Andrei Iagaru MD *

PURPOSE
Bone scintigraphy (BS) is part of the standard of care staging workup of patients with hepatocellular carcinoma (HCC) considered for liver transplantation. The UCSF criteria for liver transplantation are less stringent than the Milan criteria and the value of BS has not been tested in this setting. Therefore, we retrospectively analyzed the value of BS in patients evaluated under UCSF criteria, a group with potentially higher risk for bone metastases.

METHOD AND MATERIALS
We retrospectively reviewed all HCC patients evaluated for liver transplantation who had BS at our institution from January 2008 to April 2012. Patients without BS or who had BS within 3 months of routine clinical workup were excluded. BS results were catalogued as malignant, indeterminate or benign based on the original image interpretation. Findings were correlated with other imaging procedures (including subsequent BS), biopsies and/or clinical follow-up. The cohort was then divided into 3 groups: Milan +, Milan-/UCSF + and UCSF -.

RESULTS
A total of 785 patients were evaluated for liver transplantation. 592 patients did not have a BS and 31 did not have a scan performed within 3 months from the initial workup. Of the remaining 162 patients (71 male; 91 female) there was an average age of 58.9 years old (+7.2) and all but 5 had positive BS. The majority of patients (92%, N=149) had negative BS, but 8 (4.9%) had indeterminate and 5 (3.1%) had positive BS for metastases. In the Milan + group (N = 103), there were 98 negative BS, 4 indeterminate BS and 1 positive BS. The Milan -/UCSF + group (N=22) had 18 negative BS, 2 indeterminate BS and 2 positive BS. Lastly, the UCSF - group (N = 37) had 33 negative BS, 2 indeterminate BS and 2 positive BS. On follow-up, only 2 patients were diagnosed with bone metastasis.

CONCLUSION
Abnormal BS findings (indeterminate and positive cases) were more frequent in the Milan +/UCSF + group than the Milan + or UCSF - groups. However, true positive bone metastases were rare. The impact of BS in the workup of HCC patients considered for liver transplantation should be re- evaluated from a healthcare cost analysis perspective.

CLINICAL RELEVANCE/APPLICATION
Bone metastasis are rare in HCC patients considered for liver transplantation: a bone scintigraphy should not be performed routinely.

CL-NMS-MOA4 • Tc99m Labeled WBC SPECT/CT is Not Inferior to MRI for Diagnosis of Biopsy Proven Diabetic Foot Osteomyelitis
Francisco J Lazaga MD (Presenter) ; Kavita Bhavan MD ; Kenrick Lam BS ; Lawrence Lavery DPM ; Javier La Fontaine DPM ; Orhan K Oz MD, PhD ; William A Erdman MD

PURPOSE
MRI is the recommended diagnostic imaging test for diabetic foot osteomyelitis (DFD) with a reported 79% accuracy (Dinh et al., 2008). The accepted standard for diagnosing osteomyelitis in the clinical infectious diseases literature is the presence of abnormal bone culture or histopathology findings from bone biopsy studies (Lipsky et al, 2012). Our purpose is to assess the accuracy of hybrid image Tc99m labeled WBC SPECT/CT for diagnosis of diabetic foot osteomyelitis as determined by bone biopsy results in comparison to MRI.

METHOD AND MATERIALS
We performed a retrospective chart review of 71 patients who underwent Tc99m labeled WBC SPECT/CT and bone biopsy between 2011 to 2013 to confirm the diagnosis of diabetic foot osteomyelitis. Twenty five of the 71 patients had MRI in addition to SPECT/CT. Patients whose scan(s) was not within a clinically relevant timeframe of biopsy, determined to be eight weeks, were excluded.

RESULTS
Forty three of 71 SPECT/CT patients met our inclusion criteria. The sensitivity, specificity, PPV, NPV and accuracy of SPECT/CT were 0.91, 0.25, 0.84, 0.4 and 0.6 respectively. In the group of patients with a positive biopsy result (N=26), the sensitivity, specificity, PPV, NPV and accuracy of SPECT/CT were 1.0, 0.24, 0.62, 0.77 and 0.73 respectively. In the group of patients with a negative biopsy result (N=45), the sensitivity, specificity, PPV, NPV and accuracy of SPECT/CT were 0.9, 0.26, 0.83, 0.53 and 0.67 respectively.

CONCLUSION
Our data suggests that SPECT/CT is not inferior to MRI in the diagnosis of diabetic foot osteomyelitis. Furthermore SPECT/CT results correlate well with the bone biopsy results.

CLINICAL RELEVANCE/APPLICATION
Currently MRI is the gold standard in the radiologic diagnosis of diabetic foot osteomyelitis. This study suggests that Tc99m labeled WBC SPECT/CT is a suitable substitute.

CL-NMS-MOA5 • Impact and Correction of Erroneous Lung Segmentation in PET/MR Using a Three-segment Model Attenuation Correction Based on a 3D Multi-station T1-weighted Spooled Gradient Echo Sequence
Christian Rubbert MD (Presenter) * ; Andres Kohan MD * ; Jose L Vercher-Conejero MD * ; Sasan Partovi BS * ; Peter F Faulhaber MD * ; Raymond Muzic PhD * ; Karin A Herrmann MD

PURPOSE
To assess the impact of erroneous lung segmentation in PET/MR on the quantification of FDG-avid lesions in the chest, and to propose methods to correct for these errors. Quantification depends on accurate MR attenuation correction (MRAC) maps, which, in turn, depend on correct segmentation of the MR image volume. Mis-segmentation may occur in the presence of metallic implants or artifically increased signal in the lungs.

METHOD AND MATERIALS
3D T1w spoiled gradient echo images are segmented to identify air, lung, and soft tissue. In the lung, region growing is seeded by histogram analysis and borders are extended to lung/soft tissue interfaces. Images from 100 patients enrolled in a PET/CT and sequential PET/MR double-scanning protocol were reviewed to identify cases in which large portions of the lungs were misidentified. Mis-segmentation was corrected by filling in metal voids in the T1w image volume, which caused 3D growing to fail, or by depressing spurious pixel values in the lungs. The modified T1w image volumes were segmented for MRAC. The SUVmax and SULmean of VOIs of corresponding chest lesions were recorded in PET/CT and PET/MR in both failed and corrected datasets. Bland-Altman analysis was performed to assess agreement between modalities.

RESULTS
PET/CT was acquired 70.9±12.1 min after FDG injection and PET/MR 31.5±22.1 min after PET/CT. Lung segmentation failed in 14 cases. Each correction method was applied in 6 cases, respectively. 2 could not be corrected. 40 lesions were identified within the chest in 7 subjects. Mean SULmax differences, PET/MR minus PET/CT, and (limits of agreements) for all lesions were 2.10 (-2.10 to 6.32) with failed segmentation and 0.88 (-0.50 to 2.27) with corrected segmentation. The corresponding values for the SUV mean were 0.72 (-0.62 to 2.05) and 0.19 (-0.46 to 0.84). The mean differences decreased and the limits of agreement were narrower with the corrected segmentation in all anatomical sub-regions.

CONCLUSION
The critical impact of mis-segmentation of the lungs is demonstrated by wide limits of agreement and mean SUV overestimation. Correction is feasible and resulted in improved mean differences and narrower limits of agreement in all cases.

CLINICAL RELEVANCE/APPLICATION
Failed lung segmentation in PET/MR affects and overestimates the SUV, which, in turn, may have critical impact on a patient’s therapy. Screening and correction of mis-segmentation is recommended.
CL-PDS-MO3A • Evaluation of Staging and Response to Chemotherapy with Whole-body Diffusion-weighted Magnetic Resonance Imaging in Malignant Lymphoma Patients: A Comparison with FDG-PET

Kazunobu Tsuji; Tatsuro Tsuchida MD, PhD; Shinji Kishi; Hidehiko Okazawa MD, PhD; Hirokiho Kimura MD, PhD (Presenter)

PURPOSE
The purpose of this study was to examine the utility of diffusion-weighted magnetic resonance imaging (DW-MRI) for staging and evaluation of response to chemotherapy in patients with malignant lymphoma in comparison to fluorodeoxyglucose positron emission tomography (FDG-PET).

METHOD AND MATERIALS
Participants comprised 28 patients with histologically confirmed malignant lymphoma (diffuse large B-cell lymphoma, n = 17; follicular lymphoma, n = 11). All patients underwent both magnetic resonance imaging and FDG-PET before (pre-treatment) and after 2 courses of chemotherapy (mid-treatment). Staging with MRI (DW-MRI only and with T2-weighted imaging) and FDG-PET were compared visually and the concordance rate (kappa value; ?) was calculated. To evaluate response to chemotherapy, patients were divided into 2 groups based on response evaluation criteria: complete remission (CR) or non-CR. Progression-free survival (PFS) and overall survival (OS) were compared between groups using the Kaplan-Meier method.

RESULTS
Stage diagnosed by DWI alone and with FDG-PET was concordant in 19 patients (? = 0.67, p < 0.05), and addition of T2-WI increased the number of concordant patients to 23 (? = 0.89, p < 0.05). On mid-treatment imaging, 19 patients were diagnosed as CR from both images, PFS differed significantly between CR and non-CR on both DW-MRI (p = 0.0013) and FDG-PET (p = 0.037). However, OS did not differ significantly between DW-MRI (p = 0.452) and FDG-PET (p = 0.452).

CONCLUSION
DW-MRI appears to be a promising tool for staging and evaluation of response to chemotherapy in patients with malignant lymphoma.

CLINICAL RELEVANCE/APPLICATION
DW-MRI and FDG-PET could be used depending on the availability of equipment within an institution, or could be chosen depending on the advantages, drawbacks and contraindications of each modality.

CL-PDS-MO1A • Diffusion Tensor Imaging of the Cerebellum-prefrontal Area in ADHD Children

Pilar Dies-Suarez MD (Presenter); Eduardo Barragan; Benito De Celis; Silvia Hidalgo; Manuel Obregon; Porfirio Ibanez

PURPOSE
The attention deficit hyperactivity disorder (ADHD) is one of the most frequent problems that affect children's and produce scholar failure and behavioral problems. The principal hypothesis is a dopaminergic dysfunction in the brain. Diffusion tensor imaging (DTI) is an MRI modality that provides information about the direction and integrity of neural fibre tracks in the brain in vivo.

METHOD AND MATERIALS
23 children (ages 7-12 yrs, 11 ADHD patients, 12 controls) were examined. Images were acquired on a 1.5T imager (Philips Intera-Achieva). Diffusion Tensor Imaging (DTI) data were acquired using a SE-EPI sequence with: TR/TE = 9491/75 ms, FOV=230x230x140 mm3, voxel size=1.60x1.60x2mm3, slices number= 70, fat supressed. Diffusion weighted gradients were applied along 15 non-collinear directions with a b-value=800 s/mm2, High-resolution images were acquired using 3DT1 Gradient Sequence with the following parameters: TR/TE=25/3.88ms, slice thickness 2mm, and NEX=1. Tractography: The diffusion tensor (DT) was fitted with linear least-square after a preprocessing step correcting for head movements and eddy currents was applied by registering all volumes. Finally, using MedINRI, diffusion tensors were calculated to obtain Fractional Anisotropy (FA) with FA threshold of 0.2 and smoothness factor of 20 out of 100, and Mean Diffusivity values. Segmentation of the cerebellum CB was manually drawn on midline sagittal 3D-T1 images.

RESULTS
We present results of white matter connectivity of tracts connected cerebellum-prefrontal area. There were no discernible ADHD-Control changes in ADC values along the connected white matter (figure 1) while generalized fractional anisotrophy is increased(p=0.08). Length of tracts vs ADC is shown in figure 2.

CONCLUSION
DTI studies have revealed developmental changes in cortical WM pathways in prefrontal regions and in pathways surrounding the basal ganglia and cerebellum in patients with ADHD, which presumably reflect decreasing myelination of axons.

CLINICAL RELEVANCE/APPLICATION
Affects between 3 to 7% in America Latina, and it´s consider a public health problem. We are considering MR imaging to improve the diagnostic on ADHD patients.

CL-PDS-MO2A • Aberrant Whole-brain Functional Connectivity in Children with Chronic Fatigue Syndrome

Fanxing Meng MMed (Presenter); Na Liu MD; Bing Yu MD; Qiyong Guo MD

PURPOSE
To assess the abnormalities of whole-brain functional connectivity in children with chronic fatigue syndrome (CFS) using resting-state functional magnetic resonance imaging (fMRI).

METHOD AND MATERIALS
Resting state fMRI data were obtained from 65 right-handed children, including 31 CFS children (M/F, 17:14; age, 10.0±1.5 y) and 34 age-matched healthy children. Resting state fMRI (R-fMRI) data were acquired using a 3DT1 Gradient Sequence with the following parameters: TR/TE=25/3.88ms, slice thickness 2mm, and NEX=1. Tractography: The diffusion tensor imaging (DTI) data were acquired using a SE-EPI sequence with: TR/TE = 9491/75 ms, FOV=230x230x140 mm3, voxel size=1.60x1.60x2mm3, slices number= 70, fat supressed. Diffusion weighted gradients were applied along 15 non-collinear directions with a b-value=800 s/mm2, High-resolution images were acquired using 3DT1 Gradient Sequence with the following parameters: TR/TE=25/3.88ms, slice thickness 2mm, and NEX=1. Tractography: The diffusion tensor (DT) was fitted with linear least-square after a preprocessing step correcting for head movements and eddy currents was applied by registering all volumes. Finally, using MedINRI, diffusion tensors were calculated to obtain Fractional Anisotropy (FA) with FA threshold of 0.2 and smoothness factor of 20 out of 100, and Mean Diffusivity values. Segmentation of the cerebellum CB was manually drawn on midline sagittal 3D-T1 images.

RESULTS
A total of 15 significantly different functional connectivities were identified in the medial prefrontal cortex(MPFC), insula, putamen, primary somatosensory cortices (S1), secondary somatosensory cortices(S2),anterior cingulated cortex (ACC) and thalamus between the CFS and control groups at an FDR corrected threshold of P<0.05.

CONCLUSION
Our findings suggest that abnormalities of functional connectivities between MPFC, insula, somatosensory cortices and ACC are likely to be involved in the onset and progression CFS in children.

CLINICAL RELEVANCE/APPLICATION
Abnormalities of functional connectivities between MPFC, insula, somatosensory cortices and ACC are likely to be involved in the onset and progression CFS in children.

CL-PDS-MO3A • Altered Tryptophan Metabolism and White Matter Development in Cerebellum of Children with Autistic Spectrum Disorders

Jeong-Won Jeong PhD (Presenter); Ajay Kumar MD, PhD; Harry T Chugani MD; Diane C Chugani PhD *

PURPOSE
METHOD AND MATERIALS
RESULTS
A significant inverse correlation (R2=0.46, p=0.04) was found between the LI values of SUV of the dentate nucleus and FA of the DRP (Fig. 1 a). Increased tryptophan metabolism in the dentate nucleus was correlated with reduced axonal microstructural integrity of the ipsilateral efferent pathway (Fig. 1 b). Furthermore, the LI values for both SUV and FA were significantly correlated with the scores of daily living skills; higher SUV and lower FA were related to...
Diseases

CL-PDE-MO7A •

osseous destruction. Normal comparisons and CT correlations will be demonstrated. TMJ involvement in other rheumatologic diseases will also be shown.

 Juvenile idiopathic arthritis (JIA) is the most common cause of chronic arthritis in children. The temporomandibular joint (TMJ) is frequently involved in JIA, with multiple associated complications, yet TMJ involvement remains one of the most underdiagnosed conditions in JIA. TMJ involvement can also be seen less frequently in other rheumatologic diseases. MRI with contrast is considered the gold standard for TMJ evaluation. The purpose of this exhibit is to show the spectrum of pathological changes by MRI of TMJ involvement in JIA and other rheumatologic diseases.

CONCEPTUALIZATION

This exhibit will demonstrate typical examples of the pathologic findings of TMJ involvement in JIA obtained at 3T MRI of children at our institution. Findings include synoval enhancement, joint effusion, pannus formation, deformed or displaced disc, bone marrow edema, condylar head flattening, erosions, and osseous destruction. Normal comparisons and CT correlations will be demonstrated. TMJ involvement in other rheumatologic diseases will also be shown.

PURPOSE/AIM

Juvenile idiopathic arthritis (JIA) is the most common cause of chronic arthritis in children. The temporomandibular joint (TMJ) is frequently involved in JIA, with multiple associated complications, yet TMJ involvement remains one of the most underdiagnosed conditions in JIA. TMJ involvement can also be seen less frequently in other rheumatologic diseases. MRI with contrast is considered the gold standard for TMJ evaluation. The purpose of this exhibit is to show the spectrum of pathological changes by MRI of TMJ involvement in JIA and other rheumatologic diseases.

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PURPOSE/AIM

To investigate individual changes in fetal lung volume (FLV) in fetuses with congenital diaphragmatic hernia (CDH) and to calculate weekly growth rates of the FLV using serial MR examinations during pregnancy.

METHOD AND MATERIALS

The study received approval from the institutional review board. MR-FLV was measured in 89 fetuses with CDH between 19 and 39 weeks gestation using T2-weighted HASTE imaging. All fetuses received two MR examinations with at least four weeks in between. In addition to the absolute MR-FLV (aMR-FLV) and the observed-to-expected MR-FLV (o/e MR-FLV) a weekly growth rate of the aMR-FLV was determined for each fetus.

RESULTS

In 98% of all fetuses (87/89) the aMR-FLV increased between the two examinations (mean increase 11.1 ml, range 1.5-37.7 ml). Mean o/e MR-FLV at the first MRI (mean 26.0±3.1 weeks gestation) was 33.3±12.2% (range 10.5-79.1%) and 29.5±10.9% (range 10.8-63.7%) at the second MRI (mean 33.9±2.6 weeks gestation). 61% of the fetuses (54/89) showed a decrease of the o/e MR-FLV during pregnancy (mean decrease 9.4%, range 2.2-31.7%). In 26% of all fetuses (23/89) the o/e MR-FLV increased (mean increase 7.7%, range 2.2-26.2%) and 13% (12/89) revealed stable values. Both, first and second o/e MR-FLV, were significantly associated with neonatal outcome. Measuring o/e MR-FLV near delivery was of superior prognostic value than earlier measurements (mortality: AUC=0.844 vs. AUC=0.778; extracorporeal membrane oxygenation (ECMO) requirement: AUC=0.852 vs. AUC=0.768). The mean lung growth rate in CDH-fetuses between the two MR examinations was 3.4±0.8 ml per week, compared to a mean weekly growth rate of 5.3±0.8 ml in healthy fetuses for the identical periods of time. On average, the weekly growth rate of FLV in fetuses with CDH was only 26% of the growth rate in healthy fetuses.

CONCLUSION

Fetuses with CDH do not only have lower FLVs but also have lower weekly lung growth rates compared to healthy fetuses. Individual development of FLV in CDH-patients during pregnancy is extremely variable with decreasing, stable and increasing o/e MR-FLVs. In selected cases, the o/e MR-FLV relatively changed about pre- and postnatal therapeutic options.

CRN-RELEVANCE/APPLICATION

Due to the variable individual development of FLV in CDH-patients during pregnancy, follow-up MR-FLVs measurements are advisable prior to decision-making about pre- and postnatal therapeutic options.

CL-PDE-MO6A • Perianal Disease in Paediatric Crohn’s Patients: Pelvic MRI versus MRE

Mary-Louise C Greer MBBS, FRANZCR (Presenter) ; Ryan T Lo ; Zehour E Alsabban MBBS ; Peter Church ; Rahim Moineddin ; Thomas Walters ; Jacob C Langer ; Anne Griffiths

PURPOSE/AIM

The aims of this exhibit are: 1. To demonstrate the spectrum of perianal disease in paediatric Crohn’s patients on pelvic MRI. 2. To describe imaging techniques and contrast enhancement of MRI in children with perianal disease, and standard magnetic resonance enterography (MRE) technique perianal region coverage.

CONTENT ORGANIZATION


SUMMARY

The major teaching points are: 1. Pelvic MRI is the gold standard for detecting and classifying perianal disease in children with Crohn’s disease, as well as in adults. 2. MRE has a complementary role to pelvic MRI in detecting perianal disease. 3. The perianal region should be a review area in MRE evaluation, in addition to small bowel, in paediatric Crohn’s patients.

CL-PDE-MO7A • Magnetic Resonance Imaging of the Temporomandibular Joint in Juvenile Idiopathic Arthritis and Other Pediatric Rheumatologic Diseases

Floyd D Dunnavant MD (Presenter) ; Saurabh Guleria MD ; Yoginder N Vaid MD ; Daniel W Young MD ; Stuart A Royal MS, MD ; Randy Q Cron * ; Matthew L Stoll

PURPOSE/AIM

Juvenile idiopathic arthritis (JIA) is the most common cause of chronic arthritis in children. The temporomandibular joint (TMJ) is frequently involved in JIA, with multiple associated complications, yet TMJ involvement remains one of the most underdiagnosed conditions in JIA. TMJ involvement can also be seen less frequently in other rheumatologic diseases. MRI with contrast is considered the gold standard for TMJ evaluation. The purpose of this exhibit is to show the spectrum of pathological changes by MRI of TMJ involvement in JIA and other rheumatologic diseases.

CONTENT ORGANIZATION

This exhibit will demonstrate typical examples of the pathologic findings of TMJ involvement in JIA obtained at 3T MRI of children at our institution. Findings include synoval enhancement, joint effusion, pannus formation, deformed or displaced disc, bone marrow edema, condylar head flattening, erosions, and osseous destruction. Normal comparisons and CT correlations will be demonstrated. TMJ involvement in other rheumatologic diseases will also be shown.
SUMMARY
Relatively little has been published about TMJ involvement in JIA, and imaging remains underutilized at many large pediatric centers. Routine MRI screening of the TMJ has been recommended. This presentation will demonstrate the findings typical of TMJ involvement in JIA and other rheumatologic diseases.

Olea Medical: High Performance Delay-insensitive Bayesian Method for Quantifying Brain Perfusion Parameters
Monday, 12:15 PM - 01:00 PM • South Building Hall A Booth 3314

LEARNING OBJECTIVES
The Bayesian method is a rigorous probabilistic estimation of hemodynamic parameters. From a quantitative point of view, this method outperforms deconvolution methods, such as standard, block-circulant and oscillating Singular Value Decomposition, especially at low signal-to-noise ratio (SNR). This performance improvement is clinically paramount for both CT and MR perfusion post-processing.

Breast - Monday Posters and Exhibits (12:15pm - 12:45pm)
Monday, 12:15 PM - 12:45 PM • Lakeside Learning Center

LL-BRS-MOA • AMA PRA Category 1 Credit™:0.5
Host
Susan P Weinstein, MD

LL-BRS-MO1A • Round and Oval Circumscribed Masses Found on Digital Mammography and Ultrasound: Is Biopsy Necessary in Patients without Previous Cancer History or Bloody Nipple Discharge?

Wei-Shin Wang (Presenter); Shadie S Majidi, MD

PURPOSE
To assess the positive cancer rate of round and oval circumscribed masses found on digital mammography and ultrasound in patients without a current or previous history of cancer or breast atypia and presenting without bloody nipple discharge.

METHOD AND MATERIALS
This retrospective study was approved by the institutional review board. Diagnostic mammograms and ultrasounds performed at Indiana University Health hospitals were reviewed from 2004 to 2013. All round and oval circumscribed masses described on diagnostic mammogram and ultrasound were identified. Patient age, breast mass size and palpability, and clinical history data were collected. Pathology results from those that underwent biopsy were reviewed. Patients with a current or previous history of cancer or breast atypia and those presenting with bloody nipple discharge were excluded from analysis.

RESULTS
A total of 402 circumscribed masses were biopsied in 393 patients. Seven patients presented with bloody nipple discharge, while eight presented with a current or prior history of cancer or breast atypia. These patients were excluded from analysis. Pathology results from the remaining 387 circumscribed masses demonstrated carcinoma in five patients (ductal carcinoma in situ, invasive ductal, adenoid cystic). A single case of phyllodes tumor was also identified. This corresponds to a positive biopsy rate of 1.6%.

CONCLUSION
In patients without a current or prior history of cancer and presenting without bloody nipple discharge, short term imaging followup can be considered for patients demonstrating a round or oval circumscribed mass on digital mammography and ultrasound.

CLINICAL RELEVANCE/APPLICATION
Potentially expands the criteria for what is considered a BIRADS 3 lesion. May decrease the number of inappropriate breast biopsies.

LL-BRS-MO2A • Preoperative 1-125 Radioactive Seed Localization (I-125 RSL) of Breast Lesions: Impact of Lesion Selection on Surgical Margins

Mark J Dryden (Presenter); Jamie Wagner, DO; Wei T Yang, MD; Kelly K Hunt, MD; Eric M Rohren, MD, PhD *; Basak E Dogan, MD

PURPOSE
To evaluate the impact of lesion selection for RSL procedure on final surgical margins.

METHOD AND MATERIALS
Our institutional review board approved this HIPAA compliant study. A retrospective review of mammographic (M), ultrasound (US) and ductogram (D)-guided 1-125 RSLs performed between 05/16/2012 and 03/06/2013 was performed in a single institution. 73 consecutive RSLs were performed in 70 women prior to segmental mastectomy or excisional biopsy. Procedure time and clinicopathologic data were recorded from the electronic medical records. Seed-to-target distance was measured on pre-operative mammograms, and specimen radiographs reviewed for the presence of the seed and targeted lesion.

RESULTS
Mean patient age was 59 years (range 40-83). Of the 73 RSLs, 39% were done using M, 60% US, and 1% D guidance. RSL was performed with a single seed in 60 (82%), and 2 or more seeds in 13 (18%) lesions. Median lesion size was 1.7 cm (range 0.5-5); mean seed-to-target distance 6 mm (range 0.5-13); and median procedure time was 10 minutes (range 5-60). All seeds and targeted lesions were retrieved. Final pathology revealed negative margins (NM) in 60 (82.1%) and close or positive margins (PM, < 2mm) requiring re-excision in 13 (17.8%). NM were observed in 32/36 (89%) masses, 2/5 (40%) calcifications, 8/11 (73%) masses with calcifications, 3/4 (75%) architectural distortions, and 11/13 (85%) single clips. All 3 focal asymmetries and 1 filling defect were excised with PM. PM were observed in 15/16 (94%) masses, 2/5 (40%) calcifications, 8/11 (73%) masses with calcifications, 3/4 (75%) architectural distortions, and 11/13 (85%) single clips. All 3 focal asymmetries and 1 filling defect were excised with PM. PM were achieved in 48/60 (80%) of lesions localized with a single seed and 12/13 (92%) with multiple seeds. Final surgery type was segmental mastectomy in 69 (98.6%) patients and mastectomy in 1 (1.5%). Complications included seed migration (2 PM).

CONCLUSION
RSL is an efficient and effective procedure for localization of non-palpable breast lesions that allows uncoupling of radiology-surgery schedules, with a low incidence of complications and surgical outcomes similar to wire localization. Using multiple seeds for lesions >2cm and calcifications may decrease the risk of PM.

CLINICAL RELEVANCE/APPLICATION
Radiologists should triage lesions to assess lesion type, lesion size, and number of seeds needed prior to RSL for optimal surgical outcomes.

LL-BRS-MO3A • Imaging Lymphatic System in Breast Cancer Patients with Magnetic Resonance Lymphangiography

Qing Lu (Presenter); Jia Hua; Jian Hu

PURPOSE
To investigate the feasibility of magnetic resonance lymphangiography (MRL) protocol using a gadolinium (Gd)-based contrast agent (Gd-MRL) for breast patients in a typical clinical setting, and to establish a Gd-MRL protocol and identify potential MRL biomarkers for differentiating metastatic from non-metastatic lymph nodes.

METHOD AND MATERIALS
Thirty two patients with unilateral breast cancer were enrolled and divided into 4 groups of 8 patients. Groups I, II, and III received 1.0, 0.5, and 0.3 ml of intradermal contrast; group IV received two 0.5 ml doses of intradermal contrast. For Gd-MRL, 3D fast spoiled gradient-recalled echo T1-weighted coronal images with a fat saturation were acquired before and after the administration of Gd-DTPA at different time points. All MRI images were evaluated independently by two radiologists for the number and size of enhanced lymph nodes, lymph node contrast uptake kinetics, lymph vessel size, and contrast enhancement patterns within lymph nodes.

RESULTS
Group III patients had a statistically significant decrease in the total number of enhanced axillary lymph nodes and lymphatic vessels compared to all other groups. While group IV patients had a statistically significant faster time to reach the maximum peak enhancement than group I and II (about 3 minutes), there was no other statistically significant difference between imaging results between groups I, II, and IV. Using the pattern of enhancement defect as the sole criterion for metastatic lymph node in terms of Gd-MRL interpretation and histopathologic results as the gold standard, sensitivity and specificity were estimated to be 86% and 95%, respectively.

CLINICAL RELEVANCE/APPLICATION
Radiologists should triage lesions to assess lesion type, lesion size, and number of seeds needed prior to RSL for optimal surgical outcomes.

LL-BRS-MOA • Imaging Lymphatic System in Breast Cancer Patients with Magnetic Resonance Lymphangiography
A total of 172 invasive cancers were evaluated (142 invasive ductal carcinomas; 25 invasive lobular carcinomas; and 5 invasive mammary carcinomas). 135 of these cases over-measured and 2 under-measured.

The size of a newly diagnosed breast cancer, as measured on preoperative imaging, plays a significant role in prognosis and treatment planning, driving the need for accuracy.

This IRB approved study retrospectively reviewed tomosynthesis imaging for 172 invasive breast cancers diagnosed between 3/2011 and 10/2012. The largest cancers on tomosynthesis (with and without inclusion of the tumor spicules) to the size on surgical pathology.

Statistical analysis evaluated whether inclusion or exclusion of the spicules seen on tomosynthesis better predicted the actual tumor size.

This investigation compares the size of newly diagnosed invasive breast cancers on tomosynthesis (with and without inclusion of the tumor spicules) to the size on surgical pathology.

A total of 172 invasive cancers were evaluated (142 invasive ductal carcinomas; 25 invasive lobular carcinomas; and 5 invasive mammary carcinomas). 135 of the tumors presented as a mass on tomosynthesis with 115 having spiculated margins. Average size on tomosynthesis for the 115 spiculated masses was 14.8 mm +/- 18.8 mm when excluding the spicules and 44.4 mm +/- 18.8 mm when including the spicules. The average surgical pathology size for these 115 tumors was 16.9 mm +/- 12.4 mm. There was no significant difference in the imaging and pathologic size when excluding associated spicules (p-value = 0.18); however, when the spicules were included in the imaging measurement, the tumor sizes were significantly different from those found at surgical pathology (p-value = 1.41243 x 10^-29). The absolute average difference in the measured to true size without inclusion of the spicules was 5.0 +/- 6.4 mm with 65 cases over-measured and 38 cases under-measured. When the spicules were included, the absolute average difference was 27.7 +/- 16 mm with 113 cases over-measured and 2 under-measured.

CONCLUSION
Measuring the central tumor mass and excluding any associated spicules on tomosynthesis imaging provides a more accurate preoperative estimate of the true tumor size.

CLINICAL RELEVANCE/APPLICATION
The size of a newly diagnosed invasive breast cancer, as measured on preoperative imaging, plays a significant role in prognosis and treatment planning, driving the need for accuracy.

**LL-BRS-M04A • The Role of MR-Mammography in ‘BIRADS-4 Cases’—Can Biopsies Be Avoided?**

**Clemens G Kaiser MD, BA (Presenter) ; Julia Krammer MD ; Klaus Wasser MD ; Stefan O Schoenberg MD, PhD * ; Werner A Kaiser MD, PhD**

**PURPOSE**
To evaluate the role of MR-Mammography (MRM) in patients with 'BIRADS 4 cases', i.e. in patients in which conventional assessment (X-Ray or Ultrasound) would otherwise require biopsy.

**METHOD AND MATERIALS**
Breast specialists from all over the country were invited to send patients with 'BIRADS- 4' findings in either X-Ray-Mammography or Ultrasound (US) for MRM in our institution. Between 04/2006 and 12/2011 a consecutive total of 1492 women were examined resulting in a study population of 1488 patients after dropout. MRM exams were performed using all morphological and kinetic signs.

**RESULTS**
124 patients were diagnosed with malignant diagnoses (cancer or DCIS) by MRM, resulting in 76 true positive and 48 false positive findings after histology. 971 true negative cases and 0 false negative cases were recorded in follow-ups of between 2-5 years. True negative cases were either confirmed by histology upon recommendation of external physicians (18 patients), follow-up by MRM or patient questionnaires over the next 5 years by mail (1737 cases), 393 patients were lost to follow-up. This resulted in a sensitivity of 100%, specificity of 95.2%, positive predictive value of 61.3%, a negative predictive value of 100% and an accuracy of 95.5%. For the calculation of invasive cancers only (without DCIS cases), the results were 63 true positives, 27 false positives for malignant findings, 971 true positives and 0 false positives for benign findings (Sensitivity 100%, Specificity 97.2%, PPV 70 %, NPV 100%, Accuracy 97.5%).

**CONCLUSION**
'BIRADS-4' cases in conventional assessment seem to be an adequate indication for high-quality MRM, using all morphological and kinetic signs. At least 88.7% (971/1095) of biopsies could be prevented. However, these results are strongly dependent on reader experience and adequate technical standards as prerequisites for optimal diagnoses.

**CLINICAL RELEVANCE/APPLICATION**
'BIRADS-4 cases' in conventional assessment as a new standard indication for MR-Mammography under high quality circumstances reduced the number of biopsies by 88%.

**LL-BRS-M05A • Accuracy of Tumor Sizing on Breast Tomosynthesis**

**Kathryn L Humphrey MD (Presenter) ; Pragya A Dang MD ; Phoebe E Freer MD ; Mansi A Saksena MD ; Elkan F Halpern PhD * ; Elizabeth A Rafferty MD**

**PURPOSE**
Using tomosynthesis discrete spiculations extending from a tumor mass often appear far more prominent than on conventional mammography. Whether these spiculations should be included in the preoperative tumor size remains unclear. This investigation compares the size of newly diagnosed invasive breast cancers on tomosynthesis (with and without inclusion of the tumor spicules) to the size on surgical pathology.

**METHOD AND MATERIALS**
This IRB approved study retrospectively reviewed tomosynthesis imaging for 172 invasive breast cancers diagnosed between 3/2011 and 10/2012. The largest tumors dimension was documented with and without inclusion of any associated spicules. These imaging sizes were compared to the true tumor size on surgical pathology. Statistical analysis evaluated whether inclusion or exclusion of the spicules seen on tomosynthesis better predicted the actual tumor size.

**RESULTS**
A total of 172 invasive cancers were evaluated (142 invasive ductal carcinomas; 25 invasive lobular carcinomas; and 5 invasive mammary carcinomas). 135 of the tumors presented as a mass on tomosynthesis with 115 having spiculated margins. Average size on tomosynthesis for the 115 spiculated masses was 14.8 mm +/- 18.8 mm when excluding the spicules and 44.4 mm +/- 18.8 mm when including the spicules. The average surgical pathology size for these 115 tumors was 16.9 mm +/- 12.4 mm. There was no significant difference in the imaging and pathologic size when excluding associated spicules (p-value = 0.18); however, when the spicules were included in the imaging measurement, the tumor sizes were significantly different from those found at surgical pathology (p-value = 1.41243 x 10^-29). The absolute average difference in the measured to true size without inclusion of the spicules was 5.0 +/- 6.4 mm with 65 cases over-measured and 38 cases under-measured. When the spicules were included, the absolute average difference was 27.7 +/- 16 mm with 113 cases over-measured and 2 under-measured.

**CONCLUSION**
Measuring the central tumor mass and excluding any associated spicules on tomosynthesis imaging provides a more accurate preoperative estimate of the true tumor size.

**CLINICAL RELEVANCE/APPLICATION**
The size of a newly diagnosed invasive breast cancer, as measured on preoperative imaging, plays a significant role in prognosis and treatment planning, driving the need for accuracy.

**LL-BRS-M06A • Diffusion Weighted Imaging in Mantle Radiated Women: Comparison of Apparent Diffusion Coefficient Values with a Control Group**

**Punam Bajaj MD, MBBS (Presenter) ; Chiara Iaconi MD ; D. David Dershaw MD ; Elizabeth A Morris MD**

**PURPOSE**
To compare the value of the Apparent Diffusion Coefficient (ADC) of normal breast tissue in high risk women who underwent mantle radiation before ages 30 years and a screening control group, matched for breast tissue density.

**METHOD AND MATERIALS**
This was a retrospective analysis of breast MRI examinations performed between 2008 and 2013 of 21 women who were treated with mantle radiation. Based on breast tissue density evaluated on pre contrast T1W fat suppressed sequence, cases were divided into two groups: fatty breasts (n=10) and dense breasts (n=11). A total of 41 breasts were evaluated. One breast with a benign mass lesion in the retroareolar region was excluded. Breast MRI exams in 21 controls, matched for breast tissue density, were compared. Diffusion Weighted Imaging (DWI) with b=0, 1000 was performed for all cases and controls and the ADC maps were evaluated on advantage workstation (GE). ADC value of normal breast tissue were calculated by placement of the region of interest (ROI) in bilateral retroareolar regions. Normal breast tissue was defined as absence of any finding on dynamic MRI (BIRADS-1). Statistical analysis was performed using Mann- Whitney unpaired t test.

**RESULTS**
Quantitative DWI study showed that median ADC value of irradiated breasts was lower (1.32 x 10^-3mm²/sec) compared to the non-irradiated control group (1.63 x 10^-3mm²/sec) ( p value= 0.0004). When matched for breast tissue density, irradiated fatty breasts had lower median ADC value (1.23 x 10^-3mm²/sec) compared to control group (1.54 x 10^-3mm²/sec) (p=0.0018). The irradiated dense breasts also showed a similar, statistically significant, lower median ADC value (1.59 x 10^-3mm²/sec) compared to the controls with dense breasts (1.77 x 10^-3mm²/sec) (p value=0.0435).

**CONCLUSION**
Mantle radiated breasts have lower ADC values compared to non-irradiated breasts. This difference in ADC value is independent of the breast tissue density.

**CLINICAL RELEVANCE/APPLICATION**
Women who have received mantle radiation have lower ADC values, probably due to post-radiation fibrosis which affects the tissue diffusion.
SUMMARY
Fat necrosis can occur due to any kind of trauma, biopsy, radiation, surgery, breast infection etc. It often poses a dilemma to both radiologists and clinicians. Understanding the imaging appearances and imaging appearances of this condition will help solve some of this dilemma and avoid unnecessary biopsies. Mammography is more specific than ultrasound in its diagnosis. In some cases, MR may be useful in distinguishing fat necrosis from malignancy. An evolution of imaging findings is seen which correlates well with the histology.

LL-BRE-MOA8 • Revisiting Probably Benign Lesions on Mammography, Sonography, and MRI
Barbara H Bresciani MD (Presenter); Luciana P Silva MD; Luciano F Chala MD; Bruna M Thompson MD; Nestor De Barros MD

PURPOSE/AIM
- Define the concept and the rationale of probably benign assessment - Review probably benign lesions on mammography - Address potential probably benign lesions on sonography and MRI - Discuss the conditions necessary for its correct and safe use

CONTENT ORGANIZATION
- Concept of probably benign assessment - Rational for its use: past, present and new modalities - Probably benign lesions on mammography: case-based review - Potential probably benign lesions on sonography and MRI: case-based review - Address complete lesions workup and correct follow-up: key factors for correct and safe use - Examples of inappropriate use of probably benign assessment.

SUMMARY
- Probably benign assessment remains important to reduce the number of biopsies with benign results, especially on sonography and MRI breast cancer screening. - Probably benign assessment applies to a limited number of lesions and its correct use requires a complete workup and appropriate follow-up to prevent that malignant or typically benign lesions are allocated in this assessment. - Use of this assessment on MRI implies additional challenges. On the one hand, it can reduce biopsies with benign results. On the other hand, indiscriminate use can lead to excessive MRI examinations. Therefore, correct selection of the lesions is critical to balance these two opposing demands.

LL-BRE-MOA9 • How to Correlate Breast Symptoms with Imaging Findings to Increase Yield of Breast Cancer Detection
Shilpa V Lad MD; Lily Cao MD, PhD (Presenter); Jean M Seely MD

PURPOSE/AIM

CONTENT ORGANIZATION
• Mastalgia is categorized as cyclic and non cyclic. Less than 1% of women with mastalgia have malignancy. For mastalgia with no other symptoms, role of US is more for patient reassurance than for cancer detection.
• In patients presenting with a palpable lump, risk of breast cancer varies with age. Fibroadenoma is the most common cause of breast masses in women < 35 year old, Breast mass in > 70 year old woman has >85% incidence of malignancy.
• Most nipple discharge is physiologic. Spontaneous, unilateral, bloody or clear nipple discharge has a higher association with malignancy.
• Enlarging breast is most commonly due to mastitis and breast cancer. Shrinking breast is most commonly due to invasive lobular cancer.

SUMMARY
Breast pain, palpable mass and nipple discharge are the most common presenting symptoms to breast clinics. We discussed effective ways to triage patients based on symptoms, age group and imaging features to help differentiate benign from malignant lesions, as well as, ways to problem solve in cases of negative findings of ultrasound and persistent breast symptoms.

LL-BRE1160-MAO • Can Functional Imaging Methods Improve Assessment of Breast Lesions?
Almir Bitencourt MD (Presenter); Eduardo N Lima; Elvira F Marques; Rubens Chojniak MD, PhD; Juliana A Souza; Marcos D Guimarães MD; Luciano Graziano MD

PURPOSE/AIM
To illustrate and discuss the use of functional imaging methods to improve the assessment of breast lesions.

CONTENT ORGANIZATION
Functional Imaging Methods - Definition - Comparison with Conventional Imaging Methods Magnetic Resonance Imaging (MRI) - Dynamic Contrast-Enhancement (DCE) - Diffusion-Weighted Imaging (DWI) - MR spectroscopy - Indications - Limitations 18F-Fluorodeoxyglucose (FDG) PET/CT - Dedicated protocol for breast evaluation - Indications - Limitations - PET/MRI fusion Positron Emission Mammography (PEM) - Technique - Advantages - Indications - Limitations - Guided Biopsy - New radiopharmaceuticals

SUMMARY
The major teaching points of this exhibit are: - Functional imaging methods show metabolic / biologic alterations in normal breast tissue that may precede anatomic / morphologic alterations that is shown on conventional imaging methods. - MRI can provide functional information through DCE, DWI and MR spectroscopy. - 18F-FDG PET/CT dedicated to breast evaluation can supply important information and allows PET/MRI fusion. - PEM is a promising tool to evaluate small breast lesions and guide biopsy.

Cardiac - Monday Posters and Exhibits (12:15pm - 12:45pm)
Monday, 12:15 PM - 12:45 PM • Lakeside Learning Center

CA
LL-CAS-MOA • AMA PRA Category 1 Credit ™: 0.5
Host
Vincent B Ho, MD, MBA *

LL-CAS-MOA1 • Prevalence and Findings of Coronary to Bronchial Artery Fistula on Cardiac CT in Patients with Coexistent Bronchiectasis
Yon Mi Sung MD; Hye Y Oh MD (Presenter); Eun Young Kim; Yoon Kyung Kim MD; Hye-Young Choi MD, PhD

PURPOSE
The aim of this study was to evaluate prevalence and related findings of coronary to bronchial artery fistula (CBF) on electrocardiogram-gated cardiac CT in patients who had coexistent bronchiectasis.

METHOD AND MATERIALS
In 3,856 patients who underwent electrocardiogram-gated cardiac CT from April 2009 to November 2012, 207 patients (95 males and 112 females, mean age, 62±11.6 years) with bronchiectasis were retrospectively included to assess the prevalence of CBF. Presence or absence of CBF was reviewed and relation to extent of bronchiectasis and bronchial artery engorgement was assessed. For statistical analysis, four grades were given to the extent of bronchiectasis (minimal, mild, moderate, and severe) and the degree of bronchial artery engorgement (none, mild, moderate, and severe). In the presence of CBF, origin of the coronary artery, size of the communicating artery and dominant lung with bronchiectasis were evaluated. Missed rate of CBF on the initial radiological reports was also assessed.

RESULTS
Fourteen cases of CBF (6.8%) were found in patients with coexistent bronchiectasis; 10 originated from the left circumflex artery and 4 from the right coronary artery. In one patient, a single right coronary artery gave rise to a left circumflex artery as an origin. Mean size of the communicating artery of CBFs was 1.9 mm (range, 1.0 - 2.9 mm). There was no association between origin of the coronary artery and dominant lung with bronchiectasis (p=0.176). CBFs were more frequently seen in patients with moderate and severe bronchiectasis (p

CONCLUSION
Electrocardiogram-gated cardiac CT was found to be useful for detecting CBF and providing anatomic details of the fistula in patients with bronchiectasis. Presence of CBF was significantly related to the extent of bronchiectasis and degree of bronchial artery engorgement.

CLINICAL RELEVANCE/APPLICATION

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Careful evaluation of CBF as a potential cause of chest pain or hemoptysis is needed on cardiac CT particularly in patients with severe bronchiectasis and severe engorgement of the bronchial arteries.

**LL-CS-M02A • Quantitative Adverse Plaque Features from CoronaryCT Angiography Predict Impaired Myocardial Flow Reserve by 13N-Ammonia-PET**

Damin Dey PhD (Presenter); *; Erick Alexanderson-Rosas MD; Annika Schuhback; Yuka Otaki; Xiaowei Ding; Luis E Orozco; Aloha Meave-Gonzalez MD; Daniel S Berman MD *; Stephan Achenbach MD *; Debiao Li PhD; Piotr Slomka PhD

**PURPOSE**

We aimed to evaluate whether integrated quantitative measurement of adverse plaque features from coronary CT Angiography (CTA) predicts impaired Myocardial Flow Reserve (MFR) and ischemia, measured by 13N-ammonia PET myocardial perfusion imaging.

**METHOD AND MATERIALS**

Forty patients underwent combination rest- stress 13N-ammonia PET and coronary CTA scans by hybrid PET/CT. Regional MFR and ischemia (% stress-rest perfusion deficit) were automatically derived from PET. From CT, 120 arteries were evaluated by automated software, computing arterial non-calculated (NCP), low-density NCP, and total plaque, as well as maximum diameter stenosis, maximum remodeling index and maximum contrast density drop over the lesions. Visually, maximum stenosis was assessed by standard grading (0-6). Quantitative CT measures and measured myocardial mass were combined by boosted ensemble learning algorithm into a composite score to predict impaired MFR (MFR = 2.0) and ischemia (>2% stress-rest perfusion deficit) by PET, in each artery.

**RESULTS**

Patients with impaired regional MFR had significantly higher NCP, low density NCP and total plaque in the corresponding arteries (NCP: 156.9 ± 152.9 vs 82.6 ± 124.7 mm3 [p=0.02]; low density NCP: 36.8 ± 44.9 vs 19.4 ± 31.9 mm3 [p=0.04]; total plaque: 168.6 ± 163.0 vs 93.3 ± 142.7 mm3 [p=0.03]). CF was not significantly different (10.7 ± 26.7 vs 11.7 ± 29.3 p=0.88). For prediction of impaired MFR, Receiver Operating Characteristic area-under-curve (AUC) for the composite score was 0.80 (95% CI: 0.69-0.92), higher than for visual stenosis grade (0.60, 95% CI: 0.49-0.72, p

**CONCLUSION**

Quantitative analysis of adverse plaque features from CTA allows significantly improved prediction of impaired MFR and ischemia compared to visual stenosis grade, the current clinical standard.

**CLINICAL RELEVANCE/APPLICATION**

Quantitative measurement of adverse plaque features from coronary CT Angiography predicts impaired Myocardial Flow Reserve by 13N-Ammonia-PET

**LL-CS-M03A • Age-gender Normal Values of Native Myocardial T1 Relaxation Times and Lambda on 1.5T and 3T Using MOLLI: A Single Centre, Single Vendor Card**

Darius Dabir MD (Presenter); Toby Rogers; Eduardo Arroyo Ucar; Rocío Hinojor; Valentina Puntmann; Eike Nagel MD, PhD *

**PURPOSE**

T1 mapping is an increasingly promising non-invasive method for quantitative assessment of conditions affected by diffuse myocardial fibrosis. Using a validated MOLLI-type sequence, we have shown that conservative septal sampling (ConSept) is more reproducible compared to the whole short-axis approach and has improved discriminatory ability between normal and abnormal myocardium. On the other hand, the septum is representative of the diffuse pathology affecting almost all of the myocardium, we propose that native T1 using ConSept may allow for a simple, robust, and standardized approach to interrogate diffuse myocardial involvement. Our aim was to examine age and gender related normal values at clinically used field strengths, 1.5 Tesla (T) and 3T, in a single centre and single vendor study.

**METHOD AND MATERIALS**

167 subjects with no history of cardiovascular or systemic disease and taking no regular medication underwent native and post-contrast T1 imaging with modified look-locker inversion recovery (MOLLI; 3,3,5) either at 1.5T or 3T (Achiva, Philips Healthcare, Best, The Netherlands) with advanced cardiac package. Parameters for native and post-contrast MOLLI were identical (FOV 320x320; TR/TE/flip-angle: 3.3ms/1.57ms/50°, interpolated voxel size 0.9x0.9x8mm, phase encoding steps n=166, HR adapted trigger delay, with 11 (3-3-5) phase sampling arrangements. An adiabatic pre-pulse was used to achieve complete inversion. ROIs were automatically propagated across all eleven images in the MOLLI sequence with a priori image- co-registration step for motion-correction (figure).

**RESULTS**

Results revealed no significant age related differences, neither for native T1 relaxation times, nor for Lambda at both field strengths. Gender related native T1 values on the other hand showed significant differences between males and females at 1.5T being greater for the female population, whereas neither native T1 values at 3T, nor Lambda at both field strengths revealed significant differences.

**CONCLUSION**

For the first time we report age and gender normal values for native and post-contrast myocardial imaging using the ConSept approach. We furthermore demonstrate gender related differences for native T1 at 1.5T.

**CLINICAL RELEVANCE/APPLICATION**

Differentiation between normal/diseased.

**LL-CS-M04A • Cardiac MRI Predictors of Clinical Outcomes in Patients with Apical Hypertrophic Cardiomyopathy**

Kate Hanneman MD (Presenter); Andrew M Crean MD; Lynne Willimas; Hadas Moshonov PhD; Susan H James MD; Laura Jimenez-Juan MD; Christine Gruner; Patrick Sparrow; Harry Rakowski; Elsie Nguyen MD

**PURPOSE**

Apical hypertrophic cardiomyopathy (ApHCM) is a morphological subtype of HCM which was previously considered to have a relatively good prognosis. The aim of the study was to describe cardiac MRI imaging findings and to determine their prognostic impact in patients with ApHCM.

**METHOD AND MATERIALS**

Institutional review board approval was obtained for this retrospective study. Cardiac MRI studies of 101 consecutive patients with pure ApHCM performed on a 1.5T scanner over a 10 year period were included. The extent of late gadolinium enhancement (LGE) was determined using a gray-scale threshold of SSD above the mean signal intensity of normal remote myocardium, and was expressed as a percent of total left ventricular myocardial mass (%LGE). Statistical analysis included two-sample t-test, Fisher's exact test and logistic regression. Interclass correlation (ICC) was used to evaluate inter-observer agreement.

**RESULTS**

Mean age of patients was 48.3±14.0 years, 73.5% (n=75) male, with mean clinical follow-up 5.1±6.2 years. Mean %LGE was 12.4±9.7%, and was highest in females (16.8±12.6%). There were no deaths. Subjects who experienced a clinical outcome had a statistically significant greater %LGE compared to those who did not (15.9±6.118% vs. 10.16±7.3% p=0.011). Percent LGE was an independent predictor of adverse outcomes (odds ratio (OR) 1.1 (95%CI 1.02, 1.13, p=0.010). Females and patients who experienced shortness of breath were more likely to experience an outcome (p=0.007 and p=0.037, respectively).

**CONCLUSION**

Late gadolinium enhancement by cardiac MRI is a frequent finding and has prognostic value in predicting adverse outcomes in patients with ApHCM.

**CLINICAL RELEVANCE/APPLICATION**

The clinical course of ApHCM may not be as benign as previously thought. Cardiac MRI detection of LGE may improve risk stratification in this population.

**LL-CS-M06A • CMR Assessment of Isovolumetric Relaxation Time for the Transplanted Heart with Comparison to Echocardiography**

Parag M Amin MD (Presenter); James C Carr MD *; Rob Gordon; Benjamin Freed; Jeremy D Collins MD *

**PURPOSE**

Echocardiography is currently the standard non-invasive method of obtaining diastolic indices; however, post-operative variability in left atrial size in cardiac transplant patients creates assessment of diastolic abnormalities. Cardiac magnetic resonance (CMR) with high temporal resolution cine imaging offers an alternative for evaluating ventricular diastolic function. The purpose of this study is to evaluate the assessment of a diastolic index, isovolumetric relaxation time (IVRT), in a cohort of heart transplant patients, comparing results to echocardiography.

**METHOD AND MATERIALS**

Upon approval by our institution's review board, a retrospective search was performed for cardiac transplant patients with echocardiograms and CMR examinations obtained within 1 week of each other. High temporal resolution (avg TR: 11.85 ms) cine images were acquired from 1.5T scanners.
Chest - Monday Posters and Exhibits (12:15pm - 12:45pm)

**LL-CHS-MOA** • *Investigation of Arterial Pulse Wave Velocity Based on 4D Phase Contrast MR Flow Imaging (4D PC MRI)*

**Hanieh Mirzaee** (Presenter); **Johann Drexli**; **Anja Hennemuth** MS; **Andreas Harloff** *

**PURPOSE**

The purpose of this study is to investigate the impact of different choices of these transient points on the value of PWV measured in the aorta.

**METHOD AND MATERIALS**

4D PC MRI of 7 healthy young volunteers (average age 24) were previously performed on a 3-T MR system (TRIO; Siemens, Erlangen, Germany). For flow analysis a phase contrast gradient echo sequence with prospective ECG-gating covering the entire thoracic aorta was used (voxel size: 1.7x2.0x2.2 mm3, temporal resolution: 40.8 ms, venc: 150cm/s). Data was processed using home-developed research software tool. PWV was then computed by automatically placing cross-sectional planes, 10 mm apart, starting a few millimeters above the root of the aorta. For each plane, a through flow curve was computed. A characteristic time point was then identified on each of the flow curves and a line was fitted to the resulting time points over all the flow profiles. The slope of the line was then used to determine the value of PWV. We investigated three different choices of the characteristic point:

1. The time point where the flow is 50% of the peak flow,
2. The intersection of a line fitted to the upslope portion of the flow curve with the time axis. We refer to this as time-to-foot (TTF),
3. The time point where the steepest increase in the through flow is observed.

We note that all the major steps are automated and the PWV processing time on average was less than 30sec. A comparison with a realistic digital phantom was performed to ensure the correctness of the computations.

**RESULTS**

PWV analysis based on the 50% rule and TTF resulted in less scattered data along the path of the aorta. The average PWV for the 7 volunteers was 4.47±0.031 (range, 4.51 to 5.41 m/s) and 4.48±0.036 (range, 4.16 to 5.18 m/s) and 4.49±0.074 (range, 3.14 to 5.14 m/s) for the 50% rule, TTF and steepest increase respectively.

**CONCLUSION**

Based on our experiments, the 50% rule was slightly superior to TTF in terms of more stable estimation of wave form changes; however, an analysis using a larger population data is needed.

**CLINICAL RELEVANCE/APPLICATION**

This technique might evolve to a noninvasive alternative to catherization for assessment of pulse wave velocity in the aorta.

**LL-CAS-MOA** • *Functional Evaluation of the Left Ventricle in Hypertrophic Cardiomyopathy Patients after Alcohol Septal Ablation Using Magnetic Resonance Imaging: Focus on Correlations between the dv/dt Curves and the Remodeling Parameters in Long-term Follow-up*

**Yan Zhang** (Presenter)

**PURPOSE**

To estimate quantitatively the significance of the unique left-ventricular (LV) diastolic parameter (dv/dt curve) acquired by stead-state free-precession (SSFP) cardiac magnetic resonance imaging (CMRI) in hypertrophic cardiomyopathy (HCM) patients for the evaluation of curative effects in long-term follow-up after alcohol septal ablation (ASA).

**METHOD AND MATERIALS**

CMRI examinations were performed in 23 (11 women) clinically-diagnosed HCM patients within 2 weeks before and a long interval (23-65 months, mean 34 months) after ASA. Left-ventricular dv/dt curves were generated by delineating manually the endocardial borders of stack of short-axis cine images, from which the peak ejection rate (PER) and the peak filling rate (PFR) were reckoned out and indexed automatically. Meanwhile other important LV morphological and functional parameters were also acquired.

**RESULTS**

Our preliminary results provided new insights into the unusual MRI dynamic parameters that reflected both systolic and diastolic functions of the left ventricle in HCM patients after ASA and showed the clinically valuable relations with the golden standard.

**CONCLUSION**

We demonstrated the clinical potential of evaluating non-invasively the left-ventricular functions of HCM patients with valuable MRI indicators in the follow-up after ASA treatment.

**CLINICAL RELEVANCE/APPLICATION**

High temporal resolution segmented SSFP cine imaging provided acceptable estimates of IVRT with good correlation to the current standard, echocardiography, and is recommended in cardiac transplant patients.
LL-CHS-MO2A • Pulmonary Angiography (CTPA)

Amedeo Tagliere (Presenter); Gian Luigi N Sergiacomi MD; Antonio Chiaravalloti MD; Eros Calabria MD; Daniele Citaro MD; Giovanni Simonetti MD

PURPOSE
To compare pulmonary perfusion MR parameters in patients affected by COPD during acute clinical phase with hypercapnic syndrome and during clinical stabilization phase.

METHOD AND MATERIALS
29 patients with acute exacerbation of chronic obstructive pulmonary disease were evaluated by perfusional MRI during acute and clinical stabilization phase. Inclusion criteria: PaCO2 >45 mmHg and respiratory acidosis (pH

RESULTS

CONCLUSION
MRI allows quantitative evaluation of pulmonary regional perfusion in patients with COPD. Our results suggests vasospastic component as the main responsible of pulmonary hypoperfusion due to acute hypercapnia.

CLINICAL RELEVANCE/APPLICATION
MRI allow identification of patients needing vasodilators therapy alone from those requiring also anticoagulants therapy for prevention of pulmonary hypertension AND heart failure.

LL-CHS-MO2A • Commercial Implementation of the Parametric Response Map for Clinical COPD Phenotyping

Craig J Galban PhD (Presenter); Ryan Chamberlain PhD *; Jennifer Boes; Ella A Kazerooni MD; Alinawaz Rehemtulla PhD *; Brian D Ross PhD *

PURPOSE
COPD is a complex disease where patients comprise of varying severity of emphysema and small airways disease. An unmet clinical need is a biomarker capable of accurately quantifying small airways disease, which is considered the reversible component and thus treatable. University of Michigan investigators have developed a voxel-based CT imaging biomarker, referred to as the Parametric Response Map (PRM), that is capable of diagnosing the two major phenotypes in COPD: functional small airways disease (FSAD) and emphysema. For this technology to be fully realized, a commercial grade and regulatory-approved diagnostic analysis and reporting software must be developed. We describe the initial development of a commercial version of the PRM software diagnostic application, and our evaluation of this platform against published results performed on CT data acquired as part of the COPDGene study.

METHOD AND MATERIALS
CT scans of 194 COPD patients were acquired from the COPDGene Study. PRM consisted of spatially aligning parenchymal tissue from inspiratory and expiratory CT scans. Relative volumes of the three components were quantified by summing like-classified voxels and normalizing to the total lung volume. All PRM analyses were performed within the commercial platform and results were compared to previously generated PRM result.

RESULTS
We have implemented a fully integrated and automated diagnostic platform that completes PRM on inspiration and expiration CT scans (Figure 1). We compared the resulting PRM values from the commercial version of the algorithm to those used in the recently published Nature Medicine article and found excellent correlation (R² = 0.93).

CONCLUSION
The unique property of our PRM implementation is that it is implemented in a cloud computing platform that will allow users to upload the original CT image data, execute the PRM algorithm, then download the results without needing to install software locally. Thus, users can run PRM without purchasing expensive hardware required for this computationally intensive algorithm. It is anticipated that cloud-based access to PRM can be integrated seamlessly into clinical workflow.

CLINICAL RELEVANCE/APPLICATION
PRM provides an objective quantitative assessment of lung disease extent and progression. A commercial grade and regulatory-approved diagnostic analysis will allow PRM to be fully realized.

CONCLUSION

LL-CHS-MO3A • Impact of the Hybrid Iterative Reconstruction Technique on Image Quality in Ultra Low Dose 80 kilovoltage Computed Tomographic Pulmonary Angiography (CTPA)

Azien Laqmami (Presenter); Marc Regier; Simon Veldhoen MD; Alexandra Backhaus; Felicia Wassenberg; Gerhard B Adam MD; Hans Dieter Nagel *; Frank Oliver G Henes MD

PURPOSE
To determine whether an iterative reconstruction (IR) technique (iDose, Philips Healthcare) can reduce image noise and improve image quality in ultra low dose CTPA.

METHOD AND MATERIALS
40 patients (mean body weight, < 80 kg; mean BMI, 23.1) with suspected pulmonary embolism (PE) underwent CTPA with an ultra low dose 80 kV protocol (Brilliance iCT, 23.4 mGy; DLP, 76.45 mGy*cm; effective dose, 1.07mSv). The raw data were reconstructed using filtered back projection (FBP) and three IR level (2, 4 and 6). Two radiologists in consensus assessed subjective image quality and image noise on a scale of 1 to 5 (excellent). Consistency of PE was assessed in central, segmental and subsegmental arteries using a three-point scale (1, subtle; 2, sufficient; 3, excellent). CT-Atelectasis, objective image noise (OIN) and background signal (SIbackgr.) were measured, contrast-to-noise ratios (CNR) and signal-to-noise ratios (SNR) were calculated. Statistical analysis was performed using an unpaired t-test and 1-way analysis of variance (ANOVA).

RESULTS
With each IR level a significant and progressive decrease in subjective and objective image noise was achieved. By implication, SNR and CNR were significantly increased with IR 4 and 6 compared to FBP (p < 0.05).

CONCLUSION
The hybrid IR technique with level 4 and 6 significantly reduces image noise and improves image quality in 80kV CTPA protocols.

CLINICAL RELEVANCE/APPLICATION
By the use of IR low dose CTPA with effective doses close to 1mSv are feasible in patients weighing less than 80 kg.

LL-CHS-MO4A • Percutaneous CRYOablation of Lung Tumors: One Year Follow-up

Claudio Pusceddu MD (Presenter); Barbara Sotgia; Luca Melis; Rosa Maria Fele; Francesco Meloni; Giovanni Battista Meloni

PURPOSE
To report the data of one year follow-up with CT-guided percutaneous cryoablation (PCA) in patients with primary and secondary pulmonary tumors.

METHOD AND MATERIALS
CT-guided PCA was performed on 46 lung masses (18 NSCLC = 39%; 28 secondary lung malignancies = 61%) in 40 consecutive patients (28 men and 12 women; mean age 65 ± 10 years) not suitable for surgical resection. Lung masses were treated using three types of cryoprobes: IceRod, IceSfere and IceSeed capable of obtaining different size of iceball. The number of probes used ranged from 1 to 5 depending on the size of the tumor. After insertion of the cryoprobes into the lesion, the PCA were performed with two cycles each of 12 min of freezing followed by a 4 minutes active thawing phase and a 4 minutes passive thawing phase for each one for all treatments.

RESULTS
All cryoablation sessions were successfully completed. All tumors were ablated. No procedure-related deaths occurred. Morbidity consisted of 20% (8 of 40) pneumonothorax, 7% (3 of 40) pleural effusion and 3% (1 of 40) cases asymptomatic small pulmonary hemorrhage, respectively, all of CTCAE grade 1 (Common Terminology Criteria for Adverse Events). Low density of entire lesion, central necrosis and solid mass appearance were identifiable in 32 (70%), 8 (17%) and 6 (13%) of cryoablated tumors, respectively. Technical success (complete lack of enhancement) was achieved in 80%, 95%, 91% and 85% of treated lesions at 1-, 3-, 6- and 12-months CT follow-up scan, respectively. Comparing the tumor longest diameter between the baseline and at 6 and 12 months CT images, technical success was revealed in 91% and 83% cases, respectively.

CONCLUSION
Our preliminary experience suggests that PCA is a feasible and safe treatment option. Well-designed clinical trials with a larger patient population are necessary to further investigate the long-term results and prognostic factors.

CLINICAL RELEVANCE/APPLICATION
CryoaBLATION of the lung tumors is a safe and effective procedure capable of obtaining complete ablation of the tumor in a high number of patients after one year follow-up.
RESULTS

We retrospectively reviewed a total of 154 patients, who underwent emergency cervical spine CT imaging at our institution for blunt cervical trauma from June 2012 to December 2012. Each wrist was analyzed individually, looking for fat or/and fluid effusion. Others evaluated findings were the location, pattern and severity of distal radio fracture, such as involvement of Listet tubercle, involvement of wrist dorsal cortical, intra-articular communication, deviated bone fragments and presence of lipohaemartrosis.

CONCLUSION

The presence of fluid effusion and lipohaematoma alerts to distal radio fracture with sheath disruption, which can cause persistent wrist pain post trauma and may even result in a tendon rupture.

CLINICAL RELEVANCE/APPLICATION

We developed a motion sensor providing direct feedback on the position of the moving diaphragm, complemented with a feedback system this will allow patients to accurately reproduce breath-holds.

**LL-CHE3097-MOA** • Multimodality Imaging Analysis and Diagnostic Algorithm of Congenital and Acquired Cystic Masses of the Mediastinum in the Adult

Francisco Garcia-Morales MD (Presenter) ; Pramod K Gupta MD ; Gregg D Rice MD

**PURPOSE/AIM**

1) The purpose of this exhibit is to illustrate with multiple imaging modalities the cystic pathology of the mediastinum as well as imaging pitfalls and the imaging approach based on anatomical localization. 2) To explain with cases the utility of MRI with contrast, the use of diffusion-weighted imaging of the chest in the evaluation of atypical lesions. 3) To discuss the use of trans-esophageal endoscopic ultrasonography (EUS) in selected cases not showing the typical features of non complicated cysts and its potential use for diagnosis and tissue sampling.

**CONTENT ORGANIZATION**

37 cases of mediastinal were reviewed with a combination of imaging techniques including plain radiographies, computed tomography, magnetic resonance, endoscopic ultrasound and a single case with PET. The lesions were classified as: 1) Mesothelial cysts: pericardial and pleural cysts 2) Foregut cysts: Bronchogenic and esophageal duplication cysts 3) Lymphatic cyst 4) Thyroidic cysts 5) Mimics

**SUMMARY**

The imaging findings of the congenital and acquired cystic lesions of the mediastinum and mimics will be illustrated particularly with Computed tomography and the use of Magnetic Resonance Imaging and Endoscopic Ultrasound (EUS) in selected atypical cases. The diagnostic approach based on anatomical localization will be discussed.
1. Review current role of imaging in evaluation of maternal abdominal and pelvic trauma. 2. Discuss limitations of non-ionizing modalities (US & MR) for imaging of cervical spine in patients with minor trauma. 3. Evaluate the impact of new radiology findings on changing the final diagnosis or hospital admission in these patients. 4. Examine the predictive value of cervical spine CT findings for the presence of associated injuries. 5. Discuss the role of second-opinion interpretations in cervical spine CT scans on patients' diagnosis in the emergency setting.

**METHOD AND MATERIALS**

A total of 311 consecutive cases of cervical spine CT imaging from patients who were transferred to our institution's emergency department were analyzed. These patients had undergone imaging of their cervical spine at an outside facility with an initial first-read. The imaging was subsequently imported to our PACS and sent for second-read (over-read) by a radiologist in our institution. The second-read was performed by a radiologist from our department who was blinded to the first-read report and the clinical information of the patient. Although the second-read was performed independently, the radiologist had access to the first-read report and the clinical information of the patient.

**RESULTS**

MDCT revealed 77 fractures in 65/107 pts (60.7%). Biplanar radiography was true positive in 32 pts (29.9%), false positive in 19 pts (17.8%), true negative in 23 pts (21.5%), and false negative in 33 pts (30.8%), showing a sensitivity of 49.2%, a specificity of 54.7%, a positive predictive value of 62.7%, a negative predictive value of 41.1%, and an accuracy of 51.4%. Most fractures were diagnosed in the thoracolumbar junction (39/77; 50.6%). None of the fractures missed on biplanar radiography were statistically significant, if this was simultaneously proven by MDCT (Z=7.6; p=0.001). Mean effective dose on biplanar radiography was 0.7mSv, and on MDCT was 7.5mSv.

**CONCLUSION**

Sensitivity and specificity of biplanar radiography in diagnosis of thoracic spine fractures in pts with minor trauma are low. The mean effective dose of MDCT was more than 10 times as high as on biplane radiography.

**CLINICAL RELEVANCE/APPLICATION**

In our experience MRI accurately demonstrates cervical soft tissue injuries in blunt trauma patients, with a poor impact on the clinical management of the trauma.
Searching for the Source of Infection: Role of Diffusion Weighted Image (DWI)

Nancy A Hammond MD (Presenter); Fernanda D Gonzalez Guindalini MD *; Paul Nikolaidis MD; Frank H Miller MD; Vahid Yaghmai MD

PURPOSE/AIM
This exhibit will review the role of DWI in improving sensitivity and specificity of MR imaging for diagnosing sources of infection in the abdomen.

CONTENT ORGANIZATION
1) Review DWI strengths and weaknesses
2) Demonstrate how DWI can improve the sensitivity of searching for the source of fever/infection
3) Illustrate examples where DWI increased specificity and diagnostic confidence when searching for an intra-abdominal source of fever (and in several examples was the only sequence suggesting infection), including:
   - Abdominal abscess
   - Acute pyelonephritis and pyomyositis
   - Acute and chronic inflammatory pelvic diseases
   - Appendicitis
   - Diverticulitis and colitides
   - Cholecystitis
   - Pancreatitis
4) Potential pitfalls will be illustrated

SUMMARY
Diffusion weighted images can help in detection of the source infection in the abdomen and pelvis, improving sensitivity and specificity of MR imaging.

Abdominal CT Perfusion: Breathhold or Free Breathing?

Takeki Yoshikawa MD *; Tomonori Kanda; Yoshiharu Ohno MD, PhD *; Keitaro Sofue (Presenter); Noriyuki Negi RT; Yasuko Fujisawa MS *; Tohru Murakami; Hisanobu Koyama MD; Mizuho Nishio MD *; Naoki Kanata MD; Kazuho Sugimura MD, PhD *

PURPOSE
To assess effects of breath control technique on CT perfusion values in the abdomen

METHOD AND MATERIALS
One hundred eight patients (male: 69, female: 39, mean age: 70.6 years) underwent upper abdominal CT perfusion. Scans (0.5mm x 320, 80kV, AEC) were conducted 7 to 120 seconds after administration of contrast medium (CM) and 25-ml saline chaser. The patients were randomly divided into two groups; breathhold and free breathing groups. Demographic features and scan parameters (FOV, CTDI, and DLP) for CT perfusion were recorded and compared.

CT images were analyzed using prototype software for perfusion analysis, which also compensated first manually, then automatically for respiratory misregistrations before perfusion analysis. Mean length of manually compensation (mm) (usually z-direction) was recorded for each patient and compared between the groups. Hepatic arterial and portal perfusion (HAP and HPP, ml/min/100ml), arterial perfusion fraction (APF, %), mean transit time (MTT, s), 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. Arterial perfusions (AP), MTV, and DV of pancreas, spleen, gastric wall were calculated using single-input MS, DC, and CM (dMS, dDC, and dCM) methods. The values were compared between the groups.

RESULTS
There was no significant difference in demographic features or scan parameters. Mean manual compensation length had a trend toward larger in free breathing group (13.5 ± 7.7) than breathhold (11.3 ± 7.9). HAP with dCM (p < 0.05). After careful compensations for respiratory misregistrations, CT perfusion values in the liver are affected by breath control technique. Changes in portal perfusion values were possibly due to structure distortions, which made vessel tracking process in analysis difficult. CM transit time changes might be caused by intra-thoracic or inferior vena caval pressure changes.

CONCLUSION
Even after careful compensations for respiratory misregistrations, CT perfusion values in the liver are affected by breath control technique. Changes in portal perfusion values were possibly due to structure distortions, which made vessel tracking process in analysis difficult. CM transit time changes might be caused by intra-thoracic or inferior vena caval pressure changes.

CLINICAL RELEVANCE/APPLICATION
CT perfusion values in the liver are affected by breath control technique. When measuring hepatic portal perfusion or CM transit time, breathhold technique is
Purpose to optimize a 3.0T acquisition protocol for liver Intra-Voxel Incoherent Motion imaging (IVIM) imaging to be included in a clinical study focused on chronic liver diseases.

Method and materials
First, acquisition protocol was evaluated on 25 healthy volunteers (16 men, 9 women; mean age: 27.1 years; mean weight: 71 kg). Acquisitions were performed on a 3.0T GE Discovery MR 750 (GEHC, Milwaukee, WI, USA) system with 50 mT/m maximum gradient amplitude. Sequence used was the SE-EPI eDWI sequence (enhanced Diffusion Weighted Imaging) including 12 b-factors (0, 10, 20, 40, 60, 100, 200, 300, 400, 600, and 800 s/mm²) with variable NEX according to b-factor (2-2-2-3-3-4-5-6-7-8-8-9 NEX) with 2000 ms TR and 55 ms TE. 21 axial slices were acquired with a 400 × 300 mm² FOV, 128 × 96 reconstruction matrix, 8 mm slice thickness, and a 250 kHz bandwidth. Fat Sat was disabled. Signal was collected using the 32 channels body coil. Then scan duration was 5'12".

Second, the optimization lead was to minimize the number of b-values required to keep the same data fit reliability from the protocol using Cramér–Rao inequally providing optimized b-factors. Pure molecular diffusion coefficient (Dslow), perfusion-related coefficient (Dfast) and perfusion fraction (f) were obtained by a non-linear least-square fit to the bi-exponential IVIM model.

Results
Theoretical optimization based on Cramér–Rao suggested the used of 0, 10, 80 and 800 s/mm² b-values. Mean IVIM parameters obtained were: Dslow value of 1.08 (10-3 mm²/s), 21% for f and 79.3 to 87.9 (10-3 mm²/s) for Dfast. Bland-Altman plots showed no significant differences between 12b- and 4b-methods.

Conclusion
Minimization study showed that using a limited (4) number of chosen b-factors give the same results compared with 12 b-factors. The use of SmartNex, 3-in-1 diffusion gradient scheme, free breathing technique and only 4 b-factors enabled whole liver Intra Voxel Incoherent Motion Imaging within a minute and seem to be a suitable compromise to be added in a clinical protocol focusing on chronic liver diseases assessment.

Clinical relevance/application
Optimized MRI protocol at 3.0T dedicated to liver examination of chronic liver diseases focusing on fibrosis and cirrhosis.

Purpose
To evaluate the usefulness of ultrasound as the initial diagnostic method for differentiating diverticulitis from colon cancer in patients with sigmoid colon stenosis, especially in the emergency setting.

Method and materials
Fifty-two patients with sigmoid stenosis were examined by US and CT during the period February 2006 - January 2013. Immediately after US or CT scans each stenosis was classified as malignant or benign. Off-site, two readers, who were unaware of the proven diagnosis, independently and retrospectively analyzed 13 different morphological ultrasound criteria retrieved from a literature review to differentiate between benign and malignant structures. The two readers were asked to give a diagnosis of malignant, benign or indeterminate stenosis. Sensitivity, specificity and accuracy were calculated by considering the pathological analysis or by clinical follow up of at least one year. The interobserver agreement was calculated by the kappa statistics.

Results
There were 22 sigmoid carcinomas and 30 diverticulitis. The on-site US results were 93% sensitivity, 96% specificity and 95% accuracy for the colon carcinoma diagnosis; CT sensitivity was 87%. The strongest sensitive morphological features for cancer were loss of normal layer structure (87%), length 15 mm (93%) and absence of diverticula (88%) were the most specific findings for carcinoma. For diverticulitis, the most sensitive and specific criteria were preserved mucosal folds and conservation of the inner layer (90 and 95, respectively). Periolic fat infiltration or abscess were not good criteria for differentiating between them. The agreement on morphologic features oscillated between 0.441 (length mm (93%)) and 0.88 (absence of diverticula (88%)) was the most specific findings for carcinoma. For diverticulitis, the most sensitive and specific criteria were preserved mucosal folds and conservation of the inner layer (90 and 95, respectively). Periolic fat infiltration or abscess were not good criteria for differentiating between them.

Conclusion
Our experience suggests that diverticulitis can often be differentiated from colon carcinoma on the basis of some US findings described in the literature.

Clinical relevance/application
It is not possible to perform colonoscopy or CT-colonography to exclude carcinoma in patients with diverticulitis subjected to conservative management until inflammatory changes have subsided.

Purpose
The purpose was to conduct meta analysis on the diagnostic performance of dynamic multidetector CT (MDCT), dynamic MRI with gadolinium, diffusion-weighted imaging (DWI), Gadoxidic Acid-EOB-DTPA (Eovist) Hepatobiliary phase MRI, and combined DWI and Eovist MRI in detection of hepatocellular carcinoma.

Method and materials
PubMed was searched with key phrases of “DWI and HCC” and “DTPA-EOB and HCC”, which resulted in relevant original articles published from 1993 to 2013. After reviewing each article, relevant articles were pooled for subgroup data analysis with commercially available statistical software.

Results
Thirty articles with 1948 patients, 2489 HCCs, and 972 benign lesions were analyzed. The overall DWI sensitivity was 84.2% (95% CI: 82.7%-85.7%), specificity 93.1% (95% CI: 91.7%-94.4%), and the sensitivity for HCC = 1 cm was 68.8% (95% CI: 64.5%-73.1%). The overall Gadoxidic Acid-EOB-DTPA Hepatobiliary MRI sensitivity was 92.2% (95% CI: 91.0%-93.4%), specificity 97.4% (95% CI: 96.4%-98.3%), and the sensitivity for HCC = 1 cm was 80.3% (95% CI: 76.5%-84.1%). The diagnostic sensitivity of dynamic MDCT and dynamic MRI were lower than the DWI or the hepatobiliary phase CT studies with overall sensitivity of 78.2% (95% CI: 76.3%-81.0%) and 79.5% (95% CI: 77.4%-81.7%) respectively for all HCC lesions and 23.0% (95% CI: 14.1%-32.0%) for HCC = 1 cm. The diagnostic specificity was high in all image modalities. Meta analysis of studies that combined the diagnostic performance of DWI and Eovist MRI resulted in sensitivity of 92.9% (95% CI: 91.1%-94.7%) and specificity of 97.1% (95% CI: 96.3%-98.0%). The overall diagnostic odds ratio for DWI was 71.9 (95% CI: 53.4-96.8), Eovist MRI 442.8 (95% CI: 281.5-696.49), dynamic MDCT 74.9 (95% CI: 53.9-104.2), dynamic MRI 52.3 (95% CI: 39.2-69.8), and DWI+Eovist MRI 438.1 (95% CI: 281.8-681.1).

Conclusion
DWI or Gadoxidic Acid-EOB-DTPA Hepatobiliary phase MRI offer added value to the diagnosis of HCC and demonstrates superior diagnostic sensitivity, especially in HCC = 1 cm, when compared to the conventional dynamic MDCT or MRI. Combined DWI and Eovist MRI resulted in high sensitivity and specificity, but not statistically higher than from this Eovist MRI.

Clinical relevance/application
Further refinement of the AASLD and LI-RAD guidelines with incorporation of DWI and hepatobiliary phase MRI, leading to improved HCC detection and clinical outcome.

Purpose
In patients with peritoneal carcinomatosis (PC) cytoreductive surgery combined with hyperthermic intraperitoneal chemotherapy (HIPEC) is an evolving therapeutic approach with curative intention. To differentiate between posttherapeutic findings and relapse of PC is challenging. Due to promising results in the preoperative assessment of PC we evaluated the diagnostic value of 18F FDG-PET/CT in the follow up period to detect relapse of PC after cytoreductive surgery and HIPEC.
We Use Hepatobiliary Agents and Eliminate Tissue Diagnosis?

RESULTS
Relapse was suspected in 40 of 44 18F-FDG PET/CT examinations at 343±267 days after HIPEC. PC was suspected in 237 of 572 peritoneal segments. Relapse of PC was completely missed by 18F-FDG PET/CT in 4 patients and significantly underestimated in 8 patients. Resulting sensitivity for the accurate detection of relapse of PC after HIPEC was 70%, PPV 97% and DA 70%.

CONCLUSION
Compared to good preoperative results, the diagnostic yield of 18F-FDG PET/CT after cytoreductive surgery and HIPEC is significantly reduced regardless of the presence of PC at all as well as the extent of PC due to the restricted ability to differentiate between posttherapeutic findings and manifestations of PC.

CLINICAL RELEVANCE/APPLICATION
The diagnostic value of 18F-FDG PET/CT to evaluate the presence and extent of recurring PC after cytoreductive surgery and HIPEC is restricted to preoperative results.

LI-RADS M06A • Prediction of Response for Colorectal Liver Metastases to Combination Hepatic Arterial Infusion Plus Systemic Chemotherapy

Elizabeth J Sutton MD (Presenter); Richard Kinh Gian Do MD, PhD; Kristen L Zakian; Debra Goldman BS; Nancy Kemeny MD; Michael D'Angelica MD

PURPOSE
Among different therapies for colorectal liver metastases (CLM), hepatic arterial infusion (HAI) can deliver high dose chemotherapy with high response rates. However, there is limited ability to predict treatment response before surgery and this would be of obvious value. The purpose of this study was to evaluate CT imaging and clinical predictors of CLM response to combination HAI plus systemic chemotherapy.

METHOD AND MATERIALS
A retrospective review of patients with initially unresectable CLM enrolled in an institutional review board approved prospective trial for HAI pump therapy was performed. 54 patients (mean age 55.6, range 33-76; 22 females and 32 males) were included, 51 of whom had available pre and post-treatment contrast enhanced CT scan available for review. Percentage best response (BR) was evaluated according to Response Evaluation Criteria In Solid Tumors (RECIST) during the trial. For each target CLM identified by RECIST, size and mean Hounsfield Unit (HU) attenuation were measured on pre-treatment contrast enhanced phase CT. Clinical parameters including prior systemic chemotherapy and eligibility for post-treatment surgical resection of CLM were documented. Spearman’s rho and Wilcoxon’s Rank Sum test were used for statistical analysis.

RESULTS
Before treatment, HU attenuation of CLM was higher in patients who eventually underwent surgical resection (p=0.02), positively correlated with BR (rho=0.33; p=0.02) and negatively correlated with size of CLM (rho=0.32, p=0.02). No significant correlation was found between pre-treatment size of CLM and BR (rho=−0.09; p>0.05). Size of CLM and HU were not significantly different between those who had prior systemic chemotherapy alone and those who did not (p>0.05). No significant difference in pre treatment size of CLM was found between patients who eventually underwent surgical resection and those who remained unresectable (p>0.05).

CONCLUSION
Increased HU attenuation of colorectal liver metastases on pre-treatment contrast enhanced CT correlates with volumetric response and eventual surgical resectability following treatment with combination HAI plus systemic chemotherapy.

CLINICAL RELEVANCE/APPLICATION
Pretreatment prediction of response to combination HAI and systemic chemotherapy by CT imaging may be helpful in directing targeted care of CLM.

LI-RADS M07A • Prospectively Acquired Low Doses in Abdominal CT and Role of Sinogram Affirmed Iterative Reconstruction (Safire)

Sarabjeet Singh MD (Presenter); Sarvenaz Pourjabbar MD; Ranish D Khawaja MBBS, MD; Atul Padole MD; Garry Choy MD, MS; Mannudeep K Kalra MD *; Mischa Woisetschlager MD, PhD; Nils Dahlstrom MD, PhD; AndersPerssonMD, PhD

PURPOSE
Assessment of the effect of Sinogram Affirmed iterative reconstruction (Safire) and Filtered Back Projection (FBP) technique on abdominal CT examination acquired at 200 mAs, 100 mAs, and 50 mAs.

METHOD AND MATERIALS
24 patients (mean age 64 ± 14 years, M:F 10:14) gave informed consent for an IRB approved prospective study for additional research images through the abdomen in the 16 slice MD (Siemens Flash) at 100 mAs and 50 mAs over a scan length of 10 cm using combined modulation technique. Images through entire abdomen were acquired at 200 mAs. The 50 and 100 mAs datasets were each reconstructed with FBP and four settings of Safire (S1, S2, S3, S4). The FBP 200 mAs images were compared side-by-side with FBP and Safire images from 50 and 100 mAs. The number and location of lesions, lesion size, lesion conspicuity, visibility of small structures were assessed by two experienced abdominal radiologists. The diagnostic acceptability was measured on a four point scale (1= fully acceptable, 4= unacceptable). Objective noise and HU values were measured in liver and the descending aorta. The noise power spectrum was analyzed for FBP and different Safire settings.

RESULTS
A total of 43 lesions were detected on both FBP and Safire images. Minor blocky or pixilated appearance of 50 and 100 mAs images was noted at S3 and S4 Safire settings. No significant artifacts were noted on S1 and S2 Safire images. Image noise was suboptimal in FBP 100 and 50 mAs images, whereas noise was acceptable with S1, S2 and S3 and better than average on S4 setting. Safire could render 100 mAs images as fully acceptable for diagnostic confidence but 50 mAs Safire images were deemed to have lower diagnostic confidence compared to 200 mAs. As compared to 50 mAs FBP, objective noise was lower by 22.8% (22.9/29.7) on S1, 35% (19.3/29.7) on S2, 44.3% on S3 (16.7/29.3) and 54.8% (13.4/29.7) on S4 (p<0.05).

CONCLUSION
Safire enabled reconstruction provides diagnostically acceptable abdominal CT images acquired at 100 mAs (50% reduced dose) but 50 mAs Safire images are not completely diagnostically acceptable despite reduced image noise.

CLINICAL RELEVANCE/APPLICATION
Radiation dose reduction down to 100 mAs is achievable with Safire enabled abdominal CT examinations.

LI-RADS M08A • Performance of LI-RADS Criteria for Diagnosis of Pathologically Proven Hepatocellular Carcinoma (HCC) Using Gd-EOB-DTPA: Can We Use Hepatobiliary Agents and Eliminate Tissue Diagnosis?

Stephanie Channual MD (Presenter); Anokh Pahwa MD; James Sayre PhD; Katrina R Beckett MD; David S Lu MD *; Steven S Raman MD

PURPOSE
To determine the performance of LI-RADS for the non-invasive diagnosis of HCC using Gd-EOB-DTPA MRI.

METHOD AND MATERIALS
This was an IRB approved, HIPAA compliant study with 84 consecutive suspected HCC nodules in 78 patients confirmed by percutaneous biopsy, resection, or explant within 90 days of Gd-EOB-DTPA MRI (EOB). Nodule size, presence of a capsule, signal intensity on T1-weighted imaging, and enhancement patterns were recorded. The nodules were then categorized as LI-RADS 3, 4, or 5 based on the LI-RADS v2013.1 ACR major criteria.

RESULTS
Of the 84 nodules, 76 were confirmed HCC (90.5%). A total of 15/84 nodules were categorized as LI-RADS 3, 27/84 as LI-RADS 4, and 42/84 as LI-RADS 5. Of these, 11, 25, and 40 nodules were pathologically proven as HCC, respectively (sensitivities 14%, 33%, and 53%, respectively; specificities 50%, 75%, and 75%, respectively). The PPV of LI-RADS 3, 4, and 5 were 73%, 93%, and 93%, respectively. The NPV of LI-RADS 3, 4, and 5 were 5.8%, 10.5%, and 14.3%, respectively. The accuracy of LI-RADS 4 and LI-RADS 5 combined was 82% (69/84).

CONCLUSION
Although use of LI-RADS v2013.1 ACR criteria with EOB yields a high PPV and accuracy for diagnosing HCC, moderate specificity and sensitivity suggest that further refinement of the criteria may be necessary and tissue biopsy may be complimentary for diagnosis.

CLINICAL RELEVANCE/APPLICATION
LI-RADS standardizes the diagnosis of nodules in cirrhotic livers using MRI with extracellular contrast agents, while its performance using Gd-EOB-DTPA, a hepatocyte-specific contrast, is unknown.
**LL-GUS-MO4A • Structured Reports for Rectal Cancer MR Staging: A Bottom Up Approach**

**Bandar O Safar MD (Presenter) ; Myra K Feldman MD ; Joseph C Veniero MD, PhD**

**PURPOSE/AIM**

By viewing this exhibit, the participant will:

- Understand the MR diagnostic criteria used to stage rectal cancer using the TNM classification system.
- Recognize tumor features that impact surgical planning.
- Develop an organized, thorough approach to interpreting rectal cancer MR staging studies.
- Employ structured reporting when interpreting rectal cancer MR studies to clearly communicate findings essential for staging and surgical planning.

**CONTENT ORGANIZATION**

Our institution's structured report for rectal cancer staging will be provided. Each entry of the structured report will be discussed separately with emphasis on its importance for staging and surgical planning. Examples will be used to illustrate the spectrum of findings for each section of the structured report. Rectal anatomy and our rectal cancer MR protocol will also be reviewed.

**SUMMARY**

Rectal cancer can be accurately staged using preoperative magnetic resonance imaging. When interpreting these studies, the radiologist must clearly communicate findings essential for accurate staging and surgical planning. Structured reports (table 1) provide a clear format to communicate information needed by surgeons and oncologists to determine treatment options.

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**GU**

**LL-GUS-MOA • AMA PRA Category 1 Credit ™:0.5**

**Host**

Naoki Takahashi , MD *

**LL-GUS-MOA1 • Fusion of T2-weighted and Diffusion-weighted MR Imaging in Evaluation of Myometrial Invasion and Overall Staging in Endometrial Cancer**

**Yu Guo (Presenter) ; Wang Penghui ; Wang Ping ; Shen Wen ; Qi Ji MD, PhD**

**PURPOSE**

To evaluate the efficacy of uterine adenomyosis treatment using magnetic resonance guided focused ultrasound surgery (MRgFUS) as a minimvasive therapy, MRgFUS as an Alternative Method to Hysterectomy in Uterine Adenomyosis: Clinical Results and Technical Approach

**METHOD AND MATERIALS**

Fifty-eight patients with endometrial carcinoma who had undergone preoperative MR imaging, including conventional MR and DW MR imaging ( b =0 and 1000 s/mm2 ) were enrolled. Interpreted the depth of myometrial invasion and overall stage on T2WI imaging and T2WI-DWI fused imaging, respectively compared the agreement with postoperative pathology by using Kappa test. T2WI imaging and T2WI-DWI fused imaging were compared by using X 2 test for accuracy assessment, and receiver operating characteristic curve for diagnostic performance.

**RESULTS**

For evaluating the depth of myometrial invasion, T2WI-DWI fused imaging was significantly better compared with T2WI imaging alone. The diagnostic accuracy of T2WI-DWI fused imaging was 94.8%, higher than T2WI imaging which was 77.6% (P<0.05). CNR of renal artery were R24.75±6.25 and L24.55±6.41(group A) versus R25.16±3.67 and L24.73±3.92(group B),tR=0.18,P=0.86,tL=0.08,P=0.94,

**CONCLUSION**

Fusion of T2-weighted and Diffusion-weighted MR Imaging provide higher sensitive and diagnostic accuracy in evaluating the depth of myometrial invasion, and has higher staging accuracy and diagnostic performance compared with T2WI imaging. Fusion of T2-weighted and Diffusion-weighted MR Imaging may become a no-wounds and no-contrast agent enhancement method, providing a new choice for the diagnosis of endometrial cancer.

**CLINICAL RELEVANCE/APPLICATION**

Fusion of T2-weighted and Diffusion-weighted MR Imaging may become a no-wounds and no-contrast agent enhancement method, providing a new choice for the diagnosis of endometrial cancer.

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**LL-GUS-MO2A • The Value of Spectral CT Curve for Differentiating Metastases from Adenoma in Adrenal Glands**

**Ye Ju (Presenter) ; Ailian Liu MD ; Meiyu Sun ; Yijun Liu ; Sheng Wang ; Renwang Pu MBBCh, FRCP**

**PURPOSE**

METHOD AND MATERIALS

Fifty-eight patients with endometrial carcinoma who had undergone preoperative MR imaging, including conventional MR and DW MR imaging ( b =0 and 1000 s/mm2 ) were enrolled. Interpreted the depth of myometrial invasion and overall stage on T2WI imaging and T2WI-DWI fused imaging, respectively compared the agreement with postoperative pathology by using Kappa test. T2WI imaging and T2WI-DWI fused imaging were compared by using X 2 test for accuracy assessment, and receiver operating characteristic curve for diagnostic performance.

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**CLINICAL RELEVANCE/APPLICATION**

Fusion of T2-weighted and Diffusion-weighted MR Imaging may become a no-wounds and no-contrast agent enhancement method, providing a new choice for the diagnosis of endometrial cancer.

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**LL-GUS-MO3A • Feasibility Study of Low kVp CT Scans Association with Iso-osmolar Low Concentration Contrast Media Applied in Renal Artery Imaging**

**Ying Guo (Presenter) ; Dapeng Shi MD ; Shaocheng Zhu MA ; Minghua Sun**

**PURPOSE**

To investigate the feasibility of low kVp CT scans with iso-osmolar low concentration contrast media applied in renal artery imaging.

**METHOD AND MATERIALS**

Fifty-eight patients with endometrial carcinoma who had undergone preoperative MR imaging, including conventional MR and DW MR imaging ( b =0 and 1000 s/mm2 ) were enrolled. Interpreted the depth of myometrial invasion and overall stage on T2WI imaging and T2WI-DWI fused imaging, respectively compared the agreement with postoperative pathology by using Kappa test. T2WI imaging and T2WI-DWI fused imaging were compared by using X 2 test for accuracy assessment, and receiver operating characteristic curve for diagnostic performance.

**RESULTS**

For evaluating the depth of myometrial invasion, T2WI-DWI fused imaging was significantly better compared with T2WI imaging alone. The diagnostic accuracy of T2WI-DWI fused imaging was 94.8%, higher than T2WI imaging which was 77.6% (P<0.05). CNR of renal artery were R24.75±6.25 and L24.55±6.41(group A) versus R25.16±3.67 and L24.73±3.92(group B),tR=0.18,P=0.86,tL=0.08,P=0.94,

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**CLINICAL RELEVANCE/APPLICATION**

Fusion of T2-weighted and Diffusion-weighted MR Imaging may become a no-wounds and no-contrast agent enhancement method, providing a new choice for the diagnosis of endometrial cancer.

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**LL-GUS-MOA4 • MrgFUS as an Alternative Method to Hysterectomy in Uterine Adenomyosis: Clinical Results and Technical Approach**

**Fabiana Ferrari MD (Presenter) ; Anna Miccoli MD ; Francesco Arrigoni ; Eva Fasceatti MD ; Giulio Mascaretti MD ; Antonio Barile ; Carlo Masciocchi**

**PURPOSE**

To evaluate the efficacy of uterine adenomyosis treatment using magnetic resonance guided focused ultrasound surgery (MrgFUS) as a minimvasive therapy, alternative to hysterectomy.

**METHOD AND MATERIALS**

From October 2011 to March 2013, 54 patients aged between 24 and 51 (mean age 37.5), with symptomatic adenomyosis and uterine fibroids were treated with MrgFUS, in our department. This study includes 18 patients affected only by adenomyosis. Symptomatology was assessed through the symptoms severity score questionnaire. The technical plan was characterized by the use of a high-energy-grid-sonication. The mean energy delivered for each patient...
During our investigation period, 9.7±2.8 emergent studies were performed per month and 73% had documentation that results were verbally communicated.

RESULTS

4-hour time requirement was calculated as the number of studies that met the requirement compared to the total number of emergent studies performed. Documentation of verbal communication were considered to have not met the time requirement. Data was sorted by month and the frequency of meeting the time requirement was calculated.

Studies were categorized by whether or not the results were verbally communicated within 4 hours of the study being ordered. Studies without clear documentation of verbal communication to the primary team were recorded.

METHOD AND MATERIALS

The written reports of all in-patient emergent Nuclear Medicine studies performed from January 1, 2012 through December 31, 2012 were identified in our department's computer database. The time the study was ordered and the time the results were verbally communicated to the primary team were recorded.

PURPOSE

To evaluate the efficacy of utilization management (UM) in reducing unnecessary medical radiation through ensuring that exams that irradiate patients are not performed inappropriately or unnecessarily.

METHOD AND MATERIALS

The results of a UM program administer by a radiology benefit management company for a national health insurance plan for nearly 5 million subscribers across the USA were examined for two recent consecutive years. The radiation averted by avoiding inappropriate or unnecessary CT was expressed in terms of posteroanterior chest x-ray equivalents (CXREs) using a consistent conversion factor relating the radiation from CT to CXREs. The number of CTs avoided each day was derived from the sum of the number of CTs requested that were withdrawn and the number of CTs requested that were changed to a more appropriate modality (such as MRI or ultrasound).

RESULTS

In the first year, 8,628 CTs were withdrawn and 2,412 were changed to a different modality, sparing approximately 3.3 million CXREs. In the second year, 10,635 CTs were withdrawn and 2,643 were changed to a different modality, sparing approximately 4.0 million CXREs. In total, approximately 7.3 million CXREs were spared.

CONCLUSION

Oversight to assure the judicious use of CT averted unnecessary radiation exposure equivalent to over 7 million chest x-rays over 2 years for one health plan.

CLINICAL RELEVANCE/APPLICATION

Analysis of CT data using dedicated post processing techniques allows good preoperative prediction of preserved renal mass and with correlation to operative and functional outcomes.
George L Shih

We review the common nonparametric tests used in radiology research with practical examples.

SUMMARY

9. Spearman Rank Correlation test
   a. Categorical with nominal or ordinal scale: Chi-Square

8. Comparing More than Two Unrelated Samples:
   b. Categorical data with ordinal scale OR Continuous data with an interval/rational Scale: Two-way ANOVA (The Friedman Test)
   a. Categorical data with dichotomous scale: Cochran Q test

6. Comparing Two Unrelated Samples:
   a. Categorical data: Chi-Square and Fisher exact tests
   b. Continuous data with an interval/rational Scale: Wilcoxon rank sum test (Mann-Whitney U-Test)

4. One Sample with Two Paired Measurements
   a. Dichotomous scale: McNemar test
   b. Ordinal scale: Sign test

3. Why are nonparametric tests popular in radiology research?

2. Parametric tests vs. nonparametric tests, advantages and limitations

1. What are nonparametric tests?

OBJECTIVES

1. List some commonly used nonparametric tests and explain their applications.

2. Understand the advantages and limitations of using nonparametric tests in radiology research.

3. Analyze real-world examples to illustrate the use of nonparametric tests.

4. Compare nonparametric tests to parametric tests in terms of assumptions and data requirements.

METHODS

1. Literature review of nonparametric test applications in radiology research.
2. Case studies illustrating the use of nonparametric tests in various radiology research contexts.
3. Discussion of the practical implications and limitations of nonparametric tests.

RESULTS

1. Commonly used nonparametric tests in radiology research.
2. Applications of nonparametric tests in specific radiology research scenarios.
3. Comparison of nonparametric tests with parametric tests in terms of effectiveness and practicality.

CONCLUSIONS

1. Nonparametric tests are valuable tools in radiology research for dealing with non-normally distributed data or small sample sizes.
2. Understanding the correct application of nonparametric tests is crucial to avoid misinterpretation of results.
3. Training radiology researchers in the use of nonparametric tests can enhance the validity and reliability of their research.

Clinical Relevance/Preclinical Application

1. Nonparametric tests can help in situations where assumptions of normality or homogeneity of variance are violated.
2. Realistic expectations of nonparametric tests' performance compared to parametric tests, especially in small sample sizes.
3. Importance of accurately specifying study designs and objectives in selecting appropriate statistical tests.

We seek to educate and encourage the use of nonparametric tests in radiology research for enhanced accuracy and practicality.

NONPARAMETRIC TESTS IN RADIOLgy CLINICAL RESEARCH

David A Rosman, MD (Presenter) *; Jose Gutierrez; William Barron; Brian Cerioni; Kristen L Dean; Giles W Boland, MD; Michelle H Dean; Natalie Egan; Thomas Rizzo; Garry Choy, MD, MS

PURPOSE

Provision of imaging services remains highly competitive. Understanding what drives referrals to an imaging facility is critical to successfully recruiting volume. We sought to characterize referring physicians' motivations for referring to a particular imaging facility. We also evaluated for any differences between in-network and out-of-network referrers.

METHOD AND MATERIALS

We deployed a 17-question survey to 4130 referring physicians to ascertain what factors drive referrals. The surveys were completed either by the physician, other health-services personnel or their secretarial staff. Responses were accepted via an electronic survey, fax or handout. Data was analyzed by in-network and out-of-network referrer to determine mean values for importance and performance in each category.

RESULTS

We received 677 responses from in-network and 141 from out-of-network (total 20% of those solicited). The top three factors driving patient referrals for in-network physicians were: quality of radiology reports, ease of scheduling an appointment and electronic access to radiology reports. The top three factors for out-of-network physicians included the quality of reports, ease of scheduling and the quality of images produced. In-network more than out-of-network referrers valued specialized fellowship-trained radiologists and electronic access to radiology reports. The helpfulness of the desk staff ranked in the top 50% for out-of-network referrers but in the bottom quintile for in-network referrers.

CONCLUSION

The quality of images and reports are equally important to in and out-of-network referrers when choosing an imaging facility. However, in-network providers are more focused on subspecialty reports whereas out-of-network referrers consider accessibility factors (reception staff /ease of scheduling an appointment) more important.

NONPARAMETRIC TESTS IN RADIOLgy CLINICAL RESEARCH

Elkan F Halpern, PhD *

PURPOSE

This exhibit provides a practical review of nonparametric statistical tests for clinical radiology researchers. The description of each statistical test will be accompanied by a clinical question that the statistical test would address.

SUMMARY

We review the common nonparametric tests used in radiology research with practical examples.
LL-INS-MO2A • Computerized Method for Detection of Swelling Lymph Nodes Adjacent to Colon Cancer on CTC Images: Preliminary Results
Mitsuru Sato (Presenter); Toshihiro Ogura PhD; Norio Hayashi PhD; Yoshiaki Yasumoto; Hyunjong Lim; Kunio Doi

CONCLUSION
Our computerized method based on a template-matching technique would be useful in assisting radiologist in the detection of lymph nodules adjacent to colon cancer on CTC.

Background
A major challenge in the current computer-aided detection (CAD) in CT colonography (CTC) is to detect polyps at a high sensitivity level. However, there is almost no reports regarding the detection of swelling lymph nodes on CTC images. Our purpose was to develop a novel CAD method for detection of swelling lymph nodes adjacent to tumor using a template-matching technique on CTC images.

Evaluation
For detection of swelling lymph nodes, our method was applied to reconstructed slab maximum-intensity-projection (MIP) images in orthogonal plane of virtual endoscopic images. Since CT artifacts of MIP images can be reduced compared with that of MPR images, CAD system can be developed for detection of round patterns on relatively low noise images. Our approach consisted of the following steps: 1) creation of templates by use of swelling lymph nodes, 2) initial candidate detection using template matching technique and, 3) reduction of false positives using image features. Our scheme was evaluated with use of FROC analysis.

Discussion
Since MIP images provided extra-luminal images by depicting blood vessels as linear patterns, blood vessels were removed easily. Since this method was applied to a large number of MIP images, it is possible to have a high sensitivity in the detection of swelling lymph nodes. The initial candidate detection before classification achieved a 100% (14/14) sensitivity in the detection of peripheral lymph nodes with 12 FPs per case. The subsequent feature selection removed 66.7% (8/12) of FPs without removal of lymph nodes in a leave-one-lesion-out cross-validation test; thus, a 100% sensitivity with 4 FPs per patient was achieved.

LL-INS-MO3A • Selection of Reference Images Based on the Similarity Map by a Multidimensional Scaling: Precision for 324 Independent Test Cases
Chisako Muramatsu PhD (Presenter); Tokiko Endo MD; Mikinao Oiwa; Misaki Shiraiwa MD; Kunio Doi; Hiroshi Fujita PhD

Purpose
Previously diagnosed cases with known pathologies can be used as a reference for diagnosis of a new lesion. In order for reference images to be useful, they must be similar to and belong to the same pathologic group as the unknown lesion. In this study, precision of our new image retrieval method was evaluated.

Method and Materials
In our previous study, a similarity measure for image retrieval was determined using an artificial neural network (ANN) that estimates radiologists' subjective ratings by image features. In this study, a similarity measure was determined on the basis of a multidimensional scaling (MDS) analysis. In both studies, subjective similarity ratings for 351 pairs of masses, all possible pairs for 27 images, by 8 experts were used. In the previous study, the average subjective ratings were used as teacher data for the ANN. In this study, the subjective similarity ratings were linearly converted to dissimilarities and applied to MDS. Each dimension of the 3 dimensional MDS map was modeled by ANN with the image features. Parameters for ANN were determined by a leave-one-out cross-validation with the 27 cases. For evaluation, 324 independent test images were employed. Using the similarity measures, one to ten most similar images were retrieved for each test case. Results were compared in terms of an average precision, which is the fraction of the pathology-matched cases in the retrieved cases.

Results
Average precisions for the previous measure and MDS-based measures ranged from 0.70 to 0.69 and from 0.80 to 0.79, respectively, when the number of retrieved images was varied from 1 to 10. The precision for MDS-based method can be considered high despite the small number of training cases. Although the precision varies between cases, on average, 4 out of 5 retrieved cases were retrieved from the same pathologic group as an inquiry case.

Conclusion
Although ANN was used in both methods, MDS analysis may be advantageous by breaking down the complicated similarity relationship to several characteristic dimensions. Reference images retrieved by using the proposed similarity measure may be useful in the diagnosis of a new lesion.

CLINICAL RELEVANCE/APPLICATION
Automated image retrieval may be useful for providing reference images in clinical practice and in education.

LL-INS-MO4A • A Picture Is Worth a Thousand Words: Needs Assessment for Multimedia Radiology Reports in a Large Tertiary Care Medical Center
Lina Nayak MD (Presenter); Christopher F Beaulieu MD, PhD; Daniel L Rubin MD, MS; Jafi A Lipson MD

Purpose
Radiology reports are the major, and often only, means of communication between radiologists and their referring clinicians. Radiology reports could include embedded images ("multimedia reports") though the value to referring physicians has not been studied. The purpose of this study is to identify referring physicians' preferences about radiology reports and quantify their perceived value of multimedia reports compared with narrative text reports.

Method and Materials
1800 attending physicians from a range of specialties at large tertiary care medical center were contacted by email and a hospital newsletter linking to a 25-question web-based electronic survey between July and November 2012. 160 physicians responded, yielding a response rate of 8.9%. Survey results were analyzed using Statistical Analysis Software (SAS Institute Inc, Cary, NC).

Results
142 out of the 160 referring physicians respondents (89%) indicated a general interest in reports with embedded images and completed the remainder of the survey questions. 103 out of 142 respondents (73%) agreed or strongly agreed that reports with embedded images could improve the quality of interactions with radiologists. 97 out of 142 respondents (68%) agreed or strongly agreed that having access to the significant/key images embedded in an electronic version of the text report would significantly reduce the time required to understand/process the information in the report. 129 out of 142 respondents (91%) agreed or strongly agreed that having access to the significant/key images when reviewing a text-based report enhances understanding of the report content. Regarding physician satisfaction, 110 out of 142 respondents (77%) agreed or strongly agreed that multimedia reports would significantly improve referring physician satisfaction, and 85 out of 142 respondents (60%) felt strongly or very strongly that multimedia reports would significantly improve patient care and outcomes.

Conclusion
There are three Clouds. Two of them are designed for storage and the third one is for applications. These Clouds will be resided in two locations and connected.

Myths Against Cloud Computing

The following grading system was used: 1 = 'should never pass', 2 = 'passable/acceptable', and 3 = 'no need for improvement/perfect'. Factors reviewed were mottle, motion, density, and contrast. Positioning errors were not considered. 12 cases were then reviewed a second time on each system for intra observer agreement assessment. The scores were analyzed with a multifactor Analysis of Variance (ANOVA) procedure taking into account the effects for Monitor type, Evaluator, and image. The interaction between Monitor and Evaluator was also included in the model. Absolute agreement assessed on test/test cases.

RESULTS

The average quality score on the TW is significantly higher than for the DW system, (F=74.33, p = .012). There was no significant interaction between Monitor Type and Evaluator (F = 1.73, p = .178). Monitor effect was constant across the 3 evaluators. There was a significantly higher intraclass agreement with the DW system.

CONCLUSION

There is a statistically significant difference for QA scores given by technologists for quality of CR images when viewed on a color monitor when compared to the gray scale diagnostic monitors. Precision was higher with the gray scale DW system.

CLINICAL RELEVANCE/APPLICATION

The addition of a gray scale monitor may improve the precision and accuracy of technologist assessment on image quality prior to submission for radiologist interpretation.

Short Title: Protected Health Information on Posted Obstetric Ultrasound Images: An Analysis of Information Security among Physicians

Loyirik Temiyakarn MD (Presenter) ; Harris L Cohen MD ; Aisim F Choudhri MD

CONCLUSION

Obstetric ultrasound images posted on publicly accessible websites often result in inadvertent disclosure of protected health information. Radiologists are well positioned to educate patients on taking charge of their own information security.

Background

With the increasing availability of high quality camera phones and mobile devices, patients now have greater access to their own imaging and ability to capture screenshots at the point of care. A particularly common scenario is the new mother who uses a mobile device to obtain an image of her obstetric (OB) ultrasound and then directly posts the images to a public website or forum. The oft-overlooked concern is the public posting of protected health information, now publicly available for any would-be identity thief to take.

Evaluation

A consecutive series of OB ultrasound images were acquired from a publicly accessible website and analyzed using several criteria, including method of image capture, visibility of patient name, date of birth, imaging institution, date of exam, time of exam, estimated due date, and whether any attempt was made to obscure such data. A large percentage of images sampled were found to include protected health information in some form, such that a savvy individual could harvest enough personal information to perpetrate identity theft.

Discussion

Many patients may not realize or even care about the implications their simple image post may have. While patients are ultimately responsible for their own information security, as radiologists are well positioned to educate patients on simple measures they can take to prevent inadvertent posting of protected health information, such as proper framing, cropping, and photo editing.

Quality Assurance Scoring of Computed Radiography Images: Comparison of Gray Scale and Color Monitors during Image Processing

Jonathan Borders ; David Agard PhD ; Carly Smith RT ; Marcia Flaherty RT

PURPOSE

Technologists usually perform quality assurance (QA) at the acquiring workstation, using lower resolution color monitors compared to gray scale higher resolution monitors found on diagnostic workstations. We noticed that some computed radiographic (CR) images seemed adequate on the technologist workstation (TW) but not in a diagnostic workstation (DW). We wanted to test the effect of monitor type on image QA scoring by technologists.

METHOD AND MATERIALS

100 CR examinations performed at one institution were collected prospectively over a 5 day period. All images were taken on a single system by two technologists not included in this study. Each case was reviewed by 3 radiology technologists twice. One viewing was on a gray scale Barco 3220D monitor (1536x2048) and the other on a color HP LA2206x monitor (1920x1080). Both systems used an HP 6700 tower, Windows XPpro, with McKesson HRS-A version 11.6 software. Order of image viewing was randomized for each reviewer at each sitting with a two week delay between viewings to minimize case recall.

Evaluation

Based on the ISO 27001 requirements, the medical data, its DBMS, and log files are our most important concern.

CONCLUSION

The addition of a gray scale monitor may improve the precision and accuracy of technologist assessment on image quality prior to submission for radiologist interpretation.

CLINICAL RELEVANCE/APPLICATION

There is a statistically significant difference for QA scores given by technologists for quality of CR images when viewed on a color monitor when compared to the gray scale diagnostic monitors. Precision was higher with the gray scale DW system.

Clinical Impact of Owning a Data Warehouse System

Jesse S Guglin ; Suranarong Kamtasila ; Regina Shirley RT ; Eric A Brandser MD (Presenter) ; David Agard PhD ; Carly Smith RT ; Marcia Flaherty RT

CONCLUSION

The average quality score on the TW is significantly higher than for the DW system, (F=74.33, p = .012). There was no significant interaction between Monitor Type and Evaluator (F = 1.73, p = .178). Monitor effect was constant across the 3 reviewers. There was a significantly higher intraclass agreement with the DW system.

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CLINICAL RELEVANCE/APPLICATION

The addition of a gray scale monitor may improve the precision and accuracy of technologist assessment on image quality prior to submission for radiologist interpretation.

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A consecutive series of OB ultrasound images were acquired from a publicly accessible website and analyzed using several criteria, including method of image capture, visibility of patient name, date of birth, imaging institution, date of exam, time of exam, estimated due date, and whether any attempt was made to obscure such data. A large percentage of images sampled were found to include protected health information in some form, such that a savvy individual could harvest enough personal information to perpetrate identity theft.

Discussion

Many patients may not realize or even care about the implications their simple image post may have. While patients are ultimately responsible for their own information security, as radiologists are well positioned to educate patients on simple measures they can take to prevent inadvertent posting of protected health information, such as proper framing, cropping, and photo editing.
**Model-based Iterative Reconstruction in Optimizing Image Quality of Pelvic CT**

*Presenter: Benjamin L Yam*

**Background**
Teaching files, formal presentations, and collections of interesting cases are used to teach radiology residents and fellows. However, such materials provide only a small subset of images in order to feature noteworthy findings, whereas to make a diagnosis in regular clinical practice requires reviewing multiple stacks of images. To more effectively test the ability of trainees to recognize abnormalities on musculoskeletal MRI and CT, we developed a mobile application that presents a mixed array of normal and abnormal exams. To replicate the way they would be viewed on a PACS workstation, all cases are presented as scrollable image stacks. Presenting this content on a mobile platform enables radiology trainees to practice outside the reading room while still simulating clinical practice.

**Evaluation**
Multiplanar image stacks from musculoskeletal MRI and CT scans are randomly presented in a scrollable image viewer. Cases are classified as basic or advanced. For each case, the app allows the user to scroll through the image stack on a mobile device as if reviewing at a workstation. Once the images have been reviewed, the possible diagnoses can be revealed as a multiple-choice quiz, but only after the case images are hidden! This is intended to simulate daily practice, during which each patient’s study does not arrive with a multiple-choice list of possible diagnoses, which can sequentially be eliminated. A running score is tallied as the trainee reviews each case. At the end of the quiz, the answers are revealed by way of explanation.

**Discussion**
We have created a mobile-friendly test of visual perception for musculoskeletal imaging that presents joint, extremity, and spine MRI and CT scans as they would be viewed on a PACS workstation.

**Conclusion**
This mobile application provides an approach to giving radiology trainees additional opportunities to practice their diagnostic skills outside the reading room. The app can potentially be used as a performance tracker during training, as well as be extended to other modalities and subspecialties.

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**Comparison-Bot: An Automated Preliminary-Final Report Comparison System**

*Presenter: Amit D Kalaria*

**Background**
Regular comparison of preliminary to final reports is a critical part of radiology resident and fellow education as prior manual comparisons have documented substantial preliminary to final discrepancies. Unfortunately, there are many barriers to this comparison: high study volume; overnight rotations without an attending; the ability to finalize reports remotely; the subtle nature of many changes; and the loss of the preliminary report after finalization.

**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 radiology report messages and parses report data into a MySQL database separated by preliminary and final status. A Bash (GNU) script queries all preliminary reports over a desired time period, finds the associated final report, evaluates for differences, compiles positive difference reports by radiologist, and emails these reports automatically.

**Discussion**
Our system automatically compiles and emails a weekly summary of report differences for all residents and fellows. Differences between preliminary and final report are clearly highlighted with links to the associated study in PACS for efficient review and learning. This provides an easy way to review changes to preliminary reports with immediate access to the associated images. We hypothesize that this will improve our education and learning experience and may also decrease discrepancy rates over time. A comparison of discrepancy rates prior to and after implementation of this system with prospective discrepancy rates will be presented to quantify impact. Subjective resident and fellow survey results regarding opinions of the weekly report and how it affects their education and learning experience will also be summarized across PGY levels. We will continue to refine our discrepancy algorithm to try and more intelligently distinguish significant differences and prioritize the presentation order in the weekly reports.

**Conclusion**
We believe this system will improve our department education and learning experience and will hopefully reduce future radiology report discrepancy rates.
LL-MKS-MO2A  •  An MRI Evaluation of Piriformis Muscle Modifications Induced by Botulinum Toxin (Botox) Injections

Mohammed A Alshaikh (Presenter) ;  Fabrice Michel MD, PhD ;  Bruno A Kastler MD, PhD ;  Sebastien L Aubry MD, PhD

PURPOSE
Botox injection is a new treatment of the piriformis muscle syndrome and the modifications of the piriformis muscle treated by Botox injection or by surgical desinsertion.

METHOD AND MATERIALS
Seventeen patients presenting with a piriformis muscle syndrome treated either by Botox injection or surgery, and who benefited from an MRI were retrospectively (mean age 43 y/o). The following parameters were assessed and compared to a normal contralateral muscle: maximal thickness and volume of piriformis muscle, and its fatty infiltration according to Gouttailler's classification.

RESULTS
The affected side showed a significant reduction in thickness (p < 0.05).

CLINICAL RELEVANCE/APPLICATION
To our knowledge, our study is the first that shows quantitatively the effect of infiltration therapy by Botox over the piriformis muscle: atrophy and fatty infiltration.

LL-MKS-MO3A  •  Analysis of Ischial Spine Orientation in Patients with Compression-mediated Pudendal Neuropathy: A Study Using 3D Computed Tomography

Lina Chen MD (Presenter) ;  Richard P Marvel MD ;  Howard M Richard MD

PURPOSE
The pudendal nerve is a predominately sensory nerve arising from s2-4 nerve roots. Several potential sites of entrapment lie along the course of the nerve. One critical zone of compression is adjacent to the ischial spine and sacrotuberous ligament. We hypothesize that variations in bony anatomy of the ischial spine may predispose patients to pudendal nerve compression.

METHOD AND MATERIALS
In this IRB-approved study, CT of the bony pelvis in 32 women were retrospectively reviewed, including 16 patients (ages 22-78 y; mean = 54.3 +/- 15 y) diagnosed with pudendal nerve compression syndrome and who underwent pudendal nerve block; 16 patients (ages 22-94 y; mean 64 +/- 19 y) who presented with trauma but had no documented neurologic symptoms.

RESULTS
Of the CT measurements, the difference in the angle between the ischial spine and inner pelvic wall was found to be statistically significant between the control and neurolgia patients. Right side: neurolgia 126 +/- 4.8 degrees, control 135 +/- 4.9, P = 0.015; left side: neurolgia 126 +/- 2.4, control 134 +/- 5.4, P = 0.044). Intra-observer correlation coefficient was r = 0.80.

CONCLUSION
Assessment of the orientation of ischial spine using 3D CT may help identify patients at risk of developing pudendal compression neuropathy.

CLINICAL RELEVANCE/APPLICATION
This study demonstrates potential application of clinical 3D CT in identify patients at risk of developing pudendal compression neuropathy.

LL-MKS-MO4A  •  Is Accurate Metal Artifact Reduction Feasible at 3T? A Comparison Study between 3T and 1.5T

Lorenzo Nardo MD (Presenter) ;  Misung Han ;  Sonia Lee MD ;  Ursula R Heilmeier MD ;  Kevin Koch PhD * ;  Thomas M Link MD, PhD ;  Roland Krug PhD

PURPOSE
Given its higher signal-to-noise-ratio high field MRI at 3 Tesla is increasingly used for musculoskeletal applications, however, metal artifacts and related image distortions are also more pronounced at 3.0T. We therefore studied the impact and the feasibility of metal artifact reduction sequences at 3.0T as compared with 1.5T.

METHOD AND MATERIALS
Twenty patients (aged 58-76) with total hip replacements were scanned at 1.5T and 3.0T within a period of 2 weeks. For signal acquisition, 8-channel phased-array cardiac coils were used on both scanners. The sequence protocol included: multiacquisition variable-resonance image combination (MAVORIC) PD (coronal), MAVORIC STIR (axial) as well as standard FSE sequences. Each study was assessed by 2 radiologists for morphological abnormalities (joint effusion and neuralgia patients). Right side: neuralgia 124+/-5.4, control 135+/-4.9, P < 0.05; left side: neuralgia 126+/-5.4, control 134+/-4.9, P = 0.044). Intra-observer correlation coefficient was r = 0.80.

RESULTS
While the extent of artifacts was significantly smaller at 1.5 T compared to 3.0 T (p < 0.05): average scores ranged between 2.5 and 3.4 at 1.5 T and between 2.6 and 3.3 at 3.0 T. Also the assessment of morphological abnormalities was not significantly different between the two field strengths (p > 0.05) with average scores ranging between 2.5 and 3.0 at 1.5 T and 2.5 and 3.6 at 3.0 T. Inter-reader agreement for different anatomic details and clinical findings visualization ranged between k = 0.65 and k = 0.90.

CONCLUSION
Though artifacts were larger at 3.0T compared to 1.5 T, the visualization of morphological abnormalities and anatomic details was not significantly different between the two field strengths.

CLINICAL RELEVANCE/APPLICATION
3.0 T metal artifact reduction showed no significant difference in detection of morphological abnormalities and anatomic details when compared to 1.5 T.

LL-MKS-MO5A  •  Anterior Knee Pain Syndrome: May One and Simple Measurement Using Weight-bearing MRI Unmask Patellar Maltracking in Your Patients Negative at Standard-MRI?

Silvia Mariani MD (Presenter) ;  Alice La Marra MD ;  Stefano Necozione MD ;  Vittorio Calvisi MD ;  Antonio Barile ;  Carlo Masciocchi

PURPOSE
To prove that weight-bearing (WB)-MRI may unmask a patello-femoral maltracking with respect to standard-MRI and to define which measurement of patellar alignment is the most reliable.

METHOD AND MATERIALS
Totally 23 consecutive patients were chosen and underwent plain and contrast-enhanced pelvic CT with automated tube current modulation (ACTM). The images were reconstructed with filtered back projection (FBP group), adaptive statistical iterative reconstruction (ASIR) group 50% and MBIR (MBIR group), respectively. Image noise and CT values of bladder, ilium, gluteus maximus and subcutaneous fat were measured. The image quality was evaluated using 5-point scale. Those results among the 3 different reconstructions were compared by one-way ANOVA and Wilcoxon signed-rank tests.

RESULTS
CT value in three groups had no significant difference (P > 0.05). The image noise in MBIR group was lower than that in ASIR group (P < 0.05). MBIR can improve the overall image quality and may reduce ~77% radiation dose of pelvic CT.

CLINICAL RELEVANCE/APPLICATION
MBIR can improve the overall image quality and may reduce ~77% radiation dose of pelvic CT.
RESULTS

Group A patients showed no statistically significant variations at all measurements both on standard and WB-MRI. On the basis of standard MRI-measurements, Group B patients were divided in Group B1 (23 pts) (negative or positive at 1 measurement) and in Group B2 (52 pts) (positive at 2 or more measurements). After WB-MRI, patients of Group B1 were divided in Group B1a (6 pts) if they remained positive at 0/1 measurement and in Group B1b (17 pts) if they became positive at 2 or more measurements. All patients of Group B2 confirmed to be positive at 2 or more measurements at WB-MRI. Qualitative statistical analysis (K-Cohen) demonstrated that LPT was the best predictive measurement (k=0.278) between standard and WB-MRI. Quantitative statistical analysis (Coefficient of variations from duplicate measurements) showed that LPT (for Group B1=60.3%) and LPA (for Group B2=69%) were the most reproducible and clinically useful measurements.

CONCLUSION

The study demonstrates both the high diagnostic value of WB-MRI in unmasking PF-maltracking and the best predictive value of LPT measurement.

CLINICAL RELEVANCE/APPLICATION

This study demonstrates that WB-MRI (using LPT measurement) may be very useful in unmasking patello-femoral maltracking in patients with negative standard MRI.

LL-MKS-MO6A • Dynamic Sonography of the Anterosuperior Hip during Flexion, Adduction/Internal Rotation: A Pilot Study

Neil P Shah MD (Presenter); Catherine N Petchprapa MD; Roy Davidovitch; Jose Maria Raya Garcia Del Olmo PhD; Adler S Ronald MD, PhD

PURPOSE

Demonstrate the ability of real-time ultrasound to track the relationships between the acetabulum and femoral head (FH)/neck junction and evaluate labral morphology and femoral-labral relationship (FLR) during dynamic hip flexion (HF) and adduction/internal rotation (ADIR).

METHOD AND MATERIALS

Ultrasound (US) and magnetic resonance (MR) evaluation of 10 hips in 5 asymptomatic subjects (4 Females, 1 Male, mean age/range 30.1/22-39 years). US (ACUSON S2000™, Siemens Healthcare, Mountainview, CA); High resolution longitudinal images of the femoral neck recorded at the level of the iliopectos (IPT) and rectus femoris (RFT) tendons, and of the intervening anterosuperior (AS) labrum between them were acquired using 9 MHz linear phased array US transducer (TD). Dynamic US images, stored as cine clips, acquired in same orientation using 8 MHz small foot print sector US TD positioned between IPT and RFT during continuous passive HF to 45/90 deg (10 subjects), and 45/90 degrees HF plus 60 degrees ADIR (6 subjects). All sonographic imaging performed by one radiologist with expertise in MSK US. MR: Coronal, axial oblique fat suppressed proton density images of each hip (SKYRA; Siemens, Mountainview, CA, phased array coil, TR/TE 2800/37). Consensus review of static US for appearance of AS labrum and chondrolabral junction (CLJ), and dynamic US for FLR, course of FH motion, presence of bony conflict. MR images evaluated for presence/absence of labral/CLJ pathology, cam lesion.

RESULTS

STATIC STUDY: MR:(1:10) cam, (5:10) labral tears, (9:10) CLJ separations. US:(8:10) labral tears, (5:10) CLJ separations. DYNAMIC STUDY: Labrum visualized to 45 deg HF (10:10), 30 deg HF (0/10), and 45 deg HF/30 deg ADIR (5/6). Labrum remained apposed to FH surface up to 45 deg HF (10/10) and vertically displaced between 45-90 HF (3/10), FH rotated smoothly under acetabular rim (10/10);(0/10) bony conflict during F/ADIR.

CONCLUSION

Dynamic US can evaluate labrum and femoroacetabular relationships during dynamic 45 deg HF and 30 deg ADIR. FH rotates smoothly under acetabular rim without bone/soft tissue conflict, and labrum rides along the surface of the femoral head as the hip is flexed.

CLINICAL RELEVANCE/APPLICATION

Dynamic US combined with clinical hip examination for femoroacetabular impingement (FAI) can be used to evaluate subjects with FAI and pain.

LL-MKS-MO7A • Trabecular Bone Changes and Subclinical Secondary Osteoporosis Following Gastrectomy Detected by Multidetector CT

Miyuki Takasu MD (Presenter); Yukiko Honda MD; Shuji Date; Masao Kiguchi RT; Kenichiro Matusuzaki; Kazuo Awai MD *; Takahisa Suzuki; Kazuaki Tanabe

PURPOSE

Bone loss is a common disorder associated with gastric surgery, and a large number of postgastrectomy patients remain at risk for developing osteoporosis. The purpose of this study was to determine the prevalence of secondary osteoporosis (SO) and trabecular microstructural changes following gastrectomy using multidetector computed tomography (CT).

METHOD AND MATERIALS

Spinal microarchitecture was examined in patients post distal gastrectomy (n=92), patients post total gastrectomy (n=111), and in 85 sex- and age-matched control subjects. Bone mineral content (BMC) and bone mineral density (BMD) were measured in the lumbar vertebrae. Vertebral microarchitecture parameters obtained by clinical multidetector CT, together with bone mineral content measurement, provided useful information for assessing SO in post gastrectomy patients.

RESULT

The prevalence of SO were 29.1% for post distal gastrectomy and 33.8% for post total gastrectomy in males, and 51.6% for post distal gastrectomy and 53.8% for post total gastrectomy in females. There was significant increase in the prevalence of SO from control cohort, distal gastrectomy cohort, to total gastrectomy cohort (P<0.04 for males, P<0.02 for females). Multivariate regression analysis demonstrated that patients' age (P<0.001), sex (P<0.001), and lumbar BMD (P<0.001) were significant predictors for SO.

CONCLUSION

The prevalence of SO significantly increased from control group to total gastrectomy group. Patients’ age and sex were significantly related to the risk of SO after gastrectomy. Bone quality and failure load were significantly reduced in patients with SO.

CLINICAL RELEVANCE/APPLICATION

Vertebral microarchitecture parameters obtained by clinical multidetector CT, together with bone mineral content measurement, provided useful information for assessing SO in post gastrectomy patients.

LL-MKE-MO8A • The Many, Atypical Presentations of Musculoskeletal Hepatocellular Carcinoma (HCC) Metastases

Mostafa M Elfan MD (Presenter); Hosny S Abdelghany MD

PURPOSE

To demonstrate many uncommon, non-classical clinical presentations of HCC that have been gathered from an endemic region in the Nile Basin.

METHOD AND MATERIALS

We will highlight cases of high quality MDCT performed for various clinical symptoms not classically associated with advanced or metastatic HCC and the role of image-guided biopsy in making these diagnoses. These will include: a) gradual progressive weakness of both lower limbs; b) Retrosternal pain not responding to medications; c) severe right hip pain; and d) progressive cheek swelling. These symptoms further corresponded to musculoskeletal abnormalities, not typically associated with HCC, including: a) lumbar spinal cord compression by an expansible vertebral body lesion; b) direct invasion of the chest wall; c) a large expansible metastasis of the right acetabulum; d) expansible rib lesions with underlying rib destruction, and e) painful cheek swelling.

RESULTS

Numerous patients with a range of non-specific musculoskeletal complaints and various clinical presentations whose final diagnosis was HCC. The clinical presentation was dependent on uncommon skeletal deposits which were most often expansile with the local effect of compression as the underlying cause for the odd presentation. The important role of MDCT and Histopathological assessment in making the correct diagnosis will be stressed.

CONCLUSION

HCC can often grow silently and may present late with an odd non-classical clinical presentation.

CLINICAL RELEVANCE/APPLICATION

HCC first presentation may be by a typical musculoskeletal manifestations like cord compression manifestation.
CONTENT ORGANIZATION
- Describe the origin of SHOD, and the emergence of barefoot/minimalist running styles.
- Describe the biomechanics of these running styles, and how they lead to distinct injury patterns.
- Review the specific imaging findings in injuries associated with barefoot/minimalist and tradition (SHOD) running.
- Conclusion and future research directions.

SUMMARY
- In recent years there has been exponential growth in barefoot/minimalist style running, based on claims it can decrease running related injuries. However, injuries distinct to barefoot/minimalist running are now being observed.
- A radiologic overview of barefoot/minimalist and traditional (SHOD) running is presented.

Neuroradiology/Head and Neck - Monday Posters and Exhibits (12:15pm - 12:45pm)

Monday, 12:15 PM - 12:45 PM • Lakeside Learning Center

LL-MSE-MOA • AMA PRA Category 1 Credit ™:0.5

LL-MSE-MOA7A • Many Different Faces of Graft versus Host Disease: Radiology-pathology Case Based Review

Ammar A Chaudhry MD (Presenter) ; Maryam Gul ; Abbas A Chaudhry BSc ; Jason Z Eisenberg MD ; Sandy A Itwaru ; Nabil Tahan MPH, BS ; Marlene L Zawin MD ; Jared Dunkin MD ; Almas Abbasi MBBS

PURPOSE/AIM
Case based review of acute and chronic GVHD involving the brain, spine, thoracoabdominal viscera and musculoskeletal system with radiology-pathology correlation.

CONTENT ORGANIZATION
Multiple different presentations of graft versus host disease will be shown involving the brain, spine, thoracoabdominal viscera and musculoskeletal system. We will discuss cases of similar appearing tumors (lymphoma, sarcomas, etc), infection, inflammation, and/or injury with an emphasis on key findings differentiating these entities. Radiology-pathology correlation of all the presented entities will be discusses as well.

SUMMARY
1- GVHD is a significant complication of BMT that can involve various organs.
2- Although GVHD carries a broad differential diagnosis, it can be narrowed utilizing age, clinical features, radiologic imaging characteristics (e.g. Location, enhancement pattern, necrosis, gradient signal on MRI, etc) and pathology correlation.
3- By the conclusion of this presentation, the radiologist and clinicians should have a better understanding of various clinical presentations of GVHD and associated imaging findings. What the radiologist needs to know, what should be conveyed in the radiology/ endoscopy report and recommended to the clinician. At the end, the viewer should also be able to aid in the workup, guide any potential biopsy and imaging follow-up.

Neuroradiology/Head and Neck - Monday Posters and Exhibits (12:15pm - 12:45pm)

Monday, 12:15 PM - 12:45 PM • Lakeside Learning Center

LL-NRS-MOA • AMA PRA Category 1 Credit ™:0.5

Host
Pratik Mukherjee , MD, PhD *


Elena Garcia Garrigos MD, PhD (Presenter) ; Juan Arenas MBBS ; Irene Monjas Canovas ; Javier De La Hoz ; Marilo Guirau Rubio MD ; Paloma Tallon Guerola

PURPOSE/AIM
Review the anatomical structures and variants the radiologist should demonstrate and indicate in a CT report when planning surgery for skull base lesions by endonasal approach.

CONTENT ORGANIZATION
Brief introduction of the anatomy and relationships of sphenoidal sinus and skull base structures. Explanation of neuronavigation CT protocol technique, parameters and multiplanar reconstruction. Discussion of indications, contraindications and anatomic aspects which increase the risk of complications during endoscopic endonasal trans-sphenoid surgery (EETS).

SUMMARY
EETS has grown rapidly in the last decades as a therapeutic modality for skull base lesions. Preoperative CT with neuronavigation protocol and multiplanar reconstruction provides an accurate depiction of tumor extension, associated bone changes and anatomic variants that are crucial for a safe and effective surgical treatment of skull base lesions by the endonasal route.

Neuroradiology/Head and Neck - Monday Posters and Exhibits (12:15pm - 12:45pm)

Monday, 12:15 PM - 12:45 PM • Lakeside Learning Center

LL-NRE-MO11A • 4-dimensional CT Assessment of Vocal Cord Palsy

Kenneth K Lau (Presenter) ; Theodore Lau

PURPOSE/AIM
Laryngoscopy has been the gold standard for diagnosing vocal cord palsy (VCP), but does not provide objective and quantitative assessment. Conventional multi-detector CT only allows structural analysis of the larynx and neck. The 320-multidetector CT (320-CT) enables dynamic viewing of larynx and airway. The aim of this exhibit is to demonstrate the usefulness of the 320-CT in diagnosing VCP.

CONTENT ORGANIZATION
320-CT over 1 breathing cycle and a phonation was performed on 26 patients with suspected VCP symptoms. There were 1/26 (3.8%) patients with bilateral VCP and 12/26 (46.2%) patients with unilateral VCP which were subsequently confirmed on laryngoscopy. The 320-CT demonstrated reduced abduction movement of affected vocal cords during breathing and phonation, with co-existing vocal cord thickenings, tilting, and medialization in all VCP patients. Dilatation of the ipsilateral pyriform sinuses and laryngeal vestibules was found in 76.9%. Other patients had laryngeal dysfunction (6/26), tracheobrochomalacia (3/21), excessive dynamic airway collapse (2/21), subglottic stenosis (1/21) and vocal cord tumour (1/21).

SUMMARY
320-CT is a non-invasive imaging tool providing accurate, prompt and objective assessment of vocal cord movement abnormality. It may be a potential alternative to the semi-invasive laryngoscopy for VCP diagnosis in future.

Neuroradiology/Head and Neck - Monday Posters and Exhibits (12:15pm - 12:45pm)

Monday, 12:15 PM - 12:45 PM • Lakeside Learning Center

LL-NRS-MOA1 • Arteriolar Elasticity Obtained from Spin-Echo Signal Fluctuations in the Human Brain

Minghui Tang (Presenter) ; Toru Yamamoto PhD

PURPOSE
To map arteriolar elasticity, we focused on arteriolar vasomotion driven by respiratory PaCO2 changes, and proposed a new method that uses spectral analysis of MR signal fluctuation.

METHOD AND MATERIALS
A single slice of a healthy volunteer’s head was imaged for 45 s by using a SE-EPI pulse sequence (TR = 250 ms) under a 1.5-T MRI system. The time course of MR signal at each pixel was Fourier-transformed to map the spectral intensities in the low-frequency (L: c) and the L map represents the product of P and fluctuations in V at respiratory frequencies: \( P(V) \). Therefore, the division map of R by C (R/C map) represents \( \{(rV)\} \) \( \{P\}_c \); while \( \{(rP)\}_c \) is global in the brain, \( \{(rV)\}_c \) reflects the local arteriolar elasticity. The division map of L by C (L/C map) was also obtained.
The R/C map was almost homogeneous with a standard deviation (SD) of 10%, showing normal arteriolar elasticity of a healthy volunteer. The SD of the L/C map increased to 13%, reflecting local neuronal activities at resting state.

CONCLUSION
Arteriolar elasticity could be mapped by using the spectral analysis of SE signal fluctuation.

CLINICAL RELEVANCE/APPLICATION
Arteriolar elasticity, which may predict the progression of dementia, is an important vascular property. Our results may provide a new MRI technique for mapping arteriolar elasticity.

LL-NRS-MO2A • High Intensity Zone between Globus Pallidus and Putamen on Phase Image: Marginal Division of Neostriatum in the Human Brain

Zhifei Chen BMedSci (Presenter) ; Mengyu Liu ; Lin Ma MD

PURPOSE
To investigated the functional and structural changes of marginal division (MrD) (high intensity zone between globus pallidus and putamen on phase image) with aging in the human brain

METHOD AND MATERIALS
RESULTS
MrD had the highest HIC (left: 2149.3±19.6; right: 2155.9±17.9) and LIC (left: 1996.6±18.2; right: 1999.6±20.7), the lowest LIC ratio (right: 21.5%±7.9%; right: 19.9%±10.0%), and the highest AIC (left: 2116.4±21.4; right: 2124.7±21.0), and also showed negative with aging. The width (Head: left/right 2.01±0.41 mm/1.86±0.36 mm; Body: left/right 1.84±0.38 mm/1.49±0.29 mm; Tail: left/right 1.17±0.36 mm/1.05±0.23 mm) and area (left/right 49.44±9.71 mm²/42.75±8.80 mm²) of MrD showed negative correlation with aging presenting gradually narrower pattern based on CIsPs. Average ADC value (left/right 0.69±0.04 mm²/s/ 0.71±0.03 mm²/s) revealed negative correlation, and FA (left, 0.19±0.03; right, 0.22±0.03) value revealed positive correlation with aging.

CONCLUSION
Functional and structure changes with aging based on CIsPs and DTI could offer a simple and effective tool for the evaluation of MrD in vivo in the human brain.

CLINICAL RELEVANCE/APPLICATION
CIsPs demonstrate that the functional and structural changes of MrD, and is recommended as an initial evaluation for MrD in the brain of health adults.

LL-NRS-MO3A • Long Term Evolution of MR Spectroscopy Following Severe Head Trauma

Aurélie Drier MD (Presenter) ; Omid Khailizadeh MD, MPH ; Rajiv Gupta PhD, MD ; Julien Dinkel MD ; Didier Dormont MD ; Louis Puybasset MD, PhD ; Damien P Galanaud MD, PhD *

PURPOSE
Severe traumatic brain injury (TBI) can lead to severe brain damage that can be assessed by multiple imaging methods including MR spectroscopy (MRS). However, the long-term evolution of the spectroscopic alterations measured at the acute phase is not well-known. In this study, we used 2D spectroscopy to evaluate grey matter changes over a span of 2-years after the injury.

METHOD AND MATERIALS
This study was approved by the institutional review board of our institution. Fifteen patients who survived after a severe TBI and had a favorable outcome (normal consciousness with minimal functional impairments) were included. The first MR examination (MRI 1) was performed 2 to 4 weeks after the trauma and included a 2D spectroscopic acquisition (TR=1500 ms, TE=135 ms). A second MRI (MRI 2) was performed 2 years after the trauma and included the same sequences. The N-acetylaspartate/ Creatinine (NAA/Cr) ratio was measured in the thalamus, the lenticular nuclei and the insular cortex. For statistical comparisons, right and left ratios were pooled for each region of interest. Data are presented as mean +/- SD.

RESULTS
The NAA/Cr ratio remained stable in the thalamus between the first and second examination (patients: MRI 2: 1.57 +/- 0.36 vs. MRI 1: 1.49 +/- 0.32, p=0.34 controls: 2.04 +/- 0.25) while this ratio increased in the lenticular nuclei (patients: MRI 2: 1.42 +/- 0.26 vs. MRI 1: 1.26 +/- 0.22, p=0.02, controls: 1.8 +/- 0.20) and the insular cortex (patients: MRI 2: 1.54 +/- 0.27 vs. MRI 1: 1.36 +/- 0.29, p=0.01, controls: 1.82 +/- 0.20).

CONCLUSION
The NAA/Cr ratio in the thalamus on the first MRI was not significantly decreased in this population with favorable outcome and remained stable. The decrease of the NAA/Cr ratio in the lenticular nuclei and the insula observed at the acute phase was partially reversed 2 years after the trauma.

CLINICAL RELEVANCE/APPLICATION
These results support the use of MRS as a marker to assess clinical recovery after severe TBI.

LL-NRS-MO4A • Imaging Genomic Biomarker Signature for MGMT Promotor Methylation Identification

Rivka R Colen MD (Presenter) ; Mark Vangel PhD ; Omar Ashour MD ; Pascal O Zinn MD

PURPOSE
To create an imaging biomarker signature in order to identify those Glioblastoma (GBM) patients with MGMT promoter methylation.

METHOD AND MATERIALS
Using The Cancer Genome Atlas (TCGA), we identified 78 treatment-naïve GBM patients whom had both gene- and microRNA expression profiles and pretreatment MR-neuroimaging from the Cancer Imaging Archive. The 3D Slicer software 3.6 (http://www.slicer.org) was used for image analysis and image comparisons, right and left ratios were pooled for each region of interest. Data are presented as mean +/- SD.

RESULTS
An imaging biomarker signature was created using multiple parameters, including the MR perfusion parameter of rCBV. Multiple parameters were associated with overall survival. An increase in rCBV in the non-enhancing FLAIR hyperintense portion was associated with the strongest survival difference (p< 0.03). An imaging biomarker signature was created using multiple parameters, including the MR perfusion parameter of rCBV. Multiple parameters were associated with overall survival. An increase in rCBV in the non-enhancing FLAIR hyperintense portion was associated with the strongest survival difference (p< 0.03).

CONCLUSION
The identification of a non-invasive imaging biomarker signature as a surrogate for MGMT promoter methylation can help stratify patients in therapy and predict response versus nonresponse to therapy.

LL-NRS-MO5A • Usefulness of 3D CISS Imaging at 3T for the Identification of Abnormal Vessels Associated with Spinal Dural Arteriovenous Fistulas

Hiroyuki Uetani ; Toshinori Hirai MD ; Yasuhiro Iryo ; Yutaka Kai ; Minako Azuma (Presenter) ; Yasuuki Yamashita MD *

PURPOSE
The purpose of this study was to compare the usefulness of 3D constructive interference in steady state (CISS) imaging at 3T with conventional MRI for the identification of abnormal vessels of spinal dural arteriovenous fistulas (SDAVF).

METHOD AND MATERIALS
We enrolled 9 consecutive patients (8 men, 1 woman; age range 58-78 years, mean 66 years) who underwent conventional MRI including sagittal and axial T1- and T2-weighted- and contrast-enhanced T1-weighted imaging (T1WI, T2WI, CET1WI) and sagittal 3D CISS imaging on a 3T unit prior to surgery. SDAVF confirmation was by intra-arterial digital subtraction angiography (DSA) in all patients. The SDAVF site was the thoracic region in 8 patients and the lumbar region in one. For 3D CISS imaging we obtained multplanar reconstructions in all patients. Two experienced neuroradiologists independently evaluated the scans for the presence of abnormal vessels on 3D CISS and conventional MR images using a 3-point grading system where grade 3 = definitely positive, grade 2 = probably positive, and grade 1 = equivocal or definitely negative. Final judgments were by consensus. Interobserver agreement was determined by calculating the \( \text{IC} \) coefficient where \( \text{IC} = 0.20 = \text{poor}, 0.21-0.40 = \text{fair}, 0.41-0.60 = \text{moderate}, 0.61-0.80 = \text{good}, 0.81-0.90 = \text{very good}, \) and \( \text{IC} > 0.90 = \text{excellent} \). Grading differences were assessed with the paired t test; \( P < 0.05 \) was considered to indicate a statistically significant difference.

RESULTS
For the presence of abnormal vessels, all cases were judged as grade 3 on 3D CISS images and as grade 1 at T1WI. On T2WI scans, 2 cases were grade 3, 5
CONCLUSION
For the identification of abnormal vessels of SDAVF, 3-T 3D CISS is more useful than conventional MRI.

LL-NRS-MO6A • Preliminary Evaluation of MR Diffusion Kurtosis Imaging at 3-Tesla for Head and Neck Squamous Cell Carcinoma: A New Monitoring Tool for Early Treatment Response

Yukie Shimizu (Presenter) ; Noriyuki Fujima MD ; Daisuke Yoshida ; Tomohiro Sakashita ; Akihiro Homma ; Kohsuke Kudo MD ; Hiroki Shirato MD, PhD

PURPOSE
The purpose of this study is to investigate the usefulness of 3-T MR diffusion kurtosis imaging (DKI) for the assessment of patients with head and neck squamous cell carcinoma (HNSCC).

MATERIALS AND METHODS
Eighteen patients who were pathologically diagnosed as HNSCC were included in this study. All patients were treated with super-selective arterial infusion of cisplatin with concomitant radiotherapy. TDK1 key underwent magnetic resonance imaging (MRI) using DKI sequence before the treatment and at the early treatment period (at time point of 15-25 Gyn total 65 Gy radiotherapy). All MR scanning was performed by using a 3-T unit (Achieva TX; Philips Medical Systems, Best, The Netherlands) with a 16-channel neurovascular coil. DKI was obtained by using single-shot echo planar diffusion weighted imaging with 4 different b values of 0, 800, 1000, 2000s/mm2. Three orthogonal motion probing gradient was used. The quantitative DK value of the tumor in each of the 18 patients was calculated using DKI datasets. The change ratio of DK value between pre-treatment and the early treatment period was also calculated. After the treatment, the patients were observed into complete remission (CR) group and the other five were into non-CR group judging from multi-modality assessment and clinical follow-up. Mean of value in pre-treatment, early treatment period, and its change ratio were compared between CR and non-CR groups using non-paired T-test.

RESULTS
The change ratio of DK value in CR group was significantly lower than non-CR group (0.78±0.13 vs 0.93±0.05, P<0.05).

CONCLUSION
DKI can be useful as monitoring tool for early treatment response for the assessment of patients with HNSCC.

CLINICAL RELEVANCE/APPLICATION
DKI can be used as monitoring tool for early treatment response for the patients with HNSCC by evaluating change ratio of DK value between pre-treatment and early treatment period.

LL-NRS-MO7A • Utility Assessment of Repeat Head CT in the Setting of Mild Traumatic Brain Injury Using a Natural Language Processing Tool

Jason M Johnson MD (Presenter) ; Tarik K Alkasab MD, PhD ; Daniel Yeh MD ; Pamela W Schaefer MD

PURPOSE
To assess the rate of which repeat head CT following mild traumatic brain injury revealed worsening of imaging findings using a natural language processing tool.

METHOD AND MATERIALS
Utilizing our institutional trauma registry, 824 adults with blunt TBI who arrived within 24 hours of injury, with arrival GCS > 12 with initial head imaging positive for traumatic findings were identified. Patients with initial operative management were excluded, and the all head CTs within 7 days of injury was identified. Each exam was evaluated using a natural language processing (NLP) tool designed for high sensitivity to identify reports describing worsening findings. Imaging reports for 114 patients were manually assessed by an experienced neuroradiologist and a Kappa score was calculated for agreement between the NLP tool and a human reader.

RESULTS
Of the 819 patients identified, 164 were removed for additional review for having less than 2 CT scans. An additional 30 patients were removed due to initial operative management. Of the remaining 625 patients, 287 had 2 CTs, 172 had 3 CTs and 166 had >3 CTs. Review of the NLP revealed 86% (98/114) algorithm concordance with neuroradiologist review. The majority of the errors (81.3%; 13/16) were NLP overcalls based on the report. Of the 626 patients with at least two CT scans, the second CT scan contained language suggesting worsening in 263 cases (42.0%).

CONCLUSION
A supervised NLP tool can be used in conjunction with a patient registry to identify language associated with worsening head CT findings. We expect to use this tool to further explore clinical factors associated with worsening imaging findings to improve imaging utilization patterns.

CLINICAL RELEVANCE/APPLICATION
This tool may be important for exploring image utilization patterns and outcomes for large populations.

LL-NRE-MO8A • A Simplified Algorithm for Diagnosis of Spinal Cord Lesions

Dhiraj Baruah MD (Presenter) ; Tushar Chandra MD ; Saurabh Guleria MD ; Andrew P Klein MD ; Mohit Maheshwari MD

PURPOSE/AIM
Lesions of the spinal cord are common including congenital, neoplastic, inflammatory, vascular and neoplastic causes. Aim of this review is to discuss the relevant anatomy from imaging standpoint with drawings/ images and important clinical and imaging points to formulate a diagnosis.

CONTENT ORGANIZATION
In this exhibit, we will first overview normal anatomy of spinal cord including its vascular supply. We will present a step by step guide including clinical and Magnetic Resonance Imaging (MRI) features to arrive at a diagnosis.

SUMMARY
An understanding of the normal anatomy and imaging characteristics of pathologies of spinal cord is important for making a diagnosis. This educational exhibit will facilitate development of an easy systematic approach for MRI evaluation of spinal cord lesions.

LL-NRE-MO9A • Methodology and Applications of CT and MR Perfusion Imaging in Patients with Head and Neck Cancer

Omar Parvez MD (Presenter) ; Naoko Saito MD, PhD ; Minh T Truong MD ; Jimmy W Wang MD ; Hernan Jara PhD * ; Akifumi Fujita MD ; Osamu Sakai MD, PhD *

PURPOSE/AIM
To review the current CT and MR perfusion imaging methods in head and neck cancer. Also to describe various clinical applications of CT and MR perfusion imaging in head and neck cancer.

CONTENT ORGANIZATION
1. Review of the current CT and MR perfusion imaging techniques being used to evaluate head and neck cancers including pros and cons for each technique: A)dynamic contrast enhanced CT perfusion, B)MR perfusion, I)With intravenous contrast: a)arterial spin labeling (ASL), b)intravoxel incoherent motion (IVIM), 2. Review of the clinical applications of CT and MR perfusion imaging in head and neck cancer: A)differentiation of tumor histology, B)monitoring tumor perfusion, C)prediction of tumor response to the treatment, D)evaluation of post-treatment tumor change, E)prediction and evaluation of treatment effect in the normal tissues.

SUMMARY
The major teaching points are:
1. Understanding of various techniques of CT and MR perfusion for head and neck cancers.
2. Understanding microvascular blood supply to the tumor as well as normal tissue that affects treatment response and side-effects.
3. Perfusion information may predict tumor response to various treatments, locoregional control, and treatment-related normal tissue injuries.

LL-NRE3131-MOA • DWI-MRI and PET-MRI after Radiation Therapy of Malignant Head and Neck Tumors: What the Radiologist Needs to Know

Arthur D Varouquaux MD (Presenter) ; Angeliki Ailianou ; Pavel D Dulguerov ; Olivier D Rager ; Karim Burkhardt ; Minerva Becker MD, PhD
1. To provide a comprehensive approach for the evaluation of patients irradiated for malignant head and neck tumors. 2. To understand key imaging features of radiation-induced complications. 3. To demonstrate the importance of DWI-MRI and PET-MRI for the detection of residual/recurrent tumors. 4. To understand potential pitfalls of image interpretation and how to avoid them.

**CONTENT ORGANIZATION**

The retrospective analysis of 124 patients who underwent DWI-MRI with PET-MRI formed the basis for this exhibit. The patients were imaged after radio(chemo)therapy for malignant head and neck tumors. Imaging findings were correlated with histology in 82 patients and radiologic follow-up in 42 patients. We discuss expected tissue alterations and complications affecting soft tissues, vasculature, neural tissue and bony structures. We illustrate typical findings of tumor recurrence with emphasis on early detection, added value of DWI-MRI and PET-MRI and provide histologic correlation for the understanding of imaging findings. Pitfalls of post-therapeutic image interpretation and how to avoid them are addressed.

**SUMMARY**

Interpretation of MRI findings after radiation therapy of head and neck cancers constitutes a diagnostic challenge. DWI-MRI and PET-MRI increase the diagnostic confidence for the early detection of recurrent tumors and help to avoid unnecessary biopsy.

### Obstetrics/Gynecology Posters and Exhibits (12:15 - 12:45pm)

Monday, 12:15 PM - 12:45 PM

**LL-OBE-MOA**

**LL-OBE-M07A • Diagnostic Strategy for Cystic Masses in the Female Pelvis: A Comprehensive Review and Diagnostic Impact of Advanced MR Techniques**

Mayumi Takeuchi MD (Presenter) ; Kenji Matsuzaki MD, PhD ; Masafumi Harada MD, PhD

**PURPOSE/AIM**

Various benign and malignant tumors and tumor-like lesions in the female pelvis may appear as cystic masses. We describe the optimized MR protocol for evaluating cystic masses and the added value of advanced MR techniques in identifying the tumor origin, distinguishing benign and malignant lesions, determining specific histological subtypes, and for the planning of adequate treatment.

**CONTENT ORGANIZATION**

Pathological spectrum of cystic pelvic masses

Advanced MR techniques: CSI, SWI, MRS, DCE-MRI

Evaluation of cystic components: serous, mucinous, fatty, keratinous, pyogenic or hemorrhagic?

Practical decision tree in making differential diagnosis

Clinical outcomes and therapeutic strategy

**SUMMARY**

1. Combining conventional and advanced MR techniques can improve the diagnostic ability in determining specific tissue characterization of cystic pelvic masses.
2. By using advanced MR techniques, the characterization of cystic materials (water/fat separation by CSI, blood-sensitive SWI, water diffusion restriction in pus or epidermoid cyst by DWI, metabolite evaluation by MRS: N-acetyl mucinous compounds in mucinous material, lipid in dermoid cyst or abscess, succinate and acetate for anaerobic bacterial infection) and the evaluation of cyst wall [The presence of minute mural nodules by DCE-MRI and DWI] may lead to accurate diagnosis for the adequate treatment.

### Physics - Monday Posters and Exhibits (12:15pm - 12:45pm)

Monday, 12:15 PM - 12:45 PM • Lakeside Learning Center

**LL-PHS-M04A • 3D BRAVO Category 1 Credit ™: 0.5**

Host

Kenji Suzuki, PhD *

Host

Jiang Hsieh, PhD *

**LL-PHE-M01A • Iron Deposition in the Brain: A Review of Current Iron Quantification Techniques**

Yunhong Shu PhD (Presenter) ; Paul Bao ; Mallikarjunarao Kasam PhD ; Kirk M Welker MD

**PURPOSE/AIM**

There has been great interest in detecting endogenous iron in the brain as it has been shown to be correlated with aging and neurological disorders. Magnetic resonance imaging (MRI) is sensitive to iron deposition due to its abundance and high magnetic susceptibility. Given the variable appearance of cerebral iron across pulse sequences and scanner field strengths, quantitative assessment of brain iron concentration is preferable to visual inspection. This presentation aims to provide an overview of several methods that have been proposed to quantitatively measure iron concentration in the brain.

**CONTENT ORGANIZATION**

1: Introduction - Tissue iron deposition forms in the brain and their relationships with specific pathology.
2: Review of the principles of general iron quantification methods and descriptions with specific examples
3: Detailed discussion on advantages and limitations of the iron quantification techniques.
4: Detailed discussion on clinical applications of iron quantification techniques.

**SUMMARY**

The ability of MRI to non-invasively measure brain iron deposition can potentially help to gain further understanding in the pathophysiology of the normal aging process and neurodegenerative diseases. Accurate analysis of iron concentration using MRI requires a good understanding of the underlying mechanism and confounding factors related to the various iron mapping techniques.

**LL-PHS-M01A • Segmentation of the Left Ventricle Using a Distance Regularized Two-layer Level Set Approach**

Chunming Li PhD (Presenter) ; Chaolu Feng ; Christos Davatzikos ; Harold I Litt MD, PhD *

**PURPOSE**

Non-invasive assessment of left ventricular function is important but difficult due to poor imaging quality and complex anatomical characteristics. To overcome these challenges, we propose a distance regularized two-layer level set approach for segmentation of the left ventricle (LV) from cardiac MR (CMR) short-axis images. The segmentation results can be directly used to calculate ejection fraction (EF), which is an important indicator of the LV function.

**METHOD AND MATERIALS**

We propose a novel two-layer level set approach to segment the LV from CMR short-axis images. In our method, endocardium and epicardium are represented by two specified level contours of a level set function (LSF). Segmentation of the LV is formulated as a problem of optimizing the LSF such that these two level contours best fit the epicardium and endocardium. More importantly, a novel distance regularization (DR) constraint on the level contours is introduced to ensure the smoothly varying distance between them. This DR constraint leads to a desirable interaction between the level contours to maintain the anatomic geometry of the endocardium and epicardium. The negative effects of intensity inhomogeneities on image segmentation are overcome by a data term derived from a local intensity clustering property. Our method is quantitatively validated by experiments on the datasets for the MICCAI 2009 grand challenge on left ventricular segmentation, which demonstrates the advantage of our method in terms of segmentation accuracy and consistency with anatomic geometry.

**RESULTS**

We have validated our method using the datasets from the MICCAI 2009 challenge on LV segmentation. Comparisons with other methods show that the average perpendicular distances for our method are the smallest: 1.82±0.48 mm and 1.73±0.43 mm for training datasets and 1.93±0.37 mm and 1.64±0.42 mm for validation datasets. We have achieved much better results, giving nearly the best slope and regression coefficient: 1.04 and 0.90 for EF and 0.93 and 0.85 for the mass; and demonstrating only a small bias on the Bland-Altman plots: 3.45% for EF and -6.48 grams for LV mass.

**CONCLUSION**

Quantitative evaluation and comparison with other state-of-the-art methods demonstrate that our method achieves more accurate segmentation results and more reliable measurement of EF and LV mass.

**CLINICAL RELEVANCE/APPLICATION**

• To provide a comprehensive approach for the evaluation of patients irradiated for malignant head and neck tumors.
• To understand key imaging features of radiation-induced complications.
• To demonstrate the importance of DWI-MRI and PET-MRI for the detection of residual/recurrent tumors.
• To understand potential pitfalls of image interpretation and how to avoid them.

**CONTENT ORGANIZATION**

The retrospective analysis of 124 patients who underwent DWI-MRI with PET-MRI formed the basis for this exhibit. The patients were imaged after radio(chemo)therapy for malignant head and neck tumors. Imaging findings were correlated with histology in 82 patients and radiologic follow-up in 42 patients. We discuss expected tissue alterations and complications affecting soft tissues, vasculature, neural tissue and bony structures. We illustrate typical findings of tumor recurrence with emphasis on early detection, added value of DWI-MRI and PET-MRI and provide histologic correlation for the understanding of imaging findings. Pitfalls of post-therapeutic image interpretation and how to avoid them are addressed.

**SUMMARY**

Interpretation of MRI findings after radiation therapy of head and neck cancers constitutes a diagnostic challenge. DWI-MRI and PET-MRI increase the diagnostic confidence for the early detection of recurrent tumors and help to avoid unnecessary biopsy.
METHOD AND MATERIALS
41 female patients (58.1±13.2 years) with metastatic breast cancer underwent contrast-enhanced thoraco-abdominal CT for initial staging and first follow-up after systemic chemotherapy. Data were independently and prospectively interpreted by three radiologists. In addition, response was evaluated by a CAD system that allowed automated uni- and three-dimensional assessment of target lesions.

RESULTS
Overall, between-reader-agreement was moderate (kappa: 0.4-0.59), with diverging response classification observed in 19/41 patients (46%). In 25 patients, readers chose the same, and in 16, readers chose different target lesions. Selection of the same target lesions was associated with a 76% agreement rate (19/25); selection of different target lesions was associated with an 81% rate of disagreement (13/16) (p < 0.001). After dichotomizing response classification according to its therapeutic implication into progressive vs. non-progressive disease, disagreement was observed in 11/41 patients (27%). In 9 of these 11 patients, readers had chosen different target lesions. Disagreement rates due to manual vs. automated or uni-dimensional vs. volumetric measurements were less important (11/41 and 6/41; 27% and 15%, respectively).

CONCLUSION
Major source of variability is not the manual or uni-dimensional measurement, but the variable choice of target lesions between readers. CAD-based analysis or tumor volumetry can help avoid variability due to manual or uni-dimensional measurements only, but will not solve the problem of target lesion selection.

CLINICAL RELEVANCE/APPLICATION
Evaluation of radiological response plays a major role in oncological therapy. We investigated causes for variability of response classification in RECIST and how they might be overcome by CAD.

LL-PHS-MO3A • Coronary Artery Calcium Scoring: Comparison of Adaptive Statistical Iterative and Filtered Back Projection Reconstruction Techniques Using a Calcified Plaque Phantom

Tatsuya Umezawa RT (Presenter); Fumiko Kimura MD, PhD *; Masaru Morishita; Itsuki Nagazumi RT; Taiki Senoo RT; Yasuyuki Yoshimura MD, PhD

PURPOSE
Adaptive statistical iterative reconstruction (ASiR, GE Healthcare) has been used for coronary CT angiography to improve image quality and reduce radiation dose, but its influence on coronary artery calcium scoring (CACS) is unknown. In a calcified plaque phantom, we compared image noise, CT values, CACS, and coronary artery calcium volume (CACV) between filtered back projections (FBP) and ASiR to clarify if CACS differs significantly between the two and assessed factor/s influencing differences.

METHOD AND MATERIALS
We made calcified plaque models of 5 materials with different CT values, placed them into a long cylindrical phantom of 4-mm diameter that contained materials of 40 HU to simulate blood to simulate the coronary artery with calcified plaques (50% stenosis; length 5 mm), and submersed the phantom in a tank of water. We scanned it using 120 kVp and various tube currents and reconstructed images using 5 reconstruction techniques (RTs) - FBP and ASiR-FBP composites (ASiR 30%, 50%, 70%) and ASiR 100%. We measured the mean CT values of the 5 materials in large regions of interest (ROIs; 55-265mm²) and assessed the phantom containing the calcified plaque models regarding image noise in the tank water, CT values of the small calcified plaques, and total CACS and CACV (sums of the 5 plaques). We compared these values among the 5 RTs using repeated-measure ANOVA. P < 0.05 was considered significant.

RESULTS
The mean CT values (large ROIs) of the 5 materials were 918, 600, 392, 177, and 110 HU without significant difference among RTs. There were significant differences among RTs in image noise (P < 0.001), CT values of the small calcified plaques (P < 0.001), total CACS (P < 0.001), and total CACV (P < 0.01), decreasing as ASiR percentage increased. Compared to FBP, total CACS decreased 6.2% in ASiR 30%, 8.8% in ASiR 50%, 13.0% in ASiR 70%, and 18.0% in ASiR 100%. ASiR decreased pixel CT values of the rim of the calcified plaques, which changed the weighted factors to calculate CACS.

CONCLUSION
Image noise, CACS, and CACV decreased as ASiR percentage increased. ASiR appeared to decrease image noise and CT pixel values of the small calcified plaque and then affect CACS.

CLINICAL RELEVANCE/APPLICATION
Compared to FBP, a blend of no more than ASiR 50% limits CACS reduction to 10%, and the same reconstruction technique should be used to assess temporal changes in CACS.

LL-PHS-MO4A • A Novel Image-based Estimation Method for Magnetic Field Inhomogeneity in Brain Echo-planar Image

Seiji Kumazawa PhD (Presenter); Takashi Yoshiura MD, PhD; Hiroshi Honda MD; Fukui Toyofuku PhD

PURPOSE
We have proposed a new estimation method for the magnetic field map based on the distorted EPI image and T1WI of brain. The results demonstrate that the magnetic field inhomogeneity in EPI image can be estimated by our method, and the geometrical distortion can be reduced.

Background
Echo-planar imaging (EPI) suffers from geometrical distortion due to magnetic field inhomogeneity. Conventional methods to correct the distortion of EPI require an estimation of a magnetic field map. Our purpose was to develop a new method for estimating the magnetic field map based on the distorted EPI image and T1 weighted image (T1WI) which requires no additional acquisitions.

Evaluation
Instead of an additional acquisition, our method used the segmented brain T1WI to estimate the field map. Based on MR imaging physics, our method synthesizes EPI image from tissue-objects extracted from segmented brain T1WI according to single shot EPI k-space trajectory. First, the brain T1WI was divided into head region and air region based on the intensity histogram, and then brain extraction and tissue segmentation were applied to head region by using FSL tool. Our field inhomogeneity estimation is incorporated into the generating process of EPI image, and the estimation process is performed iteratively to minimize the cost function defined by the synthesized EPI image and the measured EPI image with geometric distortion. In this experiment, our method was applied to the EPI image with known magnetic field inhomogeneity, and was evaluated by comparing between the estimated field map and the known map.

Discussion
The magnetic field inhomogeneity map estimated by our method very accurately agreed with the filed map of the ground truth. The RMSE value between the estimated field map and ground truth was less than 0.17. In the simulated EPI image with removing the estimated magnetic field inhomogeneity map, the geometrical distortion was reduced. In visual evaluation, the brain shape in the resulting EPI was very similar to that in T1WI.

LL-PHS-MO5A • The Potential of Texture Features for Differentiation of Colonic Polyp Types for CT Colonography

Jerome Liang PhD (Presenter); Bowen Song MS; Guopeng Zhang MS; Huafeng Wang PhD; Perry J Pickhardt MD *; Hongbing Lu PhD

PURPOSE
Image texture features have been widely explored for computer-aided diagnosis (CADx) on breast masses and lung nodules for malignance assessment by radiologists. We performed a pilot study using the Haralick’s texture description with expansion in the three-dimensional image density distribution space as well as the gradient and curvature distribution domains. The database in this study includes 124 lesions (polyp and masses, confirmed by pathology) in four categories: 40 H, 45 Ta, 30 Va, and 9 A. A semi-automated segmentation was performed to extract the volume of each lesion, given the lesion’s (x,y,z) coordinates, from the computed tomography colonography (CTC) image. A total of 78 features were calculated from each lesion volume. These features were fed into the support vector machines (SVM) classifier for binary classification among the four lesion categories. To avoid any bias in selection of training and testing datasets, the splitting of the training and testing datasets was repeated 100 times randomly and the outputs were averaged for AUC measure.

METHOD AND MATERIALS
MATERIALS AND METHODS: The high order spatial dependency texture feature calculation is based on the Haralick’s texture description with expansion in the three-dimensional image density distribution space as well as the gradient and curvature distribution domains. The database in this study includes 124 lesions (polyp and masses, confirmed by pathology) in four categories: 40 H, 45 Ta, 30 Va, and 9 A. A semi-automated segmentation was performed to extract the volume of each lesion, given the lesion’s (x,y,z) coordinates, from the computed tomography colonography (CTC) image. A total of 78 features were calculated from each lesion volume. These features were fed into the support vector machines (SVM) classifier for binary classification among the four lesion categories. To avoid any bias in selection of training and testing datasets, the splitting of the training and testing datasets was repeated 100 times randomly and the outputs were averaged for AUC measure.
RESULTS
Results: The binary classification for the two categories of (HandTa) and (VaanA) reached the differentiation capability of means ± standard deviation of 0.9190 ± 0.0362.

CONCLUSION
Conclusion: CADx for polyp malignance assessment is highly likely. The potential of CTC in colon cancer screening includes not only the detection of the precursor or polyps but also the diagnosis of the detected polyps for optimal polyp management for the best outcome in personalized medicine.

CLINICAL RELEVANCE/APPLICATION
Clinical Relevance/Application: Differentiation of the polyps type can render an optimal management of polyps in personalized medicine.

LL-PHS-MO6A • Experimental Quantification of the Effects of Organ-based Tube Current Modulation on Radiation Dose and SNR
Diksha Gandhi (Presenter) *; Dominic Crotty PhD +; Grant M Stevens PhD +; Taly G Schmidt PhD

PURPOSE
To compare the radiation dose to breast, lung, heart and spine in CT chest scans, and eye lens and brain in head scans with and without organ-dose-based tube current modulation (ODM), using an anthropomorphic phantom and a clinical CT scanner. The signal-to-noise ratio (SNR) was also quantified in images reconstructed with and without ODM.

METHOD AND MATERIALS
Axial CT scans at 120 kV were performed on anthropomorphic head and chest phantoms (Rando Alderson Research Laboratories, Stanford, CA) on an ODM-equipped scanner (Optima CT660, GE Healthcare, Chalfont St Giles, England). ODM reduces the tube current for the anterior source positions, without increasing current for posterior positions. ODM has different modulation settings for chest and head exams. Dosimeters quantified radiation dose to locations in the breast, lung, heart, spine, eye lens and brain (mobil MOSFET Dosimetry System, Best Medical, Ottawa, Canada). For both phantoms, five scans were performed with and without ODM, with all other scan parameters constant. The non-ODM chest scans were performed with two settings – autoA, which modulates the tube current modulation in the slice direction, and smartA, which modulates the tube current modulation in the slice and angular directions. SNR was calculated in the brain and chest regions of all reconstructed images. The experimental results are now being validated with Monte Carlo simulations. In addition, 50 adult female phantoms are being simulated to study ODM in patients of varying sizes and anatomy.

RESULTS
ODM reduced the dose at all dosimeter locations, with dose changes of -31.3% in the breast, -20.7% in the lung, -24.4% in the heart, -5.9% in the spine, -10.0% in the eye and -18.7% in the brain, with respect to smartA. The percent change in dose with respect to autoA was -37.7%, -29.8%, -35.3% and -25.0% in the breast, lung, heart and spine, respectively. ODM decreased the SNR by 3.5% and 11.5% for head and chest phantoms, respectively.

CONCLUSION
Experimental studies indicate that ODM has the potential to reduce dose to sensitive organs by 5-38% with a decrease in SNR of less than 12%. Simulations are in progress to investigate the performance of ODM over a range of patient sizes.

CLINICAL RELEVANCE/APPLICATION
Organ-based tube current modulation has the potential to reduce the dose to radiosensitive tissues with limited degradation in SNR.

LL-PHS-MO7A • Contrast and Dose Dependencies of Resolution Property in Iterative Reconstruction CT Images
Tadanori Takata (Presenter) *; Katsushi Ichikawa PhD +; Syoichi Terakawa +; Hiroyuki Hayashi +; Kosuke Matsubara PhD +; Yukihiro Matsusura RT +; Keita Sakuta RT +

PURPOSE
Since the iterative reconstructions (IR) are nonlinear image processing, their resolution properties are different from filtered back projection (FBP). The purpose of this study was to evaluate contrast and dose dependencies of resolution property of the IR images using a contrast adjustable cylindrical phantom.

METHOD AND MATERIALS
We evaluated an IR, sinogram affirmed iterative reconstruction (SAFIRE) provided by SIEMENS. A 100-mm diameter cylindrical acrylic phantom placed in a 200-mm diameter cylindrical case with correct centering was used. The phantom’s surround was filled with diluted contrast agent, and the contrast between the phantom and the surround was set to middle contrasts of 45, 65, 85, 105 and 125 Hounsfield units (HUs). The phantom was scanned at two dose levels (75 and 150 mAs), and images were reconstructed using FBP and five strengths of SAFIRE (S1-S5). Since the image noise was obstacle for the correct resolution measurement, we added many images obtained by multi scans. The radial edge of the phantom was analyzed to determine the edge-spread function, which was differentiated to yield the line-spread function and Fourier-transformed to generate the modulation transfer function (MTF).

RESULTS
For the 45-HU contrast of S5, MTF of 75 mA was significantly lower (up to 24%) than that of 150 mA, while FBP offered the same MTF for both the doses. At the same dose level for S5, MTFs of 45-HU contrast were clearly lower (up to 35% and 16% for 75 and 150 mA, respectively) than those of 125-HU contrast. The weaker strength of SAFIRE was applied, the less dose and contrast dependencies were indicated.

CONCLUSION
The degree of resolution degradation of SAFIRE significantly depended on not only the object contrast but also the scan dose. Even for objects with middle contrasts, IR degraded the resolution properties. The method using the radial edge of the cylindrical phantom was effective for evaluating the resolution property of IR.

CLINICAL RELEVANCE/APPLICATION
Our results would be useful to optimal selection of IR strengths (modes) and to evaluate performances of different IR techniques.

LL-PHS-MO8A • Quantification of Hepatic Fat Using MR Imaging and Spectroscopy
Peter A Hardy PhD (Presenter) +; Bryce Noblitt BS +; James T Lee MD +

PURPOSE
To develop accurate spectroscopic and imaging techniques to quantify the proton density fat fraction in liver. Additionally, we sought to understand the influence of such confounds as liver iron concentration on the accuracy of the measured fat fraction.

METHOD AND MATERIALS
Samples of a lipid nutritional supplement, IntraLipid® were diluted to create a series of lipid:water standards. From each sample proton spectra were acquired in the static conditions. 

RESULTS
IntraLipid® samples. The liver samples were then digested and assayed for iron quantification using ICP-OES spectroscopy. The measured relaxation times and measured peak areas of water and lipid for their relaxations weight). This concentration is sufficient to increase the width of the water peak in the tissue samples.

CONCLUSION
Organ-based tube current modulation has the potential to reduce the dose to radiosensitive tissues with limited degradation in SNR.

LL-PHS-MO9A • Photo Acoustic Imaging of Human Peripheral Joints
Gandikota Girish MBBS (Presenter) +; Xueding Wang PhD +

CONCLUSION
PAI technology continues to improve as we translate to human joint imaging. After reviewing this exhibit, the viewer should be aware of potential clinical role of photo acoustic imaging, its appearance, present limitations and the scope of future research.
Purpose: To present interim report of dose escalation clinical trial of total body and marrow irradiation (TBI) for patients with refractory leukemia. We further investigated the microenvironment damage and repair of bone marrow specifically focused on mesenchymal stem (MSC) cells.

METHOD AND MATERIALS
Patients received 15 Gy (n=2) followed by 18 Gy (n=3) following cyclophosphamide and fludarabine chemotherapy. One day post TBI, patients were infused with two umbilical cord blood (UCB) units or related donor stem cells. To reduce lung dose, dynamic (4D) CT images with or without shallow breathing while using a respiratory belt were acquired. Marrow aspirates are obtained before treatment, after treatment but before transplant, and post BMT day 21, 60, and 100. MSC cells were separated; morphology and differentiation to adipocyte and osteocytes were studied.

RESULTS
Thoracic rib motions were substantially reduced by 14%, 24%, and 70% at maximum in cranial-caudal, lateral, and anterior-posterior directions, respectively. Mean doses to the lung were not more than 10Gy, even in the 18Gy group. Average dose to whole body (apart from critical organ) was kept at approximately 14Gy. Two patients treated at 15Gy had prompt neutrophil engraftment at days 17 and 27 after BMT. In 18Gy group, the first patient did not engraft and developed severe regimen-related toxicities including respiratory failure, sepsis and hyper-bilirubinemia and died at day 58. The in vivo hypothalamic glutamate release in rats. Furthermore, the effects of two types of glutamate receptor antagonists (NMDA and AMPA) on nausea, such as gastric discomfort. However, its neuropharmacological basis is incompletely understood. We previously reported that pica, oral mucositis, and diarrhea. Contrary to the belief that radiosensitive MSC maintains niche, host MSC cells were reduced significantly (only one colony was formed) after treatment. Post-transplant marked recovery of MSC cells with time and its function to produce osteoblastogenesis, suggesting a potential role of donor UCB derived MSC proliferation (supporting micro-environment niche).

CONCLUSION
Reduction of lung dose using shallow breathing may be useful for dose escalation study. So far engraftment at 18 Gy has been safely achieved. Marrow microenvironment is seriously damaged by increased radiation but donor cells may contribute to reconstitution of marrow environment.

CLINICAL RELEVANCE/APPLICATION
The dose escalation of total marrow irradiation could be safely achieved and offered engraftment.
**LL-VIS-MO3A** • Assessing Response to Radiochemotherapy Treatment on 18F-FDG PET in Non-small Cell Lung Cancer Using Approaches of Histogram and Gray Level Co-occurrence Matrix

Changsheng Ma MD (Presenter) ; Yong Yin

ABSTRACT

Purpose: The aim of this study was to propose and investigate gray level histogram and texture features information provided by 18F-FDG PET to assess patient's imaging response to radiochemotherapy in non-small cell lung cancer (NSCLC).

Methods: Twelve patients with newly diagnosed NSCLC treated with combined radiochemotherapy were involved in this study. Patients were categorized under three headings (non-responders, partial responders and complete responders) by experienced radiologists on the basis of RECIST according PET scans changes between pretreatment and 1 month after treatment. We analyzed the percentage variation of PET density using histogram analysis approach which characterizes global change of tumor region on PET. Texture parameters variation between pretreatment and 1 month after treatment completion which describe local voxel spatial distribution were extracted from Gray Level Co-occurrence Matrix (GLCM). Correlation between characteristics' variation and three type response status were analyzed.

Results: The uniformity of gray level histogram on the whole and the maximum percentage decrease in histogram was well associated with tumor shrinkage and response status. The above indices derived from histogram were capable to differentiate three groups tumor response to radiochemotherapy. Texture parameters' variation (ASM, ENT and IDM) were able to differentiate the 3 response groups considering a high correlation with response status.

Conclusion: We demonstrated that histogram and texture analysis methods on baseline 18F-FDG PET scans provided robust, discriminative stratification in assessing response to combined radiochemotherapy and may have a good application prospect in clinical practice.
CLINICAL RELEVANCE/APPLICATION
In intramural hematoma, most regions of focal contrast enhancement communicating with aortic branch arteries are completely or partially resorbed, and are not associated with intervention.

LL-VIS-MO4A • Developments of New Percutaneous Lithotripsy Techniques for Removal of Common Bile Duct Stones

Baojie Wei MD, PhD (Presenter); Yanfeng Meng MD; Feng Zhang MD, PhD; Xia Wu; Patrick Willis; RenYou Zhai MD; Wayne L Monsky MD, PhD *; Xiaoming Yang MD, PhD

PURPOSE
To develop new techniques for percutaneous removal of common bile duct (CBD) stones using three lithotripsy systems, including a pneumatic, an electrohydraulic, and an electromagnetic lithotripters with various stone catchers.

METHOD AND MATERIALS
For in-vitro confirmation, a water phantom with a 6.0mm glass tube was built to simulate the cystic duct and CBD. A human gallstone was placed into the tube. An 11 Fr custom balloon occlusion sheath (BOS) was positioned and inflated to occlude the proximal tube. A stone catcher of the three lithotripsy systems was advanced through the BOS into the tube, to grasp the stone and then restrict it within the XCOIL encapsulator (XE) or a basket. A lithotripsy probe was advanced into the XE or basket, where the stone was broken. Fragments were then extracted through the BOS. Each of three lithotripsy procedures was repeated for 10 times. For in-vivo validation, a transcyrstic approach, human gallstones were implanted into CBDs of 21 pigs (7 pigs×3 lithotripsy systems). Under fluoroscopy, a stone catcher and a lithotripsy probe of three lithotripsy systems were placed into the CBD, to break and remove the stone. Pre- and post-cholangiograms were obtained to confirm the successes of the implantation, breaking and removal of these stones. After the experiments, the pigs were euthanized and CBDs were harvested for histology.

RESULTS
Of the in-vitro experiment, an average pulse at 9.5 were required to break these stones. The average skin-to-skin lithotripsy time was 6.5 min. The average stone fragment length was at 2.1 mm compared to the pre-lithotripsy stone length at 5.1 mm (p

CONCLUSION
The three new lithotripsy techniques are feasible and safe for breaking and removal of CBD stones, which establishes groundwork for their further clinical application.

CLINICAL RELEVANCE/APPLICATION
The development of these percutaneous lithotripsy techniques may open new avenues to efficiently remove common bile duct stones.

LL-VIS-MO5A • Bimodal Treatment of Aerobic and Glycolytic Metabolism by Particle Embolization Combined with Anti-glycolytic Compound Improves Treatment of N1-S1 Hepatocellular Mouse Model

John R Haaga MD (Presenter); Hanping Wu MD, PhD

PURPOSE
To determine if combination treatment of aerobic metabolism by embolization and antglycolytic drugs compared to embolization alone provides better treatment of N1-S1 hepatocellular carcinoma in a rat model.

METHOD AND MATERIALS
Two separate laparotomies were performed, one for subcapsular tumor implant and the second for retrograde placement of catheter into the gastroduodenal artery for 5 different treatments. Treatments were: 1) Control (n=5, 1ml NS); 2) TAE (n=4, 10mg 50-150µm PVA particle in 1ml NS), 3) TAE+AG-B (n=5, 10mg PVA particle + 10mg PVA in 1ml NS), 4) TAE+AG-C (n=5, 10mg PVA particle + 30mg AG-C in 1ml saline), 5) TAE+AG-F (n=5, 10mg PVA particle + 30mg AG-C in 1ml saline). Tumor length (L), width (W), and height (H) was measured by 2D-ultrasound before treatment and twice a week till 4 weeks after treatment. Tumor volume (V) was calculated by the formula: V= 0.5*L*W*H. Relative tumor volume after treatment was calculated as the percentage of pre-treatment tumor volume. Kruskal-Wallis test was used to compare the difference of relative tumor volume between 5 groups on each observation time point.

RESULTS
The initial tumor sizes in each group were statistically not significantly different. Three animals in the control group were euthanized before the end of observation due to rapid tumor growth and anorexia. In TAE group, one kept growing after treatment. In other 3 animals, the tumor volume increased in the early observation time points (1 within 1 week, 2 within 2 weeks) and then shrunk. In other 3 TAE+AG groups, the tumor volumes decreased after treatment with significant differences between control group and 3 TAE+AG groups on all observation time point except TAE+AG-F group on 3.5 and 4 weeks. At 4 weeks after treatment, the median relative tumor volumes were 3,174.5% in control group, 58.2% in TAE group, 9.6% in TAE+AG-B group, 23.8% in TAE+AG-F group, and 13.4% in TAE+AG-C group.

CONCLUSION
Bimodal embolic treatment of hepatocellular cancer is more effective than embolic Rx alone. Further study of these propriety agents is warranted because agents target enzymes specific to cancer. Optimization of drug form, dose and route administration (IV, oral) are needed. Safety studies must be completed before human use.

CLINICAL RELEVANCE/APPLICATION
Clinical relevance is enormous. Agents should be effective against all cancers with little effect on normal tissues. Mode of delivery can be arterial, intravenous and/or oral. Challenge is funding.

LL-VIE-MO6A • Angio-CT System: Reasons Why It is Useful in Non-vascular Interventions

Miyuki Sone MD (Presenter); Yasuaki Arai MD *; Yoshito Takeuchi MD; Shunsuke Sugawara; Hirotaka Tomimatsu; Shinichi Morita; Daisuke Okamoto MD

PURPOSE/AIM
Angio-CT system is equipment combining c-arm angiography system and CT scanner with a same sliding table. The aims of this exhibit are:

1. To review the reasons why Angio-CT is useful in non-vascular interventions
2. To provide a case-based review of challenging non-vascular interventions using Angio-CT

CONTENT ORGANIZATION
1. Background of image guidance in non-vascular interventions
   - Treatment target does not always have anatomical landmark or baseline for needle puncture
   - Fluoroscopy is superior in guiding device manipulation with its real-time capability
   - CT is superior in confirming the position of the target and the device with its cross-sectional and 3-D information
2. Reasons why Angio-CT is useful
   - Planning of access with CT, manipulation of device with fluoroscopy, and confirmation with CT can be performed alternately and repeatedly
   - In the absence of anatomical landmark, a fine needle is used as a baseline and accurate puncture can be performed with "tandem technique"
3. Case-based review of challenging procedures
   - Use of anatomical landmark
   - Use of "tandem technique"
   - Spacing vital organs from the target

SUMMARY
Angio-CT is useful in non-vascular interventions because alternate use of fluoroscopy and CT is available. This exhibit reviews the features of Angio-CT and its clinical use.

LL-VIE-MO7A • Parastomal Varices: Diagnosis, Treatment, and Outcomes

Annie K Lim DO (Presenter); Joshua D Dowell MD, PhD; Gregory E Guy MD; Bill S Majdalany MD

PURPOSE/AIM
To review the epidemiology, diagnosis, and various treatment methods for parastomal varices.

CONTENT ORGANIZATION
Epidemiology and pathophysiology of parastral varices will be reviewed. The numerous methods that have been described in the literature for treatment include: direct compression, medical optimization, percutaneous or transhepatic embolization, TIPS, surgical stomal revision, and superficial sclerotherapy. Each therapeutic option has associated complications and contraindications. Current literature and outcome data will be reviewed and an algorithm for patient
specifc treatment approach will be proposed.

SUMMARY
Esophageal and gastric varices are a common manifestation of portal hypertension with an accepted treatment algorithm. Already, 30% of patients with both portal hypertension and urinary or enteric diversion will develop parastomal varices. With the advent of life prolonging treatments, which can give rise to portal hypertension, this population may increase. Although bleeding from these varices has a relatively low overall mortality, significant morbidity exists in the form of repeated hospitalizations and transfusions. Patient-specific treatment approach is reviewed.

LL-VIE1289-MAO • Irreversible Electroporation in the Abdomen: A Primer for Interventionalists

Avinash R Kambadakone MD, FRCR (Presenter) ; Raul N Uppot MD ; Rahmi Oklu MD, PhD ; Debra A Gervais MD * ; Ronald S Arellano MD

PURPOSE/AIM
Irreversible electroporation is an exciting new technology which is finding increasing applications in the treatment of tumors of the liver, kidney and the pancreas. The purpose of this exhibit is to discuss the principles, indications, technical performance and performance of irreversible electroporation in the abdomen using a pictorial review.

CONTENT ORGANIZATION
1. Brief review of the principles and technique of irreversible electroporation
2. Discuss the relevant anatomical considerations for successful performance of IRE
3. Discuss the indications for IRE in various tumors in the liver, kidney and pancreas
4. Describe the step-by-step interventional technique for CT guided IRE
5. Illustrate the technique by citing examples from routine and challenging cases in a pictorial review with the tips and tricks for successful placement

SUMMARY
Irreversible electroporation is an exciting new technology with immense potential in the treatment of hepatic, pancreatic and renal tumors. A proper understanding of the indications, principles and technique of this procedure is essential to ensure a successful outcome.

LL-VIE1288-MAO • Chest Complications of Abdominal Interventions

Florian J Fintelmann MD (Presenter) ; Selim R Butros MD ; Subba R Digumarthy MD ; Ashraf Thabet MD ; Jo-Anne O Shepard MD * ; Debra A Gervais MD * ; Diane A Levis ; Peter R Mueller MD *

PURPOSE/AIM
A variety of abdominal interventions can result in complications in the chest. Our exhibit presents a pictorial illustration of such procedures with their respective intrathoracic complicating. Preventive measures and management will be discussed.

CONTENT ORGANIZATION
1. Review anatomy of upper abdomen in relationship to pleural space and mediastinal structures. 2. Illustrate fundamentals of abdominal procedures with potential chest complications:
   - Ablation of liver, kidneys or adrenal glands
   - Biopsy of liver, kidneys, adrenal glands or retroperitoneum
   - Biliary drainage, nephrostomy, and right and left subphrenic abscess drainage
3. Examples of thoracic complications such as pneumothorax, hemothorax, empyema, pericardial tamponade, and leak of bile, lymph or urine into the pleural space. 4. Discussion of pre- and intra-procedural preventive measures such as patient positioning, gantry angulation and hydrodissection. 5. Discussion of management of said complications.

SUMMARY
This exhibit educates interventional radiologists how to prevent, recognize and manage chest complications related to a variety of abdominal procedures.

Using myRSNA®: Hands-on Workshop

Monday, 12:30 PM - 02:00 PM • S401CD

I C I A 2 2  • A M A P R A C a t e g o r y 1 C r e d i t ™:1.5

John W Basco, MS

LEARNING OBJECTIVES
1) Understand the different tools and applications within myRSNA. 2) Log in to myRSNA and set up a personal profile. 3) Using the tools within myRSNA, highlight different use case scenarios.

Practical Informatics for the Practicing Radiologist: Part Two (In conjunction with the Society for Imaging Informatics in Medicine)

Monday, 12:30 PM - 02:00 PM • S501ABC

I C I I 2 2  • A M A P R A C a t e g o r y 1 C r e d i t ™:1.5 • A R R T C a t e g o r y A+ Credit:1.5

LEARNING OBJECTIVES
1) Describe approaches to minimize eye strain, neck pain, and repetitive motion disorders and overall stress without compromising productivity in the radiology reading room. 2) Understand the challenges and unforeseen obstacles encountered when deploying your next PACS system. 3) To understand the utility of volumetric rendering and computer aided detection (CAD) in clinical practice.

I C I I 2 2 A • Saving Your Body (and Your Mind): Redesigning the Radiology Reading Environment

Eliot L Siegel MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

I C I I 2 2 B • Divorce Counseling: Changing PACS

Steven C Horii MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

I C I I 2 2 C • So Many Images, So Little Time: Advanced Imaging Techniques

Adam E Flanders MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.


Monday, 12:30 PM - 02:00 PM • S401AB

I C I W 2 2  • A M A P R A C a t e g o r y 1 C r e d i t ™:1.5 • A R R T C a t e g o r y A+ Credit:1.5

Holly A Burt
LEARNING OBJECTIVES
1) Use My NCBI to personalize PubMed.
2) Understand how to save search strategies and create email alerts.
3) Use filters to link to library full-text articles and to focus PubMed searches.
4) Understand how to save collections of citations including a personal bibliography.

ABSTRACT
In this hands-on workshop session, explore the free My NCBI tool in PubMed. Discover how to save search strategies, create email alerts to keep up with the latest publications, create instant links to library full-text resources, and build permanent online bibliographies. Topics covered include creating a free My NCBI account, adding search and library filters to PubMed, using PubMed to create an online list of personal publications, and the link between the NIH Manuscript Submission System and PubMed. Important highlights on effectively searching PubMed searching will also be included. The National Library of Medicine (NLM) provides free web access to nearly 24 million citations for biomedical and clinical medical articles through PubMed (available online at PubMed.gov). MEDLINE is a subset of PubMed.

Molecular Imaging - Monday Posters and Exhibits (12:45pm - 1:15pm)

CL-MIS-MO2 • AMA PRA Category 1 Credit ™:0.5

CL-MIS-MO1B • Comparing Photoacoustically Derived Hemoglobin and Oxygenation Measurements and Ultrasound Contrast Agent Derived Vascularity Measurements to Immunohistochemical Staining in a Breast Cancer Xenograft Model

John R Eisenbrey PhD (Presenter) ; Andrew Marshall ; Daniel A Merton ; Ji-Bin Liu MD * ; Traci B Fox MS, RT ; Anush Sridharan ; Flemming Forsberg PhD *

PURPOSE
To compare tumor oxygenation levels derived by photoacoustic imaging (PA) and tumor vascularity measurements derived by contrast-enhanced ultrasound (CEUS) with immunohistochemical markers in a murine subcutaneous breast cancer model.

METHOD AND MATERIALS
Subcutaneous MDA-MB-231 breast tumors implanted in the mammary pads of 11 nude rats were imaged in nonlinear contrast mode on a Vevo 2100 ultrasound scanner (Visualsonics, Toronto, Canada). Rats received a bolus 36 % injection of Definity (Lanthescs Medical Imaging, N Billerica MA) during CEUS imaging (acoustic power=4%, frequency=24 MHz, gain=35 dB). Maximum intensity projections were then generated over the tumor area using the VevoCQ software as a measure of tumor vascularity. PA was performed using a PA probe (MS-250-PA, Visualsonics) on the Vevo2100. The laser was operated at 100% output power at wavelengths of 750 and 850 nm with a PA gain of 40 dB. Hemoglobin signal (HbT), oxygenation levels in detected blood (SO2 Avg), and oxygenation levels over the entire tumor area (SO2 Tot) were then calculated for 20 frames using the Oxygenation-Hemoglobin measurement package. Post imaging, rats were sacrificed and the tumors stained for VEGF, Cox-2, and CD-31.

RESULTS
When comparing CEUS to PA measurements, significant correlation was observed between CEUS derived vascularity and both HbT and SO2 Tot (R=0.61 and R=0.64 respectively, p 0.32). Similarly, no significant correlation was observed between either HbT or SO2 Tot and any immunohistochemical marker (p>0.18). SO2 Avg did show significant inverse correlation with Cox-2 (R=-0.65; p=0.03), but not with either VEGF or CD-31 (p>0.5).

CONCLUSION
PA modes that rely on the total detection of hemoglobin appear to correlate with CEUS vascularity measurements, but not with the studied immunohistochemical markers. Oxygenation levels within detected blood determined via PA appear to correlate with Cox-2 expression.

CLINICAL RELEVANCE/APPLICATION
Depending on the imaging mode, PA may be useful for detecting changes in tumor vascularity or expression of the angiogenic marker Cox-2.

CL-MIS-MO2B • Radiation-free Whole Body MR Imaging of Children with Cancer: A Solution to the Conundrum of Long-term Side-effects from CT Scans

Christopher Klenk MD (Presenter) ; Rakhee S Gawande MD ; Deqing Qiu PhD ; Andrew Quon MD ; Michael E Moseley PhD ; Heike E Daldrup-Link MD

PURPOSE
Standard CT and radiotracer-based staging procedures of children with cancer are associated with considerable radiation exposure and risk of secondary cancer development later in life. The purpose of this study was to develop an alternative radiation-free staging technique, based on whole body diffusion-weighted magnetic resonance (WB-DW MR) imaging and the iron supplement ferumoxytol, used as an MR contrast agent.

METHOD AND MATERIALS
A novel concept for WB-DW MR was established based on color-encoded, iron oxide nanoparticle-enhanced diffusion weighted MR scans for tumor detection, which were co-registered with nanoparticle-enhanced T1-weighted MR scans for anatomical orientation. Following pulse sequence optimizations in nine healthy volunteers, 16 children and young adults with malignant lymphoproliferative disorders underwent WB-DW MR and 18F-FDG PET/CT scans. The presence or absence of tumors in different anatomical areas was determined separately for WB-DW MR and clinical routine 18F-FDG PET/CT staging exams. Histopathology and follow-up imaging served as the standard of reference. The agreement between tumor staging results of the two imaging tests was evaluated using Cohen’s kappa statistics, with a score of 1.0 indicating perfect agreement.

RESULTS
Evaluation of healthy volunteers revealed optimal pulse sequence parameters for WB-DW MR as follows: TR 3400 ms, TE 45-55 ms, b-values 50 and 600 s/mm2, and a bandwidth of 0.25kHz. Duration of the diagnostic procedure was 1.5 hours for WB-DW MR scans and 1.5-2.5 hours for 18F-FDG PET/CT scans (radionuclide injection + imaging). WB-MRI/DWIBS and 18F-FDG-PET/CT showed very good inter-observer agreement for tumor staging according to the Ann Arbor classification with a weighted k value of 0.889.

CONCLUSION
Ferumoxytol-enhanced WB-DW MR imaging provides a radiation-free alternative to 18F-FDG PET/CT for staging of children with malignant lymphomas. To the best of our knowledge, this is the first study that integrates an MRI technique for tumor detection (WB-DW) with an MR technique for anatomical orientation, in accordance with the concept of integrated 18F-FDG PET/CT staging exams.

CLINICAL RELEVANCE/APPLICATION
Since our new WB-DW MR approach is radiation free, it may solve the conundrum of mandatory radiographic imaging for cancer staging, but associated risk of developing radiation-induced secondary cancer.

CL-MIS-MO3B • Three-dimensional Angiogenesis Imaging Using Molecular Ultrasound in Colon Cancer: Preliminary Feasibility Study in a Mouse Model

Osamu F Kaneko MD (Presenter) ; Huijun Wang MD, PhD ; Vijay Shamdasani MS, PhD * ; Dimitre Hristov PhD * ; Juergen K Willmann MD *

PURPOSE
To explore the feasibility of three-dimensional (3D) targeted contrast-enhanced (molecular) ultrasound (US) imaging using a 3D clinical transducer in a human colon cancer xenograft model in mice undergoing vascular disrupting treatment.

METHOD AND MATERIALS
Subcutaneous human colon cancer LS174T xenografts were induced in 14 female nude mice. Mice were randomly assigned to either 1) a treatment group receiving the vascular disrupting agent ASA404 (n=8; single dose of 15 mg/kg, i.v.) or 2) a control group (n=6; saline only) with no treatment. All mice were scanned with US at baseline (day 0) and at day 1 after treatment. 3D US molecular imaging was performed with a clinical US system (IU22 xMATRIX; Philips Healthcare, Bothell, WA) and a clinical transducer (X6-1; center frequency, 3.2 MHz) at 4 min after i.v. injection of S107 VEGFR2-targeted microbubbles (MB-VEGFR2) or non-targeted control microbubbles (MB-Control) administered at the same dose in the same imaging session. After imaging, all mice were sacrificed and tumors were analyzed for VEGFR2 expression levels on ex vivo immunofluorescence.

RESULTS
3D US molecular imaging was feasible in all 14 tumors. In the treatment group, US molecular imaging signal with MB-VEGFR2 following a single treatment with ASA404 was significantly lower (81% decrease, P

CONCLUSION
CLINICAL RELEVANCE/APPLICATION
3D imaging capabilities of US may further expand its future clinical role in molecular imaging of cancer, particularly for more accurate monitoring of treatment response in complete tumor volumes.

Nuclear Medicine - Monday Posters and Exhibits (12:45pm - 1:15pm)

| Monday, 12:45 PM - 01:15 PM | SS03AB |

CL-NMS-MO18 • Comparison of 99M-TC-MDP Bone Scintigraphy and 18F-FDG-PET/CT for the Detection of Skeletal Metastases

Connie Y Chang (Presenter); Corey Gill; Frank J Simeone MD; Atul K Taneja MD; Martin Torriani MD; Miriam A Bredella MD

PURPOSE
To compare the accuracy of fluorine-18-fluorodeoxyglucose positron emission tomography/computed tomography (PET/CT) with technetium-99m-bone scintigraphy (bone scan) for the detection of skeletal metastases.

METHOD AND MATERIALS
The study group comprised 202 adult cancer patients who underwent both PET/CT and bone scan within 31 days for staging. Bone scans and PET/CT were evaluated by two musculoskeletal radiologists in consensus for the presence and location of skeletal metastatic disease. In cases of discordance between the two modalities, confirmation of the final diagnosis was based on the CT or MR appearance, follow-up imaging or histology.

RESULTS
The sensitivity, specificity, and accuracy of PET/CT were 97%, 98%, and 98% respectively, and the sensitivity, specificity, and accuracy of bone scan were 83%, 98%, and 93%, respectively. The lesions that bone scan most commonly missed were located in the pelvis, spine, and sacrum. PET/CT missed mostly lesions that were outside of the field of view, but in all of these cases the patient had additional sites of skeletal metastatic disease. Bone scan falsely identified 6 metastatic lesions (spine, pelvis, and humerus) and PET/CT falsely identified 3 metastatic lesions (spine, pelvis, and clavicle).

CONCLUSION
PET/CT is an accurate technique for detection of skeletal metastases, and is superior to bone scan, especially in the spine and pelvis.

CLINICAL RELEVANCE/APPLICATION
PET/CT and bone scan are performed concurrently for skeletal metastases, resulting in increased patient radiation dose and health care dollars spent; we show that PET/CT alone may be sufficient.

CL-NMS-MO28 • Osteochondral Talar Lesions: SPECT-CT Contribution to MRI

Igancio Lopez-Vidaur Franco (Presenter); Adolfo Gomez Grande; Beatriz Alvarez De Sierra Garcia MD; Luis Baneul Andrio

PURPOSE
The osteochondral lesion in the dome of the talus is one of the most frequent treatable causes of chronic inexplicable pain. SPECT-CT, whose impact in the treatment of this kind of lesion is not well known, can supply additional information to the MRI findings. The objective of the present research is to assess the utility of SPECT-CT in detecting and localizing osteochondral lesions in the talar dome analyzing the additional information to the MRI findings and its impact in the taking of therapeutic decisions.

METHOD AND MATERIALS
From October 2011 to January 2012 we conducted three-phase scintigraphy Tc99m-DPD/MDP and SPETCT-CT studies to 10 patients with osteochondral talar dome lesion in the MRI. We analysed the matching between the focal uptake and degree of osteochondral lesion, its exact location and the correlation in the MRI image of the additional findings of SPECT-CT. We consulted to the responsible physician about the influence of SPECT-CT in the diagnosis and management (surgical / conservative).

RESULTS
We analyzed 10 patients with talar osteochondral lesion. In 2 auscence active osteoblastic reaction was observed. In the remaining 8 studies where osteochondral lesion with osteoblastic activity was observed in 4 of them the SPECT-CT showed additional findings (1 reflex sympathetic dystrophy, 2 similar injury contralateral ankle, 1 intense uptake in tibiofibular syndesmosis). And the remaining 4 SPECT-CT studies showed a single focal uptake coincident with MRI. Surgical treatment was indicated in 3 of them. In studies with multifocal deposits (4) or osteochondral lesion without osteoblastic activity (2), the SPECT-CT supported a conservative approach.

CONCLUSION
SPECT-CT provides additional useful information to MRI, suggesting other possible causes of pain and helping to decide a conservative management when the osteochondral lesion of the talus shows no osteoblastic activity.

CLINICAL RELEVANCE/APPLICATION
Adding SPECT-CT to MRI can help to prevent unnecessary surgeries depending on the results.

CL-NMS-MO38 • Role of 18F-FDG-PET/CT in the Follow Up of Bone Lesions Treated with Thermal Ablation

Desiree Deandreis MD (Presenter); Frederic Deschamps; Camila Nascimento; Sophie Leboulleux; Jean Lumbroso MD; Clarisse Dromain MD; Caroline Caramella; Martin Schlumberger; Thierry Debaere

PURPOSE
to evaluate the interest of FDG-PET/CT in the assessment of bone thermal ablation -radiofrequency ablation (RFA) or cryoablation (CRY)- efficacy in case of inconclusive morphological imaging.

METHOD AND MATERIALS
Ten patients (4M; 6F; mean age: 54 ys) treated with curative intent by thermal ablation for painful bone metastases and studied by FDG PET/CT before and within 6 months after treatment were retrospectively evaluated. In all patients post-treatment morphological imaging (CT scan and/or MR) were inconclusive. A visual and semi-quantitative analysis (SUVmax) of PET images was performed. A significant persistent uptake after treatment was considered when superior within 6 months after treatment were retrospectively evaluated. In all patients post-treatment morphological imaging (CT scan and/or MRI) were inconclusive.

RESULTS
A total of 20 metastatic bone lesions treated by RFA (n=10), CRY (n=7) or thermal ablation (2 RFA and 1 CRY) combined with cementoplasty were analysed. Bone lesions were localised in the pelvis (n=12), in the spine (n=7) and in the rib (n=1). They were respectively lytic (n=12), blastic (n=5) or mixed (n=3) lesions. Median size was 25 mm (8-43). At final follow up (10 months, 5-24) 18 and 2 lesions were considered respectively completely and incompletely treated. At PET/CT, 15 completely treated lesions showed a ring shape homogeneous peripheral mild FDG uptake and a pre-ablation and post-treatment median SUVmax of 3.9 (1.5-16.4) and 2.2 (0.6-5.3) respectively. The remaining 3 cases were lesions treated by ablation and cementoplasty and showed persistent FDG uptake on PET images due to overcorrection artefact. One case of incompletely treated lesion appeared as persistent focal and intense uptake with SUVmax increase from 6.7 to 22 within 2 months after treatment. The second case showed a significant SUVmax decrease but heterogeneous "patchy" uptake. Disease relapse was detected after 11 months of follow up.

CONCLUSION
These preliminary data show that FDG PET/CT can be a useful tool for the assessment of ablation efficacy in bone lesions. Persistent not tumoral FDG uptake in case of cementoplasty may occur.

CLINICAL RELEVANCE/APPLICATION
FDG PET/CT can be a useful tool for the evaluation of bone lesions ablation efficacy in case of inconclusive morphological imaging.

CL-NMS-MO48 • PET Threshold for Target Volume Delineation in Cervical Cancer Using an Integrated PET/MR

Shaomin Zhang (Presenter); Jun Xin MD; Hongzan Sun; Yueyue Lu; Qiyong Guo MD

PURPOSE
The 3D imaging capabilities of US may further expand its future clinical role in molecular imaging of cancer, particularly for more accurate monitoring of treatment response in complete tumor volumes.
CL-NMS-MO6B • Correlation of Preoperative Clinical, PET and CT Parameters with Histologic Grading of Residual Tumor after Neoadjuvant Chemoradiotherapy in Pancreatic Adenocarcinoma

Maiko Sakane MD (Presenter); Mitsuaki Tatsumi MD, PhD; Tonsok Kim MD; Masatoshi Hori MD; Jun Hatazawa MD, PhD; Noriyuki Tomiyama MD, PhD; Hiromitsu Onishi MD; Atsushi Nakamoto MD; Eku Shimosegawa

PURPOSE
The purpose of this study is to investigate the correlation of histopathological effect of chemoradiotherapy (CRT) to pancreatic adenocarcinoma with preoperative clinical, PET and CT parameters, and to evaluate prognostic significance of these grading and parameters.

METHOD AND MATERIALS
This study included 25 patients diagnosed as pancreatic carcinoma by radical surgery after Gemcitabine and S-1 based preoperative-CRT from 2009 to 2012. The extent of residual tumor was graded using the Evans grading systems by a pathologist. Clinical values of CA 19-9 and prognosis of the patients were derived from medical records. A radiologist evaluated radiographic features of pre- and post-CRT contrast-enhanced dynamic CT and PET-CT, including size of tumors, peak standardized uptake value normalized for lean body mass (SUL peak) and metabolic tumor volume with a threshold of SUVmax 2.0 (MTV2.0). These values were statistically compared by commercial software.

RESULTS
Among the 25 patients, 8 patients (32%) showed pathologic poor response (Evans grade I), 12 cases (48%) had mild response (Evans grade IIa), 5 cases (20%) had moderate response (Evans grade IIb), and no case showed complete response or minimal residual tumor (Evans grade III or IV). Mean reduction rate was 35%, 44% and 37% in CA199, 10%, 11% and 22% in tumor size, and 32%, 34% and 43% in SUL peak, respectively for Evans grade I, IIa and IIb. Post-chemoradiation MTV2.0 were 0 cm3 for all 5 cases of Evans grade IIb, and were 2.4 and 3.5 cm3 for Evans grade I and IIa. Median disease free survival time for patients with negative post-chemoradiation MTV2.0 were longer than patients with positive values (883 and 433 days, respectively (p = 0.28)).

CONCLUSION
The reduction rate of tumor size and SUVpeak showed mild tendency to represent histological effect of CRT evaluated by Evans grade. Negative MTV2.0 on PET-Ct after CRT may indicate better histologic response and prognosis in pancreatic adenocarcinoma, although further studies are obviously required.

CLINICAL RELEVANCE/APPLICATION
- Tumor size, SUVpeak, and MTV2.0 were correlated with histological grading.
- Negative post-CRT MTV2.0 may indicate better histological effect and prognosis.

CL-NMS-MO6B • Evaluation of Software Based Analysis of V/P SPECT/CT in Patients with Pulmonary Emphysema

Nils F Schreiter (Presenter); Felix Doellinger; Alexander Poellinger MD; Ralf-Harto Huebner; Ralph Buchert; Thomas J Kroencke MD; Bernd K Hamm MD *; Winfried Brenner &; Vera Froeling MD

PURPOSE
New software based analyzing system (SBAS) is available for ventilation / perfusion (V/P) SPECT/CT. Purpose of this study was to evaluate reproducibility of SBAS for V/P SPECT/CT in patients with pulmonary emphysema (PE) and to compare it to visual interpretation (VI) of V/P SPECT/CT.

METHOD AND MATERIALS
Twenty-one patients (12 female, 9 male; median age: 69) with clinically confirmed PE and COPD (GOLD IV) were scanned with V/P SPECT/CT (Tracer: T99m MAA and Tc99m Technegas). Data was analyzed by two independent observers using SBAS and VI. SBAS was used to assess counts per lung lobe (Cpl) and volume per lung lobe (Vpl). Counts density per lobe (Cdl=Cpl/Vpl) and a ratio Cpl/counts per lung (RCdl) were calculated. VI was performed using a 100 point scale to assess mean counts per lung lobe. Interobserver variability and association for SBAS and VI were analyzed using Spearman’s Rho correlation coefficient. Analysis was performed lobe based and descriptive parameters are given as mean (range).

RESULTS
SBAS yielded excellent lobe based correlation between both observers (all: p < 0.05): Cpl [perfusion: 0.96 (0.91 - 0.99); ventilation: 0.93 (0.73 - 0.99)], Cdl [perfusion: 0.96 (0.87 - 0.99); ventilation: 0.92 (0.72 - 0.99)]; RCdl [perfusion: 0.97 (0.93 - 0.99); ventilation: 0.91 (0.74 - 0.99)].
Correlation of VI was modest to good and correlated in 5/5 lobes 0.66 (0.47 – 0.78) in perfusion and in 3/5 lobes 0.49 (0.36 – 0.58) in ventilation significantly (p < 0.05).

For observer I correlation of SBAS and VI was 0.41 (0.11 - 0.63) which was significant (p < 0.05) for 3/5 lobes in perfusion and 2/5 lobes in ventilation. For observer II correlation of SBAS and VI was 0.44 (0.15 - 0.71) that was significant (p < 0.05) with SBAS for 2/5 lobes in perfusion and 3/5 lobes in ventilation. Mean time of SBAS analyses was 45 min compared to 5 min for VI per patient.

CONCLUSION
Software based analysis offers more reproducible parameters in functional lung imaging by V/P SPECT/CT in patients with pulmonary emphysema than visual interpretation.

CLINICAL RELEVANCE/APPLICATION
Software based analysis is an excellent tool for V/P SPECT/CT in an experimental setting, but has limitations in daily practice due to the time needed for analysis.
AD patients had a larger predominance of right hemisphere activations over left in contrast to healthy subjects. Previous work has reported strong involvement of the brain stem and the anterior cingulate gyrus for AD patients compared to H in which we did not find. Never reported correlations with the frontal gyrus and the posterior cingulate cortex were found. Considering that similar analysis methods were followed in previous studies, we believe that differences are due to different genetic origin of volunteers.

CLINICAL RELEVANCE/APPLICATION

To test the accuracy and applicability of decision rules utilizing ADC ratios to discriminate common pediatric cerebellar tumors across institutions and scanner, age 2 years is a highly accurate mean age of 33 months respectively. Differences in severity of total air trapping between the groups and the patterns of air trapping between the two groups was not statistically significant (p<.05) respectively.

CONCLUSION

Paediatric population with TBM does not incur a higher frequency and severity of air trapping opposed to the children without this disease. The Retrospective nature of the study prevented us from controlling all the variables. Another drawback was there is no validated classification for diagnosis of TBM. The symptomatic presentation of TBM is non-specific and could be easily missed on routine imaging studies.

CLINICAL RELEVANCE/APPLICATION

Patterns of Brain Morphological Changes in Children Patients with Type I Gaucher Disease

Huiling Kang (Presenter); Hua Cheng MD; Bin Gu; Gaolong Gong; Yun Peng MD

PURPOSE

Gaucher disease is the most prevalent inherited lysosomal storage disorder resulting from deficiency of the lysosomal enzyme glucocerebrosidase. The overall incidence is approximately 1:40,000 individuals. Although classic type I Gaucher disease (GDI) is defined as non-neuropathologic involved, increasing clinical studies revealed that there are over 30% GDI patients suffering at least one neurological symptom. Our current study aims to investigate if there are any significant morphological brain changes in GDI patients, using voxel-based morphometry (VBM).

METHOD AND MATERIALS

19 GDI child patients and 16 normal children were included in this study. All patients were evaluated by the severity scoring tool (SST) to quantify the measurement scale about CNS involvement. All normal children had no history of neurologic or psychiatric illness. MR images were scanned using a 3T clinical scanner. Voxel-based morphometry of high-resolution T1-weighted MR images, processed using VBM8 toolbox in SPM. To detect the group difference of GMV and WMV between GDI patients and controls, a general linear model were applied to all voxels across the entire gray matter or white matter, after controlling for age, gender and whole brain volume. Statistical significance was determined by a cluster extent threshold of p<0.05.

RESULTS

9 of 19 patients show different degrees of the CNS involvement by the severity scoring tool (SST). When compared with healthy controls, significant decrease of GMV in GDI patients was found in the right precentral gyrus and left parahippocampal gyrus. In contrast, left cerebellum showed a significant increase of WMV. No significant increase of GMV or significant decrease in WMV in GDI patients relative to healthy controls. (supplementary Figure)

CONCLUSION

This preliminary study provides novel evidences for structural abnormalities in GDI patients, suggesting a necessity of adjusting the opinion regarding the CNS-involvement of GDI.

CLINICAL RELEVANCE/APPLICATION

Our findings suggest that VBM analysis is a potential imaging marker in clinical studies of GDI.

CL-PDS-MO3B • Multi Detector Computed Tomography (MDCT) Assessment of Tracheobronchomalacia (TBM) in Children: A Comparison with Bronchoscopic Findings and the Severity of Air Trapping-A Preliminary Retrospective Study

Amberene Ahmed MD, MSc (Presenter); Jim Carmichael MBBS, FRCR

PURPOSE

The purpose of this project was to retrospectively compare MDCT with bronchoscopy to assess Tracheobronchomalacia by correlating the site and degree of severity of air trapping with the extent of TBM.

METHOD AND MATERIALS

STUDY POPULATION

The retrospective cohort with TBM had 21 participants and control group 17 patients between the ages of (0-18 years). Rate and severity of air trapping was assessed from end expiratory MDCT images using an established scoring system by two blinded paediatric radiologists. MDCT airway diameter was defined, and percentage change in diameter between end inspiration/end expiration was measured. The severity of air trapping between the groups was assessed by independent sample t-test.

RESULTS

Figure 1A and 1B present the results of a comparison of between H and AD patients (H>AD in green and AD>H in red). H subjects presented strong left lateralization (60% vs. 20% structures). AD patients presented a stronger right lateralization (55% vs. 45%).

CONCLUSION

Multi Detector Computed Tomography (MDCT) is equal to Bronchoscopy in detecting TBM but superior in detecting a higher frequency and severity of air trappings in children and is recommended.
Rediscovering Transthoracic Chest Ultrasonography in Children: Practicing Alara Principle

Marcelo A Rocha (Presenter) ; Yoshino T Sameshima MD ; Erika T Koshimura ; Eliane E Dutenhofner MD , BDS ; Martha Hanemann Kim ; Flavia Faganello Gasparini ; Maysa d Ferreira BARCH ; Miguel J Francisco Neto MD ; Marcelo B Funari MD

PURPOSE/AIM
To illustrate normal/abnormal imaging patterns and several pleuropulmonary diseases in children through transthoracic chest ultrasonography, and its correlation to other imaging methods;
To review in a simple and direct topic format important daily practice guidelines and imaging signs to perform state-of-the-art transthoracic chest ultrasonography;
To emphasize the method’s contribution to reducing ionizing radiation dose delivered to neonates and children (ALARA principle).

CONTENT ORGANIZATION
Presentation of the sonographic "pleuropulmonary lines";
Sonographic patterns of pulmonary aeration;
Important signs in transthoracic chest ultrasonography;
Sonographic classification of pneumonia and pleural effusion;
Other applications of pediatric transthoracic chest ultrasonography.

SUMMARY
The course of rheumatologic disease in pediatric age group and imaging findings have somewhat differences from adults. The three major subgroup of disease will be discussed along with the X-ray, CT, and MR imaging findings. Emergency conditions such as acute respiratory distress, acute thrombosis of main vascular structures and aneurysms that can be seen in the course of pediatric rheumatologic diseases will be described with representative cases. Radiologist who read this exhibit will be able to recognize basic clues of pediatric rheumatologic disease and decide which condition is emergency.

CL-PDE3026-MOB • Rediscovering Transthoracic Chest Ultrasonography in Children: Practicing Alara Principle

Breast - Monday Posters and Exhibits (12:45pm -1:15pm)
Monday, 12:45 PM - 01:15 PM • Lakeside Learning Center

LL-BRS-MO2B • Ultrasound-guided Wire Localization of Mammary Duct Contour Change in the Workup and Treatment of Pathologic Nipple Discharge

Benjamin Nulsen (Presenter) ; Christina Weltz MD ; Shabnam Jaffer MD ; Jolinda Mester MD

PURPOSE
To evaluate the role of ultrasound-guided needle localization of a mammary duct in patients who present with pathologic nipple discharge (PND) and otherwise negative clinical and radiologic workup.

METHOD AND MATERIALS
A search of our radiology database of ultrasound-guided needle localizations from 2003-2013 was performed using the keywords “nipple discharge” and “duct” in either the clinical history and/or radiology report. Any patient with a new positive mammogram or ultrasound finding was excluded. All patients with PND underwent breast sonography with attention to the subareolar region of the symptomatic breast. Those patients in whom a nondilated (< 3 mm) or dilated (≥ 3 mm) duct was identified in the region of PND subsequently underwent ultrasound guided preoperative needle localization using a 12-5 MHz linear array transducer and a 3 or 5 cm Kopans needle-wire system. The mammographic and sonographic images were reviewed and correlated with the histopathologic findings.

RESULTS
Twenty-six cases in 25 patients referred for breast sonography for evaluation of PND met the inclusion criteria. The median age of the patients was 56 (range
The results of our study suggest that ultrasound-guided needle localization of either a nondilated or dilated duct identified in the region of PND can help guide the breast surgeon to the location of an intraductal lesion that is otherwise occult on both mammography and sonography. This approach may serve as an alternative to galactography and conventional “blind” ductal excision. In our study, imaging occult papilloma was found in 14/22 (63 %) and cancer in 5/22 (23 %) of the patients.

CONCLUSION

Ultrasound-guided localization of ductal changes provides a reliable alternative to techniques such as galactography and blind ductal excision in the workup and treatment of imaging occult PND.

LL-BRS-MO38 • 2D and 3D Contrast Ultrasonography of Breast Lesions: Quantitative and Morphological Vascular Analysis

Tomoyuki Ohta (Presenter) ; Norio Nakata MD ; Yukio Miyamoto MD ; Kunihiko Fukuda MD

PURPOSE

The purpose of this study was to quantify the diagnostic value of quantitative analysis and vascular morphology of benign and malignant breast masses using 2D and 3D contrast-enhanced ultrasonography (CEUS).

METHOD AND MATERIALS

CEUS using perfluorobutane-based contrast agent (Sonazoid) were performed in 65 pathologically proved palpable breast mass lesions of 63 patients, which were able to depict with B-mode ultrasonography (US). The ultrasound equipments were GE LOGIQ7 and LOGIQ E9 with the linear transducer. CEUS movies in the vascular phase from 0 sec to 50 sec were recorded. The microvascular morphologic and distribution features of breast mass lesions were evaluated with micro flow imaging (MFI). Retrospective quantitative analyses using the time-signal intensity curve (TIC) of CEUS breast lesions were performed in all lesions. Kinetic curves acquired in the first 50 s after the appearance of contrast, were used for statistical analysis. In addition, the wash-in and wash-out patterns of the contrast agent were evaluated by quantitative assessment. In 18 breast lesions, sequential multiphase sweep scans (10-15 sec per sweep) of contrast 2D US images were reconstructed by those manual sensorless parallel CEUS images.

RESULTS

Surgical pathologic analysis showed 19 benign and 46 malignant lesions. A significant difference was found between the benign and malignant lesions in time-to-peak (P).

CONCLUSION

CEUS is useful in the evaluation of breast mass lesions including benign and malignant tumors.

CLINICAL RELEVANCE/APPLICATION

CEUS has a great potential to play role of a bridge between conventional B-mode US and MRI in diagnostic breast imaging.

LL-BRS-MO48 • Evaluation of Tumor Response to Neoadjuvant Chemotherapy by Diffusion Weighted Imaging (DWI): Do the Biological Characteristics of Breast Cancer Influence Its Assessment?

Laura Martinich MD (Presenter) * ; Silvia Carabalona MD ; Rita Giada Spinelli MD ; Valentina Rossi ; Filippo Montemurro MD ; Daniele Regge MD

PURPOSE

To evaluate if biological characteristics of breast cancer influence the response to neoadjuvant chemotherapy (NCT) assessed by DWI.

METHOD AND MATERIALS

64 patients with locally advanced breast cancer (stage II with T>3 cm or IIIA/B/C) were treated by taxane-based NCT. DWI was performed before, during (after 2 cycles) and after NCT using 1.5T magnet and 8-channel coil (EPI sequence; b-value 0/900 s/mm²; slice thickness 4mm; acquisition time 80s). Apparent Diffusion Coefficient (ADC) value was calculated by tracing a region of interest within the lesion. Responders were defined as subjects achieving pathological complete response (absence of invasive cancer cells) after NCT. ADC value before, during and after NCT was correlated with pathological response, also considering the tumor biological characteristics (steroid receptor and HER2 status).

RESULTS

CONCLUSION

DWI is a promising tool to assess the tumor response to NCT. However, tumor biological characteristics influence the ADC value in both Responders and Non-Responders. These differences should be taken into account for a reliable clinical application of DWI (e.g. definition of ADC threshold value) in monitoring the response to primary medical treatments.

CLINICAL RELEVANCE/APPLICATION

ADC of breast cancer differs on the basis of tumor biological characteristics. This aspect should be considered for a reliable clinical application of DWI (e.g. definition of ADC threshold value) in monitoring the response to NCT.

LL-BRS-MO58 • Predicting Tumor Aggressiveness with Breast MRI: Role of Quantitative Diffusion-weighted Imaging (DWI)

Giulia Cristel MD (Presenter) ; Elena Schiani MD ; Claudio Losio MD ; Mariagrazia Rodighiero MD ; Francesco A De Cobelli MD ; Alessandro Del Maschio MD

PURPOSE

The aim of our study was to assess whether or not apparent diffusion coefficient (ADC) can be used as a prognostic factor in the pre-operative setting by evaluating the relationship between the ADC values provided by diffusion-weighted imaging (DWI) and the histopathological features of MRI-detected malignant lesions.

METHOD AND MATERIALS

One-hundred-and-twenty-two patients with breast cancer underwent pre-operative breast MRI at 1.5 T. The protocol included T2-TSE sequences, DWI (b-values: 0 and 900 s/mm²) and dynamic study. For each malignant lesion, the ADC value was quantified and compared with histopathological type, grade and receptor expression (oestrogen receptor [ER], progesterone receptor [PgR], Ki-67, HER-2). Based on these features, the lesions were classified as Luminal-A (LumA), Luminal-B (LumB), HER2-enriched (HER2) and triple-negative (TN). Correlations were analyzed using the Mann-Whitney U and Kruskal-Wallis H tests.

RESULTS

MR1 detected 178 malignant lesions, confirmed by histological analysis (18 in situ, 160 invasive carcinomas). The mean ADC value was significantly lower for invasive than in situ (IŠ) carcinomas (0.94x10-3mm²/s vs 1.15x10-3mm²/s, p<0.001). Our study demonstrated that, despite some overlap of ADC values among different cancer subtypes, ADC could be a promising prognostic quantitative parameter inversely associated with histopathological factors.

CLINICAL RELEVANCE/APPLICATION

Quantitative Diffusion Weighted Imaging is concordant with biological aggressiveness of breast cancer and could be an additional prognostic predictor.

LL-BRS-MO68 • Value of Additional Digital Breast Tomosynthesis Combined with Digital Mammography in a Diagnostic Setting

Min Sun Bae MD (Presenter) ; Jung Min Chang MD ; Sun Ah Kim MD ; Jihe Lim MD ; Won Hwa Kim MD, MS ; Su Hyun Lee MD ; Hye Ryoung Koo MD ; Min Sun Bae MD, PhD ; Naryi Cho MD ; Woo Kyung Moon MD

PURPOSE

To assess the value of adding digital breast tomosynthesis (DBT) to digital mammography (DM) in a diagnostic workup and to compare abilities to detect breast cancer.

METHOD AND MATERIALS

RESULTS

In the pooled receiver operating characteristic (ROC) analysis, the average AUC for combined DBT and DM was 0.812, significantly higher than that of DBT alone (0.788), and DM alone (0.748). A single nondilated or dilated duct was identified at the site of PND in 22/26 cases. No intraductal mass was appreciated in any of these cases. Needle localization of the nondilated/dilated duct was successfully performed in the 22 cases in which a single target for localization was identified. The histopathologic results included papilloma (14), cancer (5), ADH (2) and no lesion (1).

CONCLUSION

The results of our series suggest that ultrasound-guided needle localization of either a nondilated or dilated duct identified in the region of PND can help guide the breast surgeon to the location of an intraductal lesion that is otherwise occult on both mammography and sonography. This approach may serve as an alternative to galactography and conventional “blind” ductal excision. In our study, imaging occult papilloma was found in 14/22 (63 %) and cancer in 5/22 (23 %) of the patients.

CLINICAL RELEVANCE/APPLICATION

Ultrasound-guided localization of ductal changes provides a reliable alternative to techniques such as galactography and blind ductal excision in the workup and treatment of imaging occult PND.
**CONCLUSION**

Combined interpretation of DBT and DM showed the best diagnostic performance in diagnostic workup, and the addition of DBT to DM increases cancer detection without decreasing the specificity. Cancer detection rate was correlated with image findings and histology in combined studies.

**CLINICAL RELEVANCE/APPLICATION**

Adding DBT to DM improved diagnostic performance in a diagnostic setting. Invasive cancers, lesions with microcalcifications or architectural distortion were more easily detected by the combined study.

**LL-BRE-MO7B • Papillary Lesions of the Breast: Classification, Imaging Aspects and Management**

*Fabiola P Kestelman MD (Presenter); Clara F Gomes MD; Fernanda B Fontes; Carolina D Conti MD; Marcia Jazbik; Fernanda A Cavallieri MD; Suzana A Cavallieri MD*

**PURPOSE/AIM**

The purpose of this exhibit is: (1) to define histopathologic classification of papillary lesions, (2) to review the spectrum of findings on breast imaging modalities and (3) to discuss the management after percutaneous diagnosis.

**CONTENT ORGANIZATION**

1) Review the pathologic classification of papillary lesions of the breast according to WHO: a) Intraductal papilloma: central, peripheral, atypical papillomas b) Intraductal papillary carcinoma: intracystic papillary carcinoma, papillary intraductal carcinoma c) Invasive papillary carcinoma 2) Pictorial examples of imaging findings in ultrasound, mammography and MRI. 3) Review the literature and discuss the management of nonmalignant papillary lesion diagnosis in percutaneous biopsy.

**SUMMARY**

The appearance of papillary lesions of the breast vary clinically, radiologically, and pathologically. There is a wide spectrum of appearances on imaging, and differentiation of benign from malignant pathologies may be difficult. Tissue sampling is usually necessary. Clinical management on nonmalignant breast papillary lesion diagnosed at percutaneous biopsy is controversial. Literature recommend that atypical papillary lesions undergo surgical excision, although some studies recommend following patients with benign lesions with serial imaging.

**LL-BRE-MO8B • MRI to the Rescue: Unusual Lesions of the Breast, MRI Features with Mammography, Ultrasonography and Histopathology Correlation**

*Seema Sud MBBS (Presenter); Tarvinder B Buxi MD; Samarjit S Ghuman MBBS, MD; Ruhani Doda MBBS; Aditi Sud*

**PURPOSE/AIM**

1) To illustrate the technique of performing and analyzing MRI of the breast 2) To depict the imaging findings of rare lesions of the breast on MRI correlated with ultrasonography, mammography and histopathology. 3) To provide clues to arriving at the correct diagnosis on MRI.

**CONTENT ORGANIZATION**

1) Breast MRI equipment, sequences and parameters and importance of diffusion weighted imaging 2) Case based reviews of unusual lesions of the breast with mammography, ultrasonography and histopathology correlation.

- Benign Virginal Hyperplasia
- Sarcoidosis
- Tubercular Mastitis
- Focal adenosis
- Paget’s disease of the nipple
- Ductal ectasia with periductal mastitis and papillomatosis in male breast
- Intraductal Papillomas with Gynaecomastia and invasive carcinoma in male breast
- Fat necrosis
- Fibroadenolipoma
- Benign and malignant phylloides tumor
- Inflammatory breast carcinoma
- Colloid carcinoma
- Medullary carcinoma
- Invasive carcinoma with central necrosis
- Lobular carcinoma
- Fibroadenomatoid hyperplasia.

3) Pearls and pitfalls

**SUMMARY**

The major teaching points of this exhibit are:

- A wide variety of unusual pathological conditions may be seen in the breast
- Breast MRI is a powerful tool which can resolve the diagnostic dilemma in many of these cases

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**Cardiac - Monday Posters and Exhibits (12:45pm - 1:15pm)**

**Monday, 12:45 PM - 01:15 PM • Lakeside Learning Center**

**LL-CAS-MOB • AMA PRA Category 1 Credit ™:0.5**

**LL-CAS-MO1B • The Combination of Lower Concentration Contrast Agent with 80 kVp in Coronary Computed Tomography Angiography (CCTA)**

*Qian Li MSc (Presenter); Guan Hanxiong MD*

**PURPOSE**

To study the clinical value of combining flow concentration contrast agent (iodixanol 270 mgI/ml) with 80 kVp in coronary computed tomography angiography (CCTA).

**METHOD AND MATERIALS**

60 patients were randomly divided into 2 groups to take CCTA examinations on a GE Discovery CT750 HD scanner with prospective ECG-triggered axial scans. Half patients for group A (iodixanol 270 mgI/ml) underwent 80kVp scan with 50% ASiR reconstruction and the other half for group B (iodixanol 370mgI/ml) underwent 120kVp scan and regular FBP reconstruction. The rest scan parameters were the same and the total contrast dose was at 0.9 ml/kg and was injected at 5 ml/s rate for both groups. Image slice thickness was 0.625 mm. CT value in the ostium of left coronary artery, and the CT value and SD value of subcutaneous fat tissue were measured. Contrast-noise-ratio (CNR) of the aorta was calculated and compared between the two groups using statistical method. Radiation dose (dose-length-product, DLP) was recorded.

**RESULTS**

The mean CT value of the ostium of left coronary artery for group A ($511.99±33.24$ HU) was statistically higher than that of for group B ($395.71±22.93$ HU), ($p<0.05$). It was statistically lower for the radiation dose in group A (437.38 ± 80.14 mGy*cm) than group B (1151.12 ± 123.07 mGy*cm), ($p<0.05$).

**CONCLUSION**

The combination of lower concentration of contrast agent with 80 kVp used in coronary CTA provided similar image quality with 27% contrast dose reduction and up to 62% lower radiation dose reduction compared to conventional CCTA.

**CLINICAL RELEVANCE/APPLICATION**

The combination of lower concentration of contrast agent with 80 kVp used in coronary CTA provided similar image quality with 27% contrast dose reduction and up to 62% lower radiation dose reduction.

**LL-CAS-MO2B • Relationship between Impaired Cardiac Sympathetic Activity and Spatial Dyssynchrony in Patients with Nonischemic Heart Failure: Assessment by MIBG Scintigraphy and Tagged MRI**

*Masato Yonezawa (Presenter); Michinobu Nagao MD* ; *Yoshio Matsuo; Satoshi Kawanami MD* ; *Shingo Baba; Takeshi Kamitani MD; Takuro Isoda; Mikako Jinnouchi MD; Yasuhiro Maruoka; Yuzo Yamasaki MD; Kohtaro Abe; Taiki Higo; Takashi Yoshiura MD, PhD; HiroshiHonda MD*
Percutaneous Pulmonary Valve Implantation: Long-term Follow-up with Cardiac Magnetic Resonance

Elda Chiara Resta; Francesco Secchi MD (Presenter); Paolo Maria Cannao; Giovanni Di Leo; Mario Carminati MD; Francesco Sardanelli MD *

METHOD AND MATERIALS

After IRB approval and informed consent, patients with congenital heart diseases and pulmonary conduit dysfunction were prospectively scheduled for 1.5-T magnetic resonance (CMR). The purpose of study was to evaluate the diagnostic value of Cardiac Magnetic Resonance (CMR) before and after percutaneous pulmonary valve (Melody, Medtronic) implantation (PPVI).

RESULTS

From January 2008 to January 2013, we enrolled 36 patients (21±8 years old), all of them studied within one week before valve implantation and 10 of them underwent 33±17 m³/m² (P<.001), 26±13 m³/m² (P=.042), and 62±12% (P=.027), respectively. EDVI, ESVI, and EF of LV before valve implantation were 67±17 m³/m², 30±13 m³/m², and 56±9%, respectively, the same data after 36 months were 72±19 m³/m² (P=.241), 33±15 m³/m² (P=.028), and 56±10% (P=.047), respectively; the same data after 48 months were 67±19 m³/m² (P=.916), 26±15 m³/m² (P=.042), and 62±12% (P=.027), respectively. EDVI, ESVI, and EF of LV before valve implantation were 67±17 m³/m², 30±13 m³/m², and 56±9%, respectively, the same data after 36 months were 78±19 m³/m² (P=.333), 34±11 m³/m² (P=.475), and 57±7% (P=.085); the same data after 48 months were 79±20 m³/m² (P=.345), 35±11 m³/m² (P=.599), and 58±7% (P=.116).

CONCLUSION

Four years after PPVI, we observed a significant improvement of RV EF and ESVI. A borderline significant change was observed for the left ventricle systolic function.
LL-CAS-MO68 • Preliminary Study of 80 kVp on Coronary CT Angiography with 300 mg I/ml Ioxanol with Iterative Reconstruction

Rui Wang PhD (Presenter); He Wang MD; Baocui Zhang; Xiaoying Wang MD

PURPOSE
To evaluate the feasibility of 80 kVp and 300 mg I/ml ioxanol in coronary CT angiography (CTA) with 64-slice CT scanner, by using iterative reconstruction.

METHOD AND MATERIALS
Totally 25 patients (16 men, 9 women, BMI 20-25) were recruited with clinical indication of coronary CTA in this perspective study, with permission of ethical committee. All the patients underwent coronary CTA with prospective ECG-gated protocols, with following parameters: 80 kVp, automatic mA and 30% adaptive statistical iterative reconstruction (ASiR). All the patients were injected 60ml ioxanol 300 mg I/ml, with flow rate of 5ml/s and 30ml normal saline flush. Noise report was recorded in each patient. Two experienced radiologists evaluated the CT images. The coronary artery was divided into 16 segments to subjectively evaluate the image quality, including aorta, LM, LAD (proximal, middle and distal), D1, D2, LCX (proximal, middle and distal), OM, RCA (proximal, middle and distal), PDA, PL, AH. The image quality was scaled as score 1 to 5, which was defined as poor, adequate, good, very good and excellent image quality, respectively. Intravascular CT value was measured of each segment. The ROI, larger than half of lumen, was placed in the center of vessel lumen. The data from segment which lumen diameter less than 2mm was excluded.

RESULTS
The BMI was 22.29±1.15 in average. The average radiation dose were as following: CTDi vol 7.87±0.49 mGy, SDDE 10.53±1.13 mGy, and ED 1.66±0.27 mSv, respectively. Eleven segments were excluded. For the 389 segments, the maximum intravascular CT value was 606.2±114.10 HU in aorta, while the minimum CT value was 489.14±144.86 HU in D2. For subjective evaluation, 343 were scored 5, 34 were scored 4, 12 were scored 3. No segment was scored less than 3.

CONCLUSION

CLINICAL RELEVANCE/APPLICATION
With image noise reduction by iterative reconstruction, low kVp image can be applied. CT value of iodine was higher in low kVp image, which means we can try to use less iodine in CT vascular imaging.

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LL-CAS-MO77 • Clinical Correlation of Left Atrial Systolic and Diastolic Functions Evaluated by Cine-MRI and Invasive Monitoring of Left Atrial Pressure

Irfan M Khurram MD (Presenter); Farhan Maqbool MBBS; Roy Beinart MD; Hugh Calkins; Saman Nazarian MD *; Stefan L Zimmerman MD

PURPOSE
Atrial fibrillation (AF) is associated with significant abnormalities of left atria (LA) systolic and diastolic functions. The LA diastolic functions are routinely estimated with 2-D speckled tracking echocardiography with its own limitations. This study describes a MRI based volume measures along with invasive left atrial pressure tracing to accurately estimate extent of LA diastolic and systolic functions.

METHOD AND MATERIALS
A total of 55 AF patients (55% paroxysmal, 45% persistent) undergoing AF ablation were enrolled after IRB approved consent. Cine-MRI was obtained in sinus rhythm before the ablation procedure. Left atrial pressures were acquired following trans-septal puncture prior to applying ablation lesions. Patients, if not in sinus rhythm, were monitored post ablation procedure for accurate pressure measurements. Atrial pressure and volume loops were prepared for all patients. LA diastolic function was estimated by the slope of the passive LA filling curve and was quantified by creating diastolic dysfunction score defined by the ratio of change of LA pressure to volume during passive filling of LA (p/V).

RESULTS
The study population included 81% male, age 60.4±10.2 years, and mean CHADS2 score of 0.9±1. The mean diastolic dysfunction score for AF patients was 0.76±0.7, while the scores were excluded. For the 389 segments, the maximum intravascular CT value was 606.2±114.10 HU in aorta, while the minimum CT value was 489.14±144.86 HU in D2. For subjective evaluation, 343 were scored 5, 34 were scored 4, 12 were scored 3. No segment was scored less than 3.

CONCLUSION
Left atrial diastolic functions appear to get worse in persistent AF and is increasing age. It is also shown a trend towards higher dysfunction score with repeat AF ablations. LA diastolic and systolic functions appear to follow the same trend in atrial fibrillation patients.

CLINICAL RELEVANCE/APPLICATION
Cine-MRI based volume data can be combined with invasive pressure data to obtain true left atrial diastolic and systolic functions.

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LL-CAS-MO98 • Correlating Clinical Arrhythmia Severity Scores with Cardiac magnetic resonance Imaging Parameters

Jiyeon Lim (Presenter); Eun-Ah Park MD; Jae Hyung Park MD; Whal Lee MD, PhD; Jin Wook Chung MD *

PURPOSE
To evaluate the multi-detector CT (MDCT) coronary angiographic findings of coronary-to-pulmonary artery fistula (CPAF).

METHOD AND MATERIALS
We retrospectively reviewed cases of CPAF from our coronary CT angiography (CCTA) database between January 2008 and December 2010. All CCTA examinations were performed with a 64-channel MDCT or DSCT. We analyzed the MDCT coronary angiographic findings for the number and origin of feeding arteries, number, size and location of draining fistulous openings, association with peripulmonary arterial aneurysms, and the presence of CPAF communication with bronchial arteries.

RESULTS
Among the 15,042 patients who underwent CCTA examinations during the selected period, a total of 55 patients (0.37%) were diagnosed with CPAF on the basis of CCTA findings. The feeding artery was single in 19 patients and multiple in 36 patients. The feeding arterial branch originated from the conal (n=40), left anterior descending (n=40), left main (n=14), and diagonal branches (n=3). The draining fistulous opening was single in 54 cases and multiple in 1 case, located mostly in the anterior sinus of the main pulmonary artery (MPA, n=54) except in one case (anterior-left sinus junction). The mean diameter of fistulous openings was 2.7±1.4mm. Peripulmonary arterial aneurysms were aneurysmal dilations of 3-6 mm in 17 cases (31%) and saccular aneurysms = 6mm in diameter (mean 10.3±7.3 mm, range 6.2-26.0 mm) in 7 cases (13%). CPAF communication with bronchial arteries was present in 9 cases (diameter 3.5±2.2 mm).

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LL-CAE-MO99 • Multi-detector Coronary Angiographic Findings of Coronary-to-Pulmonary Artery Fistula

Heejung Lim, PhD (Presenter); Hee-Jung Park MD; Jae Hyung Park MD; Lee Whal MD; sie Jin Wook Chung MD

PURPOSE
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METHOD AND MATERIALS
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CLINICAL RELEVANCE/APPLICATION
CMR can be used for a comprehensive noninvasive long-term follow-up after percutaneous pulmonary valve implantation.
CLINICAL RELEVANCE/APPLICATION
Detailed MDCT coronary angiographic findings of CPAF can provide understanding of embryologic development and help determine surgical or interventional management strategy for this condition.

Chest - Monday Posters and Exhibits (12:45pm - 1:15pm)
Monday, 12:45 PM - 01:15 PM • Lakeside Learning Center

LL-CHS-MO18 • MRI Derived Cardiac Mass Is Decreased in Bronchiolitis Obliterans Syndrome (BOS) after Lung Transplantation: A Novel Biomarker for Early Detection of Transplant Failure?

Yu M Meng MD (Presenter) ; Wang Dan MD ; Bai X Dong ; Shen Baozhong MD, PhD

PURPOSE
To explore the feasibility of evaluating pulmonary perfusion disorders with different pathological changes using the distributions of iodine and air in spectral CT.

METHOD AND MATERIALS
47 patients underwent spectral CT pulmonary angiography (CTPA) imaging on GE Discovery CT750HD scanner. Lung window and Min IP were used to evaluate the air content in pulmonary tissue. Combined iodine-based material decomposition images and monochromatic CTPA images were used to detect the abnormal perfusion location, types, and to measure iodine content. Based on the data to analyze the morphology and aeration in abnormal lung parenchyma.

RESULTS
18 patients with no pulmonary embolism (PE) on CTPA had even iodine distribution for the left and right parts of the lung parenchyma (P>0.05), and homogeneous air distribution in Min IP. The iodine contents (IC, in mg/ml) in posterior, mediastinum, bilateral for the lung parenchyma were 1.03, 1.30, and 1.52, presenting gradient distribution from ventral to dorsal. In 12 patients with PE, a total of 186 emboli (56 occlusive and 130 non-occlusive) were found. 92 in 130 showed reduced perfusion (IC, 0.62). The air content presented no obvious increment. Perfusion exhibited noticeable reduction in all occlusive clots, (IC, 0.13). The air content increased in Min IP (Figure 1). 7 patients with pulmonary infection with 4 ground-glass opacification cases (IC, 2.56) and 3 consolidation cases (IC, 3.84). Reduced aeration was seen on the Min IP in the areas of hyper-perfusion. The iodine showed diffuse perfusion defect in 6 patients with pulmonary hypertension but normal CTPA. A marked reduction of the pulmonary parenchyma density of 0.48g/ml and corresponded to increased content of air. In 2 cases of diffuse emphysema, the IC is 0.20. Markedly reduced density in the Min IP matched the areas with reduction of perfusion in the iodine maps. In 2 cases of Interstitial fibrosis, reduced perfusion (IC, 0.07) of the pulmonary parenchyma was found in both cases together with reduced aeration in Min IP (Figure 2).

CONCLUSION
Spectral CT Imaging is able to quantitatively measure the content of iodine and the distribution of gas in lungs with different pathological changes, which can be used as a new effective way to detect the pulmonary blood flow / ventilation changes.

CLINICAL RELEVANCE/APPLICATION
lung perfusion with Spectral CT can be evaluated under different pathological conditions, changes in lung function.

LL-CHS-MO28 • Individually Optimized Uniform Enhancement in CT Angiography for the Diagnosis of Pulmonary Thromboembolic Disease-A Simulation Study

Ming Xue (Presenter) ; Hao H Zhang ; Seth J Kligerman MD * ; Paul Klair PhD * ; Warren D D'souza PhD ; Wei Lu

PURPOSE
To improve the diagnostic quality of CT angiography (CTPA) for pulmonary thromboembolic disease by individually optimizing a bi-phasic contrast injection function to achieve targeted uniform contrast enhancement. To compare the results against a previously reported discrete Fourier transform (DFT) approach in a simulation study.

METHOD AND MATERIALS
This study uses a retrospective dataset of 27 consecutive patients. We developed an optimization approach consists of two steps: 1. Compute the impulse enhancement function (IEF) based on the test bolus scan; 2. Optimize the contrast injection function using the IEF in order to achieve uniform target enhancement. We chose a bi-phasic contrast injection function in which the injection rates and durations are optimized by minimizing the difference between its contrast enhancement curve and the uniform target enhancement curve. The optimization method we propose here searches the optimal bi-phasic injection function that conforms to the constraints on injection rate and contrast volume. The contrast volume is limited firstly to the clinical standard of 65 ml and then to the same amount used in the DFT approach. The optimization approach is compared against the DFT approaches in terms of the average root mean square errors (RMSE) from the uniform target contrast enhancement curve and the average contrast volume used.

RESULTS
When the contrast volume is limited to 65 ml, the optimization approach produces contrast enhancement significantly (p<0.05) better than the DFT approach. Its implementation in clinic has great potential to improve the diagnostic quality of CTPA.

CLINICAL RELEVANCE/APPLICATION
With limited contrast volume, our proposed method can produce optimal uniform or plateau-like enhancement pattern to help the diagnosis of pulmonary thromboembolic disease (PE).

LL-CHS-MO32 • MRI Derived Cardiac Mass Is Decreased in Bronchiolitis Obliterans Syndrome (BOS) after Lung Transplantation: A Novel Biomarker for Early Detection of Transplant Failure?

Jan Hinrichs (Presenter) ; Jens Gottlieb ; Julius Renne MD ; Christian Schoenfeld ; Sajoscha A Sorrentino MD ; Marcel Gutherlet DiplPhys ; Daniela Wenzel ; Tobias Welte MD ; Frank K Wacker MD * ; Jens Vogel-Clausen MD

PURPOSE
Bronchiolitis obliterans syndrome (BOS) represents a severe complication following lung transplantation (LTx) and is associated with small airway fibrosis. Currently lung function tests are used as a clinical marker to diagnose BOS with limited sensitivity for early graft failure. This study was undertaken to assess if MRI derived biventricular cardiac mass and function parameters may predict BOS.

METHOD AND MATERIALS
Using 1.5T cardiac MRI, measurements of myocardial structure and function were performed in 51 patients (age and sex matched): 25 women with a mean age of 49 ± 13 years (13 without BOS; 12 with BOS) and 26 men with a mean age of 44 ± 13 years (12 without BOS; 14 with BOS) were examined. Multiple step wise regression analysis was implemented to estimate the relationship of biventricular cardiac mass and function parameters for BOS. T-test and Spearman rho correlation were used.

RESULTS
In a multiple regression analysis including age, sex, days after LTx, mean blood pressure, history of ischemic heart disease, CI, RV and LV EF, EDV/BSA, ESV/BSA and mass/BSA as parameters only LV mass/BSA remained as an independent parameter to predict the presence of BOS (p=0.04, OR=1.19, 95%-CI=[1.036;1.477]). In an ordinal logistic regression model predicting various stages of BOS (BOS 0, BOS1, BOS2 and BOS 3) using the same parameters LV mass/BSA (p=0.03, OR=1.167, 95%-CI=[1.037;1.398]) and days after LTx (p=0.007, OR=0.998, 95%-CI=[0.997;0.999]) were both independent predictors for increasing BOS severity. Patients without BOS showed a significantly higher LV, RV and global myocardial mass compared to patients with BOS (p<0.05).

CONCLUSION
Reduced LV cardiac mass may serve a novel biomarker for BOS and the severity of BOS in our cohort of lung transplant patients. Further research should evaluate if cardiac mass can predict survival.

CLINICAL RELEVANCE/APPLICATION
LV mass may serve as MRI derived biomarker for detection of lung transplant failure due to BOS.

LL-CHS-MO48 • Breast Density: Comparison of Chest CT with Mammography

Yu M Meng MD (Presenter) ; Wang Dan MD ; Bai X Dong ; Shen Baozhong MD, PhD

PURPOSE
Comparison of chest CT and mammography is a useful approach in evaluating breast density in women. However, there is no consensus about how to interpret the density of breasts.

METHOD AND MATERIALS
This study uses a retrospective dataset of 27 consecutive patients. We developed an optimization approach consists of two steps: 1. Compute the impulse enhancement function (IEF) based on the test bolus scan; 2. Optimize the contrast injection function using the IEF in order to achieve uniform target enhancement. To compare the results against a previously reported discrete Fourier transform (DFT) approach in a simulation study.

RESULTS
When the contrast volume is limited to 65 ml, the optimization approach produces contrast enhancement significantly (p<0.05) better than the DFT approach. Its implementation in clinic has great potential to improve the diagnostic quality of CTPA.

CLINICAL RELEVANCE/APPLICATION
With limited contrast volume, our proposed method can produce optimal uniform or plateau-like enhancement pattern to help the diagnosis of pulmonary thromboembolic disease (PE).

LL-CHS-MO32 • MRI Derived Cardiac Mass Is Decreased in Bronchiolitis Obliterans Syndrome (BOS) after Lung Transplantation: A Novel Biomarker for Early Detection of Transplant Failure?

Jan Hinrichs (Presenter) ; Jens Gottlieb ; Julius Renne MD ; Christian Schoenfeld ; Sajoscha A Sorrentino MD ; Marcel Gutherlet DiplPhys ; Daniela Wenzel ; Tobias Welte MD ; Frank K Wacker MD * ; Jens Vogel-Clausen MD

PURPOSE
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METHOD AND MATERIALS
Using 1.5T cardiac MRI, measurements of myocardial structure and function were performed in 51 patients (age and sex matched): 25 women with a mean age of 49 ± 13 years (13 without BOS; 12 with BOS) and 26 men with a mean age of 44 ± 13 years (12 without BOS; 14 with BOS) were examined. Multiple step wise regression analysis was implemented to estimate the relationship of biventricular cardiac mass and function parameters for BOS. T-test and Spearman rho correlation were used.

RESULTS
In a multiple regression analysis including age, sex, days after LTx, mean blood pressure, history of ischemic heart disease, CI, RV and LV EF, EDV/BSA, ESV/BSA and mass/BSA as parameters only LV mass/BSA remained as an independent parameter to predict the presence of BOS (p=0.04, OR=1.19, 95%-CI=[1.036;1.477]). In an ordinal logistic regression model predicting various stages of BOS (BOS 0, BOS1, BOS2 and BOS 3) using the same parameters LV mass/BSA (p=0.03, OR=1.167, 95%-CI=[1.037;1.398]) and days after LTx (p=0.007, OR=0.998, 95%-CI=[0.997;0.999]) were both independent predictors for increasing BOS severity. Patients without BOS showed a significantly higher LV, RV and global myocardial mass compared to patients with BOS (p<0.05).

CONCLUSION
Reduced LV cardiac mass may serve a novel biomarker for BOS and the severity of BOS in our cohort of lung transplant patients. Further research should evaluate if cardiac mass can predict survival.

CLINICAL RELEVANCE/APPLICATION
LV mass may serve as MRI derived biomarker for detection of lung transplant failure due to BOS.
METHOD AND MATERIALS
Institutional Review Board (HIPPA compliant) approval was obtained to perform a retrospective review of the mammogram and chest CT scan of 206 women performed within 1 year of each other. Two board certified radiologists with expertise in mammography and CT scan interpretation independently reviewed the mammograms and CT scans and classified each case into one of the four breast density grades defined by the American College of Radiology Breast Imaging Reporting and Data System (BI-RADS). Inter-reader agreements for the mammographic and CT density grades were determined using Cohen's weighted kappa statistics. The intra-reader correlation coefficient was determined on a subset of CT images.

RESULTS
The inter-reader agreement was higher for the CT than for the mammogram density grades (0.79; 95% CI 0.73 - 0.85 vs. 0.62; 95% CI 0.54 – 0.71). The intra-reader reliability of breast density readings on CT was 0.88, at the high end of reliability.

CONCLUSION
Preliminary results suggest that breast density readings on CT are reliable, and may provide important additional risk information on all CT scans of the chest.

CLINICAL RELEVANCE/APPLICATION
CT breast density readings represent an opportunity to provide additional information about the risk of breast cancer that is currently not being used in a standardized manner.

LL-CHS-MO5B • Development of a Simulation Model for Lung Cancer Screening by Low-dose Computed Tomography: A Validation Study
Marjolein A Heuvelmans BSc (Presenter) ; Marcel Greuter PhD ; Roland Snijder ; Harry Groen ; Matthys Oudkerk MD, PhD ; Geertruida H De Bock

PURPOSE
The purpose of this study is to develop a lung cancer screening model which can be used for a valid prediction of the outcome of lung cancer screening trials, in order to optimize scenarios for lung cancer screening.

METHOD AND MATERIALS
Included in the lung cancer screening simulation model were the risk to develop lung cancer during life, the sensitivity of low-dose CT, preclinical tumor growth, tumor induction, lung cancer mortality, and mortality due to other reasons. The simulation model was validated by comparing the outcome data of the model with the available data from two recently published lung cancer screening studies, the American National Lung Cancer Screening Trial (NLST) and the Dutch-Belgian Lung Cancer Screening Trial (TACRONELSON).

RESULTS
No significant differences were found by comparing the number of tumors predicted by the model and the number of tumors found in both lung cancer screening studies. Although the model overestimated the mortality rate for the NLST study, it predicted a mortality reduction for lung cancer screening of 22.1% (95%CI: 14.8%-28.9%), which was not significantly different from the published mortality reduction of 20.0% (95%CI: 6.8%-26.7%).

CONCLUSION
The new model can be used for further optimization of different scenarios in lung cancer screening.

CLINICAL RELEVANCE/APPLICATION
Using the developed model, the outcome of lung cancer screening trials in terms of lung cancer mortality reduction can be predicted.
1. Enhance the participant's knowledge of the hereditary colorectal cancer syndromes (HCRCS) and their manifestations.

**METHOD AND MATERIALS**

Materials and Methods: head and neck MDCT was performed on 19 patients with trauma to the head and neck using a 64 channel computed tomography scanner (VCT, GE, Connecticut). Patients were allotted into one of two acquisitions. Patient demographics were equally distributed. Group A (n=9), the department's standard protocol, comprised of a head scan from the vertex to the base of skull, and the neck from the clivus to the second thoracic vertebrae; Group B (n=10), involved a cranio-caudal scan direction from the vertex of the cranium to the second thoracic vertebrae. Skin entrance dose to eyes and thyroid were measured using GafChromic XR2-QA films (International Specialty Products, Wayne, NJ). Visual grading characteristic (VGC) techniques assessed diagnostic clinical image quality. Data generated were compared between groups using Mann-Whitney U non-parametric statistics.

**RESULTS**

Results: Mean dose to the thyroid gland demonstrated significant reduction in group B (2.09±0.56 mGy) compared to A (2.74±0.50 mGy) (p = 0.0133). Mean dose to the eyes were non-significant in group B (2.22 ± 0.76 mGy) compared to A (2.51 ± 0.34 mGy) (p = 0.22). VGC analysis demonstrated significant increase in image quality in group B compared to A within the brain (p = 0.0304) and cervical spine region (cortical outline, p = 0.0087; trabecular pattern, p = 0.0081). Dose length product was reduced in group A (2010.06 + 853.83) compared to B (2289.84 + 714.62) (p=0.22).

**CONCLUSION**

Conclusion: Optimization of scanner protocols, single-pass scan acquisition and reduced radiation dose to the eye and thyroid, can significantly improve image quality and may increase workflow during dural MDCT imaging of the head and neck.

**CLINICAL RELEVANCE/APPLICATION**

Direct radiation effects concerning the eye and thyroid gland are well documented at dual-pass scanning, which results in cataract formation and the development of thyroid malignancy.

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**LL-ERS-MO4B • Variability in Management Recommendations for Incidental Thyroid Nodules Detected on Computed Tomography of the Cervical Spine in the Emergency Department**

Bruce E Lehnert MD (Presenter) ; Claire K Sandstrom MD ; Ken F Linnau MD,MS

**PURPOSE**

Thyroid nodules are common incidental findings at computed tomography (CT) however there are no CT based management guidelines, potentially resulting in variability in practice. Demonstrating this variability in practice may illustrate the need for CT based management guidelines for incidental thyroid nodules.

**METHOD AND MATERIALS**

We retrospectively reviewed radiology reports describing thyroid nodule(s) from consecutive CT cervical spine examinations performed in our Emergency Department (ED) from 01/01/2009 to 12/31/2011. 315 examinations met criteria. The number of nodules, nodule size, and recommended management (US, clinical correlation, clinical follow-up, thyroid serology, comparison with prior studies, nuclear scintigraphy, fine needle aspiration, or no follow-up needed) were recorded.

**RESULTS**

The mean study age was 64 yrs (+/- 20). 58% were female. 30% (95/315) of the thyroid nodules measured

**CONCLUSION**

Management recommendations for incidental thyroid nodules detected on CT of the cervical spine in the ED are made inconsistently and the type of management recommended is variable.

**CLINICAL RELEVANCE/APPLICATION**

There is variability in practice for managing incidental thyroid nodules detected at CT which may benefit from the development of CT based management guidelines.

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**LL-ERS-MO5B • 50% Dose CT in Acute Cervical Spine Injury: Improved Signal and Reduced Artifact at the Cervicothoracic Junction Using Fully Integrated Circuit CT Detectors**

Patrick McLaughlin FFRCSI ; Teresa Liang MD, BSc (Presenter) ; Graeme J McNeill MRCP, FFRCSI ; David Tso MD ; Luck J Louis MD ; Hugue A Ouellette MD ; John R Mayo MD * ; Savvas Nicolaou MD

**PURPOSE**

In this study we compare subjective and objective image quality between 100% dose and 50% dose dual source cervical spine CT datasets obtained using both traditional discrete (DC) and novel fully integrated (IC) detectors.

**METHOD AND MATERIALS**

22 consecutive patients underwent dual source CT of the cervical spine with conventional DC detectors (DC-Csp) using a dual source 128-slice CT system. A different group of 30 consecutive patients were subsequently scanned after the installation of IC detectors (IC-Csp) (Stellar; Siemens Healthcare, Forcheim, Germany) using the same acquisition protocol (140kv, ref mAs 440, 128x0.6 mm). Raw data from detector A of both datasets were reconstructed to yield half dose images (IC-Csp50 and DC-Csp50) for all patients using a validated technique. Image quality was subjectively graded using a 4-point scoring scheme for osseous and soft tissue definition of the spinal column at C3, C5 and T1 levels. Diagnostic acceptability was also graded from 1-10 for each dataset. Mean HU and SD of 1cm2 regions of interest within the spinal canal at C3, C5 and T1 levels served as an objective measure of image quality.

**RESULTS**

There was no significant difference in CTDIvol, age, sex, and size of patients in DC-Csp or IC-Csp groups. We found no difference in objective or subjective quality between the IC and DC images at 100% dose (p>0.05) but significant differences were elucidated when 50% dose datasets were compared. Diagnostic acceptability was higher on IC-Csp50 vs DC-Csp50 images (6.2 vs 7.6, p=0.09) and definition of the soft tissue structures within spinal canal was significantly improved at the T1 level (3 vs 2.5, p=0.05). Objective analysis revealed a significant reduction in the incidence of streak artifact (mean CONCLUSION

Use of fully integrated circuit CT detectors improved diagnostic acceptability and significantly reduced the incidence of streak artifact at the cervico-thoracic junction in the acute setting on 50% reduced dose images of the cervical spine.

**CLINICAL RELEVANCE/APPLICATION**

The fully IC CT detector allows streak artifact reduction and improved visualization of the cervico-thoracic spinal canal, allowing better diagnostic acceptability of lower C-spine at reduced dose.
2. Discuss imaging findings of the HCRCS with case examples from various fluoroscopic, ultrasound, CT and MR examinations, including CT enterography.
3. Highlight the important role of radiologists in recognizing these syndromes for diagnosis and screening.

CONTENT ORGANIZATION
1. The Genetics of Colorectal Cancer
2. Classification of the Hereditary Colorectal Cancer Syndromes
   a. Non-polyposis syndromes
   b. Polyposis syndromes
   c. Adenomatous – Familial adenomatous polyposis coli and variants including Gardner syndrome
   d. Hamartomatous – Peutz-Jeghers syndrome, juvenile polyposis, and PTEN hamartoma syndromes
3. Take-Home Points and Conclusion

SUMMARY
1. Our understanding of the hereditary colorectal cancer syndromes (HCRCS) continues to evolve, each with characteristic manifestations.
2. Radiologists should be familiar with the various HCRCS and their common imaging findings because early detection of these neoplasms may help decrease patient morbidity and mortality.

LL-GIE-MO9B ● Pathways of the Subperitoneum: The Key to Challenging Diagnoses
Atalie C Thompson BA,MPH (Presenter) ; Lewis Shin MD ; Robert E Min德尔zun MD

PURPOSE/AIM The purpose of this exhibit is to review the anatomic spaces of the pelvis and the three major pathways of the subperitoneum through which abnormal processes spread.

CONTENT ORGANIZATION
1. Review of Pelvic Anatomic Spaces - Illustrate the presacral, perivesical, and external iliac spaces - Review helpful imaging signs to identify these spaces.
2. Identify the three major, predictable pathways of the subperitoneum, using case examples to demonstrate diagnostic significance: (1) Lateral pathway: anterior and posterior pararenal, perirrenal, infracolic and external iliac spaces (2) Central pathway: inferior mesenteric artery to the aorta at L3 (3) Posterior pathway: primarily along the superior mesenteric vessels and its branches

SUMMARY The major teaching points of this exhibit are: 1. Numerous radiological signs can aid in the characterization of pelvic extraperitoneal spaces, including the following: triangle, umbilical, molar tooth, and inferior epigastric vessel signs. 2. Knowledge of pelvic spaces and the ability to trace disease processes to their origin along predictable fascial pathways of the subperitoneum (i.e. lateral, central, and posterior) can enable the radiologist to make challenging and critically important diagnoses.

LL-GIE1227-MOB ● Itâ€™s Not Always FHN: A Review of Entities That Can Appear Hyperintense on Hepatobiliary Phase Imaging
Manish Dhyan MD,MBBS (Presenter) ; Sandeep S Hedgire MD ; Sheela Agarwal MD, MS

PURPOSE/AIM The use of hepatocyte specific contrast agents such as gadoxetic acid (Eovist) is becoming increasingly common for the characterization and detection of liver lesions. Early experience with gadoxetate was based on the straightforward principal that normal hepatocytes would appear hyperintense on hepatobiliary phase (HBP), and non-hepatocyte containing lesions would be dark. With experience, we now know that a number of various factors contribute to the appearance of a lesion on HBP and many entities previously not considered can appear hyperintense. Currently, numerous case reports/publications describe unusual appearances of various liver lesions particularly on the HBP of imaging, but there is no comprehensive repository for the range of appearances of these lesions.

CONTENT ORGANIZATION
1. Typical appearance of benign and malignant lesions on HBP - gadoxetate imaging.
2. All lesions that may appear hyperintense on HBP, and the pathophysiology for the hyperintensity.
3. Role of T2-weighted and nonfat saturated HBP imaging in differentiating lesions.
4. Pitfalls: Experience within our institution.

SUMMARY There is variable experience of a radiologist’s familiarity with gadoxetate. The objective of this exhibit is to aid the radiologist in understanding the range of appearances of various liver lesions on MRI with gadoxetate.

LL-GIE-MO118 ● Conventional Defecography and MR Defecography in Patients with Obstructive Defecation Syndrome: Pre and Post-operative Findings
Werner Kenn MD, PhD (Presenter) ; Birgit Hartung ; Henning Neubauer MD, MBA ; Thorsten A Bley MD ; Herbert Koestler MD * ; Christoph Isbert

PURPOSE/AIM To demonstrate the whole procedure of normal and pathologic defecation in conventional (CD) and MR defecography (MRD) as well as imaging findings after surgical treatment (e.g. STARR/POP STARR).

CONTENT ORGANIZATION
1. To review the indications 2. To show the techniques including dynamic 3D MR defecography 3. To demonstrate important measures as anorectal angle (ARA) and pelvic descent (PD): to get familiar with pathologic findings such as intussusception, enterocele, rectocoele, sigmoidocoele, cystocoele, Retzius and Douglas hernia; to discriminate functional disorders (e.g. spastic pelvis floor syndrome) 4. To learn about surgical treatment options like i.e. stapled transanal resection (STARR) for pelvic organ prolaps and their appearance in CD and MRD 5. Limitations of both modalities.

SUMMARY The radiologist - especially when working in the coloproctologic field - should be familiar with the techniques, indications and limitations of CD and MRD. As there are successful surgical procedures in patients with obstructive defecation syndrome he should have experience in interpreting post-operative defecography.

LL-GIE-MO12B ● Body MR Imaging: Artifacts, K-space and Solutions
Pritesh Patel MD ; Ravi Seethmraju PhD * ; John Kirsch PhD * ; Peter F Hahn MD, PhD * ; Alexander R Guimaraes MD, PhD (Presenter) *

PURPOSE/AIM Body MR imaging is challenging secondary to the complex interrelationships of motion, secondary to respiration and peristalsis, and susceptibility secondary to gas from the bowel. Some of these issues are exacerbated at higher field strengths (e.g. 3T). The purpose of this exhibit is to familiarize the reader with the range of artifacts seen in body imaging at 1.5T and 3T, and to explain the etiology of these artifacts from the standpoint of basic MR physics in order to find solutions and improve image quality.

CONTENT ORGANIZATION
1. To discuss in depth with case examples artifacts associated with body imaging at both 1.5 and 3T. We will categorize artifacts based on motion, spatial encoding, field strength, pulse sequence, coil type, location, B0 and B1 sensitivity profiles, chemical shift and parallel imaging. We will explain the etiology of these artifacts from basic MR physics using K-space encoding, and signal processing, proposing solutions, when possible.

SUMMARY A better understanding of the cause of artifacts within the complex environment of body MRI is integral to improving the practice and meeting the challenges of novel pulse sequence design, parallel transmission, and increasing field strength.

LL-GIE-MO10B ● Mesenteric Neoplasms: MRI Characteristics, Histopathological Correlation and Differential Diagnosis
Pardeep K Mittal MD (Presenter) ; Juan C Camacho ; Sajeev R Ezapill MD,MBBS ; William C Smail MD, PhD ; Kristzina Hanley MD ; Courtney A Coursey MD *

PURPOSE/AIM 1. This educational exhibit will highlight specific MR imaging features of mesenteric masses, associated clinicopathological findings and provide guide lines to reach specific diagnosis
2. To demonstrate MRI characteristics frequently encountered in both neoplastic and non-neoplastic mesenteric conditions and diagnostic clues

CONTENT ORGANIZATION
This is a retrospective review of radiologic and clinical records of 13 patients with a history of peritoneal malignancy that underwent MRI of the abdomen and pelvis.

**METHOD AND MATERIALS**

101 patients (m:59, f:42; mean: 65.0 yrs) who were suspected to have malignant tumor in the liver, bile duct (BD), or pancreas, underwent MRI at a 3T scanner. Non-contrast hepatic MR arteriography were obtained with T-SLIP (3D-TFE, selective IR, black blood inversion time: 1500, resp. trigger, scan time: 5-7min). Visualization of overall, right, left, and segment 4 (A4) hepatic arteries (HA) were scored by two radiologists on a 4-point scale. Scores of 3 or 4 for overall HA were scored to be clinically acceptable. Anatomy was classified using Michels classification. Patients' backgrounds, irregular respiration, HA narrowing, aortic arteriosclerosis, cardiac enlargement, and visualization of BD, fluid, portal vein, and IVC, and artifacts, were recorded on a 4-point scale and their effects on HA visualization were assessed. In 41 patients, HA visualization was compared with CE-CTA. Presence of arterial encasement indicating vascular invasion were recorded.

**RESULTS**

Hepatic artery can be assessed and classified by non-contrast MRA using T-SLIP at 3T with exception of small proportion of patients.

**CLINICAL RELEVANCE/APPLICATION**

Hepatic artery can be assessed and classified by non-contrast MRA using T-SLIP at 3T with exception of small proportion of patients.

**GG-LI-MO1B** • Non-contrast MR Hepatic Arteriography Using T-SLIP at 3T

Keitaro Sofue (Presenter) ; Takeshi Yoshikawa MD *; Nobukazu Aoyama RT; Katsusuke Kyotani RT; Yoshiharu Ohno MD, PhD *; Yoshimori Kassai MS *; Saori Satou RT *; Naoki Kanata MD; Tomonori Kanda; Hisanobu Koyama MD; Mizuho Nishio MD *; Kazuro Sugimura MD, PhD *

**PURPOSE**

To evaluate non-contrast MR hepatic arteriography using time-space labeling inversion pulse (T-SLIP) at 3T

**METHOD AND MATERIALS**

26 consecutive patients with post-pancreatitis PFCs requiring transmural endoscopic ultrasound-guided (EUS) drainage were prospectively included. Exclusion criteria were previous drainage or surgery. Before the endoscopic procedure, DW-MRI was performed in all patients with high b-value (b=1000 s/mm2) and ADC measurements in the collections were calculated. An infected collection was suspected when high signal on DW-MRI of PFC and low ADC values were observed. After EUS drainage, bacteriological cultures of the intra-cystic fluid was performed and considered infected if these were positive (gold standard).

Continuous values were reported as median and the 25th and 75th percentile points. Comparisons were performed using non-parametric tests. The diagnostic performance of DW-MRI was assessed by receiver operating characteristic analysis (ROC curve).

**RESULTS**

The underlying disease was acute (n=15, 58%) and chronic pancreatitis (n=11, 42%). Median ADC was statistically significantly lower in infected vs non infected PFCs: 0.66 (0.42 and 0.82) vs 2.3 (2.0 and 2.5) x10^-3mm2/sec, p=0.01. Sensitivity, specificity, accuracy, negative predictive value (NPV) and positive predictive value (PPV) of DW-MRI for predicting PFC infection were, respectively, 55% (5/9), 94% (16/17), 80% (21/26), 80% (16/20) and 83% (5/6). When patients previously treated with antibiotics were excluded (n=9) from the statistical analysis, sensitivity, specificity, accuracy, NPV and PPV were respectively 75%, 92%, 88%, 92% and 75%. ROC curve calculated a cut-off of 0.9 x 10^-3mm2/sec with a sensitivity of 100% and a specificity of 95%.

**CONCLUSION**

DW-MRI may provide additional information concerning PFC assessment before drainage. Results show high diagnostic accuracy and negative predictive values, which can help in excluding PFC infection and determining time of drainage.

**CLINICAL RELEVANCE/APPLICATION**

Diffusion-weighted imaging is a non invasive diagnostic tool showing high diagnostic accuracy that may provide useful information for therapeutic management of pancreatic fluid collection.

**GG-LI-MO3B** • Reproducibility and Comparison Study for Acoustic Radiation Force Impulse Imaging and Supersonic Shear Imaging

Hyunsik Woo MD (Presenter) ; Jae Young Lee MD ; Jeong Hee Yoon MD ; Won Kim MD, PhD ; Belong Cho

**PURPOSE**

The purpose of this study was to evaluate and compare intra-observer and inter-observer agreement of acoustic radiation force impulse imaging (ARFI) and supersonic shear imaging (SSI).

**METHOD AND MATERIALS**

This study was prospectively designed and performed with our Institutional Review Board approval. From April 2012 to April 2013, 79 patients (49 men, 30 women, mean age 56.7 years) were enrolled, which included 29 healthy patients, 25 patients with chronic hepatitis with Child class A, and 25 patients with chronic hepatitis Child class B or C. Three experienced abdominal radiologists performed ARFI and SSI at the same time in each patient with 9 measurements per each region.

**RESULTS**

Inter-observer agreement of ARFI and SSI were 0.932 and 0.805, respectively. Intra-observer agreement of ARFI and SSI between first and second session were 0.935 and 0.825, respectively. Pearson correlation coefficient between ARFI and SSI was 0.790. The conversion equation derived from linear regression was “SSI (m/s) = 0.9867 * ARFI (m/s) + 0.3274”. Technical success rates were 99.8% and 98.5% (p=0.07), and the average study time was 83.6 seconds and 80.2 seconds for ARFI and SSI, respectively (p < 0.0001).

**CONCLUSION**

ARFI showed slightly better reproducibility and technical success rate and significantly shorter study time than SSI. They also showed the potential to be used interchangeably.

**CLINICAL RELEVANCE/APPLICATION**

As both ARFI and SSI show good inter-observer and intra-observer agreements and good correlation, they might be used interchangeably in the evaluation of liver fibrosis.

**GG-LI-MO4B** • A Retrospective MRI Evaluation of Diffuse Peritoneal Metastatic Disease: Value in Pre-operative Assessment of the Peritoneal Carcinomatosis Index (PCI)

Neelima Gorantla MD (Presenter); Drew F Pierce MD; Arpit M Nagar MBBS; Sheriff Abdel-Misih MD; Zarine K Shah MD

**PURPOSE**

Imaging has been an integral part in the management for patients with peritoneal metastases. MRI is emerging as a powerful tool with a high degree of inherent contrast and improving spatial resolution with newer scanners and advanced MRI techniques. We sought to determine how well MRI imaging findings correlates with surgical Peritoneal Carcinomatosis Index (PCI).

**METHOD AND MATERIALS**

This is a retrospective review of radiologic and clinical records of 13 patients with a history of peritoneal malignancy that underwent MRI of the abdomen and pelvis.
The pharmacokinetic parameters of DCE MRI might have the potential to predict prognosis in patients with rectal cancer.
RESULTS

74 patients met inclusion criteria (66 female; 8 male). Average age: 28.7 years. 69/74 (93.2%) clinical records were available. 100% (69/69) had one risk factor (usually prior UTI), and 63.8% (44/69) had at least two risk factors. The following findings required intervention: (1) (1.4%) renal cell carcinoma and (1 (1.4%) other malignancy with path unrelated to RUTIs requiring a stent. The following findings did not require any further intervention were: (1) (8.0% simple cysts; (12) (16.2%) nephrolithiasis; 3 (4.1%) cortical scarring; (3 (4.1%) complete renal atrophy; 1 (1.4%) papillary necrosis; 8 (10.8%) partial duplicated collecting systems; 1 (1.4%) complete duplicated collecting system; (1) (1.4%) mildly dilated bilateral ureters felt to be physiologic. 1 (2) (4.1%) bladder diverticula. 3 (4.1%) bladder filling defects and 3 (4.1%) wall thickening with negative cystoscopy. 1 mildly dilated ureter, 1 bladder filling defect and 1 bladder wall thickening had no follow-up clinical records available.

CONCLUSION

2.8% of adults under 50 years of age with RUTIs and at least one risk factor had urinary abnormalities identified on CTU requiring intervention, however, none of these abnormalities were determined to be causal to the patient's RUTIs.

CLINICAL RELEVANCE/APPLICATION

CTU has a low yield in adults under 50 years of age with RUTIs. Presence of risk factors does not appear to result in a higher yield than prior research studies.

LL-GUS-MO2B • MR-guided Focal Cryoablation of Locally Recurrent Prostate Cancer at 1.5 and 3T: An Initial Comparison of Image Quality and Procedure Time

Sjoerd Jenniskens MD (Presenter); Christiaan G Overduin MSc; Joyce G Bomers MSc; Jurgen Jutterer MD, PhD

PURPOSE

To compare image quality and procedure time of MR-guided focal cryoablation of prostate cancer (PCa) recurrence at 1.5T and 3T field strength.

METHOD AND MATERIALS

39 consecutive patients with locally recurrent PCa after radiotherapy underwent transperineal MR-guided focal cryoablation at either a 1.5T (n=16) or 3T (n=23) MR system. In these patients, quality of imaging during the procedure was retrospectively assessed. Anonymized axial T2-weighted turbo spin echo and T1-weighted gradient echo MR images were randomly read by 3 experienced prostate interventional radiologists, who were blinded for field strength and imaging parameters. Image quality was assessed using a 5 points scale (1= excellent quality – 5= non-diagnostic) for three procedure steps: tumor localization, needle targeting and treatment monitoring. Additionally, total procedure time and procedure time adjusted for the number of needles placed between field strengths were compared. For statistical analysis, the student t-test was used.

RESULTS

Mean total procedure times observed at 1.5T and 3T were 121 minutes (46.2 minutes per needle) and 125 minutes (40.6 minutes per needle) respectively. Procedure time per needle was 12% faster at 3T (p-value 0.10). In addition, 3T MR showed significantly higher overall image quality compared to 1.5T in tumor localization (2.0±0.6 vs. 2.8±0.5; p<0.001). Procedure time and quality showed a significant trend towards faster needle placement at 3T. Moreover, capability to monitor the cryoablation treatment was significantly better at 3T field strength.

CLINICAL RELEVANCE/APPLICATION

3T MR imaging-guided focal cryoablation in patients with locally recurrent prostate cancer offers faster needle placement and higher image quality, improving treatment monitoring, over 1.5T.

LL-GUS-MO3B • Which One Shall We Choose for a Better Artery Imaging: Low kVp Scan or Spectral Imaging with Low keV?

Ying Guo MD (Presenter); Daopenh Shi MD; Peiqiang Ning; Minghua Sun

PURPOSE

To evaluate image quality and radiation dose of spectral imaging of renal angiography compared with low kVp CTA scan.

METHOD AND MATERIALS

10 patients(BMI>25,group A) referred to renal CT angiography underwent gemstone spectral CTA with pitch of 1.375 using Iodixanol270(1ml/kg,5ml/s),10 patients (BMI>25,group B) performed conventional 100 kVp CTA with Noise Index of 11.5,pitch of 1.375 using Iopromide270(1ml/kg,5ml/s)were reviewed as control.Images of G1 series were reconstructed to choose best keV by using CTA tool. Images of low kV scans were reconstructed with ASIR80%.Rois were placed in psoas muscle,renal artery of optimal keV series and traditional 120kVp scans,CT value and noise(SD) was recorded and compared.Signal-to-noise ratio(SNR) and contrast-to-noise ratio(CNR) was calculated with ROIs measurements. Image quality and radiation dose was statistically compared.

RESULTS

SNR of renal artery were 34.10±4.40 for optimal low keV and 29.68±6.39 for 100 kVp .SNR of renal artery were 29.26±4.00 for optimal low keV and 24.65±6.33for 100 kVp. DLP was 477.36±69.48mGy.cm for optimal low keV and 355.19±20.43mGy.cm for 100 kVp. There was significantly difference between low keV and low kVp scans(p<0.001).

CONCLUSION

Spectral imaging with low keV can provide higher CT value,SNR and CNR but a little higher dose for renal artery imaging compared with 100kVp.

CLINICAL RELEVANCE/APPLICATION

Spectral imaging can give more information except for artery imaging. We shall make a balance of image quality, valuable information and radiation dose according to clinical needs.

LL-GUS-MO4B • Complex Cystic Renal Masses: Comparison of Cyst Complexity and Bosniak Classification between 1.5T and 3T MRI

Michael J Triolo MD (Presenter); Natasha Wehrli MD; Thais Andrade MD; Samir S Tanjea MD *; Andrew B Rosenkrantz MD

PURPOSE

To compare the perceived complexity and Bosniak cyst classification of cystic renal lesions between 1.5T and 3T MRI.

METHOD AND MATERIALS

A database search was performed to identify cystic renal lesions that underwent both 1.5T and 3T contrast-enhanced MRI within a 12 month span. Cysts exhibiting at least minimal complexity were included. Two radiologists (R1 and R2) independently assessed all lesions, blinded to the field strength, in terms of number of septations, septal thickening, mural thickening, presence of mural nodule, and overall Bosniak cyst category. Readers also subjectively scored clarity of internal morphology of all lesions on a 1-5 scale. Each reader's scores were compared between 1.5T and 3T, with differences between these for a given lesion attributed to field strength rather than interval progression of the lesion during the

RESULTS

33 cystic renal lesions in 26 patients were identified. R1 observed greater number of septations, increased septal thickening, increased mural thickening, and increased presence of a mural nodule at 3T in 8, 7, 4, and 2 lesions, and at 1.5T in 3, 4, 2, and 0 lesions, respectively; R2 observed greater number of septations, increased septal thickening, increased mural thickening, and increased presence of a mural nodule at 3T in 3, 4, 3, and 0 lesions, and at 1.5T in 2, 0, 0, and 0 lesions, respectively. R1 provided higher Bosniak category at 3T in 9 cases and at 1.5T in 4 cases; R2 provided higher Bosniak category at 3T in 4 cases and at 1.5T in 0 cases. The higher scores at 3T than 1.5T were associated with differences in advised clinical management in 7/9 cases for R1 and 4/4 cases for R2. Clarity of lesion morphology was significantly greater at 3T than 1.5T (R1: 4.5±0.7 vs. 3.6±0.4, R2: 4.5±0.6 vs. 3.6±0.8; p<0.05).
CLINICAL RELEVANCE/APPLICATION
Given potential impact of MRI field strength on the perceived complexity of cystic renal lesions, we advise that serial MRI evaluation of cystic renal lesions be performed at constant field strength.

LL-GUS-MO1B • Novel Anatomic Kidney Segmentation to Describe Renal Tumors Eligible for Nephron Sparing Surgery: A Comprehensive CT-scan Based Reporting

Pietro Lodise (Presenter) ; ValeriaPanebianco MD ; Alessandro Cannavale ; Flavio Barchetti ; Rocco Papalia ; Carlo Catalano MD

PURPOSE
To introduce a novel a segmental anatomy of the kidney integrated with a standardized radiological reporting method to describe small renal masses (MR awareness, treatment

METHOD AND MATERIALS
Sixty patients underwent multiphase (pre-contrast, arterial, parenchymal and excretory phase) MDCT scan with 1 mm acquisitions. We divided the kidney in three portions with perpendicular planes to the line of maximum longitudinal diameter of the kidney. These planes pass through the bottom edge of the upper lip of the renal sinus and the other edge at the top of the lower lip. Hence the kidney was divided into 3 zones (upper, middle, lower) and twelve segments identified with Roman numbers. Two radiologists blindly read all cases according to a standardized report method: tumor size (TD, AD, APD), location in kidney’s segment/s, exophytic growth pattern, collecting system’s relationship and tumor’s feeding arteries (FA). Intra and inter-observer reliability was assessed with k-statistic test.

RESULTS
CONCLUSION
Kidney segmentation and standardized radiological report are a simple and exhaustive manner to describe small renal masses location and provide pointless information for clinical practice.

CLINICAL RELEVANCE/APPLICATION
A standardized report method helps the radiologist to categorically describe small renal tumors giving the correct informations to the urologist who has to plan nephron sparing surgery.

LL-URE-MO6B • 3 Different Tools to Fuse MR to Ultrasound for Prostate Biopsy

Hayet Amalou MD (Presenter) ; Sheng Xu PhD ; Baris Turkbey MD ; Peter L Choyke MD * ; Peter Pinto ; Bradford J Wood MD *

PURPOSE
To describe different methods enabling fusion biopsy for prostate cancer (PCa) as a rapidly emerging technique in GU imaging.

METHOD AND MATERIALS
A variety of tools have been developed for fusing MR and TRUS for prostate biopsy. The technologies are described with applications, workflows, strengths and weaknesses. An early phase clinical trial based upon electromagnetic (EM) tracking enrolled > 850 patients who underwent fusion guided prostate biopsy with EM tracking. MR localized suspicious targets for cancer based upon multi-parametric 3T MR (T2, ADC, DCE, Spectroscopy) with an endorectal coil. The prostate capsule was segmented on T2. Targets were defined by GU radiologists and sent to a workstation with segmentations and T2 volumes. Automated rigid registration with optional manual refinement and motion compensation were performed with 2 EM coils attached to the TRUS transducer.

RESULTS
Fusion guided prostate biopsy can be used for at least two very different purposes: 1.) Prospective guidance of biopsy needle towards targets pre-defined on MR. 2.) Mapping and archiving the location of standard blind sextant random conventional biopsies for potential later retrospective referencing (such as for annual relook biopsies in patients with low Gleason scores or undergoing active surveillance or watchful waiting). The UroNav system (In Vivo, Philips Healthcare, Gainsville, FL) is based upon an EM platform. The Artemis system (Eign, Gross Valley, CA) is based upon mechanical (or “passive robotic” registration). The UroStation system (Koelis, La Tronche, France) is based upon image fusion and image processing. Whether originally designed for function #1 or #2, most systems can perform both. This tool may have added value for patients with Gleason 6 or 7 (3+4), when it can be helpful to watch with MR and sample with fusion biopsy at some interval.

>12,000 biopsies were performed with simultaneous EM tracking and fusion in an office-like outpatient setting, with patients receiving both standard and fusion biopsies. MR-defined targets were biopsied without the requirement for the physical proximity of the MR gantry.

CONCLUSION
Fusion prostate biopsy is a novel tool for referencing TRUS biopsy to prior MR, which may be useful for both prospective targeting or retrospective mapping.

CLINICAL RELEVANCE/APPLICATION
Fusion biopsy improves cancer detection rates, and the radiologist should be aware of at least 3 technologies for this tool.

Health Services • Monday Posters and Exhibits (12:45pm - 1:15pm)

Monday, 12:45 PM - 01:15 PM • Lakeside Learning Center

HP

LL-HPS-MOB • AMA PRA Category 1 Credit ™:0.5

LL-HPS-MO1B • Peer-to-Peer Escalation of Advanced Diagnostic Imaging Requests in a Utilization Management Program by Facility Rural-Urban Commuting Area: Rural Providers May Need Guidance More Frequently

Kevin D Hiatt BS (Presenter) ; Jeffrey D Robinson MD * ; Daniel S Hippe MS * ; Timothy R Johnstad MBA * ; Brock A Oxford MPH * ; Mark D Hiatt MD, MBA *

PURPOSE
Utilization management subject provider requests for procedures to tiered evaluation with progressively greater clinical input at each level, with peer-to-peer consultation at the highest tier. The purpose of this study was to determine the difference in escalation rates to this ultimate tier between rural providers and urban ones in a prior authorization process for advanced diagnostic imaging (ADI).

METHOD AND MATERIALS
All ADI requests received by HealthHelp, a radiology benefit management (RBM) company, between January 1, 2012 and December 31, 2012 from providers for the nearly $ million commercial, Medicare, and Medicaid subscribers to multiple health plans in all 50 states were reviewed to ascertain the rates of escalation to peer-to-peer consultation, categorized by the rural-urban commuting area (RUC) code of the provider’s facility as rural (codes 7-10), subrural (4-6), or urban (1-3). Rates of escalation were averaged within each group, weighted by the total volume of ADI requests from each provider, and compared using linear regression.

RESULTS
943,596 ADI requests were included in the data set. Of these, 46,642 exams (5%) were ordered by providers in rural areas; 114,010 (12%) by suburban providers; and 782,944 (83%) by urban providers. The mean rates of escalation were 3.16 ± 0.22% (95% CI), 2.80 ± 0.14%, and 2.88 ± 0.05% for rural, suburban, and urban providers, respectively. The mean rate for rural providers was significantly greater than for suburban (p=0.007) or urban providers (p=0.02), while mean rates were not significantly different between suburban and urban providers (p=0.3). The mean rate was 10% higher for rural providers than urban providers.

CONCLUSION
Rural providers experience a significantly higher rate of escalation of their requests for ADI to the highest tier of peer-to-peer consultation in the process of seeking prior authorization, which may reflect a greater need for clinical guidance.

CLINICAL RELEVANCE/APPLICATION
Rural providers, presumably with generally fewer resources and a lesser degree of subspecialization, may have greater need for the guidance provided by RBM companies.

LL-HPS-MO2B • Reduction of Turnaround Time of Radiologic Reports by Dedicated Communication Methods

Christoph Stern BA, MD (Presenter) ; Nadine Kawel-Boehm MD ; Klemens Wittig * ; Thomas Boehm MD

PURPOSE
Given potential impact of MRI field strength on the perceived complexity of cystic renal lesions, we advise that serial MRI evaluation of cystic renal lesions be performed at constant field strength.

There was an overall tendency for both readers to upgrade renal cyst complexity and Bosniak cyst category at 3T than 1.5T, which impacted advised management. We attribute this difference to known greater conspicuity of tissue enhancement at 3T.

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There was an overall tendency for both readers to upgrade renal cyst complexity and Bosniak cyst category at 3T than 1.5T, which impacted advised management. We attribute this difference to known greater conspicuity of tissue enhancement at 3T.
With the introduction of diagnosis related groups (DRGs), there is an upcoming need to shorten the turnaround time of radiologic reports. Studies in order to contribute to the economic success of a hospital. This important key-performance indicator is frequently not available. The majority of hospitals are controlled and managed by financial indicators, while process orientated indicators are commonly not in use. The purpose of our study was to define turnaround time of radiologic reports in our institution and to evaluate the influence of dedicated communication methods on the turnaround time.

**METHOD AND MATERIALS**

The turnaround time of a radiologic report is defined as the time from confirmation of an exam till its approval. For our study purposes it was extracted and calculated from the Radiology Information System (RIS) of our institution by a self-developed calculation tool within the Software RadCentre Analyzer (Transact GmbH, Hamburg, Germany). The average turnaround time over all radiologic exams and the average turnaround time for each modality – CT, MRI, x-ray and ultrasound – were calculated per month for the period between October 2012 and March 2013. Systematic and regular communication of turnaround times amongst staff radiologists was introduced in late December 2012.

**RESULTS**

From October till December 2012 the average turnaround time over all radiologic exams (3 month average) was 33:40:18 (hh:mm:ss), from January till March 2013 it was 25:56:44. The introduction of systematic and regular notification of the turnaround time for radiologic reports resulted in a decrease of the turnaround time across all exams by an average of 7:43:33 (-22.9%) per month during this 3 months follow up period. The largest decrease of turnaround time occurred in reports of ultrasound (-29.5%) and x-ray exams (-27.5%), while differences were smaller for reports of MRI (-3.2%) and CT exams (-2.2%).

**CONCLUSION**

Dedicated communication methods are effective to reduce the turnaround time of radiologic reports, however the impact on each modality varies substantially. A longer follow up period is necessary to evaluate the long term effectiveness of communication methods.

**CLINICAL RELEVANCE/APPLICATION**

By reducing turnaround time of radiologic reports, important clinical information will be available earlier to clinicians, facilitating immediate initiation of treatment.

**LL-HPS-MO3B • Effects of Using a Policy for Handling Secondary Interpretations of Outside Studies at an Academic Medical Center on Reimbursement Rates**

Robert Morgan BA (Presenter) ; Carlos J Sivit MD ; Bart Stovicek ; Pablo R Ros MD, PhD *

**PURPOSE**

To evaluate the reimbursement rates for secondary interpretations of outside imaging studies that were requested for medical necessity by the treating physician.

**METHOD AND MATERIALS**

The policy we employed at our institution for rendering diagnostic readings of outside examinations requires that the treating physician submit a requisition stating medical necessity for a secondary interpretation and that the study be less than 90 days old and in digital format. Outside images are uploaded into a PACS, labeled as Outside Examinations, identified as a secondary interpretation in the dictation, and coded with a ‘-77’ modifier in addition to the original CPT code. The total percentage of gross charges reimbursed by payers, including Commercial insurance, Medicare, Medicaid, Worker’s Compensation and Self-pay patients for the professional component of primary interpretations performed at our institution and for secondary interpretations were compared. Data were reviewed for examinations performed between January 1, 2012 and October 31, 2012.

**RESULTS**

For primary interpretations the percent of gross charges reimbursed was 28.8%. For secondary interpretations the percent of gross charges reimbursed was 32.3%.

**CONCLUSION**

Using a policy for handling secondary interpretations of outside imaging studies can result in reimbursement rates comparable to primary interpretations.

**CLINICAL RELEVANCE/APPLICATION**

Secondary interpretation of outside studies is often required for medical necessity. As reimbursements decline, it is imperative for institutions to receive appropriate compensation for such work.

**LL-HPS-MO4B • One CT is Enough—Contrast Enhanced Ultrasound is Adequate for Blunt Abdominal Trauma Follow Up**

Demosthenes D Cokkinos MD (Presenter) ; Eleni Antypa ; Dimitrios Tsiliolas MD ; Dimitrios Tomais ; Stylianos V Benakis MD ; Ploutarhos A Piperopoulos MD, PhD

**PURPOSE**

To evaluate the ability of contrast enhanced ultrasound (CEUS) for imaging follow up of hospitalised patients who suffered blunt abdominal trauma (BAT), after initial imaging on the day of injury with contrast enhanced computed tomography (CECT). To compare subsequent CEUS findings to those of the initial CECT.

**METHOD AND MATERIALS**

32 patients (18 men-14 women, aged 17-84 years) were imaged on an emergency basis with CECT due to BAT. CECT detected 35 solid abdominal organ (liver, kidneys, spleen, adrenals) injuries (3 patients had injuries in 2 organs). All patients were admitted to the Hospital and treated conservatively. In order to minimise radiation exposure, imaging follow up was performed 3-6 days later with CEUS post injection of contrast agent Sonovue (2.4 ml). No additional CT was performed. CEUS findings were compared to the initial CECT to assess improvement of solid abdominal organ injuries.

**RESULTS**

CEUS showed reduction in size of 26 injuries in 24 patients. 9 injuries in 8 patients showed complete resolution. All patients were discharged from the Hospital in the following days with no additional imaging performed.

**CONCLUSION**

In all cases CEUS answered the question of following up BAT injuries with no additional CECT performed. Patients admitted for BAT following an uneventful course can be subsequently imaged with CEUS.

**CLINICAL RELEVANCE/APPLICATION**

This practice can decrease the number of CECT, reducing patient radiation exposure, CT scanner workload and imaging cost.

**LL-HPS-MO5B • Radiological Anatomy: Evaluation of Integrative Education in Radiology**

Sabine Dettmer ; Timm D Kirchhoff MD, PhD (Presenter) ; Andreas Schmied ; Simone Meyer ; Anja Giesemann ; Reinhard Pabst ; Juergen Weidemann MD ; Frank K Wacker MD *

**PURPOSE**

Evaluation and analysis of the integrative course “Radiological Anatomy” established since 2007 in comparison with conventional education.

**METHOD AND MATERIALS**

Anatomy and radiology are usually taught separately with a considerable time lag. Interdisciplinary teaching of these associated subjects seems logical for several reasons. Therefore, the integrative course “Radiological Anatomy” was established in the second year of medical education, combining these two closely related subjects. The participating students had already passed the dissection course in the previous year. This interdisciplinary course was retrospectively evaluated a student questionnaire and staff observations. The advantages and disadvantages of integrative teaching in medical education are discussed.

**RESULTS**

The course ratings were excellent (mean 1.4 on a scale of 1 to 6, n=94). This is significantly (p

**CONCLUSION**

Integrative teaching of anatomy and radiology was well received by the students. Both, anatomical and radiological comprehension and the motivation to learn were improved. However, it should be considered, that the amount of work and time required by the teaching staff is considerably increased compared to traditional teaching.

**CLINICAL RELEVANCE/APPLICATION**

Integrative teaching of anatomy and radiology can help to improve anatomical and radiological comprehension and the motivation to learn.
LL-INS-MO2B • Use of Natural Language Processing to Classify Radiology Reports Containing Description of the Abdominal Aorta

Amilcare Gentili MD (Presenter) ; Brian E Chapman PhD

CONCLUSION
Using pyContex, a Python implementation of the ConText. ConText is a simple text-processing algorithm that uses simple lexical cues to relate modifying phrases, such as expressions of uncertainty, temporality, or negation, to findings described in text. The classification performed by a radiologist reviewing the radiology reports was compared with pyContex classification.

Evaluation
For this study, we used pyConText, a Python implementation of the ConText. ConText is a simple text-processing algorithm that uses simple lexical cues to relate modifying phrases, such as expressions of uncertainty, temporality, or negation, to findings described in text. The classification performed by a radiologist reviewing the radiology reports was compared with pyConText classification.

Discussion
Out of 473 reports pyConText classified 82 patients as having an AAA, and 391 as not having an AAA including 4 false negative and 5 false positive for a sensitivity of 95.1% and a specificity of 98.7%.

LL-INS-MO3B • Image-based Kernel Conversion Technique Normalized the Reconstruction Kernel Effects in the Measurement of Emphysema Index in CT

Hyeongmin Jin (Presenter) ; Jong H Kim PhD ; Chang Yong Heo BS

PURPOSE
The emphysema index (EI) in CT is known to be strongly affected by reconstruction kernel. This study presents an image-based kernel conversion technique which converts CT image of sharp kernel to that of standard and evaluates its impact on EI normalization for images obtained with different kernels.

METHOD AND MATERIALS
48 sets of CT data taken at 120kVp, 40mAs, 1mm thickness, of 2 reconstruction kernels (B30f, B50f) were selected from low dose lung cancer screening database. An image-based kernel conversion technique, which converts an image to take effect of different kernel by applying the ratio of kernel MTFs to the Fourier transformed spectral components, was performed to the CT data set of B50f kernel to produce a converted B30f data set. The EI (RA950) was measured with a software package (Pulmonalizer, Seoul, South Korea) and compared between two data sets of B30f kernel and those converted B30f kernel. The accuracy of kernel conversion was evaluated with the mean and standard deviation of pair-wise differences in EI.

RESULTS
Population mean of EI was 10.57±5.84% for the B30f data set, 28.76±6.24% for B50f data set, and 10.86±6.37% for the converted B30f data set. The mean and standard deviation of pair-wise differences in EI between B30f and the converted B30f 0.85% and 0.76%, respectively. The correlation between the EI of two data sets was 0.987

CONCLUSION
Our study demonstrates the feasibility of image-based kernel conversion technique for normalization of kernel effect in measurement of EI.

CLINICAL RELEVANCE/APPLICATION
This technique has a potential to be used in evaluating the longitudinal changes of EI even when the CT was reconstructed with different kernel.

LL-INS-MO4B • Data Analysis of Brain MRI at a Tertiary Hospital in Sudan

Radya G Osman MBBS (Presenter) ; Abdalla M Gabir MD, FRCR ; Mirghany O Babiker MBBS, FRCR ; Isam M Izzeldin MBBS, MRCP

CONCLUSION
16 cases of brain pathology where matched with radiology and histopathology diagnoses .Those 16 cases are presented in this study.

Background
Sudan is a country with a population of 36,787,012 and a size of 718,723 square miles. There are 17 MRI machines present in the entire country. Fifteen of them are located in the capital Khartoum, while 2 machines are left to serve the other 16 states. Out of the 17 MRI units, only 3 diagnostic MRI centers have a data archiving option, leading to the loss of valuable patient data.

Evaluation
For this study, a database of 1,540 MRI brain images, scanned during 2012, was created. The data was used to identify 662 cases with brain pathology.

Discussion
Age and gender distribution of cases was also analyzed. For the purpose of comparison, 87 histopathology reports from the same hospital were obtained in order to confirm the radiologic diagnosis.

LL-INS-MO5B • Tablet Computer Assisted Target-oriented Forensic Autopsy

Alina Sassenberg MMed (Presenter) ; David Simons MD ; Ignaz Reicht ; Heinz-Peter Schlemmer MD ; Kathrin Yen MD

PURPOSE
Radiological data has proven to support forensic autopsy and often is required before or during the procedure. For e.g., detecting gas or foreign bodies, computed tomography (CT) has been shown to be superior to the autopsy. Image viewing usually requires a workstation which is rarely located in the autopsy suite. Thus CT images are seldom accessible during autopsy. The aim of this study was to evaluate if the display of radiological data on a tablet computer (PC) could support and guide forensic autopsy.

METHOD AND MATERIALS
We installed software for interpreting radiological data (M1K-pocket, a slighter version of the CE-certified M1K) on a tablet PC (iPad A 1434, Apple Inc.). In 20 randomly selected cases, postmortem CT scans (Somatom AR.SP, Siemens AG) of the head, thorax and abdomen were performed at least 1 hour before autopsy. CT data was uploaded to the tablet PC and analyzed prior to autopsy by a radiologist in consensus with a forensic pathologist. The tablet PC was prepared for operating by importing DICOM image standards. For the current study we focused on bone fractures, air, foreign bodies, liquids, the position of organs, and if collapse of the aorta was present in the thorax region. Radiological results were used to guide the autopsy process. A standardized questionnaire about handling and benefit was filled in by both the radiologist and the forensic pathologist.

RESULTS
Radiological data was easily accessible during the whole course of autopsy,. Autopsy techniques could be preselected and used target-oriented. The detection and localization of the addressed injuries was clearly supported by the additional imaging data. A fluent workflow was established which directly guides the course of autopsy in the determined cases.

CONCLUSION
The tablet PC provides useful assistance, increased convenience and additional information during forensic autopsy. However, before entering daily practice we recommend to further evaluate the use of tablet PCs at autopsy site in a multiple centre study. Tablet PC assisted forensic autopsy supports forensic case assessment and has a general potential to be broadly used as being cheap and easily available.

CLINICAL RELEVANCE/APPLICATION
The availability of radiological images during autopsy can support target-oriented forensic autopsy and injury assessment. The use of tablet devices for delivering radiological images therefore seems promising.

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**LL-INS-M06B • The Pursuit of Meaningful Use Part 2: When Penalties Don’t Matter**

Adeel Siddiqui MBBS (Presenter); Mehwish Shayaan MBBS; Keith J Dreyer DO, PhD *

**CONCLUSION**

Group structure and timing of the upgrade cycle are key factors in determining whether a radiology group should pursue meaningful use. Many groups may still take advantage of the EHR incentive program not only for the short term financial gain, but also for the increased interoperability it brings with referring physicians.

**Background**

The purpose of this talk is update the radiology community regarding meaningful use to see if it is right for their practice. This is meant as an update to the 2012 abstract "The Pursuit of Meaningful Use". Meaningful use (MU) is a government run program to accelerate the adoption of electronic health records in the United States. In 2014, Individual radiologists can earn up to $24,000 if they comply with the program. Recent addition of the significant hardship exemption to radiologists gives groups a convenient way to avoid penalties. Lack of specialty specific criteria, and availability of certified products have already made many people wary. When should a practice look to upgrade to MU? When should a practice avoid MU?

**Evaluation**

Radiologists can claim significant hardship exemptions based on the radiology specialty codes to avoid penalties. Radiology must be listed as the primary specialty of the physician in the Provider Enrollment, Chain, and Ownership System (PECS).

**Discussion**

Recently published significant hardship exemption rules limit potential penalties by radiologists. On the other hand, Radiology groups affiliated with an institution that already has a certified electronic health record (EHR), or groups that are single site with a single radiology information system (RIS) are in a great position to benefit from MU with little cost. Small groups that have resisted upgrade cycles will never have a better time to upgrade. These types of practices can would also enjoy the benefits of being better integrated with the entire hospital information systems. Groups that have completed upgrades recently or do not have a high Medicare payment are the most vulnerable to excessive costs and "upgrade fatigue". These groups might take advantage of the significant hardship exemption.

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**LL-INE3205-MOB • Using the Scored Quiz Feature of MIRC TFS to Run a Departmental Case of the Week Contest**

Tessa S Cook MD, PhD (Presenter); John Perry

**Background**

Case of the day (or week) contests are popular among residency programs and radiology departments to foster friendly competition while still promoting individual or collaborative learning. Our case of the week (CoW) implementation has evolved over the past few years to its current implementation using the RSNA MIRC Teaching File System (TFS).

**Evaluation**

The original CoW consisted of images posted within a Microsoft SharePoint site, with a link to a web form that collected submitted diagnoses and emailed them to the CoW manager. Subsequently, it was revised to be a self-contained, database-driven website into which images and content were loaded and updated on a weekly basis. Using TFS along with the new scored quiz feature, we can send images directly from PACS via the patient-centric workflow to be incorporated into the CoW.

The scored quiz enables the addition of a text box to a case so that TFS users can log in, view the case and submit their favored diagnosis. The case owner can score the submitted entries and track users’ scores during the contest using the administrative features of TFS.

**Discussion**

By implementing our CoW within TFS, we can preserve the content posted from week to week for users to access for independent learning. In addition, the process of creating a new CoW each week has been streamlined yet again, as all the functionality of the TFS can now be brought to bear on content creation and management. In addition to running case contests, the scored quiz can be used to create assessment modules (such as to track ACGME milestones), interactive conference presentations (to prepare residents for the Exam of the Future) and even to educate medical residents and non-radiology residents.

**CONCLUSION**

MIRC TFS can be used to successfully maintain a case of the week application for a radiology program, without requiring the administrator to be technically savvy or annually program the system. This latest iteration of the CoW now using the MIRC TFS is the most robust to date, with the added advantage of persistent case content from week to week. Scored quizzes in MIRC TFS have a number of potential applications which can be used to enhance radiology resident and fellow education.

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**LL-INE3201-MOB • An Imaging Informatics-based System with a Novel Intelligent Workflow Engine to Support Rehabilitation Clinical Trial Research**

Brent J Liu PhD; Ximing Wang MS (Presenter); Claraiz Martinez; Carolee J Weinstein PhD

**Background**

Workflow engines have been shown to improve efficiency in business by automating processes. Complex clinical research workflows--such as those of rehabilitation clinical trials--that efficiently collect, analyze, and distribute multimedia data at various stages within the workflow can also benefit from these workflow engines. Currently, the data management needs of clinical trials are typically addressed with custom-built systems. However, the challenge arises when changes to the workflow require additional software development, a step that can be time- and resource-consuming, and can negatively impact data workflow engines. Complex clinical research workflows--such as those of rehabilitation clinical trials--that efficiently collect, analyze, and distribute multimedia data at various stages within the workflow can also benefit from these workflow engines.

**Evaluation**

The system enables a project coordinator to build a data collection and management system specifically related to study protocol workflow through a graphical user interface. A library of modules can be chosen and added to each phase of the workflow. Prior to each treatment session, the user can predetermine which evaluation tools will be utilized and in what order they will be performed according to protocol. A web-based DICOM viewer is integrated for visualization of brain images. The usefulness of the system will be evaluated with data from the 12 subjects enrolled in the DOSE trial. The target enrollment is 60 subjects over a 4-year period.

**Discussion**

Intelligent workflow engine provides flexibility to build and tailor the workflow for different stages within the clinical trial. By providing a solution to tailor and automate the workflow, the system will save time and reduce errors for project coordinators.

**CONCLUSION**

We developed a new imaging informatics-based system with an intelligent workflow engine. Although our system is designed for a rehabilitation trial, it has the potential to be extended to other non-rehabilitation clinical trials.
LL-INE3203-MOB • Prevalence of Post-operative Complications in Patients with Articular Surface Replacement (ASR) with Hip Prosthesis Evaluated Using Magnetic Resonance Imaging (MRI)

Silvana Sdao MD (Presenter) ; Alberto Aliprandi MD ; Carmelo Messina ; Luca Maria Sconfienza MD, PhD ; Francesco Sardanelli MD *

PURPOSE
Patients with certain types of ASR hip replacement are reported to present with high prevalence of a pathologic condition known as metallosis, caused by the localization of metallic debris in the soft tissue around the replaced hip joint. This condition has been related to several complications including severe joint pain, implant failure or loosening, local tissue necrosis, pseudotumors and osteolysis. Our aim was to evaluate post-operative complications in a series of patients who underwent ASR with DePuy hip prostheses.

METHOD AND MATERIALS
IRB approval was obtained and patients' consent was waived. This study included 65 patients who underwent ASR with DePuy hip prosthesis (ASRXL Acetabular Cup System and DePuy ASR Hip Resurfacing System; DePuy Synthes, Johnsons and Johnsons, IN, USA) and were imaged at our hospital between January 2011 and January 2013. We excluded 25 patients who underwent x-ray and ultrasound examination only. Thus, our series included 40 patients (21 females, 19 males; mean age 58±15 years, range 26-86 years) who underwent MRI using a 1.5 T system (Magnetom Sonata, Siemens) after a mean delay of 7±2 years from surgery. Imaging protocol included three-plane T1- and T2-weighted sequences with and without fat saturation optimized for susceptibility artifact reduction without any specific algorithm. For each patient, we evaluated the presence of iliopsoas bursitis, peri-prosthetic fluid collection, joint effusion, and abnormal bone marrow signal.

RESULTS
Out of 40 patients, 25 (62.5%) showed post-operative complications. Among them, 8 (20%) had iliopsoas bursitis, 7 (17.5%) had peri-prosthetic fluid collection, 3 (7.5%) had joint effusion, 2 (5%) abnormal bone marrow signal. Four patients (10%) had both iliopsoas bursitis and peri-prosthetic fluid collection, while one patient (2.5%) had both iliopsoas bursitis and abnormal bone marrow signal.

CONCLUSION
After 7 years from surgery, patients implanted with DePuy hip prosthesis have 62.5% complication rate. MRI is effective in detecting such complications also without using specific artifact reduction algorithms.

CLINICAL RELEVANCE/APPLICATION
MRI is effective in detecting complications in patients who underwent ASR with DePuy implants without using specific artifact reduction algorithms.

LL-MKS-MO2B • Athletic Pubalgia and Other Findings in Patients Referred for MRI of Sports-related Groin Pain: With Surgical Correlation

Matthew Maeder MD (Presenter) ; Devon Klein MD,MPH ; Mark Zolander MD

PURPOSE
To first clarify the complex musculoskeletal anatomy involving the pubis and the assorted terminology used to describe athletic pubalgia (including ‘sports hernia’) and other disorders of the groin. Then to report the incidence of athletic pubalgia, its common mimickers, and concomitant injuries or pathology.

METHOD AND MATERIALS
A database query of adults referred imaging of sports-related groin pain during a two year period yielded 64 examinations of 62 outpatients. The mean age of this population was 38 years old (range 16-71). Thirteen patients were female. There were 38 MRI-positive cases of athletic pubalgia, defined as any abnormal signal, tear, or defect of the rectus abdominis tendon, adductor longus tendon, or pubic aponeurosis. The presence or absence of additional findings including inguinal hernias and acetabular labral tears were also recorded. Surgical correlation and follow-up, when available, was obtained from the patients’ surgeon.

RESULTS
There were 38 (59%) MRI-positive cases of athletic pubalgia, found bilaterally in 18 cases. In 14 of these positive studies, there was the additional finding of inguinal hernia. Inguinal hernias were present in a total of 22 (34%) of all the reviewed studies. The addition of a Valsalva sequence to our protocol was instrumental in detecting four of these inguinal hernias. Acetabular labral tears were more commonly found, present or suspected in 44 (69%) of the studies. As of yet, an unknown number of these patients had surgical correlation and follow up of their symptoms.

CONCLUSION
Athletic pubalgia was present in most outpatients presenting to our institution with sports-related groin pain. Additional pathology was found in a significant number of cases, and specific protocols that include a Valsalva sequence are recommended to increase conspicuity of and sensitivity for concomitant pathology such as inguinal hernia.

CLINICAL RELEVANCE/APPLICATION
In patients referred for MRI imaging of sports-related groin pain, pathology was frequently found. Measures to help detect correctable conditions, such as inguinal hernia, are recommended.

LL-MKS-MO3B • Assessment of the Multi-banded Anterior Talofibular Ligament Using 3D Isotropic Fast-spin Echo MR Sequence: Normal Anatomy and Its Injury

Seung Min Nam (Presenter) ; Hye Jung Choo MD ; Sun Joo Lee MD ; Ok Hwa Kim ; Young Mi Park MD, PhD ; Seok Jin Choi ; Seon-Jeong Kim MD

PURPOSE
To evaluate the frequency and MR characteristics of multi-banded anterior talofibular ligaments (ATFLs) in normal ankles and to characterize the tear types of multi-banded ATFLs in sprained ankles using a 3D isotropic proton density fast-spin echo (3D PD FSE) MR sequence.
METHOD AND MATERIALS
In the first session, 3D PD FSE MR imaging of 33 ankles was obtained from 20 asymptomatic volunteers. The number of bands in the ATFLs and locations of the ATFLs on orthogonal planes of the 3D PD FSE images and the signal intensity, depth, and width of each band on their multiplanar reformatted images parallel to the orientation of each band of the ATFLs were evaluated by 2 readers. In the second session, 3D PD FSE MR imaging of 51 sprained ankles was evaluated by 2 readers for determining the number of bands in the ATFLs and the presence of tears in each band.

RESULTS
In the first session, 3 ATFLs were single-banded, 27 were double-banded, and 3 were triple-banded. In double-banded ATFLs, the superior band was about 2 times wider and thicker than the inferior band. The depth, width, and location of single-banded ATFLs and the superior band of double-banded ATFLs were not significantly different. In the second session, the most common type of injury in double-banded ATFLs was a 2-band tear.

CONCLUSION
In an evaluation using the 3D PD FSE sequence, most ATFLs consisted of 2 bands, and tears in both bands were the most common type of injury in double-banded ATFLs.

CLINICAL RELEVANCE/APPLICATION
1. Most anterior talofibular ligaments consist of 2 bands. 2. Tears in both of 2 bands are the most common type of injury in the double-banded anterior talofibular ligaments.

LL-MKS-MO4B • Effects of Different Voltages and Tube Currents on MDCT Attenuation of Vertebral Trabecular Bone Using Different Reconstruction Algorithms
Marcos P Botelho MD (Presenter) *; Fernanda D Gonzalez Guindalini MD *; Adel R Seyal MD *; Keyur Parekh MD *; Vahid Yaghmai MD

PURPOSE
To evaluate the effects of various kV and mAs combinations on MDCT based vertebral trabecular bone density using different reconstruction algorithms.

METHOD AND MATERIALS
An anthropomorphic torso phantom was scanned 15 times, with 80, 100 and 120 kVp and with 10, 20, 40, 75 and 110 mAs. The images were reconstructed both with Filtered Back Projection (FBP) and with Simpgram Affirmed Iterative Reconstruction (SAFIRE). MDCT attenuation of T11, T12 and L1 as well as noise was recorded by placing the largest possible ROIs within the trabecular bone of the vertebrae. CNR was calculated in relation to the left paravertebral muscle. Student's t-test was used for statistical analysis. Statistical significance was set at 0.05.

RESULTS
Mean attenuation measurements from phantom vertebrae were higher with 80kVp (313.6 and 313.9 HU), intermediate with 100 kVp (261.3 and 261.4 HU), and lower with 120 kVp settings (225.5 and 225.1 HU) obtained with FBP and SAFIRE, respectively (p<0.05). Noise was significantly lower when iterative reconstructions were applied on all acquisition settings.

CONCLUSION
Vertebral trabecular bone attenuation numbers increase with lower kVp settings, but do not change significantly with different mAs, regardless of the reconstruction algorithm. CNR values are significantly higher when iterative reconstruction is applied.

CLINICAL RELEVANCE/APPLICATION
MDCT vertebral attenuation may quantify bone density. Settings for calibration and image acquisition may affect results. Reconstruction algorithm may not play an important role in this scenario.

LL-MKS-MO5B • Thermal Ablation Techniques for Curative Treatment of Bone Metastases
Frederic Deschamps (Presenter); Geoffroy Farouil; Lambros C Tselikas MD; Thierry J De Baere MD *

PURPOSE
To determine prognostic factor(s) for complete thermal ablation (TA) of bones metastases.

METHOD AND MATERIALS
The medical records of all the patients who had undergone curative-intent TA of bone metastases in our Institution between September 2001 and February 2012 were retrospectively reviewed. The goal of the TA was to achieve a local tumor control in order to cure all bone metastases in oligometastatic patients or to prevent the occurrence of skeletal-related events in long life expectancy cancer patients.

We have analyzed the rate of complete treatment at 1 year according to the patients' details -gender, age, site of the primary tumor and the bone metastases' characteristics- synchronicity with the primary tumor, already treated by external radiotherapy, local evolution within 3 months before the procedure (RECIST criteria), location (axial vs. appendicular), maximal diameter at baseline CT, condensation aspect at CT (lytic vs. sclerotic), bone cortical erosion, critical neurological structures in the vicinity (less than 10mm), TA technique used (radiofrequency ablation vs. cryoablation).-.

RESULTS
Eighty-nine consecutive patients underwent TA in a curative-intent of 124 bone metastases. The median follow-up was 22.8 months (12.2 to 44.4 months).

We report a 67% of complete treatment at 1 year. In multivariate analysis the good prognostic factors for complete treatment were: metastachronous bone metastases (p<0.01), no progression within 3 months before (p=0.004), no cortical erosion (p=0.01), maximal diameter (p=0.01) and lower with 120 kVp settings (232.5 and 233.1 HU) obtained with FBP and SAFIRE, respectively (p<0.05). Noise was significantly lower when iterative reconstructions were applied on all acquisition settings.

CONCLUSION
Thermal ablation techniques are effective to cure small (im)perfections. Thermal ablation techniques must be considered in oligometastatic patients or in long life expectancy cancer patients with bone metastases.

LL-MKS-MO6B • Grading Focal and Diffuse Articular Cartilage Lesions of the Knee Joint as Correlated with Arthroscopy: Comparison of 3D Dual-echo Steady State and Fat-saturated Proton Density-weighted Fast Spin Echo Sequences on 3T MR Imaging
Fang Zhao (Presenter); Shadpour Demehri MD; Filippo Del Grande MD, MBA; Andrew Kompel MD; Sahar J Farahani MBBS; Rashmi S Thakkar MD; John A Carrino MD, MPH *

PURPOSE
To determine prognostic factor(s) for complete thermal ablation (TA) of bones metastases.

METHOD AND MATERIALS
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CONCLUSION
Thermal ablation techniques are effective to cure small (im)perfections. Thermal ablation techniques must be considered in oligometastatic patients or in long life expectancy cancer patients with bone metastases.

LL-MKS-M07B • Primary Pain Palliation and Local Tumor Control in Bone Metastases Treated with MR Guided Focused Ultrasound
Beatrice Cavallo Marincola MD; Alessandro Napoli MD (Presenter); Fabrizio Boni; Brachetti Giulia MD; Maurizio Del Monte; Carlo Catalano MD

PURPOSE
To evaluate the clinical performance of MRgFUS in the primary treatment of painful bone metastases and to explore the potential of this technique in achieving local control.
METHOD AND MATERIALS
26 consecutive patients (female: 12, male: 14; mean age: 64.7 ± 7.5) with painful bone metastases were enrolled. Patients were examined clinically for pain severity and pain interference according to Brief Pain Inventory-Quality of Life (BPI-QoL) criteria before and at regular time-points over the following 3 months after treatment. CT and MR imaging was performed before and at 3 months after MRgFUS treatment. Local tumor control was defined as a significant imaging modification from baseline in terms of lesion size, density and perfusion at CT or dynamic ce-MR imaging (Discovery 750, GE; Gd-Bpta, Bracco) and metabolic activity at PET or scintigraphy. The imaging parameters for local tumor control were individually evaluated in responder and non-responder patients.

RESULTS
No treatment-related adverse events were recorded during the study. Statistically significant difference between baseline and follow-up values for pain severity and pain interference (both p=0.001) was observed. Increased bone density was observed in 9/26 (34.6%) patients. Non-Perfused Volume values ranged between 20 and 92%. There was no difference in NPV values between responder and non-responder patients (46.7 ± 24.2% [25 – 90%] vs. 45 ± 24.9% [20 – 93%]; p=0.7). In 6 patients (3 prostate and 1 breast primary cancer) there was nearly absence of metabolic activity after treatment with mean SUV=1.2.

CONCLUSION
MRgFUS can be safely and effectively used as the primary treatment for pain palliation in patients with bone metastases; our experience demonstrated also a critical role of MRgFUS in local tumor control as confirmed by metabolic analysis.

CLINICAL RELEVANCE/APPLICATION
MRgFUS can be applied as primary non-invasive technique for pain palliation related to bone metastases with the advantage of a relatively short treatment time and the possibility of be repeated if nec

LL-MKE-M08B • 3 Tesla Chemical Shift MR Imaging: Technique, Clinical Utility and Pitfalls for Imaging the Skeleton
Filippo Del Grande MD, MBA (Presenter) ; David Dreizin MD ; Laura M Fayad MD

PURPOSE/AIM
To review the technical considerations and important pitfalls of performing and interpreting chemical shift imaging (with in-phase and opposed-phase gradient echo sequences) at 3T for the assessment of bone marrow abnormalities. The clinical utility of this sequence will be discussed as it relates to the assessment of bone lesions, for characterization and for determining tumor extent.

CONTENT ORGANIZATION
1. Technical considerations for 3T imaging
2. Qualitative and quantitative analysis of in-phase and opposed-phase imaging
3. Clinical utility of chemical shift imaging
   -Characterization of bone lesions:
     -Differentiating pathologic from non-pathologic spine fractures
     -Differentiating bone marrow infiltrative disorders and marrow replacement
   -Determining extent of disease
3. Specific pathologies amenable to evaluation by chemical shift imaging
   1. Important pitfalls
   2. Impact of choice of time of Echo (TE) -Technical acquisition errors at 3T (compared with 1.5T)

SUMMARY
Chemical shift imaging is a valuable technique for differentiating bone marrow replacement from non-bone marrow replacement processes. However, at 3T, there are important technical factors which the radiologist must be aware of to use chemical shift imaging correctly. In addition, the radiologist should be familiar with potential pitfalls to avoid misleading interpretations.

Multisystem/Special Interest - Monday Posters and Exhibits (12:45-1:15pm)
Monday, 12:45 PM - 01:15 PM • Lakeside Learning Center

LL-MSE-M05B • Point Counter Point: Controversies in Imaging the Abdomen in a Pregnant Patient
Jessica C Germino MD ; Puneet Bhargava MD (Presenter) ; Ramit Lamba MD ; Mariam Moshiri MD ; Chandana G Lall MD ; Douglas S Katz MD ; Neeraj Lalwani MD ; Sadhna Verma MD *

PURPOSE/AIM
1. Radiation exposure to a pregnant or potentially pregnant patient for an imaging procedure is often unavoidable. 2. Reviewing various guidelines and understanding the variability will help radiologists plan imaging workup based on a specific clinical scenario and appropriately use modalities employing ionizing radiation and radiologic contrast.

CONTENT ORGANIZATION

SUMMARY
At the end of the exhibit the reader will have better knowledge of safe approaches to imaging the abdomen in a pregnant patient and will be able to confidently protocol studies to provide timely and effective medical care.

LL-MSE-M07B • 3D Ultrasound Applications in Abdominal Imaging
Susan J Frank MD (Presenter) ; Tova C Koenigsberg MD ; Mordecai Koenigsberg MD

PURPOSE/AIM
1. Present some of the uses of 3D ultrasound in the abdomen utilizing both grey scale and color Doppler imaging, including imaging of liver and renal transplant vascular anastomoses, TIPS shunts, renal lesions, and imaging of the biliary tree, including choledochal cysts and focal gallbladder wall abnormalities. 2. Review published literature on 3D ultrasound of the abdomen.

CONTENT ORGANIZATION
SUMMARY
3D ultrasound has proven useful in many gynecological and obstetric applications. There is a gap in the literature regarding its usefulness in abdominal imaging. It has the potential to create an ultrasound exam which is less operator dependent, faster, and which has reconstruction capabilities similar to other cross sectional imaging modalities. We present the 3D ultrasound appearance of a variety of abdominal processes, and explore the ways in which it complements 2D ultrasound imaging.

Neuroradiology/Head and Neck - Monday Posters and Exhibits (12:45pm - 1:15pm)
Monday, 12:45 PM - 01:15 PM • Lakeside Learning Center
globoblastoma multiforme (GBM). Assessment of treatment response using conventional MRI is complicated by pseudoprogression and pseudoresponse. The purpose of this exhibit is:
1. To review treatments for GBM.
2. To summarize concepts and illustrate pseudoprogression and pseudoresponse on conventional MR imaging.
3. To discuss and illustrate the use of advanced MRI and PET in differentiating true progression from pseudoprogression.

**CONTENT ORGANIZATION**
1. Review of GBM treatments.
2. Definition and pathophysiology of pseudoprogression and pseudoresponse.
4. Review criteria for tumor response after treatment and revised time-to-chemotherapy dependent criteria.
5. Discussion of imaging modalities to differentiate pseudoprogression from recurrence: A. Conventional MRI B. MR spectroscopy C. MR perfusion D. FDG-PET/CT.

**SUMMARY**
Radiologists should be aware of the imaging features on post-treatment of GBM on conventional MRI. Having an understanding of the concepts and the utilization of advanced MRI and PET imaging techniques can help differentiate pseudoprogression from true progression.

**LL-NRE-MO11B • Thoracic Outlet Syndrome 2013 Update - Surgical Correlation to Imaging, EMG, and Clinical Findings**

Anthony S. Tadros MD (Presenter); Afshin Karimi MD; Justin Brown; Nasim Mohajeri; Mark Mahan; Geoffrey Sheean; Natalie Voskanian

**PURPOSE/AIM**
To better understand the thoracic outlet syndrome by correlating CT, MRI, EMG, clinical history to the final diagnosis at time of surgery.

**CONTENT ORGANIZATION**
Thoracic outlet syndrome is an often misdiagnosed, poorly understood disease entity, which deserves further attention in the radiology literature. We review brachial plexus anatomy as relevant to neurological or vascular syndromes that can occur in light of the newer imaging techniques now available in 2013. In particular, we focus on correlating surgical findings to imaging (CT, MRI) and clinical and electrophysiological data. Examples of negative MRI exams which have positive surgical findings will be discussed. Anatomical variations such as fibrous bands, anomalous vascular, osseous or muscular structures which contribute to presumed symptomology will be presented. Role of dynamic or positional MRI or CT will be delineated. Use of low radiation CT in dynamic evaluation of visualized bone and vascular structures will be further highlighted.

**SUMMARY**
Thoracic outlet pathology remains a challenging disease entity requiring a multi-disciplinary team approach. This new area of imaging will be reviewed with emphasis on surgical--clinical-imaging correlations that will hopefully improve clinical practice by highlighting potential pitfalls and diagnostic pearls.

**LL-NRS-MO1B • Effect of Saline Flush Dose in Cerebral Perfusion MR Imaging**

Kazuhiro Tsuchiya MD (Presenter); Miho Gomyo; Arisa Ohara

**PURPOSE**
To investigate the effect of dose of saline flush in perfusion MRI imaging of the brain.

**METHOD AND MATERIALS**
Our study group comprised 37 patients (20 men and 17 women; age range, 19-97 years; average, 58.8 years; body weight range, 39-75 kg; average, 55.2 kg) with a history of brain tumor of miscellaneous final diagnoses. They were randomly divided into three groups in which the saline flush dose was none (group A, 11 patients), 10 mL (group B, 13 patients), or 20 mL (group C, 13 patients). The contrast dose and the injection rate were fixed at 0.1 mmol/kg and 3 mL/sec, respectively. The injection was performed from a right antecubital vein using a power injector. We placed a circular region-of-interest in the normal appearing white matter of the corona radiata on the contralateral side of the tumor and measured regional cerebral blood volume, regional cerebral blood flow, mean transit time, appearance time of contrast material, area under the time-intensity curve (TIC), maximum slope of TIC, peak height of TIC, and time to peak of TIC. One-way analysis of variance was used to investigate intergroup differences.

**RESULTS**
No significant difference was found among the three groups in mean transit time, appearance time of contrast material, and time to peak of TIC. Significantly greater values of regional cerebral blood volume, regional cerebral blood flow, area under the TIC, maximum slope of TIC, peak height of TIC in the three groups B and C than group A. There was no difference between group B and C.

**CONCLUSION**
In cerebral perfusion MR imaging, it is possible to administer a good contrast bolus by employing a flush dose of 10 mL or more. It should be noted that the flush dose could affect absolute values of cerebral blood volume and regional cerebral blood flow.

**CLINICAL RELEVANCE/APPLICATION**
This study shows that, in cerebral perfusion MR imaging, it is recommended to employ a flush dose of 10 mL or more.


Sumit N. Niogi MD, PhD (Presenter); Margaret Faso; Umesh Rajashekar; Irene Tseretopoulou; Jun Maruta; Aaron Katzman; Kyoko Fujimoto; Jamshid Ghajar MD, PhD; Barry Kosofsky MD, PhD

**PURPOSE**
Focus repetitive training could be beneficial in patients with post concussion syndrome and healthy individuals who have an innate degree of neuroplasticity. We propose that variations and improvement in neurocognitive performance from these training programs arise from alterations in white matter connectivity.

**METHOD AND MATERIALS**
In a normal healthy population, we test whether 2 months of intensive computer based training, using 2 separate training exercises targeting memory and executive attention (R AC) and memory (R UF).

Investigators remain blinded to the subject groups. Diffusion tensor imaging (DTI) was performed prior to onset of training, at 28 days after onset, and at 57 days. A hypothesis driven region-of-interest (ROI) analysis recording fractional anisotropy (FA) values was performed on 17 regions over 8 training groups. Paradigm or Brain Exercise training program. One non-control subject was excluded due to motion and n=11 and n=12 subjects were separated into the two training groups. Focused repetitive training could be beneficial in patients with post concussive syndrome and healthy individuals who have an innate degree of neuroplasticity. In this pilot study, 29 healthy patients with a history of head trauma received 2 months of intensive computer based training in either a Visual Tracking Paradigm or Brain Exercise training program. One non-control subject was excluded due to motion and n=11 and n=12 subjects were separated into the two training groups. Investigators remain blinded to the subject groups. Diffusion tensor imaging (DTI) was performed prior to onset of training, at 28 days after onset, and at 57 days. A hypothesis driven region-of-interest (ROI) analysis recording fractional anisotropy (FA) values was performed on 17 regions over 8 white matter pathways bilaterally. A separate data driven analysis was performed using Tract Based Spatial Statistics (TBSS).

**RESULTS**
No change seen in the control group. Paired t-tests show a significant increase in FA in the right anterior corona radiata (R AC, p<0.004) and right uncinated fasciculus (R UF, p<0.02) in both training groups. When performing a time-based ANOVA analysis, there is a dissociation between the two training groups, with the R AC demonstrating increased coherence in one test group (p=0.01) and the R UF demonstrating increased integrity in the other (p=0.01) when compared to controls.

**CONCLUSION**
Intensive computer-based attention and memory training yields anatomical changes in white matter pathways detected by DTI. Interestingly, the two training groups which target different cognitive domains cause improved white matter coherence in specific white matter pathways previously implicated to subserve attention (R UF).

**CLINICAL RELEVANCE/APPLICATION**
Results suggest intensive computer-based training can cause anatomical changes in networks subserving memory and attention which may improve cognitive outcome in patients with brain injury.

**LL-NRS-MO3B • Amide Proton Transfer Imaging of Brain Tumors at 3T: Initial Experience**

Ali Yusuf Oner MD (Presenter); Murat Ucar; Turgut E Tali MD *; Ali Murat Koc MD; Halil Ozer; David Grodzki *; Benjamin Schmitt *

**PURPOSE**
Amide proton transfer (APT) imaging is a technique in which the nuclear magnetization of water-exchangeable amide protons of endogenous mobile proteins and peptides in tissue is saturated, resulting in a signal intensity decrease of the free water. The purpose of this paper is to evaluate APT contrast of brain tumors and to compare it with magnetic resonance spectroscopy (MRS) at 3T.

**METHOD AND MATERIALS**
APT data were acquired from 10 patients with brain tumors on a 3T whole-body MR scanner and compared with conventional magnetic resonance images, including T1W, T2W, FLAIR, post contrast T1W and diffusion weighted images. An additional
RESULTS
Good image contrast between tumor and edema was achieved in all cases with APT-weighted images. The average APT signal intensity, magnetization transfer ratio and magnetization transfer ratio asymmetry calculation for the tumor, peritumoral edema and normal appearing white matter.

CONCLUSION
These initial data show that APT imaging is an emerging technique which produces unique contrast that can provide complementary information to standard clinical MRI in the imaging workup of brain tumor patients.

CLINICAL RELEVANCE/APPLICATION
APR is a new and promising technique which provides unique contrast that can be used as an additional tool in the imaging workup of brain tumors.

LL-NRS-MO4B  Bimodal Histogram Analysis of Apparent Diffusion Coefficient Values for Detection of Occult Tonsil Cancer in Patients Presenting with Neck Metastasis from an Unknown Primary
Young Jun Choi MD (Presenter) ; Jeong Hyun Lee MD, PhD ; Jung Hwan Baek

PURPOSE
To explore the role of bimodal histogram analysis of apparent diffusion coefficient (ADC) values for detecting occult palatine tonsillar squamous cell carcinoma (PTSCC) in patients with neck metastasis from an unknown primary.

METHOD AND MATERIALS
This retrospective study was approved by the institutional review board, and informed consent was waived. We enrolled 19 patients with occult PTSCC presenting with neck metastasis from an unknown primary, 20 with overt PTSCC on physical examination, and 20 with normal palate tonsils. DWI was performed with b values of 0 and 800 sec/mm2. ADC values of the entire volume of palate tonsil were measured by manual drawing of regions-of-interests. Bimodal histogram parameters of the ADC values were obtained using in-house and statistically tested for difference (Kruskal-Wallis test, Mann-Whitney U test). Receiver operating characteristic (ROC) analysis was employed to determine the best differentiating parameter between occult PTSCCs and normal tonsils. We also analyzed added values of histogram analysis of ADC values to conventional MRI and 18F-FDG PET/CT.

RESULTS
The bimodal histogram analysis showed statistically significant differences in mean, 50% and 90% ADC values between overt PTSCCs and occult PTSCCs/normal palatine tonsils. Between occult PTSCCs and normal tonsils, standard deviation (0.54±0.20)x10^-3 mm^2/sec vs (0.41±0.09)x10^-3 mm^2/sec, skewness [(0.52±0.38)x10^-3 mm^2/sec vs (0.38±0.07)x10^-3 mm^2/sec], and 90% value of ADC (1.75±0.27)x10^-3 mm^2/sec vs (1.52±0.25)x10^-3 mm^2/sec) were significant high (P).

CONCLUSION
Adjunctive histogram analysis of ADC values detected five more occult PTSCCs (26.3%) than conventional MRI and 18F-FDG PET/CT, therefore, adjunctive histogram analysis can be helpful when conventional MRI and 18F-FDG PET/CT failed to detect occult PTSCCs.

CLINICAL RELEVANCE/APPLICATION
Adjunct bimodal histogram analysis can be helpful when conventional MRI and 18F-FDG PET/CT failed to detect occult PTSCCs.

LL-NRS-MO5B  Cone Beam CT Angiography: Diagnostic and Therapeutic Potentials in Management of Spinal and Intra-cranial Arteriovenous Fistulas
Amir R Honarmand MD (Presenter) ; Joseph J Gemmelle MD ; Maryam Soltanolkotabi MD ; Michael C Hurley MBBCh ; Neeraj Chaudhary ; Aditya Pandey ; Ali Shaibani MD ; Sameer A Ansari MD, PhD

PURPOSE
To assess the relative intra-arterial cone-beam CT angiography (IACBCTA) efficacy in the anatomical identification/localization of arteriovenous fistulas (AVFs) and utility for surgical/endovascular treatment planning.

METHOD AND MATERIALS
DSA and IACBCTA images were reviewed retrospectively and independently by two neurointerventionalists. Qualitative image analysis was performed based on the level of b values of 0 and 800 sec/mm2. ADC values of the entire volume of palate tonsil were measured by manual drawing of regions-of-interests. The following parameters were scored: a) Arterial feeders, b) Venous drainers and course, c) Fistula site, d) Adjacent anatomical landmarks for cross-sectional localization, and e) Overall diagnostic value for interpretation. Differences between the scores were defined as the IACBCTA efficacy value. Observers described the treatment strategy at the end of DSA and IACBCTA grading respectively: altered or more confident treatment plan versus no value. Wilcoxon signed rank test and Kendall W coefficient of concordance were used for statistical analysis.

RESULTS
Thirty-two consecutive patients [22M/10F, mean age 60.9y] were studied. Despite moderate interobserver agreement for IACBCTA overall efficacy value (rho=0.4, P=0.02), no significant difference was observed between efficacy values (P = 0.6). Both observers assigned significantly higher scores to IACBCTA for overall diagnostic value (both observers: P).

CONCLUSION
IACBCTA adjunctively improves the anatomical delineation of AVFs, particularly in terms of fistula site and localization.

CLINICAL RELEVANCE/APPLICATION
IACBCTA adjunctively improves the anatomical delineation of AVFs conferring a more confident endovascular or surgical approach.

LL-NRS-MO6B  Period of Pseudo-normalization of Diffusion Kurtosis after Cerebral Infarctions
Toshiaki Taoka MD (Presenter) ; Masahiko Sakamoto MD ; Toshiaki Akashi MD ; Toshiteru Miyasaka MD ; Saeka Hori ; Kimihiko Kichikawa MD ; Tomoko Ochi ; Takeshi Wada MD

PURPOSE
Diffusion kurtosis is a statistical measure for quantifying the deviation of the water diffusion profile from a Gaussian distribution. The current study assessed the time course of diffusion kurtosis and evaluated the period of pseudo-normalization after cerebral infarctions.

METHOD AND MATERIALS
Subjects included 25 cases / 30 lesions of cerebral infarction. The duration between onset and imaging ranged from 1 day to 122 days. Diffusion kurtosis measurements were done with b values of 0, 1000, and 2000 sec/mm2 applied in 30 directions. Diffusion Kurtosis images are generated, including axial kurtosis (Kax) and radial kurtosis (Krerd) to the eigenvector. We also acquired T2 weighted image (T2WI), diffusion weighted image (DWI) and apparent diffusion coefficient (ADC) images. The time course of the relative values for T2WI, DWI, ADC, Krerd, and Kax were evaluated and the period for pseudo-normalization was obtained.

RESULTS
The trend curve of relative Krerd indicates that there was a trend for relative Krerd to decrease according to the duration after infarction onset, and that lesions from 10 days to 2 weeks after infarction onset showed lower Krerd values compared with the contralateral side. The trend curve of the relative Kax showed high values in cases within 10 days to 2 weeks after infarction onset. There was also a trend for relative Kax to decrease according to the duration after infarction onset, which represented the pseudo-normalization period. The days for pseudo-normalization were 45days, 21days, 14 days and 25 days for DWI, ADC, Krerd and Kax respectively.

CONCLUSION
Diffusion kurtosis values showed increases in lesions early after infarction and showed decreases earlier than DWI. Krerd showed pseudo-normalization earlier than that of ADC, and the pseudo-normalization of Kax was a little later than that of ADC. Because DKI can show different time courses after the onset of infarction compared with DWI or ADC, additional information for white matter tissue with infarction can be provided using this imaging technique. Specifically, information by DKI including Kax and Krerd seems helpful in making detailed evaluation for the duration after onset of infarction in combination with T2WI, DWI, and ADC.

CLINICAL RELEVANCE/APPLICATION
Since DKI can show different time courses, information by DKI including Kax and Krerd seems helpful in making detailed evaluation for the duration after onset of infarction in addition to T2WI, DWI and
Recently developed CAD-software has the potential to quantify and differentiate obstructive and restrictive diseases of the lung based on MS-CT data and METABOLIC PET. 4. Technical and interpretation pitfalls of high b-value DWI in comparison with standard b-value DWI with the clinical indications of bisphosphonate use increasing, it is important for radiologists to be familiar with osteoporosis, Paget disease, and malignancy-related hypercalcemia. Patients with bisphosphonate related osteonecrosis present with nonhealing extraction sockets and painful bone exposure, which adds significantly to their morbidity. The condition has gained added significance with the increasing use of bisphosphonates and longer survival of cancer patients. With the clinical indications of bisphosphonate use increasing, it is important for radiologists to be familiar with bisphosphonate related osteonecrosis. The imaging features are indistinguishable from osteomyelitis, and therefore, a history of bisphosphonate therapy is important to suggest the correct diagnosis. Clinically, bisphosphonates are potent osteoclast inhibitors. They decrease bone turnover and are widely used in the management of bony metastatic disease, osteoporosis, Paget disease, and malignancy-related hypercalcemia. Patients with bisphosphonate related osteonecrosis present with nonhealing extraction sockets and painful bone exposure, which adds significantly to their morbidity. The condition has gained added significance with the increasing use of bisphosphonates and longer survival of cancer patients. With the clinical indications of bisphosphonate use increasing, it is important for radiologists to be familiar with bisphosphonate related osteonecrosis. The imaging features are indistinguishable from osteomyelitis, and therefore, a history of bisphosphonate therapy is important to suggest the correct diagnosis. 1. Technique of DWI and how to optimize it according to b-value. 2. Methodology of qualitative quantitative assessment by DWI and ADC. 3. Utility of high and standard b-value DWI in conjunction with conventional MR and/or [18F] FDG-PET for evaluation of sinusitis and glandular function, differentiation of neoplasms in nasopharynx, head and neck region and their relation to other imaging modalities. 4. Technical and interpretation pitfalls of high b-value DWI in comparison with standard b-value DWI with the clinical indications of bisphosphonate use increasing, it is important for radiologists to be familiar with osteoporosis, Paget disease, and malignancy-related hypercalcemia. Patients with bisphosphonate related osteonecrosis present with nonhealing extraction sockets and painful bone exposure, which adds significantly to their morbidity. The condition has gained added significance with the increasing use of bisphosphonates and longer survival of cancer patients. With the clinical indications of bisphosphonate use increasing, it is important for radiologists to be familiar with bisphosphonate related osteonecrosis. The imaging features are indistinguishable from osteomyelitis, and therefore, a history of bisphosphonate therapy is important to suggest the correct diagnosis.

**CONCLUSION**

Pattern of hypoperfusion on ASL correlates well with hypometabolism on FDG-PET in most cases and can be used to distinguish various neurodegenerative diseases. Poor correlation between ASL and FDG-PET in the occipital lobe may be secondary to decreased ASL efficiency in the posterior circulation versus physiology, causes with low correlation to eyes open/closed state. Caution should be made with interpreting occipital hypoperfusion with ASL, especially when considering DLB. In such cases, occipital hypoperfusion on ASL should be confirmed with corresponding hypometabolism on FDG-PET.** CLINICAL RELEVANCE/APPLICATION**

Addition of ASL to routine brain MRI is recommended for evaluating neurodegenerative diseases.

**LL-NRE-M08B • Practical Review of Bisphosphonate Related Osteonecrosis of the Mandible and Maxilla**

Maria P Valencia MD (Presenter); Pavel Rodriguez MD; Fang Yu MD; Wilson Altmeayer MD; Achint K Singh MD

**PURPOSE/AIM**

After reviewing this Education Exhibit the participant should be able to differentiate all the possible imaging abnormalities and complications found in patients with osteonecrosis of the mandible and maxilla, related to Bisphosphonates exposure.

**CONTENT ORGANIZATION**


**SUMMARY**

Bisphosphonates are potent osteoclast inhibitors. They decrease bone turnover and are widely used in the management of bony metastatic disease, osteoporosis, Paget disease, and malignancy-related hypercalcemia. Patients with bisphosphonate related osteonecrosis present with nonhealing extraction sockets and painful bone exposure, which adds significantly to their morbidity. The condition has gained added significance with the increasing use of bisphosphonates and longer survival of cancer patients. With the clinical indications of bisphosphonate use increasing, it is important for radiologists to be familiar with bisphosphonate related osteonecrosis. The imaging features are indistinguishable from osteomyelitis, and therefore, a history of bisphosphonate therapy is important to suggest the correct diagnosis.

**LL-NRE-M09B • High b-value and Standard b-value Diffusion-weighted MR Imaging in the Head and Neck Region: Clinical Application and Pitfalls**

Koung Mi Kang (Presenter); Ji-Hoon Kim MD; Chul-Ho Sohn MD; Seung Hong Choi MD, PhD; Tae Jin Yun MD; Inseon Ryoo MD; Jisang Park MD; Eun Kyong Lee MD; Soo Chin Kim MD

**PURPOSE/AIM**

1. To demonstrate the incremental role of DWI with other imaging techniques in characterization of head and neck lesions. 2. To describe the merits and challenges of high b-value (b=2000 s/mm2) DWI in comparison with standard b-value (b= 1000 s/mm2)

**CONTENT ORGANIZATION**

1. Technique of DWI and how to optimize it according to b-value. 2. Methodology of qualitative quantitative assessment by DWI and ADC. 3. Utility of high and standard b-value DWI in conjunction with conventional MR and/or [18F] FDG-PET for evaluation of sinusitis and glandular function, differentiation of neoplasms in nasopharynx, head and neck region and their relation to other imaging modalities. 4. Technical and interpretation pitfalls of high b-value DWI in comparison with standard b-value DWI with the clinical indications of bisphosphonate use increasing, it is important for radiologists to be familiar with osteoporosis, Paget disease, and malignancy-related hypercalcemia. Patients with bisphosphonate related osteonecrosis present with nonhealing extraction sockets and painful bone exposure, which adds significantly to their morbidity. The condition has gained added significance with the increasing use of bisphosphonates and longer survival of cancer patients. With the clinical indications of bisphosphonate use increasing, it is important for radiologists to be familiar with bisphosphonate related osteonecrosis. The imaging features are indistinguishable from osteomyelitis, and therefore, a history of bisphosphonate therapy is important to suggest the correct diagnosis.

**SUMMARY**

DWI plays an important complementary role to other imaging techniques in evaluation of head and neck lesions. Knowledge of various clinical application and pitfalls along with changes according to b-value may help to better interpret head and neck lesions.
Background
MS-CT currently does not offer functional parameter of the lung. Study aimed to analyze, whether there are parameters obtainable from CT-data reflecting functional parameters calculated by whole-body plethysmography.

Evaluation
100 patients were randomly selected who underwent MS-CT (128-row CT) and whole body plethysmography (master-screen body, Jaeger, Germany) within <7 days. All data were analyzed using CAD (MeVisPulmo3D, Fraunhofer MeVis, Germany). Vital capacity (VC), FEV1, intrathoracal gas volume (ITGV), residual volume (RV), total lung capacity (TLC) were matched with CAD-based lung volume analysis (vol), mean low density (MLD), low and high attenuation values (LAV/HAV), lung weight (w) P15, PK (maximum of histogram) and FWHM (full width half max). Central obstruction, peripheral obstruction, restrictive diseases and emphysematous patients were analyzed.

Discussion
CAD-analysis was possible in all cases. Acquisition time was approx. 1 minute per case. Correlation coefficients of VC were: Vol: r=0.54, p<0.001; RV showed association to Vol: r=0.66, p<0.001. Correlation coefficients of TLC vs. vol, weight, MLD, HAV, PK and P15 were: r=0.67; r=0.51; r=0.60; r=0.56; r=0.45; r=−0.52. All p-values were significant. Only moderate correlation were observed for maximum inspiratory flow (PEF) and expiratory reserve volume (ERV).

Severity of obstructive and restrictive diseases showed different CAD-based data of volume, MLD, LAV and HAV (Oneway Anova, p<0.05).

LL-PHS-MO2B • The Effects of Pure and Hybrid Iterative Reconstruction Techniques on Computer-aided Detection (CAD) System of Pulmonary Nodules in Dose-reduced CT Scans
Masaki Katsura MD (Presenter); Izuru Matsuda MD; Masaaki Akahane MD; Koichiro Yasaka MD; Shohei Hanaoka MD; Hiroyuki Akai MD; Jiro Sato MD; Akira Kunimitsu MD *; Kuni Ohtomo MD *

Purpose
To evaluate the effects of pure and hybrid iterative reconstruction techniques on computer-aided detection (CAD) system of pulmonary nodules using reference-, low-, and ultralow-dose chest CT.

Method and Materials
Fifty-nine patients (mean±SD age, 64.7±13.4 years) gave informed consent to undergo reference-, low-, and ultralow-dose chest with 64-row multidetector CT. The reference- and low-dose CT involved the use of automatic tube current modulation with fixed noise indices (11.5±1.1mGy-cm, respectively) and the ultralow-dose CT was acquired with a fixed tube current-time product of 5mAs. Each 0.625-mm-thick image was reconstructed with filter-back projection (FBP), 50% adaptive statistical iterative reconstruction (ASIR)-FBP blending, and model-based iterative reconstruction (MBIR). CAD output was compared with the results of the reference standard which was established using a consensus panel of 2 radiologists, who identified 84 non-calcified nodules with diameters of 4mm or greater on reference-dose ASIR. Sensitivity in nodule detection between different radiation dose and reconstruction techniques was assessed using Cochran’s Q test with post hoc McNemar test and Holm correction for multiple comparisons. The mean number of false-positive findings per examination was assessed using Friedman test with post hoc testing using Wilcoxon signed-rank test and Holm correction.

Results
Compared with reference-dose CT(307.7±178.1mGy-cm), there was a 78.6% decrease in dose–length product with low-dose CT(66.0±50.8mGy-cm), and a 95.3% decrease with ultralow-dose CT(14.6±1.1mGy-cm). CAD sensitivity for nodules at ultralow-dose MBIR(26.2%) was equivalent(p=0.52-1.00) to those at reference-(FBP,23.8%;ASIR,26.2%;MBIR,26.2%) and low-dose CT(FBP,26.2%;ASIR,25.0%;MBIR,25.0%). Mean number of false-positive findings per examination tended to increase with the use of MBIR, particularly at low-dose CT(1.19), and ultralow-dose CT(1.32), although there were no significant differences among reconstruction techniques at both dose levels(p=0.08-1.00).

Conclusion
CAD sensitivity for pulmonary nodules at ultralow-dose MBIR is almost equal to that at reference-dose CT. MBIR can improve CAD performance on dose-reduced chest CT despite increased false-positive findings.

CLINICAL RELEVANCE/APPLICATION
With the use of reference-, low-, and ultralow-dose CT may play an equivalent role to that on regular-dose CT in helping radiologists detect pulmonary nodules.

LL-PHS-MO3B • Accurate Measurement of Airway Wall Thickness with a Model-based Line Profile Matching Technique in MDCT
Zepa Yang MS (Presenter); Hyeongmin Jie; Jong H Kim PhD

Purpose
Accuracy of airway wall measurement has been impaired by the combined effect of partial volume and point spread blurring in CT systems. We present a novel technique which enables to determine the wall thickness of small airways by using a model-based lesion quantification technique.

Method and Materials
Point spread functions of a commercial CT(Sensation 16, Siemens) was acquired by using a wire phantom scanning for two different kernels(B30s and B50s). A set of model-derived line profiles were created by taking convolution of the point spread functions with a set of numerical airway phantoms having varying airway diameters. Accuracy of airway wall measurement has been impaired by the combined effect of partial volume and point spread blurring in CT systems. We present a novel technique which enables to determine the wall thickness of small airways by using a model-based lesion quantification technique.

Results
59 patients (mean±SD age, 64.7±13.4 years) gave informed consent to undergo reference-MS-CT, low-MS-CT, and ultralow-MS-CT. Measurements were made for 4 types of airway phantoms with wall thickness of 0.6, 0.9, 1.2, and 1.5 mm in 40 CT slices.

Conclusion
By applying a model-based line profile matching technique, our technique could determine the airway wall thickness accurately even for the small airways.

CLINICAL RELEVANCE/APPLICATION
Our technique may allow detection of early change of airway wall thickening in early diagnosis, patient sub-typing, and therapeutic monitoring in the management of COPD disease.

LL-PHS-MO4B • Analysis of Predictive Maintenance of Linear Accelerator Beam Uniformity Using Statistical Process Control
Charles M Able MS (Presenter) *; Alan Baydush PhD *; Michael T Munley PhD *

Purpose
PdM monitoring of beam uniformity using a new method for determining SPC control limits is more effective than using traditional control limits. SPC false alarms are reduced thereby eliminating unwarranted service intervention. We are working to develop code that will provide an SPC evaluation using the new formula.

Background
The focus of this study is to determine the effectiveness of revisions to statistical process control (SPC) chart limits for linear accelerator steering coil current (beam uniformity) predictive maintenance (PdM) monitoring.

Evaluation
We have re-evaluated calculation of the limits for steering coil current (SCC) SPC charts based on our observations that the changes in SCC required for 1% change in measured beam uniformity will generally exceed the traditional limits calculated using the standard deviation of the subgroup values alone. Using empirical data obtained from controlled experiments varying the SCC while measuring the beam uniformity, we have developed a formulism that incorporates a scaling factor (Cm) in the calculation of control limits.

Discussion
SCC monitoring of an 18 MV photon beam using the new limits indicated a change in the transverse position coil operating current 2 weeks prior to multiple EXQ faults and unscheduled downtime. A change in beam uniformity of greater than 3% was found once the beam was scanned using a computerized water phantom and ion chamber. SPC charts of this steering coil using traditional limits would have resulted in 5 false positives prior to the first positive alarm indicated by the new limits.
Prostate Cancer Patients

METHOD AND MATERIALS
15 endorectal 3 Tesla MRI studies, using DCE and T2W imaging, were obtained in men with biopsy proven PCa prior to radical prostatectomy (RP). The DCE MRI protocol consisted of a contrast agent which was acquired at 95 second intervals before the bolus injection of 0.1 mmol/kg of gadolinium-DTPA, and 5 post-contrast images were acquired at the same temporal resolution. Following RP, surgical specimens, examined with whole mount histopathology by a trained pathologist, were evaluated for the presence and extent of PCa, which was subsequently mapped from histology to DCE MRI. The PZ and CG were manually segmented on T2W MRI by a radiologist, and each study was classified as having PCa in a particular zone when more than 70% of the tumor volume was present in that zone. Nine studies were found to have PCa in the PZ, and 6 had PCa in the CG. The iterative multiple reference tissue method was used on the DCE MRI data to estimate the volume transfer constant and extravascular-extracellular volume fraction for each prostate tumor.

RESULTS
Values for the transfer constant and extravascular-extracellular volume fraction averaged 0.27 and 0.43, respectively, for PZ tumors; 0.36 and 0.62, respectively, for CG tumors. Both the transfer constant and the extravascular-extracellular volume fraction are significantly higher in CG tumors than in PZ tumors (p = 0.045 for both perfusion parameters).

CONCLUSION
CG and PZ tumors manifest significantly different perfusion characteristics on DCE MRI, suggesting that vascular features of PCa depend on the tumor location in the prostate gland and that PZ and CG tumors may have distinct biologic attributes.

CLINICAL RELEVANCE/APPLICATION
Since CG and PZ tumors have different perfusion characteristics, zone-specific analysis of DCE MRI should improve assessment of PCa.

LL-PHS-M06B • Optimal Reconstruction Filter on Observation of Periodontal Ligament Space in Dental Cone-beam CT

Yuuki Houno (Presenter); Toshimitsu Hishikawa; Ken-Ichi Gotoh; Munetaka Naitoh; Eiichiro Ariji; Yoshihiko Kodera PhD

PURPOSE
Diagnosis of the alveolar bone condition is important in the treatment of periodontal disease. However, visualization of the thin alveolar bone and periodontal ligament space is difficult owing to image blurring using the current imaging technique. Therefore, identification of the marginal alveolar bone level is unreliable. In this study, we try to determine high quality images of periodontal ligament space separation were obtained by changing the reconstruction filter.

METHOD AND MATERIALS
Images from 4 different areas of 2 types of head phantoms were obtained using Alphard-3030 dental cone-beam computed tomography (Asahi Roentgen Industry Co., Ltd.). The image was reconstructed from the raw data by using 5 different reconstruction filters. Post reconstruction, these reconstructed images were compared with that of the Alphard-3030 reconstructed images by using Thurstone’s paired comparison, and a scale value was calculated. The images were evaluated limiting the clarity of periodontal ligament space boundary by 3 periodontists and 3 radiologists with >5 years of clinical experience. To confirm the image characteristics, modulation transfer function and Wiener spectrum were calculated.

RESULTS
The best image was one reconstructed with filter that increased the high-frequency component based on Shepp and Logan’s function. The Alphard-3030 reconstruction filter is used in the worst. The image reconstructed with the best filter had a higher modulation transfer factor and Wiener spectral value than the Alphard-3030 reconstructed image. These results suggest that sharp images enhance the visualization of the periodontal ligament space, and the imaging noise is insignificant. These images enable the observer to clearly view the periodontal ligament space boundary.

CONCLUSION
We determined the optimal reconstruction filter required to observe the periodontal ligament space.

CLINICAL RELEVANCE/APPLICATION
Image quality of periodontal ligament space may be improved by alternating reconstruction filter of cone-beam CT. This method can be applied to various CT apparatus without hardware replacement.

LL-PHS-M07B • Fast and Easy Dose Estimates including Tube Current Modulation and Automatic Exposure Control

Natalia Saltybaeva; Martin Hupfer PhD (Presenter) *; Daniel Kolditz PhD *; Bernhard Schmidt PhD *; Willi A Kalender PhD *

PURPOSE
Tube current modulation (TCM) and automatic exposure control (AEC) are widely used in modern CT. The aim of this work was to include the effects of TCM and AEC in a software package for fast and easy organ and effective dose estimates.

METHOD AND MATERIALS
Measurements were performed on a SOMATOM Definition Flash scanner (Siemens AG, Forchheim, Germany); the manufacturer provided all necessary information on their CARE Dose4D TCM/AEC product. TCM and AEC curves were derived for anthropomorphic phantoms by generating complete CT projection data sets by means of ray-tracing and predicting the flux at the detector. For all phantoms and parameter combinations studied, Monte Carlo (MC) calculations were performed. The Alphard-3030 reconstructed images by using Thorstone’s paired comparison, and a scale value was calculated. The images were evaluated limiting the clarity of periodontal ligament space boundary by 3 periodontists and 3 radiologists with >5 years of clinical experience. To confirm the image characteristics, modulation transfer function and Wiener spectrum were calculated.

RESULTS
Measured dose values were compared with MC results on a chip-by-chip basis. The mean differences for all TLD chips were 5%, 7%, and 6% for the adult, the 5-year old, and the 1-year old phantom, respectively. This deviation is in the range of the uncertainty associated with TLD measurements and indicates that measured dose values were compared with that of the Alphard-3030 reconstructed images by using Thurstone’s paired comparison, and a scale value was calculated. The images were evaluated limiting the clarity of periodontal ligament space boundary by 3 periodontists and 3 radiologists with >5 years of clinical experience. To confirm the image characteristics, modulation transfer function and Wiener spectrum were calculated.

CONCLUSION
The software package allows to obtain fast and accurate dose estimates when TCM/AEC is used and furthermore may serve as a learning tool.

LL-PHS-M08B • Evaluation of Alignment Discrepancy Based on Fiducial Seeds versus Bony Anatomy or Bony Anatomy Plus Endorectal Balloon for Prostate Cancer Patients

Rui Zhang (Presenter); Connel Chu; Maurice L King MD; John P Gibbons PhD

ABSTRACT
Purpose/Objective(s): Fiducial seed has long been recognized as an accurate tool to correct prostate patient setup error. The alternative techniques include aligning patient using bony anatomy information and endorectal balloon. The aim of this study was to evaluate the discrepancy in prostate daily alignment based on fiducial seeds versus bony anatomy or bony anatomy plus balloon.

Materials/Methods: All alignment evaluations were carried out by using Elekta X-ray volume imaging (XVI) software. Seventeen prostate patients with both fiducial seeds and water-filled endorectal balloon and four patients with fiducial seeds only were chosen for this study. Each patient was followed for more than one month. For each treatment fraction, a cone beam computed tomography (CBCT) was acquired and the daily shift information based on fiducial seeds was recorded for each patient as the gold standard. Then the alignment was performed again based on bony anatomy only (for patients without balloon) or based on bony anatomy plus balloon (for patients with both fiducial and balloon) using the same CBCT data. For alignment based on bony anatomy only, the auto-fusion based on bone filter was applied and the angular shifts were ignored. For alignment based on bony plus balloon, the same bone filter was applied first, then the balloon was used for anterior-posterior (AP) alignment correction. The differences between shifts determined using fiducial seeds and using the bony anatomy or bony anatomy + balloon were analyzed.

RESULTS: In the right-left (RL) direction, discrepancies between shifts based on fiducial seeds and shifts based on bony only or bony + balloon were all less than 4 mm. In the superior-inferior (SI) direction, the discrepancies were less than 15 mm for bony only, and less than 8 mm for bony + balloon. In the AP direction, the discrepancies were all less than 11 mm for bony only or bony + balloon. Over 96% (AP) and 98% (SI) of the discrepancies were within 7 mm for bony + balloon, while over 75% (AP) and 48% (SI) of the discrepancies were within 7 mm for bony only.
Towards Virtual Clinical Trials: A Framework for Clinically Relevant CT Simulations

Justin B Solomon  MSc (Presenter) ;  Juan Carlos Ramirez Giraldo  PhD ;  Karl Stierstorfer  PhD * ;  Yuan Lin  PhD * ;  Ehsan Samei  PhD *

PURPOSE
To establish a framework for creating virtual anthropomorphic computed tomography (CT) images with realistic lesions, accounting for attributes of commercial CT systems.

METHOD AND MATERIALS
A detailed computer model of a commercial CT system (Siemens Somatom Definition Flash, Siemens Healthcare, Germany) was created, accounting for the effects of different cone beam angles and detector configurations. The model was used to generate virtual CT images with realistic lesions, which were then compared to real CT images from clinical cases to validate the framework.

CLINICAL RELEVANCE/APPLICATION
The framework allows for the creation of virtual CT images with realistic lesions, which can be used to evaluate the performance of different CT systems and to train radiologists. This can help improve the accuracy of CT diagnoses and reduce the need for unnecessary imaging.

Back to Top
Clinical trials can be difficult and costly to perform. Virtual clinical trials have the potential to reduce costs and expedite the process of evaluating new CT technologies.

**Clinical Relevance/Application**

Virtual clinical trials have the potential to reduce costs and expedite the process of evaluating new CT technologies.

**RESULTS**

For all reconstruction algorithms, the proposed framework resulted in realistic images with noise properties consistent with real CT images.
Patients with AVM who underwent CK SRS and had at least 1 year follow-up were included in this study (n=67). Medical records were reviewed and
demographic, treatment parameter and outcome data were gathered and analyzed.

RESULTS
Age of patients ranged from 14 to 75 years (mean 45). Pre-SRS AVM volume ranged from 0.027-62.72 ml (median 4.4 ml). The median prescription dose was 24 Gy in 3 fractions. Per Spetzler-Martin grading, 6 patients had grade 1, 18 had grade 2, 18 had grade 3, 8 had grade 4 and none had grade 5 AVMs. According to the Cognard classification, there were 14 dural AV fistulas (21%). Two patients had AVMs located in the vein of Galen. The rate of re-bled was 4% (n=3). One patient developed an ischemic stroke post-SRS. Procedure related gliosis was observed in 19 patients (28%). The mean time to complete obliteration was 29 months. Thirty-four patients had malformations of <15 ml and >3 year follow-up. Of these patients, the obliteration rate for parenchymal AVMs was 75% (18/24) and 50% (4/8) for dural AV fistulas. One-hundred percent (2/2) of vein of Galen AVMs were obliterated. Eight patients had parenchymal AVMs larger than 15 ml and >3 year follow-up. The obliteration rate for these patients was 25%. No dural AV fistulas greater than 15 ml were reported. The obliteration rate was higher in patients with compact (67%) versus diffuse (22%) nids. Five patients had obliteration prior to 3 year follow-up; two were parenchymal AVMs and three were dural AV fistulas. Although the sample size was small, they appeared to be a trend towards favorable outcomes with a dose equivalent to 15 Gy or higher in a single fraction. Three cases were re-treated following SRS. Of those, two underwent surgery and one had embolization followed by repeat SRS.

CONCLUSION
The results suggest CK SRS is an effective treatment for AVM and dural AV fistula obliteration with low rates of re-bled and re-treatment.

CLINICAL RELEVANCE/APPLICATION
Our data show favorable outcomes for parenchymal AVM and dural AV fistula obliteration with low rates of re-bled and re-treatment.

LL-ROS-M03B • Conformal Intracavitary Brachytherapy Planning for Carcinoma Cervix Using Transabdominal Ultrasound and Assessment of Quality of Life
Pavankumar Lachi (Presenter)

ABSTRACT
Purpose/Objective(s): The purpose of this study was to evaluate the feasibility and outcomes of transabdominal ultrasound (US) guided, conformal intracavitary brachytherapy (ICB) planning for patients with carcinoma cervix. We also evaluated the impact of US-guided CIB on the quality of life (QoL) of these patients.

Materials/Methods: This was a retrospective study conducted at a single institution, from August 2016 to September 2018. The inclusion criteria were patients with locally advanced carcinoma cervix who were candidates for ICB as part of their treatment plan. The US-guided CIB was performed using a 3D-US scanner with EzeCIS software. The clinical target volume (CTV) was defined using a combination of clinical and ultrasound images. The CTV was divided into high-risk and low-risk volumes based on the presence of parametrial disease and the risk of tumor extension. The treatment plan was designed using Alpha EzeCIS software to deliver a prescribed dose of 70-76 Gy in 2-3 fractions. The plan was optimized to deliver a dose of at least 95% of prescription dose to 90% of the high-risk volume and at least 90% of the prescription dose to 90% of the low-risk volume. The dose was delivered using a combination of Ir-192 and X-ray sources. The quality of life of the patients was assessed using the EQ-5D-5L questionnaire before and after the CIB treatment.

Results: A total of 25 patients were included in the study. The median age of the patients was 55 years (range 30-75). The median follow-up time was 12 months (range 6-24). The median dose delivered was 72 Gy (range 70-76). The median time required for the treatment was 2 hours (range 1.5-3.5). The EQ-5D-5L scores were 0.5 before treatment and 0.8 after treatment (p<0.001). The overall satisfaction of the patients with the treatment was very high. The complications were low and were mostly transient.

Conclusions: Transabdominal US-guided CIB is a feasible and effective treatment option for patients with locally advanced carcinoma cervix. The US-guided CIB was well accepted by the patients and resulted in a significant improvement in their quality of life. Further studies are needed to confirm these findings and to evaluate the long-term outcomes of this treatment.

LL-ROS-M048 • Hippocampal Sparing Whole Brain Irradiation with Boost to Metastases-A Retrospective Evaluation
Franziska Fels (Presenter)

ABSTRACT
Purpose/Objective(s): This study presents a retrospective evaluation of patients treated with hippocampal sparing whole brain irradiation (HS-WBI) with boost to individual brain metastases. The goal of this study was to evaluate the tumor control, neurocognitive outcome, and dose-related toxicities.

Materials/Methods: From 08/2011 to 01/2013, 16 patients were treated with HS-WBI and boost. The hippocampus was contoured as organ at risk and enlarged with safety margins of 7-10mm to ensure appropriate dose decline around the hippocampal avoidance volume. Whole brain was irradiated with 30 Gy in 12 fractions with a restriction of 5 Gy on the hippocampus. Follow-up-MRIs were planned 6 weeks after radiotherapy and then 3-monthly.

Results: 5/16 patients were lost to follow-up. The median follow-up-time was 4 (1.5-14) months. Evaluation of tumor control showed a complete remission in 5 patients (45%), stable disease in 1 patient (9.1%) and mixed response in 1 patient. 3 patients had a progression of their metastases (27.2%). 1 patient showed a delayed progression in terms of a temporary irradiation reaction. 1 patient had an increase in leukoaraiosis, 1 patient showed radionecrosis within 2boosted metastases. No patients had hippocampal metastases. The avoidance volume was free of metastases as well. Mean dose to hippocampus was <10 Gy (calculated from EQD2, average mean dose 7.4 Gy).

Conclusions: This study is the first to report about HS-WBI and SIB to metastases. Good tumor control was seen and no patient had intrahippocampal metastases. An upcoming prospective multicenter-study will evaluate this question further and analyze the effect on neurocognition.

LL-ROS-M05B • Stereotactic Ablative Radiotherapy (SART) to Whole vs. Partial Vertebral Body for Spinal Metastasis
Anton E Khouri (Presenter)

ABSTRACT
Purpose/Objective(s): A retrospective review was conducted to compare the outcomes of whole vs. partial vertebral body (VB) SART for spinal metastases. The purpose of this study was to compare the outcomes of patients with spinal metastases treated with whole or partial VB with SART.

Materials/Methods: A CyberKnife unit was used for the delivery of SABR for all patients. Clinical target volumes (CTVs) were contoured by individual physicians with the help of a fused volumetric MRI (T1 with and without contrast and T2), so that the gross tumor could be better delineated. Whole VB was defined as inclusion of the whole VB in the CTV, whereas partial VB was defined as inclusion of only part of the vertebral body.

Results: 46 patients were included in the analysis. Vertebral levels included 5 cervical, 11 thoracic and 4 lumbar. Histologies included adenocarcinoma, squamous cell carcinoma. 11 patients received SABR as postoperative treatment. Prescribed dose was 12-30Gy in 1-5 fractions. 14 patients received SABR to whole VB, 6 patients to partial VB. 3 patients received SRS. Of those, two underwent surgery and one had embolization followed by repeat SRS.

Conclusions: Gross tumor control appears to be similar for both whole and partial stereotactic ablative radiotherapy for spinal metastasis. Further research is needed to determine the optimal CTV for spinal SABR.

LL-ROS-M06B • Which Pre-treatment FDG-PET Parameters Predict Outcome in Oropharyngeal Cancer?
Ankeet Shah (Presenter); Shlomo A Koyfman MD; John Greskovitch; Ping Xia

PURPOSE
Prior analysis of pretreatment FDG PET/CT of patients with head-and-neck cancer (HNC) indicates mixed results for predicting outcome using maximum standardized uptake value (SUVR). Recently, metabolic tumor volume (MTV) has been identified as a predictive FDG PET parameter in HNC. It is not clear, though, if primary MTV or nodal MTV is more predictive of outcome. The purpose of this study is to assess the predictive value of various FDG PET parameters, as well as primary and nodal contribution, for outcome in HNC patients.

METHOD AND MATERIALS
The dataset included 70 patients with oropharyngeal squamous cell cancer who underwent FDG PET/CT scanning prior to radiation therapy. Pretreatment parameters of SUVmax, SUVmean, total glycolytic activity (TGA), and MTV were collected as indicators of total tumor burden, stratified into the primary tumor, total involved lymph nodes, and the largest involved lymph node. We also assessed the largest diameter of primary tumors and largest diameter of involved lymph nodes as an alternative measure of tumor burden. The findings were compared between the subsets of patients that had no evidence of disease (NED) on follow-up (n=54), and those patients that had persistent disease (PD) on follow-up FDG PET/CT (n=16).

RESULTS
Among the pretreatment FDG PET parameters, MTVs in cm3 for total tumor burden and primary tumors, as well as maximum diameter in cm of primary tumor demonstrated statistically significant differences between patients with NED and PD. For total tumor burden, the PD average MTV = 24.2, and NED average MTV = 18.5. At a cutoff of 50cm3, odds ratio (OR) = 10.2 (CI 95%: 2.2-47.7). For primary volume, PD average MTV = 33.5 and NED average MTV = 9.8. At a cutoff of 20cm3, OR = 24.1 (CI 95%: 2.6-227.0). MTV differences in total involved nodal volume or largest involved nodal volume were not statistically significant. Average maximum diameter in cm of primary tumor of PD patients = 5.03 and in NED patients = 3.44. At a cutoff of 5.5cm, OR = 11.8 (CI 95%: 2.0-69.0).

CONCLUSION
This study supports the use of MTV and maximum diameter of the primary tumor, as well as MTV of total tumor burden, to assess risk of disease progression. Other FDG PET parameters were not predictive of outcome in oropharyngeal HNC.

CLINICAL RELEVANCE/APPLICATION
FDG PET scans that are commonly used for to stage and staging treatment planning can also help predict outcome of treatment in oropharyngeal cancer.

Vascular/Interventional - Monday Posters and Exhibits (12:45pm - 1:15pm)
Monday, 12:45 PM - 01:15 PM • Lakeside Learning Center
LL-VIS-MO3B • AIMA PRA Category 1 Credit ™:0.5
LL-VIS-MO1B • Comparison of Conventional and Simulated Reduced-tube Current MDCT for Evaluation of Endovascular Aortic Aneurysm Repair: A Pilot Study

Ryan H Snyder MD (Presenter) ; Kingshuk Roychoudhury ; Claire A Bridges ; Jared D Christensen MD ; Carlos J Guevara MD ; Amy M Neville MD ; Tony P Smith MD ; David R Sopo MD ; Donald P Frush MD

PURPOSE
To assess the impact of simulated CT tube current reduction on radiologists’ interpretation of CT angiograms (CTAs) following endovascular repair (EVAR) of the abdominal aorta.

METHOD AND MATERIALS
The gold standard for this study consisted of 45 standard-dose CTA examinations (64-slice GE VCT, 2 x 128-slice Siemens SOMATOM Definition Flash; non-contrast and contrast phase contrast-enhanced scans of the abdomen and pelvis) performed for evaluation of the aorta following EVAR. Of these, 26 underwent simulated 50% mA reduction and 29 underwent simulated 75% mA reduction using a validated mA reduction (noise insertion) software program. Three blinded, experienced faculty radiologists interpreted the 100 randomized studies for the presence of an endoleak, endoleak type, maximum aortic measurements, and subjective level of noise. Finally, reader confidence in detecting or excluding an endoleak was recorded for each image set.

RESULTS
Using the consensus vote (Y or N) regarding the presence of an endoleak for each full-dose examination as the gold standard, 81% (21/26) of simulated 50% mA-reduction and 76% (22/29) of simulated 75% mA-reduction scans were positive for endoleak. Sensitivity for endoleak diagnosis was not significantly different at 82% with 50% mA reduction and 89% with 75% mA reduction. Reader agreement for the presence of endoleak for the full-mA, 50% mA-reduction and 75% mA-reduction exams was 57%, 55% and 64%, respectively; thus, agreement did not significantly change with decreasing CT dose. Mean absolute measurement error for aortic cross-sectional area (cm²) was 4.4 for the 75% mA-reduced exams, compared to 2.4 for the 50% mA-reduced exams (p < 0.001, repeated measures ANOVA). Reader confidence decreased as the mA decreased, with average ratings of 4.73 for 100% mA, 4.66 for 50% mA and 4.32 for 25% mA exams (p < 0.001).

CONCLUSION
The results of this pilot study did not show a significant reduction in endoleak detection with simulated CT dose reduction; however, a follow-up study with a larger sample size may be necessary in order to detect significant differences with subtle leaks. Decreasing dose did result, however, in a significant decrease in reader confidence and increase in average measurement error.

CLINICAL RELEVANCE/APPLICATION
In order to minimize cumulative radiation dose, it is important to establish CT dose reduction thresholds above which diagnostic image quality can be maintained.

LL-VIS-MO2B • Effect of Sorafenib Combined with Transcatheter Arterial Embolization on the Therapeutic Outcome of Rabbit Hepatic Tumors

Linxiang Ruan PhD, MD (Presenter) ; Shunliang Xu ; Jingfeng Zhang PhD, MD

PURPOSE
Transcatheter arterial embolization (TAE) could result in more severe hypoxia and affected the microcirculation of hepatic tumor, which lead to tumor recurrence and metastasis at some extent. Sorafenib, the first systemic drug approved for hepatocellular carcinoma (HCC) patients, is mainly used for the prevention of HCC recurrence and metastasis. Tumor micro-circulation has a close relationship with the growth, development, invasion, metastasis and prognosis of hepatic carcinoma. This study was to verify the hypothesis that sorafenib combined with TAE could improve the therapeutic outcome of pure TAE.

METHOD AND MATERIALS
A total of twenty-four New Zealand White rabbits were successfully implanted with VX2 tumor in liver and divided into three group at random, such as pure Lipiodol-based TAE group (n = 8), sorafenib combined with TAE group (n = 8) and pure sorafenib group (n = 8). Tumors were received TAE with Lipiodol, and / or oral administration of sorafenib after implanting for two weeks. One, two, and four weeks after TAE, animals were humanely killed, and tumor samples were collected for immunohistochemical staining with CD34. Expression level of HIF-1α protein was evaluated, and micro vascular density (MVD) was calculated.

RESULTS

CONCLUSION
Sorafenib suppressed the development of tumor recurrence and metastasis through extracellular signal-regulated kinase signaling caused by elevated levels of growth factors, which could enhance the therapeutic outcome in combination with TAE against liver tumors.

CLINICAL RELEVANCE/APPLICATION
Sorafenib could enhance the therapeutic outcome in combination with TAE against liver tumors.

LL-VIS-MO3B • Evaluation of Portal Vein System in Patients after Liver Transplantation by Unenhanced MR Angiography Using Spatial Labeling with Multiple Inversion Pulses Sequence and by CT Portography

Hao Tang (Presenter) ; Daoyu Hu MD, PhD ; Zi Wang

PURPOSE
The objective of this study was to evaluate the diagnostic performance of unenhanced MR Angiography using spatial labeling with multiple inversion pulses sequence (SLEEK) in comparison with CT portography in the detection of Portal Vein System in patients with liver transplantation.

METHOD AND MATERIALS
22 patients, 21 men and 1 woman (mean age 44.3 years; age range, 15–51 years). Unenhanced MRA using SLEEK was performed on a 1.5-T MRI system for assessing portal vein system in 22 patients with liver transplantation. Then all patients underwent 16-slice CT portography within 1–4 days. The ability to present the portal vein system and to reveal portal vein system disease with SLEEK was evaluated by two experienced radiologists and was compared with CT portography results using a joint reading performed in consensus.

RESULTS

CONCLUSION
The SLEEK has a comparable ability in demonstrating portal vein system in patients with liver transplantation as well as CT portography does. It can provide helpful information for surgeons to make an accurate postoperative assessment. Unenhanced MRA using SLEEK is relatively inexpensive and is not associated with renal complications. It can be as a good choice for screening portal vein system in patients with liver transplantation, especially in patients with renal insufficiency.

CLINICAL RELEVANCE/APPLICATION
The SLEEK has a comparable ability in demonstrating portal vein system in patients with liver transplantation as well as CT portography does. It can provide helpful information for surgeons to make an

LL-VIS-MO4B • Study on a Combined Protocol of Chemoembolization and Microwave Ablation: Treatment of Hepatocellular Carcinoma in Rats

Thomas J Vogl MD, PhD (Presenter) ; Jun Qian MD ; Ulli Imlau ; Yousef Hamidavi ; Huesday Korkusuz MD ; Elsies Oppermann ; Wolf-Otto Bechstein

PURPOSE
To assess the effect of transcatheter ablation (TACE) combined with microwave ablation for the treatment of hepatocellular carcinoma in an animal model.

METHOD AND MATERIALS
All experiments were approved by the German government and the institutional animal research review board. After subcapsular liver implantation of Morris Hepatoma 254A in SDW rats, the animals were randomly assigned to three interventional treatment groups as follows: (A) TACE (0.1 mg of mitomycin + 0.1 ml of lipiodol + 5.0 mg of degradable starch microspheres) + microwave ablation (2450MHz; 35 W; 45 s) (n = 10); (B) TACE alone (control group 1, n = 10); (C) microwave ablation alone (control group 2, n = 10). Tumor volume before (V1) and after the treatment (V2) was assessed by MRI and the tumor growth ratio (V2/V1) was calculated. Immunohistochemical analysis was performed for quantification of positive MMP-9 and VEGF tumor cells in each treatment.
RESULTS
Mean tumor growth ratio was 1.3385 + 0.1949 in group A, 3.1901 + 0.1323 in group B, and 4.1779 + 0.1862 in group C, respectively. Compared with the ratio in groups B and C (controls), the ratio in group A showed significant reduction in tumor growth (P < 0.05).

CONCLUSION
Treatment with combined TACE/microwave ablation, compared with the treatment of TACE or microwave ablation alone, significantly inhibits tumor growth and intrahepatic metastases in an animal model of hepatocellular carcinoma.

CLINICAL RELEVANCE/APPLICATION
Transarterial chemoembolization in combination with microwave ablation are relevant treatment options in hepatocellular carcinoma.

LL-VIS-MO5B • Quantification of Lower Leg Arterial Calcifications by High-Resolution Peripheral Quantitative Computed Tomography (HR-pQCT)

Janina M Patsch MD, PhD (Presenter) ; Martin A Zulliger MD ; Gundula Edelhauser MD ; Thomas M Link MD, PhD * ; Michael Weber ; Christian Loewe MD *

PURPOSE
HR-pQCT is a low-radiation-dose, in-vivo research tool primarily designed for the assessment of bone geometry, density and microarchitecture of the distal extremities. Vascular calcifications are frequently observed as incidental findings but quantitative analysis of vascular calcifications captured by HR-pQCT has not been performed yet. The objectives of our study were to validate a quantitative tool for the assessment of lower leg arterial calcifications (LLAC) by HR-pQCT and to test method reliability.

METHOD AND MATERIALS
RESULTS
Agatston score was low in 24% (0-10HU), intermediate in 35% (11-400HU), and high in 41% of patients (>400HU). 76% had LLAC in HR-pQCT. Comparing LLAC (HR-pQCT) and CAC (MDCT), there were positive correlations between LLAC mass and CAC as measured by Agatston score, mass score, and volume score (Spearman’s $\rho=0.6$; P<0.05).

CONCLUSION
Based on low radiation dose and significant associations with CAC, LLAC assessment might be a novel, patient-friendly, quantitative measure applicable to epidemiological and cardiovascular research.

LL-VIS-MO6B • Applications of Dual-Energy CT in Vascular Imaging

Sivakumar Srinivasan MD, FRCP (Presenter) ; Hui Seong Teh MBBS, FRCR ; Ashish Chawla MD, MBBS ; Jerome I Bosco MD, MBBS

PURPOSE/AIM
To illustrate the usefulness of Dual-Energy computed tomography (CT) in imaging of vessels involving various anatomical region from head to extremities. To discuss the pitfalls of Dual energy CT

CONTENT ORGANIZATION
• Introduction.  
  • Review of Dual Energy CT in imaging the vessels of head and neck, chest, abdomen and pelvis and extremities with case examples.  
  • Virtual Non-contrast images, automated dual-energy bone removal and plaque removal.  
  • Advantages of advanced integrated tools (syngo.viaTM) with RIS-PACS which aid in faster and efficient post-processing techniques.  
  • Pitfalls.

SUMMARY
• Dual energy CT helps in faster post-processing with lesser radiation dose compared to the conventional CT angiography. Automated Dual-energy based bone removal tool is very effective especially in the head and neck, for elimination of the skull base. Plaque removal tool is highly useful in Carotid arteries and arteries of the lower extremities. Virtual non-contrast images are useful to rule out bleed, to assess extravascular structures and also to rule out hyperdense non-iodine material within the lumen. Pitfalls include incomplete bone subtraction in few areas, inefficient hard plaque removal in the infrapopliteal arteries and increased noise in obese patients.

LL-VIS-MO7B • Current Percutaneous Vascular Closure Techniques and Associated Complications

Amit Bhakoo MD (Presenter) ; Brandon P Olivieri MD ; Mohammed Ezuddin ; Anne Beasley ; Robert E Beasley MD

PURPOSE/AIM
An increase in the number of endovascular procedures performed over the past decade has led to the development of new techniques intended to improve the efficacy and safety of vascular closure. Knowing the mechanism of action, components, risk-benefit and complication profiles unique to each closure technique is important for the reduction of adverse events. Further, an understanding of imaging findings and treatment options for vascular access-related complications is crucial for safe patient care.

CONTENT ORGANIZATION
Compare and contrast mechanisms of action of current vascular closure techniques.  
Describe multimodality imaging findings and treat the options of vascular access complications (pseudoaneurysm, arteriovenous fistula, access site/reperforation hematoma, and arterial dissection/occlusion).

SUMMARY
Having a thorough understanding of various closure techniques is important for the reduction of adverse events in endovascular procedures. The participant will gain understanding of the efficacy, complication and risk-benefit profiles for currently available percutaneous vascular closure techniques, as well as the imaging findings and treatment options of their associated complications.

Reducing CT Dose (Sponsored by the Associated Sciences Consortium) (An Interactive Session)

Monday, 01:30 PM - 03:00 PM • S105AB

QA CT

MSAS23 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Ellen Lipman , MS, RT

MSAS23A • Going Beyond the Protocol: A Comprehensive Approach to Optimizing CT Dose and Quality

Phuong-Anh T Duong MD (Presenter)

LEARNING OBJECTIVES
1) Understand how to develop a process for radiation dose and image quality optimization. 2) Briefly review common techniques for reducing CT radiation dose including. 3) Learn ways to monitor quality and dose. 4) Discuss ways to improve compliance with imaging protocols.

ABSTRACT
As radiation dose in CT continues to be a concern, many radiology practices are in the process of revising their CT protocols to optimize radiation dose and quality. Optimizing CT radiation dose and quality is a challenging task requiring knowledge to implement complex technology and collaboration between radiologist and technologist. It is not enough to change imaging protocols alone; monitoring and training are necessary to ensure consistent quality. This course focuses on the development of processes for dose reduction and continuous quality improvement drawing on the experience of an academic healthcare system as a case study. Methodologies for evaluating current imaging protocols, reducing radiation dose, monitoring exam quality and dose, assessing changes in protocols, and improving protocol compliance will be discussed.

MSAS23B • A Case Study Using the American College of Radiology Dose Index Registry

Brent Little MD (Presenter)
ABSTRACT

Radiation dose reduction and standardization are essential components of quality assurance and quality improvement in CT imaging. This course will highlight a departmental initiative to decrease and standardize CT radiation dose at a large academic medical center. The practical aspects of measuring baseline doses, implementing dose reduction strategies, and measuring results will be emphasized. Our use of the American College of Radiology dose index registry to identify average dose and dose outliers will be described. Cause analysis of variation in doses across sites, scanners, and exams will be discussed. An approach to planning, implementation, and continuous evaluation of dose reduction measures will be presented.

Case-based Review of Magnetic Resonance: Woman's Imaging (An Interactive Session)

Monday, 01:30 PM - 03:00 PM • S100AB

LEARNING OBJECTIVES

1) Describe normal versus anomalous pulmonary venous anatomy. 2) Understand the imaging findings of complications of ablation for atrial fibrillation. 3) Describe abnormalities of the pulmonary veins identifiable on routine CT. 4) Identify the most common pericardial abnormalities evaluated with CT.

ABSTRACT

Ovarian cancer continues to present at advanced stage of disease. 1) Typical imaging features of ovarian cancer at presentation. 2) Mimics of disseminated ovarian cancer. 3) The role of image guided biopsy in management. Endometrial cancer, now the most common female genital tract malignancy, usually presents in the post-menopausal woman with vaginal bleeding. 4) How to establish deep myometrial invasion and cervical involvement which may modify the surgical approach. Cervical cancer is reducing in incidence in the developed world but still a major killer of young women in the developing world. 5) How to use MR imaging as a staging examination that replaces examination under anaesthetic (EUA). 6) The emerging role of CT-PET in management. A case-based teaching approach will be used.

Malignancies of the Female Pelvis

John A Spencer MD (Presenter)

LEARNING OBJECTIVES

1) Typical imaging features of ovarian cancer at presentation. 2) Mimics of disseminated ovarian cancer. 3) The role of image guided biopsy in management. 4) How to establish deep myometrial invasion and cervical involvement which may modify the surgical approach. Cervical cancer is reducing in incidence in the developed world but still a major killer of young women in the developing world. 5) How to use MR imaging as a staging examination that replaces examination under anaesthetic (EUA). 6) The emerging role of CT-PET in management. A case-based teaching approach will be used.

Pulmonary Veins and Pericardium

James P Earls MD *

LEARNING OBJECTIVES

1) Understand pathology of the native coronary arteries beyond simple plaque disease. Topics will include coronary artery aneurysms, anomalies, and fistulae. 2) How to optimize the study performance and interpretation will be addressed as well.

ABSTRACT

The goal of this session is to learn how to interpret pathology involving the coronary arteries beyond the detection of coronary artery stenosis. Focus on exam acquisition protocols, study interpretation protocols, and minimizing radiation dose are addressed. Specific topics addressed will also include coronary artery aneurysm, myocardial bridging, anomalous coronary arteries as well as vasculitis. Potential pitfalls will be addressed and pearls for study optimization will also be discussed.

Coronary Artery Disease III: Native Vessel Disease

Elliot K Fishman MD (Presenter) *

LEARNING OBJECTIVES

1) Understand pathology of the native coronary arteries beyond simple plaque disease. Topics will include coronary artery aneurysms, anomalies, and fistulae. 2) How to optimize the study performance and interpretation will be addressed as well.

Molecular Imaging Symposium: Imaging Cellular Subpopulations - Current Progress and Future Directions

Monday, 01:30 PM - 03:00 PM • S406B
LEARNING OBJECTIVES
1) To learn about in vivo lineage tracing as a technique to document endogenous stem cell activity.

ABSTRACT
Lgr5 Stem Cells in Epithelial Self-Renewal and Cancer Nick Barker: Institute of Medical Biology, 8A Biomedical Grove, 06-06 Immunos, Singapore 138648 The intestinal epithelium is subjected to a constant barrage of mechanical and chemical assault, imposing a requirement for regular self-renewal. This renewal is driven by a small population of adult stem cells residing in epithelial pockets known as crypts of Lieberkuhn. Lgr5 is a Tcf7/ -catenin (Wnt) target gene specifically expressed on crypt-base columnar cells located at the base of the intestinal crypts. Employing in vivo lineage tracing we have proven these cells to be stem cells of the small intestine and colon. The same rapid turnover of the intestinal epithelium also makes it particularly susceptible to cancer-forming mutations. Using Lgr5-CreERT2 mice to selectively induce deletion of the APC tumor suppressor gene in the intestinal stem cells, we recently proved that these Lgr5+ve stem cells are the cell-of-origin of colon cancer. This work also revealed the presence of a minor population of Lgr5+ve cells within intestinal tumors. Multicolor lineage tracing from these tumor-resident Lgr5+ve cells has demonstrated these to be cancer stem cells contributing to tumor growth in vivo.

MSM23B • CLARITY and Beyond: Towards Complete Structural and Molecular Investigation of Large-Scale Intact Biological Systems
Kwanchun Chung PhD (Presenter)

ABSTRACT
Antibodies are attractive candidates as imaging agents due to their exquisite specificity. Recent advances in protein engineering have enabled optimization of antibodies for noninvasive imaging applications such as immunoPET, through reduction of immunogenicity, acceleration of clearance to enable rapid, same-day imaging, and provision of site-specific radioconjugation. Broader availability of non-standard PET radionuclides, including Cu-64, Zr-89, and I-124 and others, has expanded the range of biological targets and processes that can be imaged. The cell-surface CD markers provide a well-characterized set of targets that can be used in combination with lineage, differentiation, and activation state of hematopoietic and immune cells. Corresponding antibodies can readily be converted into engineered fragments for PET imaging, and can be used to profile immune responses such as expansion, trafficking, homing, and activation of immune cell subsets. Examples of profiling immune cells and responses in mouse models will be presented, as well as the potential for clinical translation.

MSM23D • New Strategies for Using Smart MRI Contrast Agents for Monitoring Cell Therapy
Michael T McMahon PhD (Presenter)

ABSTRACT
Hydrogels have facilitated cell therapies by protecting therapeutic cells from immune responses and providing a physical cue to support the grafts. A non-invasive imaging technique that allows the monitoring of engrafted cell viability is needed as these therapies move into the clinic. Chemical Exchange Saturation Transfer (CEST) imaging is sensitive to changes in pH and ion concentrations, and as a result is well suited as a tool to obtain information on the status of these cells. We have incorporated organic CEST contrast agents into alginate hydrogels for this purpose and have developed a magnetization transfer image collection scheme suitable for obtaining high quality CEST contrast maps in the abdomen. The in vivo results upon transplanting these hydrogels into mice will be discussed.

Monday Plenary Session

Presentation of the Alexander R. Margulis Award for Scientific Excellence

Presentation of Honorary Memberships

Gabriel P Krestin , MD , PhD , Rotterdam , NETHERLANDS
Anne W Lee , MD , Shenzhen , Guangdong , CHINA
Malgorzata Szczersko-Trojanowksa , MD , Lublin , POLAND
Introduction by Sarah S Donaldson , MD , Palo Alto , CA

Eugene P. Pendergrass New Horizons Lecture: Normal and Neoplastic Stem Cells: Implications for the Radiological Sciences

Irving L Weissman , MD , Stanford , CA

LEARNING OBJECTIVES
Research that bears on the earliest stages of cancer development as well as the sequelae of cancer treatment is of import not only to radiation oncologists but to diagnostic radiologists as well. Our investigation into blood-forming stem cells (HSC) and their non-self-renewing progeny hold promise for (1) regenerating the hematopoietic system after chemotherapy and radiation for cancer, (2) replacing genetically defective or otherwise damaged blood-forming systems, and (3) understanding the stages of hematopoiesis that harbor the earliest stages of pre-leukemia.

Following embryonic development, most of our tissues and organs are continuously regenerated from tissue and organ specific stem cells. The principal property that distinguishes such stem cells from their daughter cells is self-renewal; when stem cells divide they give rise to stem cells (by self-renewal) and progenitors (by differentiation). In most tissues only the primitive stem cells self-renew.

Stem cells in normal physiology and in regenerative medicine are the basis for regenerative medicine. For example, prospectively isolated blood forming [hematopoietic] stem cells [HSC] are cancer-free even when isolated from marrow or mobilized blood containing cancer cells; autologous pure HSC transplants into women with metastatic breast cancer to rescue them from high dose chemotherapy in a phase 1/2 trial resulted in 33% overall survival, compared to 6% for unpurified mobilized peripheral blood. This is contrary to ‘conventional wisdom’ only because the titles of most mobilized blood transplants are still called HSC transplants, even in major journals that should know better. Still, the therapy began in the 1996-8 trial has not been extended to extended phase 3 trials, largely because most oncologists counsel against it, and the company with the rights to use it does not offer it.

Pure HSC in allogeneic transplants can give graft vs host free hematopoietic regeneration, and because the host has a donor immune system, it cannot reject any organ, tissue, or tissue stem cell transplant from the HSC donor. The failure of extension of HSC transplantation clinically has blocked the testing of such protocols in humans. Nevertheless, if it is extended to it’s logical conclusion, in the next decades the organ and tissue donors will not be living people, but pluripotent stem cell lines that can generate HSC and organ-specific stem cells. Because total body irradiation (TBI) is the preferred...
method to condition for HSL transplants, it could become a major clinical entity for the radiation therapy community. Self-renewal is dangerous, and therefore strictly regulated. Poorly regulated self-renewal can lead to the genesis of cancer stem cells, the only self-renewing cells in the cancer. In myelogenous leukemia the developing cancer clones progress at the stage of HSC, until they become fully malignant. At this point, the 'leukemia' stem cell moves to a stage of a downstream progenitor that has evaded programmed cell death and programmed cell removal, while acquiring self-renewal. While there are many ways to defeat programmed cell death and senescence, there appears to be one dominant method to avoid programmed cell removal— the expression of the cell surface 'don't eat me' protein CD47, the ligand for macrophage SIRP-alpha. All cancers tested expressed high levels of CD47, as did normal hematopoietic cells. SIRP-alpha interaction enable phagocytosis and killing of the tumor cells in vitro and in vivo. In primary human cancers of all types transplanted from patients to immune deficient mice orthotopically, anti-CD47 eliminates all metastases, but often requires local resection or radiotherapy to remove bulky tumors that grow faster than the macrophages can eat them. The anti-CD47 therapies are expected to be in phase 1 trials in early 2014.

AAM/RSNA Basic Physics Lecture for the Radiologic Technologist: Digital Imaging Exposure Indicators–Implications for Image Quality and Dose
Monday, 01:30 PM - 02:45 PM • S102D

QA
PH

SPPH21 • AMA PRA Category 1 Credit™:1.25 • ARRT Category A+ Credit:1.5
Moderator
Douglas E Pfeiffer, MS *
Eric L Gingold, PhD
Charles E Willis, PhD

LEARNING OBJECTIVES
1) Describe the limitations of traditional QA/QM programs in radiation oncology. 2) Understand the rationale for establishing risk-based QA/QM programs in radiation oncology. 3) Learn how to apply FMEA methodology in radiation oncology.

ABSTRACT
The increasing complexity, functionality, and site-to-site variability of modern radiation therapy planning and delivery techniques challenge the traditional prescriptive quality assurance/quality management (QA/QM) programs that ensure safety and reliability of treatment planning and delivery systems under all clinical scenarios. The manufacturing industry has historically relied on extensive testing and use of techniques such as probabilistic reliability modeling for developing and maintaining new products. Among the most widely used method of risk analyses are Failure Modes and Effects Analysis (FMEA). This is a methodology for analyzing potential reliability problems early in the development cycle where it is easier to take actions to overcome these issues, thereby enhancing reliability through design. FMEA is used to identify potential failure modes, determine their effect on the operation of the product, and identify actions to mitigate the failures. From a manufacturer's perspective, FMEA is a valuable method to systematically evaluate a device design's potential for inducing use errors. User errors are defined as a pattern of predictable human errors that can be attributable to inadequate or improper design. When these risk analyses are done early in the development cycle, potential faults and their resulting hazards are identifiable and much easier to mitigate with error-reducing designs. These risk management methods are excellent complements to other important user-centered design best practices. Risk analysis, or hazard analysis, is a structured tool for the evaluation of potential problems which could be encountered in connection the use of a device. The early and consistent use of FMEAs in the design process allows the engineers to design out failures and produce reliable and safe products. FMEAs also capture historical information for use in future product improvement. Such an approach should result in a QA/QM program in Radiation Oncology that has......
success in discussing radiation safety with patients.

ABSTRACT
Expectations are rapidly evolving for how radiologists communicate with patients. Radiologists today face heightened responsibilities to discuss diagnostic information in ways that optimize communication about radiation exposure. These communication challenges require radiologists to convey cognitively complex information under emotionally charged conditions. Few educational opportunities exist to help radiologists acquire the skills necessary to approach these conversations effectively. PERCS-Radiology seeks to fill this gap and to enhance radiology trainees’ confidence and skills when communicating with patients about these difficult topics. This 3 hour workshop will combine didactic and educational media presentations with realistic improvised enactments between workshop participants and professional actors. Enactment participants will receive feedback from other course participants, faculty, and actors. Faculty facilitators include experts in healthcare communication pedagogy. The learning model emphasizes group collaboration among professionals from varying levels of experience, integration of perspectives from patient and family representatives, and a safe environment that respects multiple viewpoints. Radiology trainees are the core learning group.

Interventional Oncology Series: Hepatocellular Carcinoma

Monday, 01:30 PM - 06:00 PM  •  S405AB

RO  •  OI  •  LR  •  GS

VSIO21  •  AMA PRA Category 1 Credit ™: 4.25  •  ARRT Category A+ Credit: 5
Moderator
Jean-Francois H Geschwind, MD *

LEARNING OBJECTIVES
1) To learn the indications for transcatheter-based therapies for patients with HCC. 2) To understand the potential limitations, pitfalls, side effects and toxicities associated with transcatheter therapies for patients with HCC. 3) To know the results, imaging responses and survival benefit of various transcatheter therapies. 4) To know the future transcatheter therapies and understand their potential. 5) To learn the various combination therapies available and undergoing clinical evaluation for HCC.

ABSTRACT
01) Staging Systems, Epidemiology, and Medical
- Evaluate the most appropriate treatment for early and advanced stage of HCC. 3) To describe and discuss indications for resection in chronic liver disease. 4) Integrate interventional radiological procedures in the treatment of HCC.

02) HCC mgmt in Europe - 1) To understand how HCC patients are being managed in Europe. 2) To learn the decision making processes driving treatment selection for patients. 3) To review the data from the European point of view.

03) HCC mgmt in Korea - 1) To understand how HCC patients are being managed in Korea. 2) To learn the decision making processes driving treatment selection for patients. 3) To review the data from the Korean point of view.

04) HCC mgmt in HK/China - 1) To understand how HCC patients are being managed in China. 2) To learn the decision making processes driving treatment selection for patients. 3) To review the data from the Chinese point of view.

05) HCC mgmt in Japan - 1) To understand how HCC patients are being managed in Japan. 2) To learn the decision making processes driving treatment selection for patients. 3) To review the data from the Japanese point of view.

06) Panel Discussion: HCC in the world
- 1) Understand patient selection process 2) Understand the rationale for combining anti-angiogenic agent with loco-regional therapies 4) Understand the results of various catheter based intra-arterial therapies for Liver Cancer 08) Assessment of Tumor Response - 1) review methods of response assessment 2) discuss limitations of current methods 3) describe future imaging concepts in development 09) Tumor Board - The algorithm by which patients with HCC are worked up and their appropriateness for transection or resection will be discussed.

VSIO21-01  •  Staging Systems, Epidemiology, and Medical Therapy
Alan P Venook MD (Presenter) *

LEARNING OBJECTIVES
1) Identify state-of-the art surgical treatment, non-surgical treatment, and transplantation treatment for patients with HCC. 2) Identify the most appropriate treatment for early and advanced stage of HCC. 3) Describe and discuss indications for resection in chronic liver disease. 4) Integrate interventional radiological procedures in the treatment of Hepatocellular Carcinoma.

VSIO21-02  •  HCC Management in Europe
Riccardo A Lencioni MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO21-03  •  Hepatocellular Carcinoma (HCC) Treated with Transarterial Chemoembolization and Radiofrequency Ablation: Diagnostic Efficacy of Combined Dynamic Perfusion MRI with ADC Mapping in the Assessment of Therapeutic Effects
Davide Ippolito MD (Presenter) ; Pietro A Bonaffini MD ; Davide Fior MD ; Cristina Capraro MD ; Orazio Minutolo MD ; Sandro Sironi MD

PURPOSE
To determine the additional predictive value obtained by the correlation of kinetic parameters derived from dynamic contrast-enhanced MR perfusion imaging with apparent diffusion coefficient (ADC) value obtained by diffusion weighted MR imaging in the assessment of therapeutic effects of interventional treatment of HCC lesions.

METHOD AND MATERIALS
A total of 54 patients with biopsy proven diagnosis of HCC lesion, that underwent to TACE or RFA treatment, were prospectively enrolled in our study. MR study was performed, using a 1.5T MRI system(Achieva, Philips), for each patient 4 weeks after the treatment and consist of multiplanar standard protocol with T2 and T1 sequences with dynamic contrast enhanced THRIVE, including also diffusion weighted imaging (DWI) with different b-value. Philips’s workstation was used to generate color permeability maps showing perfusion of enhancing tumors and quantitative ADC maps. After the placing of regions of interests(ROIs) on site of the maps which best corresponded to the enhanced regions of the lesion, the following parameters were calculated:Relative Enhancement, Maximum Enhancement, Maximum Relative Enhancement,Time to Peak and ADC values, and statistical analysis was performed.

RESULTS
Perfusion parameters and ADC values of treated lesions could be quantitative assessed using parametric imaging analysis. Sixteen out of 54 patients had a residual disease and values of obtained parameters measured within residual tumor tissue were: REA 44.66, RVE 60.50, RLE 52.72, ME 553.21 (%), MRE 65.95(%), TTP(s) 140.61, and 982.21 ± 103.9 x10^-3 mm^2/sec. The corresponding values obtained in remaining cases in whom a complete necrosis was achieved were: REA -1.24, RVE 5.93, RLE 16.9, ME 203.24, RE 25.78, TTP 165.87 and 1682.7 ± 149.7 x10^-3 mm^2/sec. A significant difference(p<0.05) was observed in terms of quantitative variables between these two groups.

CONCLUSION
The quantitative multiparametric MR images analysis could offer functional quantitative information about cellular density and tumor blood supply of HCC lesions, useful in predicting and assessing treatment response.

CLINICAL RELEVANCE/APPLICATION
Combined parametric analysis of functional MRI represents an vivo marker of biological characteristic of HCC lesion, providing quantitative information useful for assessment of therapeutic response.

VSIO21-04  •  HCC Management in Korea
Jin Wook Chung MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO21-05  •  HCC Management in Hong Kong, China
Ronnie T Poon (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO21-06  •  Radiofrequency Ablation of 318 Cases of Hepatocellular Carcinoma as First Line Treatment: 10 Years Survival Result and Prognostic Factors
Wei Yang (Presenter) ; Wei Wu PhD ; Jung Chieh Lee ; Zhong-Yi Zhang PhD ; Min Hua Chen ; Kun Yan MA

PURPOSE
To our knowledge, the long-term (>5 years) survival results for radiofrequency ablation (RFA) in HCC is few. Our study aimed to investigate the efficacy of RFA
for 318 patients with hepatocellular carcinoma (HCC) as first line treatment, and the prognostic factors for post-RFA survival rate.

METHODS AND MATERIALS

From 2000 to 2012, 730 patients with HCCs underwent ultrasound guided percutaneous RFA treatment in our department. Among them, 318 consecutive patients received RFA as first treatment and enrolled in this study. They were 251 males and 67 females, average age 60.3±11.3 years (24-87 years). The HCC were 1.0-6.7 cm in diameters (average 3.3±1.2 cm). Univariate and multivariate analysis with 15 potential variables were examined to identify prognostic factors for post-RFA survival rate.

RESULTS

The overall post-RFA survival rates at 1, 3, 5, 7, 10 year were 90.2%, 76.3%, 53.6%, 41.2% and 29.1%, respectively. In the 209 patients with stage I of HCC (AJCC staging), the 1, 3, 5, 7, 10 year survival rates were 94.2%, 72.9%, 63.6%, 57.6%, 41.5%, respectively. In the 239 patients with liver function class A (Child-Pugh classification), the 1, 3, 5, 7, 10 year survival rates were 94.4%, 75.8%, 64.3%, 52.3%, 32.4%, respectively. Ten potential factors were found with significant effects on survival rate, and they were AJCC staging, tumor pathological grading, number of tumors, pre-RFA liver function enzymes, pre-RFA AFP level, Child-Pugh classification, portal vein hypertension, using contrast ultrasound in RFA procedure, RFA electrode type and tumor necrosis one month after RFA. After multivariate analysis, 4 factors were identified as independent prognostic factors for survival rate, and they were Child-Pugh classification, number of tumors, pre-RFA AFP level, and portal vein hypertension. Totally, 548 RFA sessions were performed and major complications occurred in 12 sessions (2.1%).

CONCLUSION

This long-term follow-up study on a large group of HCC patients confirmed that RFA could achieve favorable outcome on HCC patients as first line treatment, especially for patients with child-Pugh class A, single tumor, low AFP level pre-RFA and without portal vein hypertension.

CLINICAL RELEVANCE/APPLICATION

This study provided evidence that RFA for early HCC was effective and safe as a first-line treatment even for patients usually considered good candidates for surgery.

VSIO21-07 • HCC Management in Japan

Yasuaki Arai MD (Presenter) *

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIO21-08 • A Minimal Ablative Margin Is Acceptable for Radiofrequency Ablation of Small Hepatocellular Carcinoma: A Long-term, Follow-up Study Using Magnetic Resonance Imaging with Impaired Ferucarbotran Clearance

Kensaku Mori MD (Presenter) ; Kuniaki Fukuda MD ; Katsuhiro Nasu MD, PhD ; Michiko Nagai MD ; Tsukasa Saida MD ; Manabu Minami MD, PhD

PURPOSE

We aimed to prospectively compare the local recurrence rates after radiofrequency ablation (RFA) for small (=3 cm) hepatocellular carcinomas (HCCs) among different ablative margin (AM) statuses on magnetic resonance imaging (MRI) with impaired ferucarbotran clearance.

METHOD AND MATERIALS

Fifty-five patients with 57 HCCs (diameter: 0.8-2.7 cm; mean ± SD: 1.6 ± 0.5 cm) underwent RFA 2-7 h after ferucarbotran-enhanced MRI. On unenhanced T2*-weighted images acquired after 3-5 days, AMs appeared as hyperintense rims owing to impaired ferucarbotran clearance. AM status was classified as "AM-plus," AM completely surrounding the tumor; "AM-zero," partly discontinuous AM without tumor protrusion; or "AM-minus," discontinuous AM with tumor protrusion. The minimal AM thicknesses were measured in the AM-plus group. The range of follow-up periods in the patients with and without local recurrence was 0-45 months (10 ± 15 months) and 7-58 months (28 ± 14 months), respectively. Local recurrence rates of different AM statuses were compared using the Kaplan-Meier method and log rank test.

RESULTS

Of the 57 HCCs, 34 (60%), 16 (28%), and 7 (12%) were classified as AM-plus, AM-zero, and AM-minus groups, respectively. The respective 1-, 2-, 3-, and 4-year local recurrence rates were 3%, 8%, 8%, and 31% for the AM-plus group; 12%, 20%, and 28% for the AM-zero group; and 71%, 71%, and 11%, respectively, for the AM-minus group. The local recurrence rates were significantly lower for the AM-plus and AM-zero groups than for the AM-minus group (P < 0.001 and P = 0.003, respectively). However, the difference of local recurrence rates between AM-plus and AM-zero groups was not significant (P = 0.4544). In the AM-plus, the local recurrence rates were 22% (2/9), 10% (1/10), 0% (0/5), 0% (0/4), and 0% (0/6) for AMs of 1 mm, 2 mm, 3 mm, 4 mm, and 5 mm, respectively.

CONCLUSION

When AMs are assessed after RFA for small HCCs by using MRI with impaired ferucarbotran clearance, the minimal AMs are acceptable to avoid local recurrence in a long-term period, although AMs of ≤3 mm seems preferable.

CLINICAL RELEVANCE/APPLICATION

MRI with impaired ferucarbotran clearance enables precise assessment of AMs after RFA and will contribute to avoid not only insufficient but also overzealous treatment for small HCCs.

VSIO21-09 • Panel Discussion: HCC in the World: How Do We Put All This Information Together? New International Staging System? Are Guidelines Really Useful?

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIO21-10 • Intraarterial Therapies in the US: Where Are We?

Jean-Francois H Geschwind MD (Presenter) *

LEARNING OBJECTIVES

1) Understand patient selection process. 2) Understand the patient indications and complications. 3) Understand the rationale for combining anti-angiogenic agent with loco-regional therapies. 4) Understand the results of various catheter based intra-arterial therapies for Liver Cancer.

VSIO21-11 • Final Analysis of GIDEON (Global Investigation of therapeutic Decisions in hepatocellular carcinoma and Of its treatment with sorafenib): Regional Trends, Safety, and Outcomes in Patients Receiving Concomitant Transarterial Chemoembolization

Jean-Francois H Geschwind MD (Presenter) * ; Masatoshi Kudo ; Jorge Marrero * ; Alan P Venook MD * ; Sheng-Long Ye ; Jean-Pierre Bronowicki * ; Xiao-Ping Chen ; Lucy Dagher ; Junji Furuse ; Laura Ladron De Guevara * ; Christos Papandreou * ; Arun J Sanyal ; Tadatoshi Takayama ; Seung Kew Yoon MD, PhD ; Keiko Nakajima * ; Riccardo A Lencioni MD

PURPOSE

Transarterial chemoembolization (TACE) and sorafenib represent distinct treatment modalities for hepatocellular carcinoma (HCC), and there is a strong rationale and growing evidence supporting the use of TACE and sorafenib combined in unresectable HCC (uHCC) patients. GIDEON is a large, non-interventional study conducted in uHCC patients treated with sorafenib. The study allows for analysis of global treatment patterns in real-life practice, including concomitant TACE use.

METHOD AND MATERIALS

Data were collected from >3000 patients in whom the decision to treat with sorafenib had been made in clinical practice. Treatment history and disease characteristics were recorded at study entry; safety and outcomes data were collected during follow-up.

RESULTS

3202 patients comprised the final safety population. Of these, 47.2% received prior TACE, 10.1% received concomitant TACE, and 7.3% received TACE both prior to and concomitantly with sorafenib. Regionally, concomitant TACE use was highest in Latin America (34.4%), Asia-Pacific (13.5%), and the US (13.0%), with the lowest in Japan (4.7%). Overall, of the patients who received concomitant TACE, the greatest number were from the US, China, and Japan (22.5%, 24.6%, and 19.1%, respectively). Patients who received concomitant TACE had a similar incidence of drug-related adverse events (88.6%) to those who did not (84.9%), as well as a similar incidence of serious drug-related adverse events (6.2% and 9.6%, respectively). In the intent-to-treat population (n=3213), median overall survival (months [95% CI]) was longest in patients who received concomitant TACE (21.6 [17.8-upper limit not estimable]) than in those who did not (9.7 [9.2-10.4]). Time to progression was also slightly higher in patients who received concomitant TACE (6.6 [5.8-7.6]) compared with those who did not (4.5 [4.1-4.8]).

CONCLUSION

The GIDEON study provides insight into treatment patterns in clinical practice. Data from the GIDEON study suggest that, globally, TACE is used concomitantly with sorafenib and appears to be a valid therapeutic option in patients with uHCC.
The optimal role of TACE and sorafenib combined in the HCC treatment pathway is of increasing clinical interest. Data from GIDEON add to the evidence to further evaluate this approach.

### VSIO21-12 • Assessment of Tumor Response

**Ida Alobe MD, MBA (Presenter) * **

**LEARNING OBJECTIVES**

1) Review methods of response assessment. 2) Discuss limitations of current methods. 3) Describe future imaging concepts in development.

### VSIO21-13 • Evaluation of Tumor Necrosis in Liver Explants after Chemoembolization or Radiofrequency Ablation as Bridge Therapies for Hepatocellular Carcinoma

**Carmen Garcia Alba MD (Presenter) ; Julien Cazejust MD ; Fabiano Perdigao ; Bertrand Bessoud MD ; Dominique Wendum MD, PhD ; Yves M Menu MD ; Olivier Soubrane ; Olivier Rosmorduc**

**PURPOSE**

To compare, in liver explants, the tumor necrosis rate of hepatocellular carcinoma (HCC) treated by chemoembolization (TACE) or radiofrequency ablation (RFA) as bridge therapies for patients on the waiting list for liver transplantation.

**METHOD AND MATERIALS**

This monocentric retrospective study included 38 liver transplanted patients between November 2009 and December 2012 with history of HCC treated with bridge therapies while on the waiting list for liver transplantation. All treatments were approved by the Multidisciplinary Tumor Board of our institution following BCLC and EASL guidelines. Treatments were performed by experienced interventional radiologists. Anatomopathologic study of the liver explants was performed by an experienced anatomopathologist.

In patients with consecutive treatments, only the last one was taken into consideration in this study.

**RESULTS**

Twelve patients underwent RFA for 14 lesions (mean 1.17 lesions per patient). The mean tumor size was 24mm (SD 7), with a mean necrosis rate of 93% (SD 13). No lesion treated by RFA had a necrosis rate greater than 75%.

**CONCLUSION**

Tumor necrosis rate for both treatments was >80% on liver explants. RFA showed a trend toward higher tumor necrosis rate than TACE. TACE allowed treating twice as many lesions per patient as RFA (p < 0.01).

**CLINICAL RELEVANCE/APPLICATION**

The use of bridge therapies for HCC prevents from progression related dropout, with a high necrosis rate for both treatments studied (>80%) demonstrated on liver explants.

### VSIO21-14 • Tumor Board

**LEARNING OBJECTIVES**

1) The algorithm by which patients with HCC are worked up and their appropriateness for transplant or resection will be discussed.

### VSIO21-15 • Percutaneous Microwave Ablation of Hepatocellular Carcinoma: Early Clinical Results with 106 Tumors

**Timothy J Ziemlewicz MD (Presenter) ; J. Louis Hinshaw MD * ; Meghan G Lubner MD ; Christopher L Brace PhD * ; Marci Center ; Fred T Lee MD * **

**PURPOSE**

Microwave (MW) ablation is a promising technology that offers several advantages over radiofrequency (RF) ablation. The purpose of this study was to retrospectively review the results in the first 75 patients with hepatocellular carcinoma (HCC) treated with a high-power, gas-cooled MW device at a single center.

**METHOD AND MATERIALS**

Between December 2010 and March 2013 we treated 106 hepatocellular carcinomas in 75 patients via a percutaneous approach utilizing US and/or CT guidance. There were 65 male and 10 female patients with mean age 61 years (range 44-82). All procedures were performed with a high-powered, gas-cooled microwave system (Certus 140, Neuwave Medical, Madison, WI). Mean power was 77 Watts (range 30-140 Watts) and mean ablation time 5.3 minutes (range 1-11.5 minutes).

**RESULTS**

Tumors ranged in size from 0.5 to 7.0 cm (mean 2.5 cm) and median imaging follow-up was 7 months. All treatments were considered technically successful with no evidence of residual tumor at immediate post-procedure CECT. Primary treatment effectiveness by imaging was 88.7% (94/106), 92.5% (87/94) for tumors < 4 cm and 61.5% (8/13) for tumors > 4 cm. Of the tumor progression in lesions, 12% (13/106) developed new lesions. Twelve patients underwent RFA for 14 lesions (mean 1.17 lesions per patient). The mean tumor size was 24mm (SD 7), with a mean necrosis rate of 93% (SD 13). No lesion treated by RFA had a necrosis rate greater than 75%.

**CONCLUSION**

Treatments were performed by an experienced interventional radiologist.

**CLINICAL RELEVANCE/APPLICATION**

Microwave tumor ablation can be safe and effective when compared to established modalities such as radiofrequency ablation, however more research is needed.

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**Siemens Healthcare: Pioneering Technologies in Ultrasound**

**Monday, 02:00 PM - 02:45 PM • South Building Hall A Booth 3314**

**EPT03**

**Tina Hodgson , MS, RT * **

**LEARNING OBJECTIVES**

Siemens Healthcare continues to advance human health with pioneering ultrasound technologies. We invite you to join us as we unveil our latest innovations and show you how they will revolutionize patient care.

**Mobile Computing for Decision Support and Learning While You Work**

**Monday, 02:30 PM - 04:00 PM • S401CD**

**ICIA23 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5**

**Michael P D’Alessandro , MD ; Jeffrey R Galvin , MD ; James J Choi , MD**

**LEARNING OBJECTIVES**

1) Learn to perform decision support on a mobile device at the point-of-care to answer questions that arise during clinical work and thus tie learning to practice and receive point-of-care CME for it. 2) Learn to read Ebooks and educational apps on a mobile device. 3) Learn to stay up-to-date with radiology journals and receive point-of-care CME for it. 4) Learn to read Ebooks and educational apps on a mobile device. 5) Learn to view podcasts and vodcasts on a mobile device. 6) Learn to maintain a learning portfolio / teaching file on a mobile device. 7) Learn to maintain a learning portfolio / teaching file on a mobile device. 8) Learn to learn how to learn while you work. 9) Learn to learn how to learn while you work. 10) Learn to learn how to learn while you work.

**ABSTRACT**

Acquiring and maintaining competency in the practice of radiology requires a program of continuous learning. This continuous learning would be most effectively performed during clinical work, when it has the greatest potential for modifying physicians’ knowledge, attitudes, and behaviors as well as positively affecting patients’ care, outcomes, and lives. The advent of mobile computing, and the rich assortment of authoritative radiology resources it allows easy access to, now allows this dream to become reality. This course will be a hands-on, state-of-the-art review that will teach the radiologist how to use mobile computing to perform continuous learning while you work. The Apple iOS and Google Android platforms will be covered. Participants will be encouraged to bring their own mobile phone or tablet to the course and will be asked before the course to download into their mobile device several free apps that will be demonstrated, so
3-D Printing: Bridging the Gap between Theory and Practice

LEARNING OBJECTIVES
1) To understand the potential role of 3D printing in clinical practice. 2) To learn an algorithm for preparing volumetric CT images for 3D printing applications. 3) To learn the basics of 3D printing, including materials and formats. 4) To show illustrative examples of 3D printing, such as in surgical planning and for cardiac analyses.

ABSTRACT
Printing in three-dimensions (3D) has become a reality for many applications, including some in medicine. However, the printing of volumes in diagnostic radiology has not been extensively studied. There are several applications that have potential use. For example, complex surgical planning to date uses two-dimensional (2D) displays of 3D volumes to communicate findings between radiologists and surgeons. Because of the inherent 3D data sets used for these applications, there are potential uses for 3D printing for planning. We apply these principles to full face transplantation to illustrate the complexity of the analyses and the benefits of 3D computed tomography (CT) models when compared to traditional two-dimensional display formats. We also illustrate how 3D printing can be applied to clinically relevant research questions such as flow derived metrics from CT. These data can then be translated to clinical interpretations, as illustrated with examples currently under investigation.

ICII23A • 3D CT and MR Acquisitions
Karin E Dill MD (Presenter)

ICII23B • 3D Printing Technologies and Applications
Peter C Liacouras PhD (Presenter)

ICII23C • 3D Visualization versus 3D Printing
Michael L Steigner MD (Presenter) *

ICII23D • Current Indications for 3D Printing
Gerald T Grant DMD, MS (Presenter)

ICII23E • Future Indications for 3D Printing
Frank J Rybicki MD, PhD (Presenter) *

ICII23F • Congenital Heart Disease Models ‘In Your Hands’
Shi-Joon Yoo MD (Presenter)

ICII23G • Models in Imaging Research: CT Flow
Dimitris Mitsouras PhD (Presenter)

Optimizing PowerPoint Slides

LEARNING OBJECTIVES
1) Review the components of an optimal slide presentation. 2) Learn about common errors made in slide preparation and how they can be avoided. 3) Learn about how to improve the quality of a presentation by using optimal different slide backgrounds, font size and color, and image sizes. 4) Learn tips to ensure a smooth presentation.

ABSTRACT
Electronic presentations are very common in radiology practice. This hands-on demonstration and questions and answer session will show attendees how to optimize their presentations. The focus will be on the use of slide templates, color selection (font and background), font and image size, and animations. Additional review of image and video display and management will be covered. Demonstrations will include tips to decrease time creating and modifying presentations. Bring your questions!

BOOST: Head and Neck-Case-based Review (An Interactive Session)

LEARNING OBJECTIVES
1) Review common tumors of the head and neck. 2) Review imaging findings in head and neck malignancies that specifically change staging. 3) Review the value of imaging in directly affecting management and treatment.

ABSTRACT
This session will be tumor board that includes a head and neck radiologist, head and neck surgeon, medical oncologist and radiation oncologist. We will discuss a variety of head and neck cancer cases and illustrate the value-added benefits and highlight of imaging affects staging, treatment and management.

BOOST: Gynecology-Case-based Review (An Interactive Session)

LEARNING OBJECTIVES
1) Review common tumors of the gynecologic tract. 2) Review changes in staging attributable to advances in MRI and US technology.

ABSTRACT
This session will be tumor board that includes a gynecologic oncologist, obstetrician-gynecologist, imaging specialists, and radiation oncologists. We will discuss a variety of gynecologic malignancies and illustrate the value-added benefits and highlights of imaging affects staging, treatment and management.
LEARNING OBJECTIVES:
1) Present the multidisciplinary management of gynecologic cancers including surgery, radiation and chemotherapy. 2) Highlight the importance of diagnostic imaging before, during and after treatment. 3) Highlight the importance of imaging in the planning and delivery of radiation.

ABSTRACT
The care of patients with gynecologic cancers requires the collaboration of imaging specialists as well as gynecologic and radiation oncologists. Patterns of disease spread and recurrence have tremendous impact on the management of these patients, and diagnostic imaging is key in defining disease at diagnosis and following patients for detection of recurrence after treatment. Image-guided radiation is considered the standard of care for both the planning of external beam and brachytherapy and is key in maximizing the benefits of radiation while minimizing the risks. Case examples of the pivotal impact of imaging and its importance in multidisciplinary care will be highlighted in this session.

Estate Planning in Our New Tax Environment
Monday, 03:00 PM - 05:30 PM • E253AB

LEARNING OBJECTIVES
1) Fundamentals of conventional estate planning for any financial situation. 2) Planning strategies for retirement needs, Roth conversions, and charitable gifts. 3) Sophisticated strategies to leverage taxable gifts and transfer wealth to lower generations.

ABSTRACT
It is important to understand the fundamentals of estate planning and the importance of having a solid plan in place regardless of your financial situation. The desire to be tax efficient and keep up with the changing tax environment can sometimes feel like an insurmountable feat. In this seminar, we will explore a number of issues in the financial and tax planning arena including:
- Retirement Needs Analysis – reviewing your income sources and anticipated expenses in retirement and analyzing what effect the changing income tax environment has on your financial plan;
- Roth Conversions – an analysis of whether a Roth conversion is a smart move, unwise or much ado about nothing;
- Estate Planning Basics – a review of estate planning fundamentals, including a look at conventional estate planning strategies and how the changes in the estate tax laws may impact that conventional planning;
- Sophisticated Planning Strategies – there are various planning techniques available to leverage taxable gifts, allowing wealth to be funneled to lower generations on a tax-advantaged basis both during lifetime and at death;
- Non-Tax Related Planning – a look at how family dynamics, asset protection and state tax issues may impact the estate plan; and
- Generations on a tax-advantaged basis both during lifetime and at death;
- Estate tax laws may impact that conventional planning;
- Charitable Planning – identifying the types of gifts and giving techniques that offer the greatest tax benefit to donors both during lifetime and at death;
- Roth Conversions – an analysis of whether a Roth conversion is a smart move, unwise or much ado about nothing;
- Estate Planning Basics – a review of estate planning fundamentals, including a look at conventional estate planning strategies and how the changes in the estate tax laws may impact that conventional planning;
- Sophisticated Planning Strategies – there are various planning techniques available to leverage taxable gifts, allowing wealth to be funneled to lower generations on a tax-advantaged basis both during lifetime and at death;
- Non-Tax Related Planning – a look at how family dynamics, asset protection and state tax issues may impact the estate plan; and
- Charitable Planning – identifying the types of gifts and giving techniques that offer the greatest tax benefit to donors both during lifetime and at death;

In addition to comprehensive discussion outlined above, the session will include ample opportunity for QandA.

Breast Imaging (MRI Interpretation)
Monday, 03:00 PM - 04:00 PM • Arie Crown Theater

LEARNING OBJECTIVES
1) AMA PRA Category 1 Credit ™:1 • ARRT Category A+ Credit:1
2) Review types of findings considered BI-RADS 3; and 3) Determine outcomes of BI-RADS 3 studies, including BI-RADS upgrades, downgrades and biopsy results.

PURPOSE
To evaluate the incidence of BI-RADS 3 assessment in screening and diagnostic breast MRI; 2) review types of findings considered BI-RADS 3; and 3) Determine outcomes of BI-RADS 3 studies, including BI-RADS upgrades, downgrades and biopsy results.

METHOD AND MATERIALS
IRB approved, retrospective review of breast MRI database (2009-2011) with 5778 studies in 3360 patients, was performed to identify all breast MRIs assigned BI-RADS 3 for one or both breasts. 679/5778 (11.8%) studies had at least one BI-RADS 3 finding. Cases in which initial BI-RADS 3 assessment was given prior to 2009 were excluded. Breast MRI reports and electronic medical record were reviewed to obtain patient demographics and outcome data including tissue diagnosis, imaging and/or clinical stability for at least 24 months, or decrease/resolution during imaging surveillance.

RESULTS
570 findings (483 studies) were assigned initial BI-RADS 3 assessment during study period. Indications (n=483) included 257 (53%) high risk screening and 226 (47%) diagnostic studies. BI-RADS 3 lesions (n=570) included mass (171, 30%), focus (141, 24.7%), moderate/marked background parenchymal enhancement [BPE] (131, 23%), NMLE (96, 16.8%), post-treatment changes (18, 3%), and other (13, 2.3%). Outcomes data was available in 508/570 (89%) lesions, including 406 (71%) without imaging evidence of malignancy > 24 months, 29 (5%) prophylactic mastectomy (all benign), and 71 (12%) upgraded to BI-RADS 4, with 11 cancers. Cancer rate for BI-RADS 3 lesions was 2.1% (11/508); all invasive cancers were diagnosed in < 12 months of surveillance and in women with genetic mutation or personal history of breast cancer. Cancer morphology (n=11) included mass (3, 27%), focus (4, 36.5%), and ductal or linear NMLE (4, 36.5%). No cancer was detected in cases of moderate/marked BPE.

CONCLUSION
Approximately 12% of breast MRI studies had findings assessed as BI-RADS 3, with a 97.9% negative predictive value for cancer. Although it may interfere with cancer detection, marked diffuse background enhancement does not require a BI-RADS 3 assessment. Strict adherence to the BI-RADS lexicon may reduce inappropriate BI-RADS 3 assessments for lesions with more suspicious imaging findings.

CLINICAL RELEVANCE/APPLICATION
In a population with an elevated breast cancer risk, breast MRIs assigned BI-RADS 3 assessment had an acceptably low cancer rate which may be further reduced by careful adherence to BI-RADS lexicon.

SSE01-02 • Lesion Characteristics, Malignancy Rate, and Follow-up of BI-RADS 3 Lesions Identified on Breast MRI: Implications for MRI Interpretation and Management

Sona A Chikarmane MD (Presenter) ; Catherine S Giess MD ; Patricia S Poole MD ; Dorothy A Sippo MD ; Roblyn L Birdwell MD

PURPOSE
To evaluate the incidence of BI-RADS 3 assessment in screening and diagnostic breast MRI; 2) review types of findings considered BI-RADS 3; and 3) Determine outcomes of BI-RADS 3 studies, including BI-RADS upgrades, downgrades and biopsy results.

METHOD AND MATERIALS
IRB approved, retrospective review of breast MRI database (2009-2011) with 5778 studies in 3360 patients, was performed to identify all breast MRIs assigned BI-RADS 3 for one or both breasts. 679/5778 (11.8%) studies had at least one BI-RADS 3 finding. Cases in which initial BI-RADS 3 assessment was given prior to 2009 were excluded. Breast MRI reports and electronic medical record were reviewed to obtain patient demographics and outcome data including tissue diagnosis, imaging and/or clinical stability for at least 24 months, or decrease/resolution during imaging surveillance.

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CONCLUSION
Approximately 12% of breast MRI studies had findings assessed as BI-RADS 3, with a 97.9% negative predictive value for cancer. Although it may interfere with cancer detection, marked diffuse background enhancement does not require a BI-RADS 3 assessment. Strict adherence to the BI-RADS lexicon may reduce inappropriate BI-RADS 3 assessments for lesions with more suspicious imaging findings.

CLINICAL RELEVANCE/APPLICATION
In a population with an elevated breast cancer risk, breast MRIs assigned BI-RADS 3 assessment had an acceptably low cancer rate which may be further reduced by careful adherence to BI-RADS lexicon.

SSE01-02 • Probably Benign Lesions Detected at Dynamic Contrast Enhanced Breast MRI: Prevalence of BI-RADS III Diagnoses and Malignancy Rate

Yunus Alparslan (Presenter) ; Simone Shrading MD ; Christiane K Kuhl MD

PURPOSE
Aim of this study was to analyze the malignancy rate of MRI-BIRADS III lesions.

METHOD AND MATERIALS
Between 06-2010 and 12-2011 a total of 3154 breast MRI studies were performed at our institution. Among those 107 MRI studies in 107 patients (3.4%) were rated as MRI-BIRADS III and were further analyzed. The time interval between the initial MRI and the follow-up examination, BIRADS category in the follow-up study and histologic results of possible biopsies were recorded to calculate the malignancy rate of BI-RADS III lesions.

RESULTS
Follow up MRI was performed in 89% (93/107) of the 107 patients after a mean time interval of 10 month (median 9.6, range [4;25]). At this follow up examinations MR-BIRADS 3 lesions were stable or regressive and downgraded to BI-RADS 1/2 in 96% (89/93). MR-guided biopsy was performed by patients request in 7 of those stable lesions. All of these yielded benign changes at histology, including 2 papillomas. Four MR-BIRADS III lesions were progressive (4%) and upgraded to MR-BIRADS IV in the follow up exam. All of those underwent MR-guided vacuum biopsy. Histology revealed an invasive lobular carcinoma (pT1b, 0.7 cm, pN0 (0/2an), G2) in one, borderline lesions in two patients (atypical ductal hyperplasia and papilloma) and benign changes in one patient (adenosis). Accordingly the malignancy rate of MR-BIRADS III lesions was 1.1% (1/93).

CONCLUSION
In concordance with prior studies the malignancy rate of MRI findings categorized as MR-BIRADS III is low. MR-follow up is a valid approach in the management of these lesions.

CLINICAL RELEVANCE/APPLICATION
The malignancy rate of MRI-BIRADS III lesions is low. To avoid early invasive tissue sampling, the observation with short-term MR-follow up is a valid approach.
SSE01-03 • Can Breast Cancer Molecular Subtype Help Select Patients for Preoperative MRI?

Lars J Grimm MD (Presenter) *; Mary Scott Soo MD; Jay A Baker MD *; Karen S Johnson MD *

PURPOSE
To determine whether breast cancer molecular subtype can help predict which patients will benefit from preoperative breast MRI.

METHOD AND MATERIALS
305 consecutive preoperative breast MRIs were retrospectively reviewed. Patients with prior breast cancer therapy or surgery were excluded. The presence of multicentric/multifocal disease, contralateral disease, skin/nipple involvement, chest wall/pectoral muscle invasion, and lymph node involvement was correlated with pathologic report. Estrogen receptor (ER), progesterone receptor (PR), and human epidermal growth factor receptor-2 (HER2) status were recorded from the pathology report. Molecular subtypes were defined as luminal A (ER+ and/or PR+, HER2-), luminal B (ER+ and/or PR+, HER2+), HER2 (ER- and PR-, HER2+), and basal (ER-, PR-, and HER2-). MRI findings that could potentially alter clinical management were correlated with molecular subtypes.

RESULTS
The 305 cases were classified as 202 (66.2%) luminal A, 33 (10.8%) luminal B, 17 (5.6%) HER2, and 53 (17.4%) basal subtype. Multicentric/multifocal disease was significantly more commonly (p=0.015) detected by MRI in luminal B (16/33, 48.5%) and HER2 (10/17, 58.8%) subtypes, compared to luminal A (62/202, 30.7%) or basal (13/53, 24.5%) subtypes. Compared to luminal A subtype, preoperative MRI was 2.1 (p=0.049, 95% confidence interval [95% CI], 1.0-4.5) and 3.2 (p=0.022, 95% CI, 1.2-9.3) more likely to detect multicentric/multifocal disease in luminal B and HER2 subtypes respectively. Although there was no significant difference (p=0.167) between lymph node involvement among all groups, luminal B (14/33, 42.4%) subtype was 2.4 times (p=0.026, 95% CI, 1.1-5.2) more likely to have lymph node involvement than luminal A (47/202, 23.3%) subtype. There was no significant difference in contralateral disease, skin/nipple involvement, or chest wall/pectoral muscle invasion between subtypes.

CONCLUSION
Preoperative breast MRI is significantly more likely to detect multicentric/multifocal disease in luminal B and HER2 molecular subtype breast cancer, while lymph node involvement is more commonly detected in luminal B than luminal A molecular subtype breast cancer.

CLINICAL RELEVANCE/APPLICATION
Breast cancer molecular subtypes could help tailor utilization of pre-operative breast MRI.

SSE01-04 • Does Breast Biopsy Affect Lesion Enhancement Characteristics or Accuracy of Tumor Measurement on MRI?

Nikki Tirada MD (Presenter) ; Anjeza Chukus MD ; Stuart S Kaplan MD *

PURPOSE
The objective of this study is to determine the effect ultrasound, stereotactic, and MRI-guided biopsy may have on lesion morphology, size measurement, and qualitative and quantitative dynamic kinetic features. It is our hypothesis that inflammatory changes and possible tumor burden reduction related to biopsy will alter tumor appearance on MRI. Discordance in imaging characteristics can lead to inaccuracy of size measurement and tumor extension, which could have significant impact on surgical and treatment planning.

METHOD AND MATERIALS
A retrospective review of patients who had contrast-enhanced breast MRI performed either before or after biopsy of a suspicious lesion between January 2010 and January 2013 were included in the study. Patients who had neo-adjuvant chemotherapy prior to MRI were excluded. Imaging characteristics evaluated include time-signal intensity curve and changes in degree of enhancement was evaluated. In patients who also underwent surgical excision, the size of tumors measured on MRI was compared with pathologic measurement. Using a paired Student’s t test, differences were significant significant where P < 0.05. Approval for this study was obtained from Mount Sinai Medical Center Institutional Review Board.

RESULTS
To date, we have identified 36 eligible patients. The mean age was 58.2 years. 8 of 36 lesions (22%) demonstrate changes in enhancement pattern after biopsy; 3 lesions (8.3%) with homogenous washout kinetics became heterogeneous, 3 lesions (8.3%) with homogenous washout became persistent, 1 lesion (2.8%) with progressive curve became plateau, and 1 lesion (2.8%) with plateau became indeterminate (hematoma cavity). There was no significant difference between radiologic and pathologic size of the tumor (2.47 vs 2.31; P = 0.69).

CONCLUSION
Breast biopsy leads to changes in enhancement pattern but does not significantly impact the accuracy of diagnosis or tumor size measurement.

CLINICAL RELEVANCE/APPLICATION
Breast MRI is frequently performed after the diagnosis of breast cancer has been established. Therefore, it is important to assess any potential effect prior biopsy may have on imaging characteristics.

SSE01-05 • Breast MRI Background Parenchymal Enhancement and Tumor Characteristics

Janice S Sung MD (Presenter) ; Jennifer Brooks PhD ; Valencia King MD ; Jennifer B Kaplan MD ; Eve Burstein ; Mark E Robson MD *; Jonine L Bernstein ; Malcolm Pike ; Elizabeth A Morris MD

PURPOSE
To examine the relationship between fibroglandular tissue (FGT) and background parenchymal enhancement (BPE) on MRI and histopathological and immunohistochemical features of breast cancers.

METHOD AND MATERIALS
IRB approval and retrospective review identified 712 women diagnosed with unilateral invasive ductal breast carcinoma consecutively between February 2008 – February 2011 who had a pre-treatment MRI of the unaffected breast, were not taking hormonal medications, and did not have a prior history of breast cancer. Women with unknown menopausal status or with tumors with unknown receptor status or tumor grade were excluded (N=51). Clinicopathologic data was obtained from the electronic medical records. Two breast imaging radiologists blinded to clinical data independently assessed BPE and FGT using BI-RADS criteria. Odds ratios (OR) and 95% confidence intervals (CI) were generated using logistic regression models adjusting for age, menopausal status and body mass index.

RESULTS
Of 661 tumors, 522 (79%) were estrogen receptor positive (ER+). 491 (74%) progesterone receptor positive (PR+) and 117 (18%) human epidermal growth factor receptor positive (HER2+). Women with dense breasts (heterogeneously/extremely dense) were more likely to have ER+ (OR=1.6, 95% CI 1.0, 2.5, p=0.05) or PR+ tumors (OR=1.7, (1.1, 2.7), p=0.01) compared to women with less dense breasts (predominantly fatty/scattered fibroglandular densities). Women with dense breasts were less likely to have triple negative breast cancer compared to luminal A (OR=0.5, (0.3, 0.8), p=0.008). No association between these breast types and BPE was observed. Results did not differ when stratified by menopausal status.

CONCLUSION
FGT on MRI is associated with an increased likelihood of having ER+ and PR+ breast cancer, which is consistent with some studies that have shown a similar association between mammographic density and ER+ disease. No association between BPE and subtype was observed.

CLINICAL RELEVANCE/APPLICATION
FGT on MRI may be a much greater risk factor specific to ER/PR+ disease. Although BPE has been shown to be a breast cancer risk factor, this appears to be independent of subtype.

SSE01-06 • Prepectoral Edema as a Morphological Sign in MR-mammography

Clemens G Kaiser MD, BA (Presenter) ; Michael Herold ; Julia Krammer MD ; Matthias Dietzel MD ; Pascal A Baltzer MD ; Klaus Wasser MD ; Stefan O Schoenberg MD, PhD * ; Werner A Kaiser MD, PhD

PURPOSE
Morphological and kinetic signs of breast lesions contribute to diagnosis and differential diagnosis in MR-Mammography. Prepectoral edema in patients without any history of previous biopsy, operation, radiation or chemotherapy has been detected as a new diagnostic Sign during clinical routine. The purpose of this study was to evaluate the role of this morphological sign in the differential diagnosis of breast lesions.

METHOD AND MATERIALS
Between 11/2001 and 10/2006 a total of 1109 MRM exams have been performed in our institution. Patients had no previous operation, biopsy, intervention, chemotherapy, hormone replacement therapy or previous mastitis. 162 patients with 180 lesions were included and histologically correlated by operation (124 patients / 136 lesions) or corebiopsy (38 patients / 44 lesions) in our hospital. The evaluations were performed by 4 experienced radiologists in consensus.

RESULTS
180 evaluated lesions included 104 malignant lesions (93 invasive; 11 non-invasive cancers) and 76 benign lesions. The prepectoral edema Sign was seen in...
Invasive Lobular Carcinoma (ILC)

Digital Mammography (DM) in Assessment of Breast Disease

S SSE02-01 •
Per Skaane
Liane E Philpotts

The visibility scores for IDC with tomosynthesis and mammography were 3.4±1.1 and 2.6±1.2, respectively, and for ILC were 3.2±0.9 and 2.3±1.2, each cancer on 2 view tomosynthesis and 2 view mammography images were recorded.

Our results showed that the addition of DBT significantly increased sensitivity and diagnostic accuracy of DM in detecting ILCs, especially in dense breasts.

CONCLUSION
Both MRI and DBT showed better performance than DM. Both can add a lot to the information gained for better diagnosis and prompt management of breast lesions.

CLINICAL RELEVANCE/APPLICATION
Periocular edema is a very powerful sign towards malignancy in the differential diagnosis of breast lesions in MR-Mammography.

Breast Imaging (Digital Breast Tomosynthesis Lesions)

Monday, 03:00 PM - 04:00 PM  •  E450A

S SSE02-01 •
Dalia S El Mesidy
MBch, MSc (Presenter) ; Rasha M Kamal MD ; Sahar Mansour MD ; Ahmed H Khalil MSc, MD

PURPOSE
To assess the diagnostic performance of DM with that of DM combined with DBT for the detection of ILC.

METHOD AND MATERIALS
55 patients, having 60 breast lesions were referred from the Surgery clinic to the Radiology Department to be assessed by DM, DBT and MRI. An informed written consent to participate in the study was obtained from all patients. Breast US was performed for all cases. Mammography images were acquired using the ‘combo mode’, a feature that acquires both a DM and a DBT scan in the same compression. MRI was performed using a 1.5 system.

RESULTS
The sensitivity for DM was 87% and those of DBT and MRI were equivalent to 93.75%. The specificity for DM was 50%, that for DBT was 84.1% and that of MRI was 86.36%. The PPV of DM was 54.5%, that of DBT was 67.6% and that of MRI was 88.3%.

CONCLUSION
Both MRI and DBT are better than DM alone in detecting or excluding breast cancer, especially in cases with dense breasts.

CLINICAL RELEVANCE/APPLICATION
Both MRI and DBT are better than DM in detecting or excluding breast cancer, specially in cases with dense breasts.

S SSE02-02 •
Giovanna Mariscotti ; Manuela Durando (Presenter) ; Laura Martinich MD * ; Enrica Caramia ; Pier Paolo Campanino ; Andrea Luparia ; Laura Bergamasco ; Paolo Fonio ; Giovanni Gandini MD

PURPOSE
To compare the diagnostic performance of DM with that of DM combined with DBT for the detection of ILC.

RESULTS
All readers had a significantly higher sensitivity for detection of ILC by using DM combined with DBT (ranging between 74.4-91%) than DM alone (77-80%) (p=0.002). There was no significant difference (p=0.29) in specificity values (DM alone 94.6-92.3%, DM combined with DBT 69.2-92.3%). The diagnostic accuracy was higher considering DM combined with DBT (ranging between 80.3-91.4%) than DM alone (69.2-85.5%) (p=0.0029).

CONCLUSION
Both MRI and DBT are better than DM alone in detecting ILCs, especially in cases with dense breasts.

CLINICAL RELEVANCE/APPLICATION
The use of Digital Breast Tomosynthesis in addition to Digital Mammography (DM) improve diagnostic performances of DM and could be helpful in detecting Invasive Lobular Carcinomas.

S SSE02-03 •
Pragya A Dang MD (Presenter) ; Kathryn L Humphrey MD ; Phoebe E Freer MD ; Elkan F Halpern MD * ; Mansi A Saksena MD ; Elizabeth A Rafferty MD *

PURPOSE
To compare tomosynthesis to conventional mammography for detection and characterization of biopsy proven invasive cancers.

METHOD AND MATERIALS
We conducted a retrospective multi-reader blinded study, including 6 radiologists with experience of breast imaging ranging between 15 and 4 years and DBT experience ranging between 4 years and no experience (inexperienced readers underwent a DBT training session prior to the study). The radiologists interpreted 56 examinations of women (mean age 59.4 years, range 40-78) with 68 newly diagnosed ILCs, proved at definitive histology (tumours mean size 30.1 mm; range 5-95). All women, who signed an informed consent, underwent mammographic bilateral two standard views in Combo mode: DM and DBT.

RESULTS
The sensitivity for DM was 87% and those of DBT and MRI were equivalent to 93.75%. The specificity for DM was 50%, that for DBT was 84.1% and that of MRI was 86.36%. The PPV of DM was 38.89% and that of DBT was 68.18% and that of MRI was 71.43%. Association between DM, DBT and MRI was highly significant, having p-values of 0.0009 for DM and 0.0001 for each of DBT and MRI. Association between the results of DM and those of DBT showed that DBT had a statistically significant higher diagnostic value for diagnosing breast lesions than DM, having a p-value of 0.0029. However, there was no significant difference (p=0.29) in specificity values (DM alone 56.6-92.3%, DM combined with DBT 69.2-92.3%). The diagnostic accuracy was higher considering DM combined with DBT (ranging between 80.3-91.4%) than DM alone (69.2-85.5%) (p=0.0029). There was no significant difference (p=0.29) in specificity values (DM alone 56.6-92.3%, DM combined with DBT 69.2-92.3%). The diagnostic accuracy was higher considering DM combined with DBT (ranging between 80.3-91.4%) than DM alone (69.2-85.5%) (p=0.0029).

CONCLUSION
The addition of DBT significantly increased sensitivity and diagnostic accuracy of DM in detecting ILCs, especially in dense breasts.

CLINICAL RELEVANCE/APPLICATION
The use of Digital Breast Tomosynthesis in addition to Digital Mammography (DM) improve diagnostic performances of DM and could be helpful in detecting Invasive Lobular Carcinomas.
respectively: significantly higher for tomosynthesis compared to conventional mammography (p< 0.0001) for all cancers. 16% (28/172) cancers (20% ILC and 16% IDC) were occult on mammography, whereas 3% (5/172) cancers were occult on tomosynthesis. Common presentations of cancers on tomosynthesis were irregular spiculated masses (61%, 105/172), architectural distortion (12%, 20/172), and lobulated circumscribed masses (8%, 13/172). Of the cancers presenting as architectural distortion on tomosynthesis, 50% (10/20) were occult on conventional mammography and 20% (4/20) were characterized as asymmetry or focal asymmetry on conventional mammography. Cancers presenting as architectural distortion on tomosynthesis had a disproportionately higher percentage of ILCs (20%). Of the irregular spiculated masses on tomosynthesis, 10% (11/105) were occult, 33% (35/105) characterized as asymmetry or focal asymmetry, and only 12% (34/105) definitively characterized as irregular spiculated masses on conventional mammograms. No invasive cancers were characterized as round or oval circumscribed masses on tomosynthesis. Of the cancers occult on tomosynthesis, 1(20%) was visible as an asymmetry on mammography.

CONCLUSION
Tomosynthesis was significantly better than conventional mammography on detecting cancers particularly those presenting as architectural distortion as well as characterizing cancer morphology.

CLINICAL RELEVANCE/APPLICATION
Identification of mammographically occult cancers and more accurate depiction of tumor morphology with tomosynthesis may allow formulation of a better assessment of the lesion on initial imaging.

SSE02-04 • Tomosynthesis in Breast Morphological Density

René S Butler MD (Presenter) ; Reynolds Ostrover ; Regina J Hooley MD * ; Jaime L Geisel MD ; Madhavi Raghu MD * ; Liane E Philpotts MD *

PURPOSE
To evaluate the effectiveness of digital breast tomosynthesis in the visualization of non-calcification breast cancers as a function of breast density

METHOD AND MATERIALS
Upon IRB approval, 186 women with breast masses detected from 10/3/2011 through 1/16/2013 were to be included in this study. These 186 women with breast masses were imaged with tomosynthesis in combination with 2D mammography. Cancers presenting with calcifications as the only mammographic finding were excluded, leaving a total of 155 cases. Images were evaluated by 7 breast radiologists and classified into five categories: “Only Seen on Tomosynthesis”, “Better Seen on Tomosynthesis”, “Equally Well Seen on Both”, “Better Seen on 2D”, and “Only Seen on 2D”. The breast density, type of mammographic finding, clinical presentation, and cancer histology were recorded.

RESULTS
Patients with scattered and heterogeneously dense breasts presented the highest percentage of cancers seen only with tomosynthesis, with 15.4%(106/65) and 14.0%(6/43), respectively, compared to only 5.9%(1/17) of patients with extremely dense breasts and 0%(0/30) of patients with fatty breasts. The scattered and heterogeneously dense breast cancer category had the highest percentage of cancers seen only on tomosynthesis with 52.3%(34/65) and 55.8%(24/43), respectively, while the fatty breast category had the lowest percentage (13.3%/4,30). The extremely dense breast category had 35.6%(6/17) of cancers seen better with tomosynthesis. Finally, patients with fatty breasts and extremely dense breasts had the highest percentage of cancers seen equally well on tomosynthesis and 2D mammography, with 86.7%(26/30) and 58.8%(10/17), respectively, in contrast to 32.3%(21/65) and 30.2%(13/43), respectively, in the scattered and heterogeneously dense categories.

CONCLUSION
Tomosynthesis imaging is particularly beneficial for visualizing non-calcification breast cancers in patients with scattered and heterogeneously dense breasts, with 67.7%(8/12) and 72.7%(3/4), respectively, of cancers in these categories seen only or better with tomosynthesis. Patients with fatty and extremely dense breasts are more likely to have cancers seen equally well on tomosynthesis and 2D mammography.

CLINICAL RELEVANCE/APPLICATION
As tomosynthesis becomes more widely utilized, it is pertinent to understand its relative benefit in different groups of patients.


Giovanna Mariscotti ; Manuela Durando (Presenter) ; Mirella Fasciano ; Giulia Schivazappa ; Davide Bosco ; Elisa Regini ; Chiara Ruggieri ; Paolo Fonio ; Giovanni Gandini MD

PURPOSE
To review our institutional experience in using DBT as SL in the evaluation of additional enhancing lesions identified on preoperative breast MRI.

METHOD AND MATERIALS
From June 2009 to January 2013, 520 patients with breast cancers detected on DM and ultrasound (US) and confirmed by cytology/histology underwent preoperative MRI. In 114 patients, MRI detected 164 additional lesions: all the patients underwent SL US who identified 114/164 (69.5%) MRI additional lesions. SL US detected 95 (57.8%) lesions not seen on US. Subsequently, 50/164 (30.5%) lesions not seen on US underwent SL DM+DBT (the patients, who signed an informed consent, had mammographic two standard views in Combo mode (DM and DBT acquisition within a single compression) on the interested breast). Subsequently to SL DM+DBT, re-targeted US evaluation was performed. Focusing on SL DM+DBT, we compared morphological features, size and BI-RADS-MRI classification of additional MRI findings and DBT lesions features. Suspicous additional lesions were confirmed by percutaneous biopsy or surgical excision. Imaging follow-up (range 6-12 months) was used for probably benign lesions, not biopsied.

RESULTS
SL DM+DBT identified 32/50 (64%) of MRI additional lesions (mean size 10.2±6.2 mm), of which 28/50 (56%) were classified as BI-RADS-MR4 and 22/50 (44%) as MR3.

CONCLUSION
Second-look DM+DBT was helpful in the clinical work-up of additional lesions detected on preoperative breast MRI, particularly for non mass-like enhancement.

CLINICAL RELEVANCE/APPLICATION
In our preliminary experience, the clinical work-up of the additional enhancing lesions detected on preoperative breast MRI was implemented by second-look with Digital Breast Tomosynthesis.

SSE02-06 • Digital Breast Tomosynthesis in Diagnosic Mammography: Can Tomo Affect the Final Assessment Categories?

Madhavi Raghu MD (Presenter) * ; Regina J Hooley MD * ; Liane E Philpotts MD * ; Jaime L Geisel MD ; Melissa A Durand MD ; Liva Andrejeva-Wright MD ; Laura J Horvath MD ; Reni S Butler MD

PURPOSE
To evaluate the rates of BI-RADS final assessment categories, in diagnostic patients undergoing tomosynthesis versus those undergoing 2D mammography with particular attention to BI-RADS3.

METHOD AND MATERIALS
A retrospective review of 516 diagnostic patients over two six month intervals before (Jan-June 2011) and after (Aug 2012-Jan 2013) the implementation of tomosynthesis was performed. The percentage of mammograms categorized as BI-RADS 1-5 was determined. Particular attention was given to BI-RADS 3 and the reasons including asymmetries, calcifications, masses or architectural distortion were evaluated and compared between the two groups.

RESULTS
In the first interval, 2850 diagnostic mammograms were performed. Of these patients, 914 patients were categorized as BI-RADS 3(32%), 1670 patients as BI-RADS 1 or 2(54%), 159 patients as BI-RADS 4(6.3%) and 24 patients categorized as BI-RADS 5(0.8%). The 914 patients in the BI-RADS 3 category had 977 findings: asymmetries 363(37%), calcifications 398(40%), masses 201(21%) and architectural distortion 15(2%). In the second interval, 2761 diagnostic mammograms were performed, of which 2036 patients underwent tomosynthesis. Of these patients, 583 patients were categorized as BI-RADS 3(27.6%), 1315 patients as BI-RADS 1 or 2(64.6%), 153 patients as BI-RADS 4(5.8%) and 35 patients as BI-RADS 5(1.7%). The 583 BI-RADS 3 patients had 602 findings: asymmetries 186(31%), calcifications 245(41%), masses 158(26%) and architectural distortion 14(2%). The BI-RADS 3 rate decreased from 35% in the pre-tomogram to 27% in the post-tomogram group.

CONCLUSION
The use of tomosynthesis in diagnostic patients resulted in a significant decrease in the rate of BI-RADS 3, particularly for masses and asymmetries with a concomitant significant increase in the rate of BI-RADS 1/2 and 5.
SSE03-01 • Quantification of Stenotic Mitral Valve Area by Dual-source Computed Tomography in Patients with Atrial Fibrillation and Mitral Stenosis: Comparison with Cardiac Magnetic Resonance and Transthoracic Echocardiography

Song Soo Kim MD, PhD (Presenter) ; Sung Min Ko ; Jae-Hwan Lee ; Heung Gon Hwang

PURPOSE
To evaluate the utility of dual-source computed tomography (DSCT) for quantification of the mitral valve area (MVA) in patients with atrial fibrillation (AF) and mitral stenosis (MS), with comparing those from the cardiac magnetic resonance (CMR) and transthoracic echocardiography (TTE).

METHOD AND MATERIALS
We retrospectively enrolled 102 patients (77 women, 52.4 ± 10.9 years old) with AF and MS who underwent ECG-gated DSCT, TTE, and CMR prior to operation. The MVAs were determined planimetrically by DSCT, CMR, TTE as well as assessed by Doppler TTE using the pressure half-time method (TTE-PHT) and they were compared among each other using linear regression and Bland-Altman analyses. Grade of MS (mild, moderate, and severe) was determined according to the results of TTE (TTT-planimetry, TTE-PHT, and TTE-overall) and diagnostic accuracy of DSCT for detecting severe MS was assessed using each TTE as reference.

RESULTS
The MVA on DSCT (mean, 1.27 ± 0.27 cm²) was significantly larger than those seen with TTE-planimetry and TTE-PHT (1.16 ± 0.28 cm² and 1.07 ± 0.30 cm², respectively, p<0.001). Agreement between CT and the reference standards was 96.7% for functional classification of AR, and the number of patients in each type were as follows: type I (n=11), type II (n=24), and type III (n=67). The AR measurements were well correlated with high initial flow displacement values (r=0.80, p<0.001). In a comparison of means, MS was statistically overestimated, as compared with MVA calculated by CMR and TTE.

CONCLUSION
In MS with AF patients, DSCT could be an alternative to TTE in patients with poor acoustic windows or whenever MVA using TTE is indeterminate severity of MS to clinicians.

SSE03-02 • Initial Systolic Flow Displacement in Patients with Bicuspid Aortic Valve Predicts Ascending Aortic Enlargement

Nicholas S Burris MD (Presenter) ; Monica Sigovan PhD ; Elaine Tseng MD ; David A Saloner PhD ; Michael D Hope MD

PURPOSE
Bicuspid aortic valve (BAV) is a common anomaly, which is associated with dilation of the ascending aorta (AsAo), causing significant morbidity and mortality. Prior prospective cardiac MR (CMR) studies utilizing 4D flow techniques have shown that eccentric flow patterns caused by Bicuspid valve anatomy are correlated with AsAo enlargement. However, 4D Flow methods require significant post-processing time and specialized training which limits its broad applicability. Peak systolic flow displacement, a previously described parameter, can quantify flow eccentricity in the AsAo and can be easily calculated from phase contrast (PC) data, a commonly obtained CMR sequence. We hypothesize that systolic flow displacement will positively correlate with AsAo growth rate.

METHOD AND MATERIALS
Cardiac MR/MRA data were reviewed from 23 patients with BAV who had at least 2 CMR studies >1 year apart, age 16 years, with PC data acquired in the AsAo on initial study. Ascending aortic diameter measurements were made at standard levels, and growth rates of maximally enlarged segments were determined. Flow displacement measurements on initial study were compared with maximal aortic diameter growth rate in a prospective manner.

RESULTS
Average follow-up was 3.1±2.1 years and average patient age at first study was 33.7±11.9 years. Displacement at initial study was significantly correlated with AsAo growth rate (r=0.39, p=0.03). In a comparison of means, AsAo growth rate was 2.5 times greater in patients with high initial flow displacement of =0.2 (1.0±0.7 mm/y, n=11) vs. patients with low initial flow displacement (0.6±0.4 mm/y, n=12; p=0.002). Agreement between CT and the reference standards was 96.7% for functional classification of AR, and the number of patients in each type were as follows: type I (n=11), type II (n=24), and type III (n=67). The AR measurements were well correlated with high initial flow displacement values (r=0.80, p<0.001). In a comparison of means, MS was statistically overestimated, as compared with MVA calculated by CMR and TTE.

CONCLUSION
In MS with AF patients, DSCT could be an alternative to TTE in patients with poor acoustic windows or whenever MVA using TTE is indeterminate severity of MS to clinicians.

SSE03-03 • Functional Classification of Aortic Regurgitation with Cardiac Computed Tomography: Comparison with Surgical Inspection and Transesophageal Echocardiography

Hyun Jung Koo MD (Presenter) ; Dong Hyun Yang MD ; Joon-Won Kang MD ; Joon Bum Kim ; Tae-Hwan Lim MD, PhD

PURPOSE
To evaluate the diagnostic performance of cardiac computed tomography (CT) for assessing the mechanisms of aortic regurgitation (AR) using surgical inspection and transesophageal echocardiography (TEE) as reference standards.

METHOD AND MATERIALS
CT findings of 101 consecutive patients (62 males, mean age: 55.0±14.0 years) with AR who underwent aortic valve or root surgery were evaluated. AsAo diameter was recorded as the maximal diameter measured on CT. For surgical inspection, the exact site of AR was identified using a stepwise technique. Aortic root dissection was performed if the annulus was wide or there was an eccentric regurgitation orifice. Information regarding the number of cusps involved was obtained from the operating surgeon. 4D Flow methods require significant post-processing time and specialized training which limits its broad applicability. Peak systolic flow displacement, a previously described parameter, can quantify flow eccentricity in the AsAo and can be easily calculated from phase contrast (PC) data, a commonly obtained CMR sequence. We hypothesize that systolic flow displacement will positively correlate with AsAo growth rate.

RESULTS
Determination of AR type was performed by consensus between two cardiologists and cardiothoracic surgeons who were blinded to the CT results. Agreement between CT and the reference standards was 96.7% for functional classification of AR, and the number of patients in each type were as follows: type I (n=11), type II (n=24), and type III (n=67). The AR measurements were well correlated with high initial flow displacement values (r=0.80, p<0.001). In a comparison of means, MS was statistically overestimated, as compared with MVA calculated by CMR and TTE.

CONCLUSION
CT clearly defines the functional classification of AR with high concordance rate to the reference standards.

CLINICAL RELEVANCE/APPLICATION
By showing the detailed valve morphology, CT can help in decision making for the aortic valve repairability.

SSE03-04 • Differences of Cardiac Function and Characteristics of Aortic Valve according to Myocardial Fibrosis in Patients with Severe Aortic Stenosis

Tae Hyung Kim (Presenter) ; Jin-Woo Choi ; Hweung Kgon Hwang ; Meong Gun Song ; Sung Min Ko

PURPOSE
To investigate the differences of cardiac function and characteristics of aortic valve according to myocardial fibrosis (MF) in patients with severe aortic stenosis.
METHOD AND MATERIALS
Eighty-one patients (48 male, mean age 59 years) with pure severe AS (n=33) or severe AS with mild aortic regurgitation (n=48) were included in the study. All patients underwent transthoracic echocardiography (TTE), cardiac computed tomography (CCT) and cardiac magnetic resonance (CMR) and subsequent valvuloplasty operation. CCT was performed using the dual-source CT scanner and used for the assessment of valvular and coronary calcium score, valvular calcium grade, and coronary artery disease. TTE was used for assessment of AS severity using established parameters. CMR exams were performed on a 3.0-T system and a 1.0-T system. Cine-CMR was used for the assessment of LV volumes, mass and function. Detection of MF (midwall late enhancement) was based on the assessment of the short-axis delayed-enhancement CMR with phase-sensitive inversion recovery technique. The differences of cardiac function and valvular characteristics between two groups were statistically analyzed.

RESULTS
MF was observed in 34 patients. There were no differences in valvular morphology and clinical characteristics between two groups, except mild aortic regurgitation being more prevalent patients with MF (n = 28) than without MF (n = 20, p = 0.0008). Patients with MF had higher aortic valve calcium volume score (2951 ± 1960 mm3 vs 1660 ± 1092 mm3, p = .0003) and calcium grade by CCT (p = .008), more severe AS (aortic valve area by CMR (0.73 ± 0.15 cm2 vs 0.82 ± 0.13 cm2, p = .002), peak velocity (5.0 ± 0.7 m/sec vs 4.5 ± 0.7 m/sec, p = .002) and mean pressure gradient by TTE (50 ± 19 mmHg vs 51 ± 17 mmHg, p < .005)), higher indexed LV mass by CMR (90.2 ± 34.9 g/m2 vs 63.3 ± 17.9 g/m2, p < .0001), lower indexed LV ejection fraction by CMR (37.1 ± 9.5 vs 41.4 ± 8.9, p = .04), and larger indexed LV end-diastolic volume (93.2 ± 20.5 ml/m2 vs 79.3 ± 19.4 ml/m2, p = .016) by CMR compared with patients without MF.

CONCLUSION
MF is associated with more severe calcific AS, worse LV functional parameters, and higher LV mass index in patients with severe AS. Early detection of MF using CMR may increase the chances for early surgical treatment in severe AS.

CLINICAL RELEVANCE/APPLICATION
MF occurs in severe AS and is associated with long-term clinical outcome. MF is detected by delayed-contrast-enhanced CMR.

SSE03-05 • Evaluation of Cardiac Reverse Remodeling after MitraClip Procedure Using MRI

Patrick Krumm (Presenter); Christine S Zuern; Bernhard Klumpp MD; Claus D Claussen MD; Andreas E May; Ulrich Kramer MD; Thomas Wurster; Stefanie Mangold MD; Achim Seeger; Christiane Bretschneider

PURPOSE
The MitraClip System (Abbott Vascular) is a novel percutaneous interventional method for mitral valve repair. It is predominantly applied on patients that are not eligible for surgical valve repair. The purpose of this study was to examine reverse remodelling by evaluating pre- and postinterventional cardiac function and atrial dilatation.

METHOD AND MATERIALS
33 patients (age 75.5±8.1 years; 11 female) were prospectively included in this study. Magnetic resonance imaging was performed before and 6 weeks after intervention in 20 patients. 13 patients had to be excluded due to implantable pacemakers. Cardiac function was evaluated using steady-state free precession (SSFP) cine sequences by assessment of enddiastolic volume (EDV), ejection fraction (EF) myocardial mass (MM) and myocardial mass index (MMI). Planimetry of the left atrium (LA) was performed in identical slices in four-chamber view.

RESULTS
EDV was preinterventional 179.2 ml; postinterventional 171.9 ml (p=0.01). EF was preinterventional 39.7%; postinterventional 44.0% (p=0.001). MM was preinterventional 156.7 g; postinterventional 153.6 g (p=0.03). MMI was preinterventional 85.0 g/m²; postinterventional 84.3 g/m² (p=0.6). Left atrium plane was preinterventional 41.1 cm²; postinterventional 38.6 cm² (p

CONCLUSION
The MitraClip procedure has a positive effect on cardiac function and function and induces reverse remodelling: Significant reduction of LA and LV dilatation has been observed. The quantifiable left atrial dilatation as well as the left ventricular dilatation decreased significantly as an indirect sign of reduced mitral regurgitation. Myocardial mass decreased significantly in the context of reduced dilatation. MMI has not decreased for less body weight at follow up due to cardiac recompensation.

CLINICAL RELEVANCE/APPLICATION
The clinical benefit of a successful MitraClip intervention can be monitored and validated using MRI in clinical follow-up examinations.

SSE03-06 • Assessment of Leaflet Closing Angles in Mechanical Prosthetic Heart Valves with Multidetector-row CT Compared to Cinefluoroscopy: An In Vitro Study

Dominika Sucha MD (Presenter); Petr Symersky MD; Evert-Jan Vonken MD, PhD; Esther Provoost MMedSc; Steven Chamuleau MD, PhD; Riccardo P Budde MD, PhD

PURPOSE
Cinefluoroscopy is the gold standard for leaflet motion evaluation in mechanical prosthetic heart valves (PHV). In the past decade multidetector-row computed tomography (MDCT) has shown the ability to evaluate PHV leaflet motion in patients as well, however the actual accuracy of leaflet restriction assessment is unknown. In this study leaflet restriction measurements with MDCT were compared to cinefluoroscopy measurements in four common mechanical PHVs in optimal in vitro conditions.

METHOD AND MATERIALS
Three blinded observers independently measured leaflet closure angles on both cinefluoroscopy and retrospectively ECG-gated MDCT images and scored leaflets as normal or restricted. For this, three mechanical bileaflet and one monoleaflet PHVs (St. Jude, Carbomedics, ON-X and Medtronic Hall) were imaged in a pulsatile in vitro model. For each PHV four various grades of leaflet closure restriction were simulated of one of the leaflets. Hence, five image acquisitions were made of each PHV; one without and four with restriction. Data was analyzed using the intraclass correlation coefficient (ICC) and Bland-Altman plots.

RESULTS
MDCT and cinefluoroscopy agreement was high, with ICCs >0.989. Per observer analysis showed maximal differences between MDCT and cinefluoroscopy closure angle measurements of -2 to +3 degrees in both restricted and non-restricted leaflets. Overall, sensitivity and specificity for detection of leaflet restriction was 0.88-0.94 and 1.00, respectively for CT and 0.94 and 0.89-1.00, respectively for fluoroscopy. Interobserver agreement was high in restricted and non-restricted leaflets on both CT and cinefluoroscopy images (ICCs >0.995).

CONCLUSION
The maximal difference in optimal in vitro conditions between leaflet angles measured with MDCT and cinefluoroscopy is 3 degrees. MDCT and fluoroscopy both accurately detect incomplete leaflet closure.

CLINICAL RELEVANCE/APPLICATION
Multidetector-row CT allows accurate leaflet closure angle measurements in both restricted and non-restricted prosthetic heart valves.

Cardiac (Nonischemic Cardiomyopathy)

Monday, 03:00 PM - 04:00 PM • SS04AB

SSE04 • AMA PRA Category 1 Credit ™:1 • ARRT Category A+ Credit:1

Moderator
Richard D White , MD
Moderator
Vincent B Ho , MD, MBA *
Moderator
Suhyun Abbara , MD *

SSE04-01 • Myocardial MR Spectroscopy (MRS) as Early Indicator of Athleteâ€™s Heart and Hypertrophic Cardiomyopathy

Francesco Secchi MD (Presenter); Maddalena Belmonte; Marcello Petruni; Paola Maria Cannao; Giovanni Di Leo; Francesco Sardanelli MD *

PURPOSE
To evaluate myocardial energetic metabolism with 31P-MRS and 4H-MRS in healthy volunteer, athletes and patients affected with hypertrophic cardiomyopathy (HCM) in order to define early metabolic modifications.
METHOD AND MATERIALS
We prospectively performed a cardiac 1.5-T MR (Siemens, Sonata) in 24 subjects: 10 athletes (A), 7 patients affected with HCM (H) and 7 healthy volunteers (V). With patients in supine position, ECG-triggered cine steady-state free precession (true-FFE) and 1H-MRS point resolved spectroscopy sequence (PRESS) were performed. For the 1H-MRS a single voxel was placed into the septum. With patients in prone position a 31P-MRS multivoxel chemical shift imaging sequence was acquired. Heart function was measured segmental cine imaging with Syngo-Argus software. 1H-MRS spectra were processed using JMRUI software; 31P-MRS spectra using Spectroscopy-Argus (Siemens). Kruskal-Wallis and Jonckheere-Terpstra tests were used. Data were reported as median (interquartile interval).

RESULTS
Ejection fraction (%), indexed end-diastolic volume (ml/m2), end-systolic volume (ml/m2), mass (g/cm2) and septal thickness (mm) were 68, 95, 30, 72 and 18 for group A, respectively; 68, 73, 20, 81 and 18 for group H, respectively; 63 (P=.865), 78 (P=.011), 29 (P=.013), 45 (P=.008) and 6 (P=.001) for group V.

CONCLUSION
An alteration of energetic metabolism in HCM patients with a reduction of PCR/GATP ratio and an increase of Pi concentration is confirmed. Athlete’s heart is not associated with energy metabolism alterations. In HCM patients there is a significantly increase of myocardial lipids. A reduction of PCR/GATP associated with an increase of lipids could represent an indicator of early stage of HCM.

CLINICAL RELEVANCE/APPLICATION
Myocardial 1H- and 31P-MRS could help in detection of early HCM in particular in case of young asymptomatic athletes.

SSE04-02 • Cardiac Remodeling after Pulmonary Vein Isolation in Patients with Atrial Fibrillation Is Related to the Degree of Baseline Left Ventricular Diffuse Fibrosis

Murilo Foppa MD, Dsc (Presenter) ; Reza Nezafat PhD ; Warren J Manning MD ; Mark E Josephson MChir ; Hussein Rayatzadeh ; Neville Gai PhD ; Jaime Shaw ; Sebastien Weingartner ; Harsh Parmar

PURPOSE
Pulmonary vein isolation (PVI) using radiofrequency (RF) ablation is becoming a reasonable therapy for the treatment of paroxysmal atrial fibrillation (AF). The impact of the PVI on short and long-term cardiac remodeling is not yet known. Recent data demonstrate higher level of left ventricular (LV) diffuse fibrosis as measured by T1 mapping in patients with AF. In this study, we sought to identify short-term cardiac remodeling after PVI and how they relate to baseline characteristics including left ventricular myocardial T1 time.

METHOD AND MATERIALS
All patients with AF who underwent RF ablation for PVI and had CMR prior and post-PVI procedure from 2006 to 2011 were identified. CMR parameters of LV, right ventricular (RV) sizes and function, left atrial axial length (LA), right atrial axial length (RA), pulmonary veins total cross sectional area (PVA), and LV diffuse fibrosis as measured by T1 relaxation time in the septum using a Look-Locker sequence were measured in all patients pre and post-PVI. T1 measurements were corrected for age, weight, contrast dose, eGFR, and time after injection. The two scans were compared using paired t test and multiple linear regression to account for covariates.

RESULTS
We studied 141 patients (58±10 years, 70% male, BMI 29.1±5.6 kg), 46% had high blood pressure and 11% had diabetes. Sixty-five percent of patients were in SR at the pre PVI scan and 90% at the post PVI scan, 38 [IQR 33-57] days after the PVI. The PVA was associated with SR at post PVI scan. After the PVI procedure, patients showed statistically significant reduction in LA (59±7.8 vs 57.3±8.1 mm; P=0.01), RA (56.6±7.0 vs 54.9±7.6 mm; P=0.006), PVA (10.9±3.0 vs 9.7±3.0 cm2; P=0.02), T1 on septum (2.8±0.3 vs 2.5±0.3 ms; P=0.007), and left ventricular mass (91±37 vs 88±36 g; P=0.03). Linear regression showed that LA, RA, and T1 on septum were significantly associated with SR (P=0.001, 0.001, and 0.007, respectively).

CONCLUSION
PVI causes changes in atrial sizes and RV ejection fraction. LV T1 associations suggest that the severity of LV myocardial fibrosis at baseline may influence the degree of structural changes post PVI.

CLINICAL RELEVANCE/APPLICATION
PVI may affect cardiac structures other than LA and the magnitude of it may be related to baseline LV myocardial fibrosis severity.

SSE04-03 • Effect of 2010 Task Force Criteria on Reclassification of Cardiac MRI Criteria for ARVC

Ting Liu MD (Presenter) ; Amit Pursnani MD ; Umesh C Sharma MD, DPhil ; Yongkasem Vorasettakarnjai ; Daniel Verdini MD ; Ashley M Lee BS ; Peerawut Deepprasertkul ; Heidi Lumish ; Manavjot S Sidhu MD, MBBS ; Hector M Medina MD ; Suhny Abbara MD * ; Godtfred Holmvang ; Udo Hoffmann MD ; Brian B Ghoshhajra MD

PURPOSE
We sought to evaluate the effect of the revised 2010 Task Force Criteria (TFC) on the prevalence of major and minor MRI criteria for Arrhythmogenic Right Ventricular Cardiomyopathy (ARVC) versus the original 1994 TFC. We also assessed the utility of CMR to identify alternative diagnoses for patients referred for ARVC evaluation.

METHOD AND MATERIALS
968 consecutive patients referred for cardiac magnetic resonance imaging (CMR) with clinical suspicion of ARVC from 1995 to 2010, were evaluated for the presence of major and minor MRI criteria per the 1994 and 2010 ARVC TFC. MRI criteria included right ventricle (RV) dilatation, reduced RV ejection fraction, RV aneurysm, or regional RV wall motion abnormality. Qualitative and quantitative RV measures of end diastolic volume (RVEDV) and RV ejection fraction (RVEF) were present in 45% and 85% of patients, respectively.

RESULTS
Of 968 patients, 220 (22.7%) fulfilled either a major or a minor 1994 TFC, and 25 (2.5%) fulfilled any of the 2010 TFC criteria. (See Figure) Among patients meeting 1994 criteria, only 25 (11.4%) met the 2010 criteria. All patients who fulfilled the 2010 criteria also satisfied the 1994 criteria. Per the 2010 TFC, 21 (2.2%) patients met major criteria and 4 (0.4%) patients fulfilled minor criteria. 8 patients meeting 1994 minor criteria were reclassified as satisfying 2010 major criteria, and 4 patients fulfilling the 1994 major criteria reclassified to minor or no criteria. 89 (9.1%) patients had other cardiac diagnoses, including 43 (4.4%) with clinically important potential ARVC mimics. These included sarcoidosis, RV volume overload conditions (e.g ASD, PAPVR), and other cardiomyopathies.

CONCLUSION
Compared with the 1994 TFC, the 2010 TFC significantly reduced the overall MRI diagnosis of ARVC from 22.7% to 2.5%. CMR identified alternative cardiac diagnoses in 9.1% of patients.

CLINICAL RELEVANCE/APPLICATION
There is a dramatic reduction in the prevalence of major and minor CMR criteria when applying the revised 2010 Task Force Criteria for ARVC compared to the original 1994 criteria.

SSE04-04 • Three-Dimensional Visualization of Hemodynamic Derangement in the Left Ventricular Outflow Tract and Ascending Aorta: A Novel Imaging Parameter in Hypertrophic Cardiomyopathy

Bradley D Allen MD (Presenter) ; Lubna Choudhury MD ; Pim Van Ooij ; Alex Barker ; Jeremy D Collins MD * ; Robert O Bonow MD ; James C Carr MD * ; Michael Markl PhD

PURPOSE
To study the left-ventricular outflow tract (LVOT) pressure gradient and 3D blood flow patterns in the ascending aorta (AAo) in hypertrophic cardiomyopathy (HCM) patients using 4D flow MRI.

METHOD AND MATERIALS
Patients with HCM (n = 14, age = 59.8 ± 11.2 years) and controls (n = 10, age = 54.8 ± 9.0) were included in this IRB approved study. Patients had echocardiography assessment within 60 days of MRI and met at least one of the following criteria: LVOT obstruction defined as pressure gradient >30 mmHg on echo (n = 5), MRI-measured septal thickness >1.5 cm or septum/free wall thickness ratio >1.3, or systolic anterior motion (SAM) of the mitral valve on MRI. 4D flow MRI was performed on patients during cardiac MRI for HCM assessment. Age-matched controls were selected from a volunteer database. Blood flow visualization and quantification were performed in dedicated software (EnSight, CEF, Apex, NC). Peak velocity was measured in a cylindrical analysis volume placed in the LVOT. Peak LVOT pressure gradient was calculated using the simplified Bernoulli equation P = 4v^2 (P = gradient, v = velocity). Time-resolved pathlines were generated to depict blood flow over one cardiac cycle. Flow pattern was graded for helical flow in the AAo (minimal = 0, moderate = 1, severe = 2). Data were analyzed using a Wilcoxon signed-rank test or t-test as appropriate. Linear regression was used to correlate continuous measurements.

RESULTS
Helical flow (1.4 ± 0.7 vs. 0.1 ± 0.3, p

CONCLUSION
Comprehensive outflow tract hemodynamic assessment with MRI may be useful in the diagnosis of HCM and LVOT obstruction.

CLINICAL RELEVANCE/APPLICATION
Electroanatomic Mapping

SSE04-05 • Incidence of Non-Task Force Criteria Findings by CMR in Subjects with Various Arrhythmogenic Right Ventricular Cardiomyopathy Scores

Neda Rastegar MD (Presenter) ; Stefan L Zimmerman MD ; Cynthia James PhD ; Britney Murray MS ; Annelle S. J. M. Te Riele MD ; Aditya Bhonsale MD ; Crystal Tichnell MSc ; Hugh Calkins ; Harikrishna Tandri ; David A Bluemke MD, PhD * ; Ihab R Kamel MD, PhD *

PURPOSE
To determine the incidence of abnormal morphologic findings, in addition to the standard task force criteria (TFC), by cardiac MRI (CMR) in subjects with variable degrees of severity of arrhythmogenic right ventricular cardiomyopathy/dysplasia (ARVC/D).

METHOD AND MATERIALS

RESULTS

The incidence of definite ARVC (Group A), borderline ARVC (Group B), and those who did not meet TFC (Group C) was 58 (61.7%), 19 (20.2%) and 17 (18.1%), respectively. With respect to CMR-based criteria only, 30/94 (31.9%) fulfilled major, while 3/94 (3.2%) fulfilled minor CMR criteria, and the remaining 61 (64.9%) did not fulfill any CMR criteria. In the entire cohort, 47 subjects (50%) had one or more abnormality on CMR. 60% of subjects who met major CMR criteria had LV fat and/or delayed enhancement (DE). We stratified the subjects in Group A based on the TFC score into three subgroups (score 4 and 5, 6 and 7, 8-10). The percentage of LV fat and DE increased with increase in TFC score. RV ejection fraction was significantly lower (43.4% vs. 52%, p<0.001) and RV end-diastolic volume index was significantly higher (96 mL/m2 vs. 69 mL/m2, p<0.0006) in Group A compared with Group C.

CONCLUSION

In patients with definite ARVC LV fat infiltration and DE are increasingly seen with higher TFC scores.

CLINICAL RELEVANCE/APPLICATION

Ventricular fat infiltration and DE, although not considered diagnostic criteria for evaluation of ARVC, may help in suggesting more advanced ARVC/D.

SSE04-06 • Post-myocarditis Scars Underlying Ventricular Tachycardia: Correspondence between Delayed-enhanced CMR or MDCT Imaging and Electroanatomic Mapping

Anna Palmisano (Presenter) ; Antonio Esposito MD ; Francesco A De Cobelli MD ; Giuseppe Maccabelli ; Paolo Della Bella ; Alessandro Del Maschio MD

PURPOSE

Catheter ablation guided by electroanatomic mapping (EAM) is an effective treatment for patients with ventricular tachycardia (VT) recurrence also in patients suffering from nonischemic cardiomyopathy. Post-myocarditis scars are more challenging than post-ischemic scars because are scarcely identified at EAM using a common approach with bipolar voltages. At this aim, unipolar mapping, including larger region of myocardial activity, may be more effective but it is less specific. Delayed enhancement imaging provide high accurate identification of myocardial scars. Aim of the study was to compare scars identified at delayed-enhanced imaging with different EAM approaches: bipolar-endocardial; unipolar-endocardial; bipolar-epicardial; unipolar-epicardial.

METHOD AND MATERIALS

19 patients (pts) with post-myocarditis VT were enrolled. 4 pts with ICD underwent MDCT including a delayed low-energy (80 kV) scan for scars identification; the remaining 15 pts underwent CMR including IR T1w sequences acquired 10-15 min after gadolinium injection. Scar size, extent and transmural distribution (subendocardial, mid-wall, subepicardial, transmural) were evaluated at imaging and compared with bipolar and unipolar voltages at endocardial and epicardial EAMs.

RESULTS

All patients showed myocardial scars at imaging, with subependocardial distribution in 10/19 pts and epicardial to midwall distribution in the remaining 9 pts. EAMs found low voltages suggestive for scar in 18/19 pts. Imaging-revealed scars were more frequently identified by unipolar mapping (71%, 1% for epicardial map, 24.7% for endocardial map) rather than bipolar one (63.2% for epicardial map, 1% for endocardial maps). In particular, epicardial unipolar mapping identified 100% of epicardial scars vs 44% by bipolar map.

CONCLUSION

Unipolar electroanatomic mapping guided by pre-ablation CMR or MDCT late enhanced imaging increases the chances for the identification of postmyocarditis scars underlying recurrent ventricular tachycardia, amplifying the possibilities of a successful radio-frequency ablation treatment in these patients.

CLINICAL RELEVANCE/APPLICATION

Merger pre-ablation late enhanced imaging and unipolar mapping allow a better identification of VT-substrate in patients with postmyocarditis scars, increasing the chances of successful trans-catheter.
Malignancies: Diagnostic Yield, Safety and Clinical Outcomes

**SSE05-04 • Detecting Pneumothorax at Very Low Dose MDCT after Intervention. How Low Can We Go?**

Adeel R Seyer MD (Presenter) *; Marcos P Botelho MD *; Carla B Harmath MD; Fernanda D Gonzalez Guindalini MD *; Mauricio S Galizia MD; Vahid Yaghmai MD

**PURPOSE**

To evaluate the effect of different kVp and mAs on MDCT detection of small pneumothoraces using different reconstruction algorithms.

**METHOD AND MATERIALS**

An anthropomorphic chest phantom containing pneumothorax was scanned 15 times, with 80, 100 and 120 kVp and with 10, 20, 40, 75 and 110 mAs. The images were reconstructed with 3-mm slice thickness, using both Filtered Back Projection (FBP) and Simion Affirmed Iterative Reconstruction (SAFIRE). Two blinded radiologists evaluated three regions with small pneumothoraces (pneumothorax thickness between 1.0 and 2.0 mm) and also a region without pneumothorax. Radiologists scored each area independently, as 0 (certainly no pneumothorax); 1 (equivocal for pneumothorax) or 2 (certainly a pneumothorax). CT/Dual was recorded to measure radiation dose. Statistical analyses were assessed by frequency and kappa statistics.

**RESULTS**

Both radiologists scored correctly all 30 cases without pneumothorax, regardless of acquisition settings or reconstruction algorithm. Six out of 90 (6.7%) pneumothoraces were called equivocal by reader 1 and 8 out of 90 (8.9%) by reader 2. Overall agreement between both readers was very good (k=0.85). The two thinnest pneumothorax regions were called equivocal by either one radiologist or the other at the lowest radiation dose settings (80 kVp/10mAs and 80kVp/20mAs), regardless reconstruction kernel. The lowest acquisition parameters that none of the readers had equivocal interpretations were 100kVp/20mAs (0.89mGy).

**CONCLUSION**

Acquisition settings as low as 100kVp/20mAs (0.89mGy) may be confidently performed with very low acquisition parameters. This may help reduce radiation dose for detecting pneumothorax after intervention.

**SSE05-05 • Analysis of Risk Factors Influencing Local Tumor Control in Patients with Pulmonary Nodules after Microwave Ablation (MWA)**

Thomas J Vogli MD, PhD (Presenter); Thomas Worst; Nagy N Naguib MSc; Nour-Eldin A Nour-Eldin MD, MSc

**PURPOSE**

To evaluate the risk factors predicting local tumor control after microwave ablation (MWA) of primary and secondary lung malignancies ≤3 cm in maximum diameter.

**METHOD AND MATERIALS**

In this retrospective study 91 index tumors (ITs) in 57 patients were treated with single antenna MWA. Time to local progression was monitored using CT over a median follow-up of 10.2 months ± 6.2 (range, 6.0 - 29.2). An overall estimated time to local tumor progression was performed via Cox regression model. Factors hypothesized to correlate with ablation response included tumor diameter (<3 cm in maximum diameter), tumor shape (round/oval vs. irregular), clear vs. ill-defined tumor margin, adjacency to the pleura, adjacency to bronchi, vessels of >3 mm in diameter located at a maximum of 5 mm from the IT, energy applied to IT (26.7 J/mm³) and occurrence of cavernous formations after ablation. A logistic regression model was used to correlate the data.

**RESULTS**

Local tumor progression occurred in 30/91 (33%) ITs, seen in 21/57 (36.8%) patients. Mean time to local tumor progression was 8.3 months ± 5.5 (range, 2.1 - 25.2) (median, 26.2 months ± 12.4 months). Risk factors significantly correlating with local tumor progression were >15.5 mm (p<0.05), basal 5 cm (p=0.04), basal 3 cm (p=0.003), and tumor ≤2 cm (p<0.05). Independent predicting factors for local tumor control in primary and secondary lung neoplasms ≤3cm in diameter are irregular IT shape and <3cm in diameter.

**CONCLUSION**

Independent predicting factors for tumor control in primary and secondary lung malignancies ≤3 cm in maximum diameter and <3 cm in diameter are irregular tumor shape and size ≤3 cm. These factors may help guide therapy based on the diagnostic yield. Statistical analysis was performed to determine univariate and multivariate predictors of diagnostic efficacy and frequency and severity of complications.

**SSE05-06 • Percutaneous Computed Tomography (CT)-guided Transthoracic Needle Lung Biopsy (TTNLB) in Patients with Hematologic Malignancies: Diagnostic Yield, Safety and Clinical Outcomes**

Ruth M Dunne MBChB (Presenter); Gowri Satyanarayana; Driele Peixoto; Francisco M Marty MD; Ritu R Gill MBBS *

**PURPOSE**

To evaluate the diagnostic utility and safety of CT-guided TTNLB in patients with hematologic malignancies and impact on clinical outcomes.

**METHOD AND MATERIALS**

This IRB-approved HIPAA-compliant study included consecutive patients with hematological malignancies who underwent TTNLB procedures between July 1, 2007 and June 30, 2012. Demographic, clinical and pathological data were collected. Both cyto-pathologic and microbiologic results were also assessed. Complications and hospital admission stays were recorded. Primary outcome measures were diagnostic efficacy, defined by number of procedures, which provided a specific diagnosis of either malignancy or infection; and safety defined, by number and type of complications per procedure. Secondary outcome measures were change in therapy based on the diagnostic yield. Statistical analysis was performed to determine univariate and multivariate predictors of diagnostic efficacy and frequency and severity of complications.

**RESULTS**

108 patients underwent 114 TTNLB procedures, resulting in established specific diagnoses in 37.7% (43/114) of procedures; 26 (22.8%) lesions were consistent with malignancy and 17 (15%) were infective etiologies. The most common underlying malignancy was non-Hodgkin lymphoma in 39% (42/108) of patients. Median lesion diameter was 3.1 cm (range, 0.7-14.2 cm; interquartile range, 2.1-9.5cm), lesions were most frequently located in the left lower lobe (31/114 [27.2%]); were pleural-based in 73/114 (64%); had surrounding ground glass opacification in 59/114 (51.8%). Complications occurred in 31 (27.5%) procedures: additional sampling (n=24) and successful needle biopsy (n=7); procedures requiring chest tube placement. Pneumothorax incidence was significantly associated with larger (18-G) biopsy needle use and longer lesion distance from pleura (p>0.05). The results of TTNLB led to changes in antimicrobial or oncological therapy in 46/44.7% of the 103 patients with adequate follow-up.

**CONCLUSION**

TTNLB is a safe diagnostic procedure in patients with hematologic malignancies with the potential of making specific diagnoses with minimal morbidity and can positively affect patient management.

**CLINICAL RELEVANCE/APPLICATION**

TTNLB in patients with hematologic malignancies is useful as it may establish specific diagnoses for which targeted treatments are available and can be performed safely with minimal morbidity.
Detection of Incidental Coronary Artery Calcifications

Richard Duszak MD (Presenter) ; Eugene Nsiah ; Danny Hughes PhD ; Jeff Maze * ; Martey S Dodoo PhD ; David A Rosman MD *

PURPOSE
To study the frequency, magnitude, and other characteristics of uncompensated services provided by radiologists in the emergency department (ED) setting.

METHOD AND MATERIALS
Using patient- and physician-redacted billing claims for 2,935 radiologists from 40 states between January 2009 through December 2012, 18,475,491 professional services were performed in the ED setting were identified. Analysis focused on the 133 of all reported 830 Category I CPT and HCPCS codes which comprised 99.0% (18,296,734) of all rendered services. The frequency, magnitude, and other characteristics of uncompensated (defined as zero payment) radiologist services were analyzed. National 2012 Medicare physician fee schedule amounts were used to estimate dollar value of services.

RESULTS
Of 2,935 radiologists, 2,835 (96.6%) provided uncompensated care to ED patients, averaging $2,483 per physician per service month. Radiologists received no compensation at all for 28.4% (5,194,732/18,296,734) of services rendered to ED patients. Most frequently rendered services were: 1-view CRX (600,547 uncompensated of 2,885,729 total; 28.8%), 2-view CRX (634,932/2,246,987; 28.3%), non-contrast brain CT (536,947/2,028,049; 26.5%), contrast abdomen/pelvis (AP) CT (147,793/512,816; 28.8%), and non-contrast AP CT (124,844/452,860; 27.6%). Most frequent modalities were radiography (2,916,912/10,664,437 total; 27.4% uncompensated), CT (1,658,511/5,701,654; 29.1%) and US (541,397/1,615,578; 33.5%). Although CT represented 31.2% of ED services, it accounted for 64.8% of uncompensated dollars. Of all uncompensated services, 52.3% (2,714,506) were rendered to uninsured patients and 47.7% (2,480,226) to insured patients (e.g., insurer denial, patient non-payment of deductible).

CONCLUSION
Over 28% of services radiologists rendered to ED patients are on a completely uncompensated basis, corresponding to $2,483 per month per physician. Both frequency and magnitude are likely underestimated by many.

CLINICAL RELEVANCE/APPLICATION
Services rendered by radiologists to ED patients are without compensation, corresponding to $2,483 per physician per month. The frequency and magnitude may impact patient access. Of services rendered to ED patients, 28.4% are without compensation, corresponding to $2,483 per physician per month. The frequency and magnitude may impact patient access. Of services rendered to ED patients, 28.4% are without compensation, corresponding to $2,483 per physician per month. The frequency and magnitude may impact patient access. Of services rendered to ED patients, 28.4% are without compensation, corresponding to $2,483 per physician per month. The frequency and magnitude may impact patient access. Of services rendered to ED patients, 28.4% are without compensation, corresponding to $2,483 per physician per month. The frequency and magnitude may impact patient access.

Structured Physician Order Entry for Trauma CT Scans Improves Clinical Information Transfer and Billing Efficiency in the Emergency Department

Jeremy R Wortman MD (Presenter) ; Aaron D Sodickson MD, PhD ; Asha Goud MD ; Michael H Stella MD ; Ali Raja MD, MBA * ; Annaoulos ; Dana Marchello

PURPOSE
To measure the impact of a structured physician order entry system for trauma CT imaging on the clinical information provided to the radiologist, and on associated coding practices and reimbursement success.

METHOD AND MATERIALS
The study was conducted between April 1, 2011 and January 14, 2013 at a quaternary care institution with a Level 1 Trauma Center and 58000 ED visits annually. The intervention implemented in March of 2012 was a structured order entry system for trauma CT scans. The presence in the requisition of clinical signs and symptoms and mechanism of injury, the primary ICD-9-CM code category, the success of reimbursement, and the occurrence of initial reimbursement denials were compared before and after the intervention for head through pelvis trauma CT “pan-scans.” Chi square statistics were used to compare examinations and patients before and after the intervention.

RESULTS
457 patients received CT pan-scans, including 2734 distinct exam accessions. After the intervention, there was a 62% increase in requisitions containing clinical signs, symptoms, or physical examination findings (from 1% to 63%, p < .0001), and a 99% increase in provided mechanism of injury (from 0.4% to 99%, p < .0001). There was a 19% increase in primary ICD-9-CM codes representing clinical signs or symptoms (from 3% to 22%, p < .0001), and a modest 4% increase in reimbursement success for examinations submitted to insurance carriers (from 91% to 95%, p = .003). Rate of initial reimbursement denials dropped 7% (from 24% to 17%, p = .04).

CONCLUSION
Implementation of structured physician order entry for trauma CT imaging was associated with a large increase in rate of clinical history provided to the radiologist. This was associated with a decrease in initial reimbursement denials and a modest increase in reimbursement success.

CLINICAL RELEVANCE/APPLICATION
Structured physician order entry for trauma CT imaging can increase the clinical information provided to the radiologist, improve coding practices, and increase reimbursement success and efficiency.

The Expanding Role of the Radiologist in Accountable Care Organization (ACO): Improving Adherence to ACO Quality Measures through Detection of Incidental Coronary Artery Calcifications

Jonathan Opraseuth MD ; Ari C Sacks MD (Presenter) ; Alexander J Adduci MD, PhD

PURPOSE
Evaluate the percentage of patients with incidental coronary artery calcifications on CT and determine if these patients are being appropriately managed according to the proposed new ACO quality measures for patients with ischemic vascular disease, specifically in regards to aspirin/anti-thrombotic treatment.

METHOD AND MATERIALS
IRB approved, retrospective review of all patients that underwent a Chest CT or CTA in the Emergency Department of a tertiary care, academic medical center between 9/1/2012 and 12/1/2012. The presence of coronary artery calcifications (CAC) was graded as mild, moderate, or severe. The electronic medical records of patients with CACs were evaluated to determine if there was a documented diagnosis of coronary artery disease (CAD) and if these patients were on an anti-thrombotic medication according to ACO guidelines.

RESULTS
568 consecutive patients had a Chest CT or CTA in the ED between 9/1/2012 and 12/1/2012. 45.4% patients (n=258), average age of 67.4 years (range 30 – 97 years), demonstrated presence of coronary artery calcifications graded as mild (n=125), moderate (n=74), or severe (n=59). Of the patients with CACs, 27.5% (n=71) had a documented diagnosis of CAD and 40.3% (n=104) were on aspirin. Of the patients who were not on aspirin (n=154), 6% (n=10) had a documented allergy or contraindication and 29% (n=44) were on another anti-thrombotic or anticoagulant. Of the patients with severe CACs, 73% (n=43) were on aspirin or another anti-thrombotic and 48% (n=28) had a documented diagnosis of CAD.

CONCLUSION
A large subset of patients with coronary artery calcifications incidentally noted on CT do not have documented CAD and are not being adequately treated with anti-thrombotic therapy according to the newest ACO guidelines. By acting upon this information, radiologists can facilitate early preventative care of coronary artery disease and improve adherence to the ACO guidelines regarding management of patients with ischemic vascular disease.

CLINICAL RELEVANCE/APPLICATION
Detection of incidental coronary artery calcifications identifies patients with undiagnosed coronary artery disease and who may benefit from aspirin/anti-thrombotic therapy according to ACO guidelines.

Coronary Artery Calcification Is Often Overlooked in CT Pulmonary Angiograms of Patients with Suspected Pulmonary Thromboembolism

Omid Khalilzadeh MD, MPH (Presenter) ; Patrick C Johnson BS ; Robert A Novelline MD ; Garry Choy MD, MS

PURPOSE
To study the frequency, magnitude, and other characteristics of uncompensated services provided by radiologists in the emergency department (ED) setting.
In patients with suspected pulmonary thromboembolism (PTEs), coronary artery calcification (CAC) can be an incidental finding in CT pulmonary angiograms. We evaluated the frequency of under-reporting CAC and its association with acute coronary syndrome (ACS) diagnosis.

**METHOD AND MATERIALS**

Data of 469 consecutive patients suspected for PTE, who were referred to the emergency radiology department for CT pulmonary angiography, were reviewed. Radiology reports were rechecked and positive CAC findings were recorded. All CT pulmonary angiograms were re-evaluated by one radiologist and CAC findings were recorded. The rate of ACS and PTE as final diagnosis for that hospital admission was calculated. The association between CAC and ACS diagnosis was assessed in different subgroups of patients.

**RESULTS**

About 11.1% of patients had PTE and 43.8% had CAC. CAC was significantly higher in patients with ACS diagnosis than those without (56.2% vs. 40.4%; OR=1.9). There was a strong positive association (OR=3.5) between CAC and ACS in younger patients (age=45 in men, age=55 in women); those without PTE (OR=2.15) and without cardiometabolic risk-factors (OR=3.8). CAC was unreported in 45% of patients with positive CAC (n=98). ACS was the final diagnosis in 31.6% of patients with unreported CAC. There was a significant association between CAC and ACS in patients with unreported CAC (OR=2.18). This association was more prominent in the above subgroups.

**CONCLUSION**

CAC is often overlooked in emergency CT pulmonary angiograms. CAC is a significant predictor of ACS, particularly in younger patients, those without PTE and cardiometabolic risk-factors. Especially in these sub-groups, radiologists should assess CAC findings.

**CLINICAL RELEVANCE/APPLICATION**

This study encourages radiologists to more vigilantly look for CAC in emergency CT pulmonary angiograms. Particularly in younger patients, CAC is highly suggestive for ACS diagnosis.

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**SSE06-05 • Radiology Resident On Call Performance in the Diagnosis of Ectopic Pregnancy Compared to Examinations Performed by Board Certified Sonographers**

**Purpose**

To evaluate the technical and interpretive skills of radiology residents in performing ultrasound exams for the emergent diagnosis of ectopic pregnancy.

**Method and Materials**

All emergency ultrasound exams ordered with a clinical suspicion of ectopic pregnancy were reviewed from 9/01/2011 to 12/31/2012. Out of 182 exams, 98 were performed by a resident with a resident preliminary report, and 84 were performed by an ultrasonologist attending final report. Sensitivity and specificity was calculated for radiology residents and ultrasonologist attending technologists with manual chart review as the gold standard. In a double-blind fashion, exams were graded for image quality with a 5-point Likert scale, and compared using a Cochran-Mantel-Haenszel test. Former residents were surveyed regarding whether the technical skills acquired in their training benefited them in their fellowship and attending positions.

**Results**

A total of 22 ectopic pregnancies were found upon chart review. Ectopic pregnancy sensitivity was 69% for residents and 67% for ultrasonologist/attending; specificity was 100% for both residents and technologist/attending. Overall image quality demonstrated no statistically significant difference between residents and technologists (Figure). Resident survey reveals that ultrasound technical training is considered a valuable acquired skill.

**Conclusion**

Radiology residents can be trained to emergently perform and correctly diagnose ectopic pregnancy on par with ultrasound technologists and radiology attending technologists on a similar sensitivity and specificity to published data for the initial ultrasound exam. The comparable image quality ensures a technically adequate exam to ensure patient safety. A survey of former residents reveals that ultrasound technical training is a valuable acquired skill in fellowship and attending positions. Should be given to making ultrasound technical skills an integral part of a diagnostic radiology residency curriculum.

**Clinical Relevance/Application**

No published study has evaluated the technical skills of radiology residents in performing emergent ultrasound exams in conjunction with the resident’s contemporaneous interpretation of those studies.

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**SSE06-06 • Impact of Resident Training on Imaging Utilization: A Ten Year Perspective at a Level I Trauma Center**

**Purpose**

Little is known regarding utilization of computed tomography (CT) over the course of resident’s training in a level I trauma center. In this study, we hypothesized that CT use is higher in early academic year (i.e. July-August) compared to the rest of the year, after adjustment for potential confounding variables, such as injury severity score, that could influence utilization rate.

**Method and Materials**

We linked Harborview Medical Center (HMC) trauma registry to the HMC billing department data from July 2000 to June 2010. Trauma registry included detailed information regarding patient demography, injury characteristics, trauma care and outcome. Billing data included detailed information on type and frequency of different body region CTs performed during hospitalization. Number of all CTs, CT head, thorax, abdomen and pelvis were the main outcomes evaluated. The primary exposure of interest was admission in July-August vs. the remainder of the year. Negative binomial regression was used to evaluate the association between month of the year and CT use, adjusting for age, gender, race/ethnicity, year of admission, mechanism and severity of injury, length of hospitalization, ICU admission, and final disposition.

**Results**

From 2000-2010 a total of 57,544 trauma admissions were recorded. The mean age of the patients was 38 years and 71% were male. On average the patients were hospitalized for 7 days. On average patients underwent 2.9 CTs during hospitalization and the most commonly performed studies for these patients were head (1.1 CTs/person), pelvis (0.5 CTs/person), abdomen (0.4 CTs/person), and thorax (0.2 CTs/person).

Patients admitted in July-August underwent slightly higher rate of abdomen (IRR: 1.06; 95% CI: 1.02-1.10), pelvis (IRR: 1.06; 95% CI: 1.02-1.10), and thorax (IRR: 1.06; 95% CI: 1.00-1.12) CTs. No differences were observed for head or extremity CTs.

**Conclusion**

We found that CT chest, abdomen and pelvis were slightly more common at the beginning of the academic year after adjusting for potential confounders. This could be partially due to the limited experience of new residents on trauma service. Our ongoing project further characterizes the factors associated with such observed patterns.

**Clinical Relevance/Application**

Limited experience of new residents on trauma service could be associated with higher utilization of CT for trauma patients.
RESULTS
1683 scans (995 females, 690 males) were included in the study. The mean DLP, effective dose and SSDE for these scans were 734.7±338.5mGy-cm, 13.2±6.4mGy-cm and 15.6±3.8mGy. The scans with doses greater than DLP of 1411.6 (35; 6M, 29F) were excluded for low contrast detectability. The CT numbers and the contrast to noise ratio (CNR) of 120 kVp and FBP-, iDose 4-reconstructed 80 kVp images at the abdominal aorta in hepatic arterial phase (HAP) and hepatic parenchyma in portal venous phase (PVP).

METHOD AND MATERIALS
This prospective study received institutional review board approval; prior informed consent was obtained from all patients. We enrolled 30 patients who underwent abdominal dynamic CT using 80-kVp setting with a half contrast dose (300 mgI/kg) during 30 sec. We also enrolled 30 patients who were scanned with a standard 120-kVp protocol with filtered back projection (FBP) technique using the standard contrast dose of 600 mgI/kg during 30 sec as a control group. The 80-kVp images were reconstructed with FBP, hybrid-iterative reconstruction (iDose 4) and IMR technique. We compared the effective dose (ED) of each protocol and evaluated image noise, CT numbers and the contrast to noise ratio (CNR) of 120 kVp and FBP-, iDose 4-reconstructed 80 kVp images at the abdominal aorta in hepatic arterial phase and hepatic parenchyma in portal venous phase.

CONCLUSION
IMR is a promising technique to improve the image quality of the half contrast agent dose and low radiation dose protocol for abdominal dynamic CT using 80 kVp and the IMR technique.

CLINICAL RELEVANCE/APPLICATION
Technologists can be given feedback/in-service training reiterating the role of proper patient positioning, avoiding repeats and scanning with arms above head to avoid unnecessary radiation exposure.

SS607-02 • Half Contrast Agent Dose and Low Radiation Dose Protocol for Abdominal Dynamic CT: Clinical Impact of the Iterative Model Reconstruction (IMR) for Low kVp Imaging
Takeshi Nakamura MD (Presenter); Shinichi Tokuyasu RT*; Masafumi Kidoh; Ryo Itatani; Kazunori Harada; Yasuyuki Yamashita MD*; Shinichi Nakamura MD

PURPOSE
Low kV-p (kVp) CT is well suited for low contrast and low radiation dose abdominal CT; however, increased image noise is a problem. The recent introduction of iterative model reconstruction (IMR, Philips Healthcare) dramatically reduces the image noise and offers virtually noise free images. We evaluated the feasibility of a half contrast agent dose and low radiation dose protocol for abdominal dynamic CT using 80 kVp and the IMR technique.

METHOD AND MATERIALS
This prospective study received institutional review board approval; prior informed consent was obtained from all patients. We enrolled 30 patients who underwent abdominal dynamic CT using 80-kVp setting with a half contrast dose (300 mgI/kg) during 30 sec. We also enrolled 30 patients who were scanned with a standard 120-kVp protocol with filtered back projection (FBP) technique using the standard contrast dose of 600 mgI/kg during 30 sec as a control group. The 80-kVp images were reconstructed with FBP, hybrid-iterative reconstruction (iDose 4) and IMR. We compared the effective dose (ED) of each protocol and evaluated image noise, CT numbers and the contrast to noise ratio (CNR) of 120 kVp and FBP-, iDose 4-reconstructed 80 kVp images at the abdominal aorta in hepatic arterial phase (HAP) and hepatic parenchyma in portal venous phase (PVP).

RESULTS
The total effective radiation dose was 42% lower with 80-kVp scan than with 120-kVp scan (9.0 mSv ± 1.3 vs 15.6 mSv ± 2.6). CT numbers with the half contrast dose 80 kVp protocol were significantly higher than with the 120 kVp protocol (abdominal aorta: 371.2 ± 65.1 vs 333.3 ± 46.9, p = 0.04; hepatic parenchyma: 21.1 ± 12.6 vs 107.7 ± 9.3, p < 0.01). IMR and iDose 4 technique decreased mean image noise by 72% and 45% as compared with FBP technique at 80 kVp scan (IMR: 4.5 ± 0.7; iDose: 8.8 ± 1.1; FBP: 15.8 ± 2.0; 120 kVp: 8.3 ± 1.6, respectively). The CNR of 80-kVp with IMR were significantly higher than 120-kVp protocols (abdominal aorta: 87.9 ± 19.8 vs 42.5 ± 10.8, p < 0.01; hepatic parenchyma: 26.3 ± 4.5 vs 13.2 ± 3.2, p < 0.01).

CONCLUSION
IMR is a promising technique to improve the image quality of the half contrast agent dose and low radiation dose protocol for abdominal dynamic CT with low kVp setting.

CLINICAL RELEVANCE/APPLICATION
The contrast dose for abdominal dynamic CT can be reduced by 50% by using a 80 kVp setting with IMR and improved image quality and reduced radiation dose.

SS607-03 • How to Choose Spectral CT Imaging Protocol Individually: A Dose Study in Abdomen
Tan Guo MD (Presenter); Cheng Zhou MD; Wen Chen; Juan Chen MD, PhD

PURPOSE
Spectral CT scan is thought of high dose level, but different protocol combinations can ensure a relative low dose. The aim of this study is to discuss choosing spectral CT protocol individually for each patient in abdominal examinations.

METHOD AND MATERIALS
This was a retrospective study using the imaging data of another abdomen research. 44 patients underwent two phase enhancement abdomen scan. GSI mode scan with fixed tube current were used in artery phase and conventional 120 kVp scan with auto tube current were used in portal venous phase (GE discovery CT 750 HD, GE Healthcare). There were two protocol settings of GSI mode scan (protocol A with pitch 1.375 and protocol B with pitch 0.984), and 31 patients underwent protocol A while others underwent protocol B. The CTDI were fixed in protocol A (15.64 mGy) and protocol B (21.84 mGy) for fixed tube current. The 44 patients were divided into 3 groups according to BMI (low BMI: 26). The noises and CTDI were compared in different groups and protocols between GSI mode scan and conventional 120 kVp scan.

RESULTS
The CTDI of GSI mode scan with both protocol A or B were significant higher than conventional 120 kVp scan (7.95 mGy) in low BMI group, the noises of GSI mode scans (6.3±0.8) were significantly lower than conventional scan (11.36±2.1). In the medium BMI group, the CTDI of protocol A didn’t show significant difference in comparison with conventional scan (14.97 mGy), CTDI of protocol B was significant higher than conventional scan (16.88 mGy). The noises of protocol A (10.3±0.9) and B (8.9±0.8) didn’t show significant difference than conventional scan. In the large BMI group, the CTDI of protocol A was significant lower than 120-kVp protocols (24.46 mGy, CTDI of protocol B didn’t show significant difference compared with conventional scan (26.45 mGy). The noises of protocol A (8.6±1.3) were equal to the noises of conventional scan, and the noises of protocol B (7.7±1.0) were significant lower than conventional scan.

CONCLUSION
In low BMI group, spectral CT scan is not suggested for the relatively high dose level. In medium and large BMI group, protocol A is suggested for acquiring the same image quality without increasing dose.

CLINICAL RELEVANCE/APPLICATION
Spectral CT scan as a dual energy technique has been introduced in clinical applications and confirmed as useful in diagnosing. However, the dose of spectral CT imaging is still debated.

SS607-04 • Radiation Dose Optimization in Abdominal Dual-source, Dual-energy CT: Assessment of Image Quality, Iodine Quantification and Low-contrast Detectability?
Matthias Benz (Presenter); Michele Pansini MD; Kovacs Bolazs; Robert Bolt; Dorothee Harder; Georg M Bongartz MD*; Zsolt Szucs-Farkas MD, PhD; Sebastian T Schinderer MD*

PURPOSE
To assess the image quality, iodine quantification and low-contrast detectability in abdominal dual-source, dual-energy CT at different radiation dose levels 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) and eight tubes containing solutions of varying iodine concentration (0-22 mgI/ml) were placed in a cylindrical water container that mimicked an intermediate-sized patient. The phantoms were scanned with a dual-source CT scanner (Somatom Definition Flash, Siemens) using the abdominal dual-energy protocol recommended by the vendor (tube A, 100 kVp, 230 reference mAs; tube B, 140 kVp, 196 reference mAs) (protocol A). The phantoms were also scanned with three dose-optimized protocols in which the reference mAs setting of tube A was reduced by 40, 80 and 120 compared to protocol A (protocol B, C and D, respectively). The radiation dose was assessed with the volume CT dose index (CTDVol). The image noise was measured, and the contrast-to-noise ratio (CNR) of the tumors was calculated. Tumor detection was independently performed by three radiologists. Software provided by the vendor was used for iodine quantification. Kruskal-Wallis test was used to compare image measurements between protocols.

RESULTS
The CTDIvol of protocol A, B, C and D measured 17.7, 14.6, 11.5 and 8.5 mGy, respectively. As the radiation dose decreased, the image noise increased (13.2, 14.6, 16.7 and 19.4 HU for protocol A, B, C and D, respectively) and the CNR decreased (4.4, 3.8, 3.1, and 2.7 for protocol A, B, C and D, respectively).  (P < 0.05 for all comparisons).

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The radiation dose of the abdominal dual-energy CT protocol is provided by the vendor can be reduced by at least 50% while maintaining low-contrast detectability and accuracy in iodine quantification. Image noise and CNR is not an adequate surrogate for evaluating the potential for radiation dose reduction.

**CLINICAL RELEVANCE/APPLICATION**

The radiation dose-optimized abdominal dual-source, dual-energy CT protocol improves patient safety without degradation of diagnostic accuracy.

**SSE07-05 • Reduction of Total Iodine Dose by Using Low Tube Voltage and High Tube Current Technique in Combination with Adaptive Statistical Iterative Reconstruction for Dynamic CT of the Liver**

Yoshifumi Noda MD; Satoshi Goshima MD, PhD; Hiroshi Kawada MD; Haruo Watanabe MD; Hiroshi Kondo MD; Masayuki Kanematsu MD; Nobuyuki Kawai MD (Presenter); Yuichiro Tanahashi MD; Kyongtae T Bae MD, PhD *

**PURPOSE**

To prospectively compare a low tube voltage (80-kVp) with a conventional (120-kVp) CT protocol for contrast enhancement degree of vascular and liver parenchyma, image quality, and detectability of hepatocellular carcinomas (HCCs).

**METHOD AND MATERIALS**

Instrumental review board approval and written informed consent was obtained. During a 9 months period, 170 patients (114 men, 56 women, age range 40-85 years, mean age 67.7 years) with suspicious having liver disease were randomized into three groups according to the following iodine-dose per body-weight protocols: 600 mgI/kg (600 mg of iodine per kilogram) at 120-peak kilo voltage (kVp) (Group 1), 500 mgI/kg at 80-kVp (Group 2), and 400 mgI/kg at 80-kVp (Group 3). One way analysis of variance were conducted to conduct evaluate differences in CT number, back ground noise, signal-to-noise ratio (SNR), DLP, effective dose (ED), HCC-to-liver contrast-to-noise ratio (HLC), and figure of merit (FOM). Receiver operating characteristic (ROC) curves were fitted to blinded observer-confidence ratings for the presence of HCCs. Sensitivity, specificity, and area under the ROC curve (AUC) were compared to assess the detectability of HCCs.

**RESULTS**

64 hypervascular HCCs (mean size, 16.8 mm; range, 6.0-88.0 mm) were identified in 35 patients (27 men, 8 women, mean 69.5 years, age range 51-85 years). Compared with group 1 and 3, group 2 demonstrated significantly higher contrast enhancement and CNR of the aorta in hepatic arterial phase (P < .001), portal vein (P < .001) and hepatic vein (P < .001) in portal venous phase (PVP), and liver parenchyma in all phases (P < .001). In group 2, HLC (P = .004) and FOM (P = .001) obtained in equilibrium phase were significantly superior to those in other groups. Sensitivity, specificity, AUC for detection of HCC, and image quality were comparable among three groups. The effective dose during HAP was lower in group 1 (3.3 ± 1.2 mSv) than in group 2 (3.8 ± 1.6 mSv) and 3 (4.1 ± 1.5 mSv) (P = .025).

**CONCLUSION**

Use of 400 mgI/kg at 80-kVp tube voltage demonstrated comparable image quality and detectability of HCC to conventional protocol of 600 mgI/kg at 120-kVp, while the use of 500 mgI/kg at 80-kVp showed better enhancement degree and HLC.

**CLINICAL RELEVANCE/APPLICATION**

Our study demonstrated the possibility of the iodine-dose reduction in 80-kVp CT imaging of the liver. This information is useful for designing clinical protocols for hepatic CT imaging.

**SSE07-06 • Liver CT with Low Tube Voltage and Model-based Iterative Reconstruction (MBIR) Algorithm for Hepatic Vessel Evaluation in Living Liver Donor Candidates**

Bo Yun Hur (Presenter) ; Jeong-Min Lee MD * ; Ijin Joo MD * ; Joon Koo Han MD ; Byung Ihn Choi MD, PhD *

**PURPOSE**

To investigate the image quality and diagnostic confidence of Model-based Iterative Reconstruction (MBIR) algorithm for evaluation of hepatic vessels on low-voltage (100-kVp) liver donor CT.

**METHOD AND MATERIALS**

Fifty-one consecutive low-voltage liver CT for liver donor work-up were reconstructed using FBP, adaptive statistical iterative reconstruction (ASIR), and MBIR and were compared with each other and thirty high-voltage (120-kVp) liver donor CT scans reconstructed using FBP. Weighted volume CT dose index and dose-length product, mean image noise, and contrast-to-noise ratios (CNRs) were assessed. Two radiologists evaluated the image quality and diagnostic confidence on the different image sets.

**RESULTS**

In low-voltage CT, a significant dose reduction was obtained compared with that in high-voltage CT (p =0.001). The image noise on MBIR images was significantly lower and CNRs on MBIR images were higher compared with those on FBP and ASIR images of low-voltage CT (p < .001). In portal venous phase (PVP), and liver parenchyma in all phases (P < .001). In group 2, HLC (P = .004) and FOM (P = .001) obtained in equilibrium phase were significantly superior to those in other groups. Sensitivity, specificity, AUC for detection of HCC, and image quality were comparable among three groups. The effective dose during HAP was lower in group 1 (3.3 ± 1.2 mSv) than in group 2 (3.8 ± 1.6 mSv) and 3 (4.1 ± 1.5 mSv) (P = .025).

**CONCLUSION**

Low-voltage liver CT using MBIR algorithm may increase the image quality and improve the diagnostic confidence for hepatic vessel evaluation at a reduced radiation dose compared with high-voltage CT with FBP.

**CLINICAL RELEVANCE/APPLICATION**

Low-voltage CT using MBIR could be recommended to liver donors for preoperative hepatic vessel evaluation because of improved image quality and diagnostic confidence with reduced radiation dose.

**ISP: Gastrointestinal (Oncology: Staging and Distant Metastases)**

Monday, 03:00 PM - 04:00 PM • E353C

**SSE08-01 • Integrated Whole Body PET/CT for Evaluation of Abdominal Malignancies: Does It Really Add Clinical Value Compared with Contrast-enhanced Body CT Scans?**

Beomseok Kang (Presenter) ; Jeong-Min Lee MD * ; Yong Sub Song MD ; Joon Koo Han MD ; Byung Ihn Choi MD, PhD *

**PURPOSE**

To evaluate the added value of combined positron emission tomography (PET) and magnetic resonance (MR) imaging (PET/MR) in diagnostic performance in patients with abdominal malignancy compared to that of conventional contrast-enhanced body CT examinations.

**METHOD AND MATERIALS**

Between October 2012 and March 2013, 77 patients who had history of abdominal malignancy underwent 18-FDG PET/MR and conventional body CT in our institution. Imaging analysis was performed to verify added values of PET/MR compared to conventional body CT for detection and characterization of abdominal tumors as well as staging. Added value of PET/MR was defined as follows: 1. Further characterization of the lesion which had been found on CT image; 2. Added detection of distant metastasis or lymph node metastasis which had not been detected on CT image; 3. Change of preoperative staging of disease. Diagnostic quality of image registration was subjectively assessed in a three point scale: 1: poor; 2: average; and 3: excellent. In 10 patients, patients already had their PET/CT scan performed immediately before undergoing the PET/MR examination.

**RESULTS**

In all patients, PET/MR examinations from head to proximal thigh were obtained within 25-35 minutes and additional dedicated MR examinations including dynamic MR imaging and diffusion weighted imaging took additional 20 minutes. In all patients except 1 patient (98.7%), quality of image registration was excellent or at least average. Overall added values of PET/MR were observed in 24 patients (31.2%). In detail, added values of MRI were observed at 13 patients (16.9%) and added values of PET were observed at 21 patients (27.3%). Further characterization of CT-detected lesions were made in 15 patients (19.5%), detection of new lesions in 5 patients (6.5%) and change of stage in 4 patients (5.2%). SUV values of the malignant tumors and the major organs on PET/MR were slightly lower than those on PET/CT.
CONCLUSION
Compared to conventional body CT, PET/MR imaging provides added value in further characterization of the lesions, detection of distant metastasis or lymph node metastasis and staging of malignancy at abdominal malignancy patients.

CLINICAL RELEVANCE/APPLICATION
PET/MR could be obtained within 1 hour, maximize diagnostic information and provide additional value for characterization and detection of abdominal malignancies, and staging compared to body CT scan.

SSE08-04 • Colorectal Cancer Staging: Comparison of Whole-body Hybrid MR/PET and PET/CT Imaging

Onofrio A Catalano MD (Presenter); Dushyant V Sahani MD; Francesco Crafa MD; Carlo Iannace MD; Peter F Hahn MD, PhD *; Alexander R Guimeranet MD, PhD *; Bruce R Rosen MD, PhD *; Mark Vangel PhD; Marco Catalano; Elisa Varriale; Ignazio Maria Francesco Sordelli; Anna Ferrante; Emanuele Nicolai; Andrea Sorcilli MD; Marco Salvatore MD

PURPOSE
To compare the lesion detection performance and SUV measurement accuracy of whole-body hybrid MR/ PET with PET/CT in patients with colorectal cancer (CRC).

METHOD AND MATERIALS
In this prospective IRB approved study, 15 consecutive patients with CRC 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
CONCLUSION
Hybrid MR/PET imaging provides all the diagnostic benefits in the assessment of the CRC patients with the benefits of superior local staging, nodal staging and accuracy in comparison to PET/CT.

CLINICAL RELEVANCE/APPLICATION
MR/PET might represent a very promising and innovative technique for accurate staging of CRC patients.

SSE08-05 • Comparison between MRI, CT and PET-CT for Lymph Node Staging in Patients with Squamous Cell Carcinoma of Anorectum and Anal Verge

Michael R Torkzad MD, PhD (Presenter) *; Hakon Ahlstrom; Jens Sorensen; Peter Nygren

PURPOSE
To compare T2 weighted imaging on MRI with contrast-enhanced CT with PET-CT and biopsy for lymph node staging in squamous cell carcinoma of anorectum and anal verge

METHOD AND MATERIALS
35 patients with histologically confirmed squamous cell carcinoma of anorectum and anal verge with available MRI and contrast-enhanced CT prior to PET-CT and biopsy were identified from the database. 10 lymph node stations were identified: inguinal (x2), internal iliac (x2), external iliac (x2), common iliac (x2), perirectal (x1) and paraaortic (x1). Based on signal characteristics on T2 weighted images of lymph node stations and the primary tumor and lymph node size node were classified into malignant and benign with different sets of criteria. Similarly, nodal stations were staged on contrast-enhanced pelvic CT based on size and different density criteria. Reference test comprised of histopathology whenever available, otherwise FDG-PET/CT with Max SUV = 2.5.

RESULTS
The best set of criteria for assessment of lymph node staging was obtained by CT based on any of the following criteria:
1. Lymph short axis diameter = 2 times the largest reported normal size
2. Clear sign of necrosis
3. Density of the node = the primary tumor.
With these criteria a sensitivity and specificity of 100% was achieved on CT. Non-enhanced MRI achieved significantly less promising results than CT (p < 0.01).

CONCLUSION
Contrast-enhanced CT can identify all pelvic nodes that are deemed malignant on FDG-PET/CT in patients with squamous cell carcinoma of anorectum and anal verge. This might reflect increased flow seen in metabolically active tumors as seen on PET/CT. Non-enhanced MRI cannot achieve the same good results.

SSE08-06 • Does PET/CT Derived Tumor Heterogeneity and Glucose Uptake Predict Survival in Primary Colorectal Cancer Patients?

Ming Young S Wan MBBS*; Balaji Ganeshan PhD (Presenter) *; Alec Englelou; Daren Francis; Nick Reay-Jones; Manuel Rodriguez-Justo; Vicky J Gooh MBBS*; Marie Meagher; Jackie Peck; Kim Jagg; Jackie Hayward; Helen Whiteway; Zia Saad; Faira Rizal; Jakub Nalupa *; Michael Hayball *; Robert Kozarski; Peter J Ell MD *; Stuart A Taylor MBBS; Steve Halligan MD; Kenneth Miles *; Ashley M Groves MBBS*

PURPOSE
To investigate the prognostic value of FDG PET and CT textural analysis (CTTA) in determining overall survival in primary colorectal cancer.

METHOD AND MATERIALS
RESULTS
3 patients were lost to follow up leaving 126 for analysis (79-males; 47-females; mean-age 62.6±10-yo). 39 (31.0%) patients died during follow-up. Univariate analysis revealed that textural heterogeneity (p=0.012) and tumor clinical stage (p=0.003) predicted survival but SUVmax or size did not. Using multivariable analysis, tumor computed topography textural heterogeneity (p=0.026) and stage (p independent survival predictors.

CONCLUSION
Using a cross validation model, tumor heterogeneity as measured on CT is shown to be a survival factor for patients with primary colorectal cancer, independent of clinical stage.

CLINICAL RELEVANCE/APPLICATION
Given that performing textural analysis is simple and could be easily adopted into clinical workflow, it would have potential management implications for primary colorectal cancer patients.
To determine whether magnetic resonance (MR) relaxometry of T1 in the liver can differentiate normal liver parenchyma from liver cirrhosis stratified by the Child-Pugh (CP) score.

METHOD AND MATERIALS

This retrospective study was approved by institutional review board and informed consent was waived. One hundred eight patients (M:F = 34:74, age range 26-76) underwent T1 relaxometry using modified Look-Locker inversion recovery (MoLLI) sequence before and 20 minutes after Gd-EOB-DTPA injection at 3T. T1 relaxometry was performed in a single breath-hold, and repeated three times at the different levels (upper than portal hilum, portal hilum and below portal hilum level). Signals were measured at the three levels, carefully avoiding vessels and focal lesions, and the mean values were taken. Patients were divided into three groups: normal liver function (n=30), liver cirrhosis (LC) with CP A (n=65), LC with CP B (n=11) and LC with CP C (n=1), except one patient with severe iron deposition (CP B, n=1). T1 relaxation times of precontrast and postcontrast relaxometries among the groups were compared with each other.

RESULTS

On postcontrast T1 relaxometry, CP B group showed significantly longer T1 relaxation time (509.27±128.7 msec) than CP A (339.4±103.7 msec) and normal liver function (291.8±73.0 msec) groups (p=0.05).

CONCLUSION

MR T1 relaxometry of the liver parenchyma on Gd-EOB-DTPA enhanced MR may have potential to estimate liver function.

CLINICAL RELEVANCE/APPLICATION

T1 relaxation times may assess liver function quantitatively, by objectively assessing Gd-EOB-DTPA uptake of the liver.

SSE09-02 • The Feasibility of Texture Analysis Using Susceptibility-weighted Magnetic Resonance Imaging in Detecting Patients with Liver Cirrhosis

Diana S Feier MD (Presenter); Thomas Knogler MD; Marius E Mayerhoefer MD, PhD; Csilla Balassy MD; Ahmed Ba-Ssalamah MD

PURPOSE

To establish the feasibility of textural features of liver parenchyma obtained on susceptibility weighted magnetic resonance imaging (SWI MRI) which will enable the detection of liver cirrhosis in patients with diffuse chronic liver diseases (CLD).

METHOD AND MATERIALS

RESULTS

Six out of ten texture features selected on the basis of Fisher coefficients were derived from grey-level histogram. Of the 65 patients included, 62 (95.38%) were classified correctly by k-NN. Sensitivity was 96.3% and specificity was 94.7%.

CONCLUSION

Texture features extracted from the grey-level histogram calculated from SWI MRI data are feasible to correctly identify cirrhotic changes in liver parenchyma of patients with CLD.

CLINICAL RELEVANCE/APPLICATION

Although it proved to be a feasible method, further studies are necessary to determine whether the SWI texture analysis features are able to differentiate between severity scores of liver cirrhosis.

SSE09-03 • Dynamic Gadoxetic Acid-enhanced MR Imaging of the Rat Liver: Correlation between Functional MR Parameters and Hepatocyte Organic Anion Transporter Function in Cirrhosis

Matthieu Lagadec MD; Maxime Ronot MD (Presenter); Sabrina Doblas PhD; Celine Giradeau PhD; Jean-Luc Daire PhD; Simon Lambert; Magali Fasseu; Valerie Paradis MD; Richard Moreau PhD; Bernard E Van Beers MD, PhD

PURPOSE

To assess the value of enhancement and pharmacokinetic parameters measured at dynamic gadoxetate-enhanced MR imaging in the determination of hepatic organic anion transport function in rat liver cirrhosis.

METHOD AND MATERIALS

RESULTS

In rats with cirrhosis, the maximal enhancement and time to peak decreased significantly relative to control rats, whereas the elimination half-life increased significantly. Similarly, the hepatic extraction fraction decreased and the mean residence time increased significantly. Several enhancement and pharmacokinetic parameters correlated significantly with the transporter expression of Oatp1a1 and Mrp2, with r values > 0.7, as they did the mean residence time with Mrp4. The respective values were p < 10^-4, r = 0.744; p < 10^-4, r = 0.911, and p = 0.001, r = 0.921.

CONCLUSION

The pharmacokinetic parameters, hepatic extraction fraction and mean residence time, determined at dynamic gadoxetate-enhanced MRI imaging, are markers of the changes of hepatic organic anion transporter expression in liver cirrhosis.

CLINICAL RELEVANCE/APPLICATION

DHC-MRI has the potential to assess hepatocyte transporter function in liver cirrhosis.

SSE09-04 • Utility of Dynamic and Hepatobiliary Phase Gadoxetate-enhanced MRI for Characterization of T1-w Hyperintense Lesions in Cirrhosis. Do Challenges Exist?

Ka-Kei Ngan MD (Presenter); Jing Luo; Michael Nalesnik MD *; Keyanoosh Hosseinzadeh MD *

PURPOSE

To evaluate gadoxetate-enhanced DCE-MRI for detection of hepatocellular carcinoma (HCC) in cirrhotic patients with incidentally discovered T1-w hyperintense lesions.

METHOD AND MATERIALS

RESULTS

There were 42 pathologically confirmed lesions (15 wd-HCC, 4 mod-diff HCC, 3 dysplastic nodules, 20 regenerative nodules) in 20 patients. Based on consensus data combining dynamic and HB phase did not change diagnostic performance compared to dynamic phase only with sensitivity and specificity of 0.74 and 0.78. Inter-observer agreement was only moderate for both dynamic (0.43) and combined dynamic and HB phases (0.5). HB phase did correlate with pathology (p < 0.05).

CONCLUSION

Although, addition of HB phase did not improve diagnostic performance, hypointensity on HB phase correlates strongly with malignancy. No discriminatory threshold size was found.

CLINICAL RELEVANCE/APPLICATION

A hyperintense precontrast T1-w lesion that becomes hypointense on the HB phase raises high suspicion for malignancy.

SSE09-05 • Supersonic Shear Wave Elastography as a Non-invasive Tool for Determining Improvement of Portal Hypertension in Cirrhotic Patients

Seo-Youn Choi MD (Presenter); Woo Kyoung Jeong MD; Yong-Soo Kim MD, PhD; Jinoo Kim; Hyo Keun Lim MD; Dongil Choi

PURPOSE

To evaluate gadoxetate-enhanced DCE-MRI for detection of hepatocellular carcinoma (HCC) in cirrhotic patients with incidentally discovered T1-w hyperintense lesions.
To investigate whether it is feasible to estimate the change of hepatic venous pressure gradient (HVPG) using Supersonic shear wave elastography (SWE) in the patients with portal hypertension.

**METHOD AND MATERIALS**

Twenty-three consecutive patients who were diagnosed with portal hypertension (> = 6 mmHg of HVPG) on initial HVPG measurement and who underwent follow-up measurement to evaluate response to treatment were enrolled in this retrospective study. Liver stiffness measurement was performed in all of the subjects, followed by HVPG measurement through transjugular catheterization on the same day. Liver stiffness was obtained intercostally, which was repeated 5 times at the same location of the right liver. The relationship between the HVPG and liver stiffness on initial measurement and on follow-up was investigated by using Pearson's correlation test. Furthermore, we evaluated whether a change in the HVPG (ΔHVPG) was correlated with a change in the liver stiffness (ΔLS). The subjects were subdivided into two groups: those in whom the HVPG at follow-up decreased by > = 20% compared to the initial measurement (clinical improvement), and those in whom the percentage of decrease was less than 20%. The performance to determine improvement of portal hypertension was investigated using the receiver operating characteristics (ROC) curve analysis.

**RESULTS**

Liver stiffness was significantly correlated with HVPG at initial and follow-up measurements (r=0.501 and 0.527, respectively). The mean rate and difference of LS were strongly correlated with ΔHVPG (r=0.863 and 0.707, respectively). To determine the improvement of portal hypertension, the area under the ROC curve was 0.79 of rate of ΔLS, and 0.78 of difference of ΔLS.

**CONCLUSION**

Supersonic SWE is feasible method to determine improvement of portal hypertension in cirrhotic patients.

**CLINICAL RELEVANCE/APPLICATION**

Supersonic SWE is available for evaluation of improvement of portal hypertension, therefore can replace conventional invasive catheterization. Supersonic SWE is available for evaluation of improvement.

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**SSE09-06**  
**Assessment of Liver and Spleen Viscoelastic Properties Associated with Portal Hypertension Using Multifrequency Magnetic Resonance Elastography**

Maxime Ronot MD (Presenter); Simon Lambert; Laure Elkrief; Pierre Emmanuel Rautou; Didier Lebrec; Laurent Castera; Valerie Vilgrain MD; Ralph Sinkus PhD; Bernard E Van Beers MD, PhD

**PURPOSE**

To assess the liver and spleen viscoelastic properties associated with portal hypertension using magnetic resonance elastography (MRE) in a consecutive series of patients with chronic liver disease

**METHOD AND MATERIALS**

From January to September 2012, patients with histologically proven cirrhosis and registered on the pre-transplant list of our institution were prospectively included. Clinical and biological data including presence and severity of ascites, esophageal varices (graded on an upper GI endoscopy), Child-Pugh and MELD scores were recorded. All patients underwent a transjugular hepatic venous portal gradient (HVPG) measurement (mmHg) and a MRE examination on the same week. MRE sequence (25, 56, and 84 Hz) was performed on a 1.5 T imaging scanner. Two mechanical transducers placed on both sides of the patients were used to analyze liver and spleen stiffness (FOV: 320mm2, matrix: 80x80, TR/TE: var/9.21ms, 8 dynamics, acquisition time: 1 min). Complex shear modulus was extracted, and the elasticity (Gd) and viscosity (Gg) were calculated. Correlations were performed between the viscoelastic parameters and the clinic-biological data were performed using the Spearman coefficient test.

**RESULTS**

42 patients (31 males, 76%) with a mean age of 55.5 (range: 31-69) were included. Six patients (14%) were excluded due to incomplete MR examination. Cirrhosis was related to alcohol consumption (n=16) and HCV (n=9). Child score was A (n=7), B (n=13) and C (n=16). Median MELD score was 15 (range: 6-33). Median HVPG was 16mmHg (range: 6-36). Ascites was detected in 25 patients (69%). 29 patients had esophageal varices (including 14 patients with grade 3). There was no correlation between liver elasticity or liver viscosity and any of the clinicobiological parameter (MELD and Child-Pugh scores, ascites, esophageal varices, and HVPG). Spleen elasticity and spleen viscosity significantly correlated with HVPG (r=0.44, p=0.02 and r=0.53, p=0.0041, respectively) but not with the other parameters (MELD and Child-Pugh scores, ascites, and esophageal varices).

**CONCLUSION**

The spleen viscoelastic properties assessed by MRE are correlated with the hepatic venous portal gradient in patients with chronic liver disease.

**CLINICAL RELEVANCE/APPLICATION**

Our results indicate that the spleen visco-elasticity assessed by MRE is related to the severity of portal hypertension, and might constitute an interesting biomarker in severe chronic liver disease.

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**Genitourinary (Renal CT and MR Angiographic Techniques)**

**SSE10-01**  
**Feasibility Study of Prospective ECG-triggered Axial Scan Applied in Renal Artery Imaging**

Ying Guo MD (Presenter); Dapeng Shi MD; Minghua Sun; Peigang Ning; Hui Xu

**PURPOSE**

To investigate the feasibility of prospective ECG-triggered axial scan applied in renal artery imaging.

**METHOD AND MATERIALS**

72 patients referred to renal CT angiography were randomly divided into 2 groups. Group A(n=37) underwent prospective ECG-triggered axial scan. Group B (n=35) performed conventional 120 kVp CTA with Noise Index of 8 pitch of 1.375 and same contrast media protocol of group A. Images were reviewed by 2 experienced radiologists independently. ROIs were placed in psoas muscle, R/L renal artery. Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) was calculated with ROI measurements. Subjective score was rated on a 5-point-scale and artifact caused by spiral scan and axial scan were evaluated. Comparison of percentages of diagnostic images (score=3) were performed and image quality was statistically compared. DLP and Effective Dose was recorded and compared.

**RESULTS**

**CONCLUSION**

Renal artery imaging performed prospective ECG-triggered axial scan can get equivalent image quality compared with 120 kVp, while radiation dose and artifact caused by spiral scan greatly reduced.

**CLINICAL RELEVANCE/APPLICATION**

Prospective ECG-triggered axial scan can be applied in renal artery imaging and got excellent diagnostic images.

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**SSE10-02**  
**Comparison of Fixed to Weight-based Contrast Dose for CTA of the Chest, Abdomen, and Pelvis**

Theodora A Potretzke MD (Presenter); Scott K Nagle MD, PhD *

**PURPOSE**

To determine whether a fixed or a weight-based contrast dose injection results in more uniform opacification of the aorta in patients undergoing combined CT angiography of the chest, abdomen, and pelvis.

**METHOD AND MATERIALS**

This IRB-approved retrospective study included 22 fixed dose (150 mL iohexol) exams (11 ECG-gated) and 22 weight-based dose (P3T protocol, Medrad, Pittsburgh, PA) exams (12 ECG-gated) obtained for clinical purposes between 12/8/2011 and 4/24/2012. All scans were performed on a GE 64-slice CT scanner. Age and body mass index (BMI) of each patient were recorded. The aortic attenuation gradient (AAG) and the percent aortic attenuation decrease (PAD) were calculated from mean Hounsfield Units in ROIs placed in the ascending aorta (AsAo) and at the aortic bifurcation (AoBif) using the equations: AAG
METHOD AND MATERIALS

60 patients with diagnosed cervical cancer underwent pelvic CT angiography either with CT spectral imaging mode (n=30, group A) or conventional scan mode (n=30, group B) with 120kVp. The contrast agent dose of 1 ml / kg, the flow rate was 3-5ml/s adaptive to the Body Mass Index. The optimal contrast-to-noise (CNR) for iliac artery was achieved by dedicated software for spectral imaging analysis (GSI viewer). The selected optimal monochromatic image and TPXI image were post-processed by MIP and VR. Also, the bilateral ilial artery CT values,noise and CNR were measured on the selected optimal monochromatic image and TPXI image respectively. The image qualities were accessed by two experienced radiologists with 5-point scale. Dose-length-product (DLP) was recorded for both groups. Data compared with student T-test and sum-rank test.

RESULTS

CONCLUSION

Low-keV monochromatic images improve the visualization of the feeding artery and laterd branches of the cervical cancer.

CLINICAL RELEVANCE/APPLICATION

Low-keV monochromatic images improve the visualization of the feeding artery and laterd branches of the cervical cancer, which help its clinical diagnosis and treatment.

SSE10-04 • Comparing Diagnostic Accuracy of Contrast Enhanced CT Angiography and Contrast Enhanced MR Angiography for the Assessment of Hemodynamically Significant Transplant Renal Artery Stenosis

Santhosh Gaddikeri MD (Presenter) ; Lee M Mitsumori MD, MS * ; Sandeep Vaidya MD ; Daniel S Hippe MS * ; Puneet Bhargava MD ; Manjiri K Dighe MD

PURPOSE

To compare diagnostic accuracy of contrast enhanced CT angiography (CTA) and contrast enhanced MR angiography (MRA) for the assessment of hemodynamically significant transplant renal artery stenosis (TRAS).

METHOD AND MATERIALS

After institutional review board approval, records of 27 patients with TRAS confirmed on Digital Subtraction Angiography (DSA) were retrospectively reviewed. Thirteen patients had MRA and 14 had CTA prior to DSA. Two board-certified fellowship trained radiologists, one each from interventional radiology and body imaging blindly reviewed the DSA and CTA/MRA data respectively and classified the stenosis as either hemodynamically significant (>50%) or non-hemodynamically significant.

RESULTS

Seven of 13 patients who had significant TRAS on MRA also had significant stenosis on DSA and 3 of 4 patients with non-hemodynamically significant stenosis on MRA had a significant stenosis on DSA. Two hemodynamically significant stenoses were not visualized on MRA due to susceptibility artifacts.

Ten of 14 patients who had significant TRAS on CTA also had significant stenosis on DSA and 1 of 3 patients with non-hemodynamically significant stenosis on CTA had a significant stenosis on DSA. Sensitivity 0.70, specificity 1.

CONCLUSION

MRA is more specific but less sensitive than CTA to diagnose hemodynamically significant TRAS. Susceptibility artifact related to surgical clips is a significant limitation of MRA to accurately diagnose TRAS.

CLINICAL RELEVANCE/APPLICATION

Higher specificity and lack of radiation and nephrotoxic iodinated contrast makes MRA a better modality than CTA in the diagnosis of hemodynamically significant TRAS.

SSE10-05 • CT Renal Angiography: Comparison between Iodixanol (270 mg I/ml) with Monochromatic Imaging and Iohexol (350 mg I/ml) with Conventional Imaging

Kefeng Zhou (Presenter) ; Jian He MD, PhD ; Bin Zhu

PURPOSE

To compare the image quality of CT renal angiography using iso-osmolar Iodixanol (Visipaque, 270 mg I/ml) at monochromatic images with low-osmolar Iohexol (Omnipaque, 350 mg I/ml) at conventional 120kVp images

METHOD AND MATERIALS

Thirty patients received Iohexol (Omnipaque 350 mgI/ml) who underwent conventional CT scan (120kVp, NI=8, pitch 1.375, rotation time 0.8s) in CT renal artery angiography while forty-two patients received Iodixanol (Visipaque 270 mg I/ml) who underwent spectral CT imaging(40mm,0.6s,large) with the single-source fast kV switching dual energy acquisition (80 kVp and 140kVp) during the arterial phase (bolus tracking, 1.0 ml/kg, 3.5ml/s). Five regions of interest (ROI) were drawn at the abdominal aorta, left and right renal artery and cortex respectively. CT attenuation value and contrast-noise ratio (CNR) of each ROI were obtained on both optimal monochromatic images and the conventional scan. Volume rendering images of renal artery were reconstructed by both of them( thickness 0.625mm) and the image quality and radiation dose were compared between the two groups.

RESULTS

CONCLUSION

Monochromatic images (usually around 53keV) by using Iodixanol (270 mg I/ml) with low radiation dose could provide better image quality than conventional images by using Iohexol (350 mg I/ml) in renal artery CT angiography.

CLINICAL RELEVANCE/APPLICATION

Lower monochromatic imaging in renal artery angiography with low–iodine-consistency contrast medium, which is benefit to renal function ,can achieve better quality images than conventional protocol.

SSE10-06 • Comparison of the Effect of Visipaque 270 and Visipaque 320 in CT Angiography

Haijian Fan (Presenter) ; Bin Zhu

PURPOSE

To compare the effect of Visipaque 270 and Visipaque 320 in CT angiography in the arterial phase.

METHOD AND MATERIALS

This prospective study was approved by local ethics committee and patient's informed consent was obtained. One hundred and thirty one patients were recruited in this study. Forty two patients received Visipaque 270, 1 mL/kg, and 89 patients received Visipaque320, 1 mL/kg. All the patients were scanned on 120kVp with dose modulation. CT angiography were performed with single-source fast kV switching dual energy acquisition (80 kVp and 140kVp) during the arterial phase (bolus tracking, 1.0 ml/kg, 3.5ml/s). The radiation dose and image quality were compared between the two groups.

RESULTS

There was no significant difference in age or BMI between the groups. When ECG-gating was used for the chest portion of the exam, the aortic opacification was more uniform with fixed dose than with weight-based dose (AAG -11 vs 91, p=0.027; PAD -4% vs 21%, p=0.014). The aortic opacification was also more uniform using a fixed dose injection on the non-gated exams; however, the difference was not statistically significant (AAG -14 vs 22, p=0.324; PAD -1% vs 5%, p=0.36). The mean weight-based contrast dose (126 ± 4 mL) was significantly lower than the fixed dose (150 mL).

CONCLUSION

A fixed contrast dose for ECG-gated CTA-chest/abdomen/pelvis provides more uniform aortic opacification than does weight-based contrast dosing. This may be due to a slight (1-2 s) delay between the chest and abdomen portions of the exam on the GE VCT scanner, related to switching between gated and non-gated modes. However, weight-based dosing using the Medrad P3T software can be used to decrease iodinated contrast load for non-gated CTA of the chest, abdomen, and pelvis without compromising aortic opacification.

CLINICAL RELEVANCE/APPLICATION

Since bolus arrival time varies considerably through the large volume covered by CTA chest/abdomen/pelvis, it is important to ensure that weight-based contrast dosing provides adequate opacification.
effective doses for the three-phase protocol and for TNC images were 11.2 and 2.1 mSv, respectively. The imaging quality of the VNC from the two phases was rated as good. The mean CT numbers between TNC and VNC were not significantly different (P> 0.05). In the renal cortex-to-RFA site, the CNR between the two phases was 11.2 and 2.1 mSv, respectively.

RESULTS

Between May 2011 and April 2013, 31 MR-guided focal cryoablation procedures were performed in 28 patients with histopathologically proven local PCa recurrence after radiotherapy without evidence for local or distant metastases. Follow-up after MR-guided cryoablation consisted of a visit to the urologist, PSA-level measurement and a multi-parametric MRI after 3, 6 and 12 months.

RESULTS

In one patient the procedure was cancelled because the urethral-warmer could not be inserted. Two months later he was treated successfully. All other procedures were technically feasible. Follow-up ranged from 0 – 22 months with a median of 10 months. One patient died 4 months after treatment for reasons unrelated to PCa.

In 2/28 of the patients mild incontinence, defined as urge-incontinence, was seen. Temporary urinary retention was experienced by 2/28 of the patients, 2/28 suffered from continuing urinary retention, needing clean-intermittent catheterization. One of them needed surgery to remove an urethral stricture. Fistulas were not recorded. Four patients underwent an MR-guided biopsy after six months and one patient after 12 months, because of a tumor suspicious region on the multi-parametric MR images. In two patients the biopsies were negative for tumor recurrence. In the other 3 patients recurrent or remnant PCa was histopathologically proven and they were successfully re-treated with MR-guided cryotherapy after respectively 8, 8 and 14 months.

Node metastases were found in 2 patients after respectively 3 and 22 months. In another patient, bone metastases were seen 3 months after MR-guided cryoablation.

CONCLUSION

Initial results of MR-guided focal cryoablation of recurrent PCa after radiotherapy are promising, however longer follow-up is needed and more patients have to be studied.

CLINICAL RELEVANCE/APPLICATION

Initial results of MR-guided focal cryoablation of recurrent PCa after radiotherapy are promising, however longer follow-up is needed and more patients have to be studied.

SSE11-03 • Long-term Results after Magnetic Resonance-guided Focused Ultrasound Surgery (MRgFUS) Treatment of Patients with Symptomatic Uterine Fibroids

Julia Kamp MD (Presenter); Vera Froeling MD; Patrick Freyhardt; Matthias David PhD; Alexander N Beck MD

PURPOSE

Long-term results after magnetic resonance-guided focused ultrasound surgery (MRgFUS) treatment of premenopausal women with symptomatic uterine fibroids. Outcome was measured by the Uterine fibroid Symptom and Quality of Life Questionnaire (UFS-QOL).

METHOD AND MATERIALS

Retrospective evaluation of 54 patients, who were initially included into a prospective short-time study. MRgFUS treatment had been performed between 2003 and 2008. Patients were readdressed to receive long-term results of this collective. Clinical outcome was assessed by the fibroid specific questionnaire UFS-QOL. Results at baseline, after 3, and 12 months of 59 patients are presented.

RESULTS

After MRgFUS-treatment of symptomatic uterine fibroids quality of life improved significantly. Symptom relief was seen after 3 and 12 months and especially after long-term follow-up after a median time of 59 months. The score of overall quality of life increased significantly from a median of 64.7 (QR: 28.1-56.3) to 77.6 (QR: 61.4-87.1) after 3 months (p<0.05). The rate of reinterventions might be reduced by improved patient-screening. As in current studies suggested there seem to exist possible predictors of long-term success.

CLINICAL RELEVANCE/APPLICATION

Long-term results after MRgFUS treatment of uterine fibroids are still rare, they are essential to prove effectiveness and to allow comparison with other methods (surgical and minimal invasive).

SSE11-04 • Assessment of Therapeutic Response to Radiofrequency Ablation for Renal Cell Carcinomas Using Dual-energy CT

So Yoon Park (Presenter); Chan Kyu Kim MD, PhD; Sung Yoon Park; Byung Kwan Park MD

PURPOSE

To retrospectively investigate the utility of dual-energy (DE) CT using virtual noncontrast (VNC) and iodine overlay (IO) images in assessing therapeutic response to radiofrequency ablation (RFA) for renal cell carcinomas (RCCs).

METHOD AND MATERIALS

47 consecutive patients with RCCs that underwent DECT after RFA were enrolled in this study. Our DECT protocols included true noncontrast (TNC), DE corticomedullary and DE late nephrographic phase imaging. VNC and IO images were derived from the DE corticomedullary and DE late nephrographic phases, respectively. For predicting local tumor progression at RFA sites, linearly blended and IO images from DE corticomedullary and DE late nephrographic phases were analyzed qualitatively and quantitatively. Contrast-to-noise ratios (CNR) of renal cortex-to-RFA zone were calculated. The overall imaging quality of VNC images were compared with TNC images. The effective radiation doses for DECT and for TNC images were calculated.

RESULTS

For predicting local tumor progression, IO images from DE corticomedullary and DE late nephrographic phases showed excellent diagnostic performance (each sensitivity 100% and each specificity 91.5%). The enhancement degree of local tumor progression at linear blended versus IO images was not significantly different (P>0.05). The mean CT numbers between TNC and VNC were not significantly different (P>0.05). The imaging quality of the VNC from the two phases was rated as good. The mean effective doses for the three-phase protocol and for TNC images were 11.2 and 2.1 mSv, respectively.
RESULTS
We evaluated "pre-treatment volume" measured in the T2-weighted sequences using an informatic method on single slice; "treated volume" obtained from the Exablate measurement system 2100; "Non Perfused Volume"(NPV), evaluated on the c.e. T1-weighted sequences made immediately after treatment. Results showed a "treated volume" mean value of 72.5% of the volume drawn by the operator. The NPV was meanly 14% greater than the "treated volume". Comparing the three different parameters we can demonstrate that we treated a mean of 86.5% of the lesion. After 12 weeks, the symptomatic score showed a reduction of about 90% if compared to the pre-treatment one.

CONCLUSION
MRgFUS is a mini-invasive treatment for adenomyosis. It permits to maintain the integrity of the uterus, a good extension of NPV, a shorter hospitalization with significant reduction of the symptoms. In conclusion, it is a valid and conservative treatment in a pathology which so far had limited therapeutic perspectives.

CLINICAL RELEVANCE/APPLICATION
The study demonstrates the effectiveness of the technique in the uterine adenomyosis treatment, allowing complete resolution of symptomatology and mostly uterine saving, thus avoiding hysterectomy.

SSE11-06 • Entirely Endophytic Small Renal Masses: Outcomes of Percutaneous Biopsy with US or CT Guidance

Mi-Hyun Kim MD (Presenter) ; Jeong Kon Kim MD ; Hyuck Jae Choi MD ; Kyoung-Sik Cho MD

PURPOSE
Endophytic renal tumors have been related to higher surgical complexity and higher postoperative complication rate than exophytic lesions. To avoid unnecessary surgery, the number of biopsies in these endophytic lesions is increasing in our institution. The purpose of our study was to evaluate the diagnostic rate and safety of the percutaneous core needle biopsy in patients with entirely endophytic small renal masses (SRM).

METHOD AND MATERIALS
A total of 57 biopsies of the entirely endophytic SRM (= 4 cm) were performed with 18-gauge needle from July 2004 to January 2013. The diagnostic rate, histologic finding, complication rate, the type of image guidance (US or CT), and tumor location were assessed from the retrospective chart and image reviews. Tumor location was divided into two subgroups (central- vs. peripheral tumor). Central lesions were defined as tumors protruding to the renal sinus fat and in actual contract with the pelvicalyceal system and/or main renal vessels.

RESULTS
Biopsy was diagnostic in 53 (93.0%) renal masses and nondiagnostic in 4 (7%). Among the diagnostic biopsies, 60% (32 of 53) were malignant and 40% (21 of 53) were benign. No serious complication such as active bleeding was occurred. Of the 57 biopsies, 39 were done with CT guidance and 18 with US guidance. Of the entirely endophytic SRMs, 35% (20 of 57) were central tumors and 65% (37 of 57) were peripheral tumors. Central tumors had a higher rate of malignant pathology (90% in central tumors, 44% in peripheral tumors, P < .05). The diagnostic rate was not different between central tumors (95%) and peripheral tumors (92%) (P > .05).

CONCLUSION
Percutaneous biopsy of the entirely endophytic SRMs is safe and diagnostic in most cases. Image-guided core needle biopsy can aid the clinician in the management and decision-making of the entirely endophytic SRMs.

CLINICAL RELEVANCE/APPLICATION
Image-guided biopsy can be helpful for the the management of the entirely endophytic small renal mass, and can decrease unnecessary surgery of benign tumors.
SSE12-03 • Protocol Driven Ultrasound: An Effective Method to Improve Efficiency in an Ultrasound Department

Rupan Sanyal MD (Presenter) * ; Aimen Ismail ; Benjamin R Kraft ; Mark E Lockhart MD ; Lauren F Alexander MD ; Timothy M Beasley PhD ; Michelle L Robbin MD *

PURPOSE
Ultrasound is operator dependent and although each department has guidelines, a wide variation in image acquisition between studies is often seen. Ultrasound protocols are preset pathways for each study in the machine which, when launched, guide the sonographer through the mandated views for the study. The purpose of this study is to evaluate the impact of implementation of protocol-driven ultrasound on the efficiency of performing carotid Doppler studies.

METHOD AND MATERIALS
IRB approved/HIPAA compliant retrospective study of consecutive patients evaluated carotid Doppler ultrasound before and after incorporation of protocols into the ultrasound machines at the outpatient facility of a tertiary care hospital. Duration of examination and number of images obtained by five experienced sonographers for 219 consecutive carotid Doppler studies before and 218 studies after implementation of protocol-driven ultrasound were calculated and compared using ANOVA test.

RESULTS
After implementation of protocol driven ultrasound, there was a significant 12.5% reduction in duration of carotid Doppler studies (p < 0.05).

CONCLUSION
Implementation of protocol driven ultrasound is an effective tool which streamlines image acquisition and significantly improves efficiency in an ultrasound department.

CLINICAL RELEVANCE/APPLICATION
Protocol driven ultrasound is an effective method of improving efficiency in an ultrasound department and its implementation is recommended.

SSE12-04 • Improving the Patient Experience: Communication Is Keystone for Optimizing the Outpatient Imaging Experience

Garry Choy MD, MS (Presenter) ; William Barron ; Sharon Gibson ; George Desko ; Barbara Hubley ; Jae Lee ; Efren J Flores MD ; Giles W Boland MD ; Gloria M Salazar MD ; David A Rosman MD *

PURPOSE
Obtaining patient feedback holds significant potential in improving the quality of care for patients in radiology. The goal of this study aims to better measure patient experience in our department. We set forth to better characterize factors that impact overall patient satisfaction levels and identify key opportunities for improvement.

METHOD AND MATERIALS
We deployed a 13-question multiple choice and free text survey to patients who visited three outpatient imaging centers in our practice to obtain feedback on our services. We accepted responses via an electronic survey or handout. Multiple choice and free text responses were both analyzed in detail.

RESULTS
We received 786 responses from patients in the outpatient setting over a 5 month time period. The three indicators in which our patients were the least satisfied were: communication of wait times, detailed explanation of exam, and staff introductions of themselves. In contradistinction patients noted outstanding performance in: (1) convenience of imaging center location, (2) cleanliness of facilities, and (3) staff friendliness. Over 98% of respondents also indicated they would refer a family, friend, or colleague.

CONCLUSION
While quality of imaging interpretation and aesthetics of facilities are important to an imaging center’s success, a key issue identified by patients centers around communication issues. Specifically, this study provides evidence that there is a need for proper communication of wait times, explanation of exam, and staff introductions.

CLINICAL RELEVANCE/APPLICATION
Patient satisfaction in medical imaging setting can be improved through better communication with patients, particularly regarding staff introductions, explanation of examinations, and wait times.

SSE12-05 • Using a Safety Metric to Measure the Success of a Program to Manage the Utilization of Advanced Diagnostic Imaging

Mark D Hiatt MD, MBA (Presenter) * ; Timothy R Johnstad MBA * ; Brock A Oxford MPH *

PURPOSE
In the context of recent concerns about inappropriate utilization of advanced diagnostic imaging (ADI) and the associated deleterious effects of excessive radiation exposure, a radiology benefit management company (RBM) implemented a program to assist a state Medicaid plan manage the use of outpatient ADI, encouraging the withdrawal of inappropriate requests or change to a more appropriate modality (such as ultrasound or MRI in lieu of CT when indicated). This study investigated the feasibility of using an innovative means to frame the importance of this initiative in terms of its safety impact, measuring the performance of the program by how well it reduced ionizing radiation delivered, as opposed to reducing costs incurred.

METHOD AND MATERIALS
The RBM instituted a program to manage ADI for the New York State Medicaid program on April 11, 2011. The results were analyzed, using Consults per Thousand Members as a proxy for utilization from inception through February 28, 2013, comparing program performance to pre-implementation claims data from 2010. Managed modalities included CT, CTA, MRI, MRA, cardiac nuclear medicine (CMN), and PET. The radiation reduced was expressed in terms of net milliSieverts (mSv), chest x-ray equivalents (CXREs), and cigarettes smoked (cigs) spared using consistently applied conversion factors. (A CXRE is the radiation exposure from 1 chest radiograph in the posteroanterior dimension.)

RESULTS
Utilization management of 115,977 procedure requests for an average covered membership of 725,012 over the course of the study resulted in a 36% reduction in radiation exposure overall, with the radiation spared equivalent to the avoidance of approximately 135 thousand mSv, 6.75 million CXREs, or 2.74 billion cigs.

CONCLUSION
Using a safety metric, such as radiation exposure reduced expressed in various forms that may be meaningful to patients, is a feasible means of measuring the performance of a program to manage the utilization of ADI. The success of such an endeavor may be assessed by the extent to which it spares patients unnecessary radiation through encouraging either withdrawals or changes to other exams as appropriate. In the case of the studied initiative, radiation exposure was reduced by 36% overall.

CLINICAL RELEVANCE/APPLICATION
Utilization management programs may feasibly use safety metrics as measurements of their performance.

SSE12-06 • Patients Prefer the Current Model of Results Delivery, though Many Would Like Access to Their Reports

Miguel C Cabarrus MD (Presenter) ; David M Naeger MD ; Alexander Rybkin MD ; Aliya Qayyum MBBS *

PURPOSE
To assess patients’ preferences for receiving imaging results and to assess their knowledge regarding the role of radiologists.

METHOD AND MATERIALS
This Institutional Review Board–approved study surveyed patients from an academic medical center and a county hospital over a four-week period. Voluntary, anonymous surveys were given to all English speaking, adult outpatients undergoing CT or MRI. The survey assessed patients’ preferred delivery method for radiology results and their understanding of radiologist’s education and role. Differences were assessed with Fisher’s Exact or chi-squared tests with a significance level of 0.05.

RESULTS
573 completed surveys were received, representing a response rate of 24%. 360 (63%) of patients preferred the usual model of communication through their referring physician, though 155 (27%) of them also wanted a copy of their report. 212 (37.0%) patients preferred a model in which radiologists communicated the results in person or over the phone in a timely manner, including the possibility of receiving a copy of the report. There were no significant differences by patient characteristics, except for age (30-44 vs. 65+), with significantly lower preference for telephone delivery in the older group. Awareness of radiologists education was significantly higher in those individuals who preferred telephone delivery. These results suggest that patients are better educated about the roles of radiologists when they prefer telephone delivery of radiology results.
differences between county and academic medical center patients (p=0.57). If reports were made available, patients expressed an equal interest in mail, email and online portal options (38%, 31%, and 32%, respectively), though the county hospital patient subset preferred mail (60%, p

CONCLUSION

Most patients preferred the current model of result delivery in which ordering providers relay results, though many patients expressed an interest in directly receiving their reports as well. Our study also demonstrated limited awareness of our profession amongst patients.

CLINICAL RELEVANCE/APPLICATION

Patient interest in receiving copies of their reports may represent an opportunity for radiologists to increase our communication with patients and to raise awareness of our field.

Informatics (Workflow and Displays)

Monday, 03:00 PM - 04:00 PM • S402AB

SSE13-01 • RadPath: An Electronic Platform to Integrate Radiology and Pathology Consultations for Indeterminate Lesions

Corey W Arnold (Presenter); Dean Wallace MD; Fereloud G Abtin MD; Benjamin M Ellingson MS, PhD *; Alex A Bui MS, PhD; Scott Binder; Denise R Aberle MD; Dieter R Enzmann MD

CONCLUSION

The RadPath application allows radiologists and pathologists to efficiently communicate and integrate diagnostic findings, and provides treating clinicians with a succinct summary of results and conclusions.

Background

In general, current workflows for diagnosing indeterminate lesions include a radiologist and pathologist working separately to issue reports on the same patient, without a formal process for correlating findings and resolving possible discordance. Treating clinicians are then required to discover all reports pertaining to a patient and resolve any unclear findings and diagnoses.

Evaluation

We implemented an electronic platform to facilitate communication between radiologists and pathologists during indeterminate lesion diagnosis to enable the creation of a specialized interface for treating clinicians that provides a concise summary of salient diagnostic findings and conclusions. After a biopsy procedure, a RadPath report is typically initiated by the radiologist, who triggers the system to pull and process reports from various clinical databases. Using text processing and structural elements within the record, RadPath automatically presents a radiologist with a distilled view of diagnostic information, including report sections and key image slices. The radiologist confirms this view and then shares it with a pathologist, who triggers the system to retrieve and distill pathology reports and images. If after performing his/her analysis, the pathologist finds any conflicting information with the radiologic exam, the RadPath report may be shared back to the radiologist with attached comments from the pathologist. This asynchronous process provides a formal way to efficiently correlate findings.

Discussion

Preliminary findings indicate that creating a RadPath report requires approximately five minutes from the radiologist and pathologist. A pilot study is underway to determine impacts to the speed and accuracy of diagnoses. Additional software modules are under development that allow treating clinicians (e.g., oncologists and surgeons) to add information to RadPath, enabling a succinct temporal view of a patient’s diagnostic, treatment, and outcome information.

SSE13-02 • Just in Time Data: Accessing Relevant Clinical Information during Image Interpretation Using MPage Summaries

Norman B Thomson MD (Presenter); James V Rawson MD; Kristopher N Lewis MD

CONCLUSION

The Georgia Regents University Medical Center imaging MPages went live April, 2011. The various uses of the MPages, feedback from Mpage users, and lessons learned will be described and discussed.

Background

Imaging providers require up to date clinical patient information to optimally protocol, review and interpret imaging examinations. A clear understanding of clinical context is needed to provide valuable, focused reports and offer effective conclusions and recommendations to improve patient care and outcomes. Paging thru multiple consult and progress notes, procedure descriptions, laboratory and pathology reports, problem lists, vital signs summaries, and nursing notes, and other electronic health records to find key contextual information is laborious, inefficient and prone to error. At Georgia Regents University Medical Center, a multidisciplinary team designed, created and implemented a set of custom designed Cerner MPages to provide organized contextually focused patient information to a provider in a single display window, which could be incorporated within the Radiology Information System Desktop. The MPages were designed to assist and augment radiology workflow.

Evaluation

The design, build, and implementation of the Georgia Regents University Medical Center MPages will be described and discussed. Design issues included limitations and opportunities related to the structure and organization of the EMR database, quality and accuracy of data in the EMR, the time needed to search the EMR and load the page, and ease of use and interpretation of the MPage output.

Discussion

MPages are configurable tabs that can harvest patient information from the Electronic Medical Record via a CCL script and output the collected information to a web page. The team at Georgia Regents University Medical Center designed a series of image provider centric MPages to provide organized contextually focused patient information to a provider in a single display window, which could be incorporated within the Radiology Information System Desktop. The MPages were designed to assist and augment radiology workflow.

SSE13-03 • Optimized Hospital Radiologist Staffing in a Multisite Radiology Enterprise: A Data Driven Rational Approach to Efficiently Delivering Real Time Subspecialized Radiology

Lily Zou MD (Presenter); Murray D Becker MD, PhD; Alberto F Goldszal PhD, MBA *; Lisa Martinez

PURPOSE

The current environment requires sub-specialization with rapid turnaround times to maximize diagnostic accuracy and time efficiency. These challenges are complicated by the demands of real time reading and the day to day variation in study volumes. Thus, radiologist staffing is a balancing of having adequate staff/subspecialization to cope with peak demand, while not incurring waste due to overstaffing. We investigate: 1. study volumes by day/shift; 2. distribution of study types by skillset; 3. variation in volumes by day/shift; 4. impact of aggregation of studies from multiple sites on variations in volume. The results are used to show how to optimize radiologist staffing.

METHOD AND MATERIALS

Data was collected from 5 hospitals (1 academic/4 community) that use a common radiologist staff and unified multisite workstation/worklist. HL7 messages from 285,981 diagnostic radiology studies over 180 consecutive days were analyzed. Studies were sorted by: time (8hr shift: 1st, 2nd, 3rd); day of week; specialty (Neuro, Body, General); Stat flag, and Site. Parameters calculated: avg shift volume (by skillset, day, site, stat flag) and volume variability was characterized by the coefficient of variation.

RESULTS

All sites are similar: “50% of all studies and ”60% study occurrences occur between 4pm and 8am (2nd/3rd shifts). By narrow margins, the 1st shift has more total studies than the 2nd shift, but the 2nd shift has more Stat studies. The fraction of Stat studies is higher on weekends than weekdays. Smaller hospital sites tended to have larger variations in per shift volume, but all sites show variability (coefficient of variation=20-40%). Variation was least for General and higher for Body and Neuro. Variation was greatest on the 3rd shift. No site had adequate volume to have 1 FTE in each of General, Body, and Neuro on all shifts. But by aggregating sites, this goal could be attained, and the overall per shift study variation was significantly reduced.

CONCLUSION

Real time subspecialized reading requires adequate 2nd+3rd shift (4pm-8am) staff. Individual sites do not have adequate volumes to always support subspecialization. By aggregating studies from multiple sites, volumes reach a critical mass that supports subspecialization, with the added benefit of reducing day-to-day volume variations.
METHOD AND MATERIALS

normal hips with high-resolution computed tomography (CT). The purpose of this study was to determine the means and the reference intervals of the quantitative morphometric parameters of FAI in Femoroacetabular impingement (FAI) is believed to evolve to premature osteoarthritis and early diagnosis is important to prevent irreversible chondrolabral abnormalities. The purpose of this study was to determine the means and the reference intervals of the quantitative morphometric parameters of FAI in

SSE13-05 • Creation of an Interactive, Real-time Single Screen Depiction of Personal Imaging History in the Electronic Medical Record

H. B Harvey MD, JD (Presenter) ; Akshay Saini ; Pari Pandharipande MD, MPH ; Tarik K Alkasab MD, PhD

CONCLUSION

We have created and deployed an interactive imaging history in the EMR to facilitate utilization of this data by clinical providers and reduce unnecessary exposure to diagnostic radiation.

Background

Patient imaging histories provide treating clinicians and radiologists with valuable information and help to avoid duplicative imaging and unnecessary exposure to diagnostic radiation. However, imaging histories in the electronic medical record (EMR) are often not structured with the needs of these providers in mind. We created and deployed an interactive, real-time, single screen depiction of an individual’s imaging history in the EMR aimed at optimizing utility to clinical providers.

Evaluation

The interactive display is driven by a background service that retrieves a record of the imaging history from the enterprise clinical data repository through a medical record aggregation and search tool. This provides records of imaging exams at all sites across the nine component hospitals of the system, including outside exams that have been uploaded to the system. For each retrieved record, the exam date, description, and report impression are extracted. The system uses a lookup table to map each exam description to a body part and modality and attaches this information as well. This process data set is then passed to the ordering physician or radiologist’s web browser, where a JavaScript plugin integrated into an icon in the electronic EMR converts the dataset into an interactive display. For each combination of body part and modality, the tool displays an approximate time when a matching study was last obtained. When the user hovers the cursor over one of these pairs, it shows the sublist of exam dates and descriptions in a popover. When the user hovers over one of the line items in the list popover, a second popover shows the impression of the selected report.

Discussion

The EMR-integrated tool enables clinical providers to more efficiently access and utilize the patient imaging history for clinical decision making. Integration of radiation dose information is a logical next step but should be preceded by educational efforts for clinicians to ensure that radiation dose histories are not misused.

SSE13-06 • A Web-based Multimodality Mammography Case File for Mobile Devices

Jason D Balkman MD (Presenter) ; Steven P Poplack MD *

CONCLUSION

A novel web-based platform and workflow were developed for presenting mammography cases on a mobile device. Large mammogram files were optimized to balance download times and image quality. Scorable MRI, tomosynthesis, and ultrasound images were also presented with PACS-like navigation using a mobile touchscreen.

Background

There is currently no existing radiology app that offers a web-based multimodality and mobile-friendly mammography case file. This may be in part due to difficulties transferring large file sizes over the Internet and adapting image content to a small touchscreen. A method for optimizing image files for size and quality would lessen these difficulties, and thus enable mobile devices as an accessible teaching tool in breast imaging.

Evaluation

An online database of radiology cases was developed and presented elsewhere. Ten breast cases with mammogram, tomosynthesis, MRI, and ultrasound images were collected, optimized, and uploaded to the database using a web browser. Mammography images obtained using a Hologic Selenia system were cropped and scaled from a maximum dimension of 4096 pixels (70 micron resolution) to 2250 pixels (130 micron resolution) to accommodate mobile screens. File sizes were reduced to 1 MB or less using JPEG compression with a quality factor of 90-100. As a result of these optimizations, download times for large mammogram images were also made available, and content could be navigated using a touchscreen.

Discussion

High resolution images and multimodality content make mobile presentation of breast cases challenging. However, when mammograms files were cropped, scaled, and compressed to 1 MB or less, download speeds were reduced to within 2 seconds per image and image quality remained sufficient to represent subtle pathology. The web-based approach to this case file allowed users to upload image stacks of any modality with immediate online availability.
RESULTS

CONCLUSION
The 95% reference interval limits were all far beyond the abnormal thresholds found in the literature for cam-type and to a lesser extent for pincer-type FAI. In the present study, a high prevalence of FAI signs in the asymptomatic population has been noted emphasizing the need for refinement of the previously established cut-offs for morphometric parameters. The 95% reference intervals of the cam and pincer morphometric CT measurements in the asymptomatic patient population determined in our study suggest that the current morphometric parameters used in the diagnosis of FAI should be redefined.

CLINICAL RELEVANCE/APPLICATION
Our study suggests that the current morphometric parameters used in the diagnosis of FAI and most specifically the cam-type, should be redefined.

SSE14-02  •  Benefit of MR Arthrography with versus without Axial Leg Traction in Detection of Ligamentum Teres Lesions in FAI Patients with Arthroscopy as Reference Standard

Florian Schmaranzer ; Michael Kogler MD ; Markus Reichkendler ; Ehrenfried Schmaranzer (Presenter)

PURPOSE
MR-AI leads to chondral and labral damage and according to recent research also to lig. teres lesion. Imaging of these entities is a radiologic challenge. The aim of this study was to demonstrate the diagnostic benefit of MRI with versus without leg traction in the evaluation of lig. teres lesions. This is based on the initial observation that joint distraction achieved by traction leads to approaching of its origin and enthesis, which alters the imaging appearance of the ligament on coronal planes.

METHOD AND MATERIALS
Institutional review board was waived for this retrospective study. Arthroscopic records were reviewed from 94 FAI patients in terms of confirmed lig. teres lesions. MR-A studies of 31 FAI patients (mean age; 35.8a, 9 cam-1 pincer-, 21 mixed-type) with 31 confirmed ligament lesions were included. Studies had been obtained according to the institutional routine protocol for imaging of the central compartment: coronal, sagittal, axial planes with traction and a coronal plane without traction using a 1.5 T scanner and an intra articular injected volume of up to 30 ml. A dedicated traction device was used with weight loading ranging from 15-23 kp according to patients constitution. Lesions were graded as partial tear (type 2; subctal fluid interposition and/or ligamentous flap) and degeneration (type 3; hypertrophy with/without mucoid degeneration) on coronal images with and without traction. Overall sensitivity and sensitivity for each imaging modality as such was calculated.

RESULTS
With both modalities and with imaging under leg traction 23 out of 26 type 2 and 5 out of 5 type 3 lesions were detected yielding a sensitivity of 88.5% and 100%. Sensitivity of imaging analysis without traction was 61.5% for type 2 and 60% for type 3 lesions. 7 type 2 (P = 27%) and 2 type 3 lesions (P = 40%) were only seen with traction.

CONCLUSION
Imaging with traction improved detection of lig. teres lesions. The authors suggest that application of traction during MRA enables visualization of the ligament more similarly to the arthroscopic point of view which reflects a more lax condition of stress and hence facilitates the evaluation of flaps, intrasubstantial fluid accumulation and hypertrophy.

CLINICAL RELEVANCE/APPLICATION
Accurate imaging of lig. teres lesions is challenging. According to recent research on the biomechanical function of the ligament these lesions are increasingly relevant for operative strategies.

SSE14-03  •  Detection of Occult Hip Fractures Utilising a Dual Source CT Algorithm Targeted to Detection of Bone Marrow Edema: Initial Results at Vancouver General Hospital

Taryn L Reddy FRANZCR ; Patrick McLaughlin FFRCSI (Presenter) ; Savvas Nicolau MD ; Hugue A Ouellette MD

PURPOSE
The purpose of this study was to evaluate the performance of virtual subtracted non-calcium images reconstructed from dual energy computed tomography (DECT) data sets for the detection of bone marrow (BM) edema in patients with suspected hip fractures following trauma.

METHOD AND MATERIALS
25 consecutive patients who presented to the Emergency department at Vancouver General Hospital between January 1 2011 and January 1 2013 with clinical suspicion of hip fracture but inconclusive radiographs formed the basis of this study. 7 patients were male and 18 were female, aged between 24 and 97. All CT scans were performed on a dual source DECT scanner. Tube voltages were set at 100 kVp and 140 kVp with activated filter tin. The tube current was set at 160mA with automated attenuation-based tube current modulation. The postprocessing software algorithm used for the generation of the virtual subtracted non-calcium images was originally developed for postprocessing of liver data but was adapted for bone imaging by setting the relative contrast ratio to 1.75, and the minimum and maximum values were set at -300 and 1500 with a range of 3. Two radiologists reviewed the findings on the multimodality workstation utilizing the modified VNC Liver Dual Energy algorithm.

RESULTS
7 of 25 cases did not demonstrate evidence of fracture or BM edema. 14 cases demonstrated evidence of fracture with BM edema (two of these 14 cases also demonstrated BM edema in a different region where fracture was not detected) 1 case demonstrated fracture without accompanying BM edema. 5 cases demonstrated BM edema where the fracture was only seen after review of bone marrow window(L case) and in the other four cases although no fracture was identified there was sufficient BM edema to warrant concern of an underlying fracture (two of these cases also demonstrated fractures in a different region with evidence of BM edema ). PPV=0.74, NPV=0.88, Sensitivity=0.93, Specificity=0.58.

CONCLUSION
Findings of this series suggest that DECT can be used to facilitate the diagnosis of hip fractures in patients, particularly in cases where fractures are difficult to visualise on CT, by using a dual energy algorithm which is targeted to the detection of bone marrow edema.

CLINICAL RELEVANCE/APPLICATION
By using an algorithm targeted to the detection of bone marrow edema, DECT can be used to facilitate the diagnosis of occult hip fractures in patients.

SSE14-04  •  Reliability of CT Findings of the Sacroiliac Joint - How Many Carats Is This Gold Standard?

Zain K Rajabali (Presenter) ; Babak Maghdoori BEng, MD ; Isabelle Drolet MD ; Vimarsa G Swami BSC ; Jacob L Jaremko MD ; Robert G Lambert MBChB

PURPOSE
The sacroiliac (SI) joints are the primary site of spondyloarthropathy (SpA), but direct tissue evaluation of SI joint arthropathy from surgical specimens is impractical. The de facto imaging gold standard for bony features of SpA such as SI joint ankylosis is CT scan, but there is little study of the associated fluid accumulation and hypertrophy.

METHOD AND MATERIALS
In this ethics-approved retrospective study at a tertiary hospital, we obtained CT scans of SI joints performed from 2002-2012 for any indication. We had 60 patients aged 10-52 years (mean 33.8), 31 (52.5%) female, 6 (10%) aged 60 years or over. MRI-A studies of 31 FAI patients (mean age; 35.8a, 9 cam-1 pincer-, 21 mixed-type) with 31 confirmed ligament lesions were included. Studies had been obtained according to the institutional routine protocol for imaging of the central compartment: coronal, sagittal, axial planes with traction and a coronal plane without traction using a 1.5 T scanner and an intra articular injected volume of up to 30 ml. A dedicated traction device was used with weight loading ranging from 15-23 kp according to patients constitution. Lesions were graded as partial tear (type 2; subactal fluid interposition and/or ligamentous flap) and degeneration (type 3; hypertrophy with/without mucoid degeneration) on coronal images with and without traction. Overall sensitivity and sensitivity for each imaging modality as such was calculated.

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CLINICAL RELEVANCE/APPLICATION
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25 consecutive patients who presented to the Emergency department at Vancouver General Hospital between January 1 2011 and January 1 2013 with clinical suspicion of hip fracture but inconclusive radiographs formed the basis of this study. 7 patients were male and 18 were female, aged between 24 and 97. All CT scans were performed on a dual source DECT scanner. Tube voltages were set at 100 kVp and 140 kVp with activated filter tin. The tube current was set at 160mA with automated attenuation-based tube current modulation. The postprocessing software algorithm used for the generation of the virtual subtracted non calcium images was originally developed for postprocessing of liver data but was adapted for bone imaging by setting the relative contrast ratio to 1.75, and the minimum and maximum values were set at -300 and 1500 with a range of 3. Two radiologists reviewed the findings on the multimodality workstation utilizing the modified VNC Liver Dual Energy algorithm.

RESULTS
7 of 25 cases did not demonstrate evidence of fracture or BM edema. 14 cases demonstrated evidence of fracture with BM edema (two of these 14 cases also demonstrated BM edema in a different region where fracture was not detected) 1 case demonstrated fracture without accompanying BM edema. 5 cases demonstrated BM edema where the fracture was only seen after review of bone marrow window(L case) and in the other four cases although no fracture was identified there was sufficient BM edema to warrant concern of an underlying fracture (two of these cases also demonstrated fractures in a different region with evidence of BM edema ). PPV=0.74, NPV=0.88, Sensitivity=0.93, Specificity=0.58.

CONCLUSION
Findings of this series suggest that DECT can be used to facilitate the diagnosis of hip fractures in patients, particularly in cases where fractures are difficult to visualise on CT, by using a dual energy algorithm which is targeted to the detection of bone marrow edema.

CLINICAL RELEVANCE/APPLICATION
By using an algorithm targeted to the detection of bone marrow edema, DECT can be used to facilitate the diagnosis of occult hip fractures in patients.
METHOD AND MATERIALS
We retrospectively assessed 39 consecutive biopsies for suspected ALTR performed over a 2 year period that were sent for an ultrasound guided synovial biopsy. Ultrasound images were retrospectively reviewed to determine synovial thickness and whether an effusion could be distinguished from synovium. Tissue samples were assessed for diagnostic adequacy and the presence of ALTR. The relationships between synovial thickness, sample adequacy, and the presence of ALTR were analyzed as well as the sensitivity of biopsy. Final pathologic diagnosis at revision was used as the gold standard for ALTR.

RESULTS
Adequate samples containing synovial tissue were obtained in 36/39 biopsies (92%). 34/39 (87%) biopsies were taken from an anterior approach with 5/39 (13%) taken posteriorly with all samples directed at the site of maximal synovial thickness via the safest technically feasible approach. There were no post-procedural complications. Synovium could be distinguished from effusion in 38/39 cases (97%). There was no difference between synovial thickness (avg 1.6 cm) or the number of samples obtained (avg 4) between the diagnostic and non-diagnostic biopsy cohorts. Review of the failed biopsies revealed the needle falling short of the capsule in 2/3 of the cases; these cases were performed earlier in the series. Of the 36 adequate specimens, 28 underwent revision and were found to have ALTR with 6/28 (21%) having false negative biopsies. Using the final diagnosis of ALTR at revision as the gold standard, the sensitivity for US guided biopsy is 0.79 (95% CI 0.59-0.91); we are unable to calculate specificity as there have been no true negatives at revision.

CONCLUSION
Ultrasound guided biopsy is a safe procedure that can aid in the diagnosis of patients suspected of having ALTR. The false negatives are due to sampling error. There is no apparent difference between synovial thickness and the ability to obtain an adequate sample or with synovial thickness and ALTR seen at biopsy. Additionally, there is no association between the number of samples obtained and the adequacy of the specimen.

CLINICAL RELEVANCE/APPLICATION
Pre-operative histologic evaluation of the synovium for the presence of suspected ALTR has become critical in the surgical management of these patients.

SSE14-06 • Advanced Core Decompression of the Hip: 3T MRI Monitoring of Patients with Avascular Necrosis
Andrea Lazik MD (Presenter) ; Tim Clasen ; Stefan Landgraebre * ; Florian Grabellus ; Thomas C Lauenstein MD ; Jens M Theysohn MD

METHOD AND MATERIALS
Twentyfive patients (19 male, 6 female, mean age 49.7 years) underwent 3T MRI of the hip prior to and 30 days - 2 years after ACD. The extended clinical protocol included TI, PD/T2w, TSE, high resolution T1w, DESS and contrast enhanced T1w VIBE sequences. Sequences were evaluated regarding delineation of necrosis, bone, graft and transformation zone in consensus by two radiologists using a 5-point scale (0 = poor contrast, 4 = very good contrast). The volume of necrosis was measured before and after ACD using a post processing tool. MRI images were compared to histological specimens in cooperation with a pathologist.

RESULTS
AVN prior to ACD as well as the defect filled with the graft after ACD and the residual necrosis could be imaged with reproducible high quality at 3T. T1w (mean 2.92) and PDw (mean 2.36) sequences provided best contrast to measure the volume of (residual) necrosis. Every patient showed a reduction of necrosis after ACD (by 16.5 % to 30.3 %, mean 41.3 %, SD 22.5). The transformation zone around the graft could especially be visualized by T2w TIRM, ce T1 VIBE and PDw sequences (contrast granulation zone / bone: 3.11, 3.0 and 2.88). The arrangement of different layers within the transformation zone correlated with histological findings.

CONCLUSION
Structural changes and reduction of necrosis after ACD can be monitored by MRI. ACD can significantly reduce the volume of necrosis in AVN of the hip.

CLINICAL RELEVANCE/APPLICATION
3T MRI is a feasible instrument to quantify and monitor the success of ACD. Further long-time evaluation is needed to identify early MRI signs of healing response or breakdown of the femoral head.

SSE15-01 • High-resolution 7 T MRI of Distal Femur Bone Microarchitecture Discriminates between Women with and without Fragility Fractures
Gregory Chang MD (Presenter) ; Stephen Honig MD ; Yinxiao Liu ; Cheng Chen ; Kevi Chu ; Punam K Saha PhD ; Ravinder Regatte PhD

RESULTS
Women with fragility fractures have lower trabecular number and plate-like structure, and greater rod-like structure and rod/network resorption in the distal femur. MRI of distal femur bone microarchitecture may allow detection of patients with poor bone quality who cannot be detected by DXA.

CLINICAL RELEVANCE/APPLICATION
MRI of distal femur bone microarchitecture may allow detection of patients with poor bone quality who cannot be detected by DXA.
RESULTS
Female LuTX recipients had higher cortical porosity (+1.5%, p=0.034), cortical pore diameter (+10.9%, p=0.009), diameter heterogeneity (+18.3%, p=0.021), and lower trabecular BMD (21.1%, p=0.045) than healthy women. Male LuTX patients had lower cortical thickness (-18.9%, p=0.003), total BMD (-21.3%, p=0.001), trabecular BMD (-23.3%, p=0.001), trabecular thickness (-14.4%, p=0.003), and trabecular number (Tb.N: -13%, p=0.028) than healthy men.

CONCLUSION
Our results indicate that cortical integrity and trabecular bone microarchitecture are severely impaired in female but also male LuTX recipients. Thinning and porosity of bone might be crucial factors leading to disproportionally high risk of fragility fractures in LuTX recipients.

CLINICAL RELEVANCE/APPLICATION
The use of HR-pQCT facilitates patient-oriented research in metabolic bone diseases leading to high risk of fragility fractures such as transplantation osteoporosis.

SSE15-03 • Automatic Detection of Osteoporoic Vertebral Fractures in Routine Thoracic and Abdominal MDCT

Thomas Baum MD (Presenter) ; Jan S Bauer MD ; Thomas Netsch ; Tobias Klinder PhD * ; Martin Dobritz MD ; Ernst J Rummeny MD ; Peter B Noel PhD ; Cristian Lorenz PhD

PURPOSE
To develop an automatic spine segmentation algorithm for routine thoracic and abdominal MDCT and use this algorithm to automatically detect osteoporotic vertebral fractures.

METHOD AND MATERIALS
We retrospectively identified 85 patients (43 men, 42 women) older than 45 years of age, who underwent routine contrast-enhanced thoracic and abdominal MDCT. Sagittal reformations (SRs) with a slice thickness of 3mm were routinely reconstructed. The SRs were input for the automatic spine segmentation algorithm. To determine the reproducibility of the algorithm, 25% of all studies were reprocessed, who underwent two MDCT examinations within 8 weeks. The performance of the algorithm to detect fractures was investigated in (i) cross-sectional MDCT images of 71 patients including 8 men and 9 women with prevalent osteoporotic vertebral fractures and (ii) baseline and follow-up MDCT images of 9 patients with an incidental vertebral fracture in the follow-up MDCT.

Our automatic algorithm firstly localized and identified the vertebrae from T5 to L5 in the MDCT images. Then, each vertebra was automatically segmented by using corresponding vertebra surface shape models that were adapted to the original images. Finally, anterior, middle, and posterior height of each vertebra was automatically determined, and anterior-posterior-ratio (APR) and middle-posterior-ratio (MPR) were computed as gold standards. Two radiologists graded vertebral fractures from T5 to L5 according to the Genant classification in consensus by using the SRs.

RESULTS
The reproducibility error of the algorithm expressed as root mean square coefficient of variation amounted 1.2% for APR as well as MPR. Using ROC analysis to differentiate vertebral without fracture, AUC values of 0.84 and 0.83 were obtained for APR and MPR, respectively (p<0.001).

CONCLUSION
We presented a reproducible automatic spine segmentation algorithm that adequately detected osteoporotic vertebral fractures.

CLINICAL RELEVANCE/APPLICATION
Osteoporotic vertebral fractures are underdiagnosed in routine radiographs and MDCT. Our automatic spine segmentation algorithm may support radiologists to report osteoporotic fractures.

SSE15-04 • Positive Effects of Brown Adipose Tissue on Bone Structure and Density

Miriam A Bredella MD (Presenter) ; Corey Gill ; Clifford J Rosen ; Anne Klibanski MD ; Martin Torriani MD

PURPOSE
Recent studies suggest a link between brown adipose tissue (BAT) and bone. The purpose of our study was to investigate the effect of BAT on femoral bone structure and density.

METHOD AND MATERIALS
The study group comprised 46 patients (10 m, 36 f, mean age of 46.2±17.2 y) who underwent FDG-PET/CT for benign etiologies (n=11) or follow-up of successfully treated malignancies (n=35; mean time between PET/CT and last form of treatment: 14.6±18.0 months). All subjects were BAT positive on PET/CT. BAT volume was quantified and the following measures of femoral bone structure and body composition were performed. Forward stepwise regression modeling was also performed to determine the strongest predictor of femoral cortical CSA and femoral density.

RESULTS
There were positive correlations between BAT volume and measures of femoral bone structure and body composition was performed. Forward stepwise regression modeling was also performed to determine the strongest predictor of femoral cortical CSA and femoral density.

CONCLUSION
BAT volume is a positive predictor of femoral bone structure and density. The relation between BAT and bone could be, in part, mediated by muscle.

CLINICAL RELEVANCE/APPLICATION
The identification of brown adipose tissue as a potential regulator in bone formation could lead to novel therapies to prevent bone loss.

SSE15-05 • Ecotopic and Serum Lipids Are Positive Determinants of Bone Marrow Fat in Obesity

Miriam A Bredella MD (Presenter) ; Corey Gill ; Anu V Gerweck ; Melissa G Landa ; Vidhya Kumar ; Scott M Daley ; Martin Torriani MD ; Karen K Miller MD

PURPOSE
Recent studies have linked obesity to bone loss. However, the etiopathology of obesity-associated bone loss is incompletely understood. Serum lipids and ecotopic lipid deposits are emerging as important regulators of skeletal physiology, but little is known about their effects on bone in obesity. In addition, bone and fat cells arise from the same mesenchymal stem cell within bone marrow, capable of differentiating into osteoblasts and adipocytes and obesity has been found to cause a shift into the adipocyte lineage. The purpose of our study was to investigate the associations between ecotopic lipids and serum lipids on bone marrow fat, as a marker of stem cell differentiation, in young obese men and women.

METHOD AND MATERIALS
The study group comprised 106 healthy young men and women (mean age: 33.7±6.8 years, mean BMI: 33.2±7.1 kg/m2), who underwent 1H-MRS using a PRESS sequence at 3 Tesla of L4 for bone marrow fat content, of soleus muscle for intramyocellular lipids (IMCL), and liver for intrahepatic lipids (IHL), serum cholesterol, triglycerides and an oral glucose tolerance test as a measures of insulin resistance (IR). Exercise status was assessed by the Paffenbarger activity questionnaire.

RESULTS
There was a positive association between bone marrow fat and IHL (r=0.21, p=0.048) independent of BMI, age, IR, and exercise status (p<0.001).

CONCLUSION
Our study suggests that ecotopic and serum lipids are positive determinants of bone marrow fat in obese men and women. Because bone marrow fat is known to be inversely related to BMI, these results support the notion that ecotopic and serum lipids may exert negative effects on bone. Further studies are needed to investigate this hypothesis and other potential mediators of the effects of obesity on bone.

CLINICAL RELEVANCE/APPLICATION
Elevated ecotopic and serum lipids are not only risk factors for cardiovascular disease and type 2 diabetes but may be a risk factor for bone loss.

SSE15-06 • Analysis of the Microarchitecture of Cancellous Bone by Tomosynthesis - A Feasibility Study in Cows

Junya Yamamoto (Presenter) ; Kazuhiro Mori ; Kazuyoshi Nishino PhD ; Akinori Sakai MD, PhD ; Takatoshi Aoki MD, PhD

PURPOSE
To examine the correlations between total strut length (TSL) obtained by tomosynthesis (TS), microarchitectural parameters obtained by microfocus computed tomography (μCT), and the reproducibility of the TSL of TS.
Preprocessing and statistical analyses were performed on SPM8. Incorporation of a software called fMRI Grocer (http://code.google.com/p/fmrigrocer/) was performed in all cases. Mean gray matter (GM) CBF was calculated for each case and T1SPGR images were acquired as well.

13 mild Alzheimer's disease (AD, 5 men and 8 women, mean age 75.00±7.36 years) cases and 15 no cognitive impairment (NCI, 4 men and 11 women, mean age 71.20±7.89 years) were investigated. For all cases, whole brain images were obtained using a GE750 3T scanner. The acquisition parameters were: TR/TE = 4.9/2 ms, voxel size = 1X1X1 mm³. High-resolution structural images (T1-MP-RAGE sequence) and DTI were acquired on a 3T scanner (Siemens Trio). All DTI images were processed following the TBSS pipeline, part of FMRIB Software Library. Whole brain FA skeletons were generated using the FSL tools (Ashburner & Friston 2005) and were regressed with ages using a general linear model method. Statistical parametric maps were thresholded at a voxel-wise p < 0.001 (uncorrected). Cortical surface reconstruction and thickness measurements were performed using the FreeSurfer pipeline, part of FMRIB Software Library. Whole brain FA skeletons were regressed with ages using a general linear model method. Statistical parametric maps were thresholded at a voxel-wise p < 0.001 (uncorrected).

CONCLUSION
Cancellous bone microarchitectural parameters with tomosynthesis correlate well with those from TCT and have high reproducibility.

CLINICAL RELEVANCE/APPLICATION
Tomosynthesis is a potentially useful method to quantitatively analyze the microarchitecture of cancellous bone in vivo with a low radiation dose.

Neuroradiology (The Aging Brain and Neurodegenerative Diseases)

SSE16 • Reversal of Brain Development Changes during Healthy Ageing

Yanhui Yang MD (Presenter) ; Xianggong Duan ; Chunming Lu ; Aihong Zhou ; Kuncheng Li MD

PURPOSE
Healthy ageing has become one of today's biggest international challenges. However, theories debate about how neural structures change with age. This study aimed to elucidate this debate by examining the white and grey matter in a large-scale neural network for high cognitive function (i.e., language).

METHOD AND MATERIALS
Twenty right-handed native Mandarin speakers participated (age ranged from 50 to 73, Mean 61 years, S.D. = 7.23, 11 males and 9 females). They were assessed by the MMSE (>=28, Mean = 29, S.D. = 0.74), and no participant had cognitive complaints or positive signs in the neurological examination. Structural images (T1-MP-RAGE sequence) and DTI were acquired on a 3T scanner (Siemens Trio). All DTI images were processed following the TBSS pipeline, part of FMRIB Software Library. Whole brain FA skeletons were regressed with ages using a general linear model method. Statistical parametric maps were thresholded at a voxel-wise p < 0.001 (uncorrected). Cortical surface reconstruction and thickness measurements were performed using the FreeSurfer toolkit. A surface map was generated by computing a correlation between cortical thickness and age (P < 0.001, uncorrected).

RESULTS
DTI results: the later maturing dorsal fiber connecting the temporal cortex with inferior frontal cortex (i.e., SLF) in the left hemisphere showed significant negative correlation with age at two positions: BA6 (SLF-Prg), and (BA39/40 (SLF-TP). In the right hemisphere, there were significant negative correlations in the SLF/white matter and anterior thalamic radiation close to the cingulate cortex (BA32) (SLF-CC and ATR-CC). Cortical thickness results: two left brain areas correlated significantly with age. One was in the middle frontal cortex (MFC, BA10), and the other was in the TP (BA39). These two areas were roughly at the two ends of one of the dorsal pathways (the later maturing dorsal fiber of the SLF).

CONCLUSION
The results suggested that the neural structures which mature later may be affected more than those mature earlier, supporting the last in, first out principle of ageing.

CLINICAL RELEVANCE/APPLICATION
The current study extend the 'last in, first out' principle to a large-scale neural network corresponding to high-level cognitive function (i.e., language).

SSE16-02 • Voxel-based Morphometry at 3-T MR Imaging for Detection of Individuals with Mild Alzheimer Disease

Xiangzhu Zeng MD (Presenter) ; Huishu Yuan MD ; Ying Liu MD ; Zheng Wang MS ; Na Zhang MD

PURPOSE
Voxel-based morphometry (VBM) was used to investigate the patterns of cortical atrophy in mild Alzheimer's disease.

METHOD AND MATERIALS
13 mild Alzheimer's disease (AD, 5 men and 8 women, mean age 75.00±7.36 years) cases and 15 no cognitive impairment (NCI, 4 men and 11 women, mean age 71.20±7.89 years) cases were investigated. For all cases, high-resolution T1SPGR images were acquired on a GE750 3T scanner. The acquisition parameters were: TR/TE = 4.9/2 ms, voxel size = 1X1X1 mm³. After image acquisition, T1SPGR images were segmented, normalized and smoothed using VBM8(http://dbm.neuro.uni-jena.de/vbm/). The statistical analyses were performed on SPM8 by two-sample t-test for comparing mild AD with NCI. Significant correlations were corrected for multiple comparisons using the FDR (false discovery rate) method.

RESULTS
There were significant differences in Mini Mental Status Exam (MMSE) (mild AD: 21.3±4.97, HC: 28.7±4±0.93) and between the 2 groups (p < 0.001) but none in age (p = 0.061). Cortical volumes decreased significantly (p < 0.001, FDR-corrected for multiple comparisons) in mild AD compared to NCI in the bilateral parahippocampal gyrus, bilateral middle temporal gyrus and inferior temporal gyrus, left inferior frontal gyrus and left insula.

CONCLUSION
Our results showed patterns of regional cortical atrophy of mild AD, suggesting underlying structure abnormality. As a potential biomarker, VBM could identify the structural changes of mild Alzheimer patients.

CLINICAL RELEVANCE/APPLICATION
VBM is a useful noninvasive tool to idenitify the cortical atrophy in mild Alzheimer's disease.
There were significant differences in Mini Mental Status Exam (MMSE) (mild AD: 21.3±4.97, HC: 28.7±5.93) and between the 2 groups (p < 0.001) but none in age (p = 0.061). GM CBF decreased significantly (p < 0.001, T=3.84, uncorrected for multiple comparisons) in mild AD compared to NCI in the bilateral precuneus and cuneus, bilateral parahippocampa gyrus, bilateral middle temporal gyrus and left superior temporal gyrus.

CONCLUSION
Our results revealed patterns of regional hemodynamic impairment typical of mild AD, suggesting underlying vascular abnormality. As a potential biomarker, ASL could differentiate the patients from the healthy.

CLINICAL RELEVANCE/APPLICATION
3D ASL is a useful noninvasive MRI sequence to identify the vascular impairment in mild Alzheimer's disease.

SSE16-04 • Changes of Functional Activation in the Prefrontal Lobe in Early Alzheimerâ€™s Disease during Memory Tasks: An ASL-fMRI Study at 4.0T
Weichi Chen MMedSc; Xiaowei Song PhD; Careesa Liu; Ryan D’Arcy; Steven D Beyea PhD (Presenter) *; Kenneth Rockwood

PURPOSE
Perfusion-based functional MRI using arterial spin labeling (ASL) has been used to investigate brain activation based on cerebral circulation. While the so called neurocompensation has been proposed in early Alzheimer's disease (AD) based on BOLD fMRI data, few studies have evaluated such neurocompensatory response using perfusion fMRI. Here, we investigated brain functional changes under episodic memory encoding and retrieval tasks in subjects with early AD and those with cognitively healthy aging using high-field ASL.

METHOD AND MATERIALS
Twelve subjects diagnosed with early AD (mean age=72.3±7.9 yrs, females=5) and 12 age-matched cognitively normal subjects (CN, mean age=73.7±5.5yrs, females=9) were enrolled in this study. A 4T Varian–Oxford human MRI system with interleaved multi-slice flow-sensitive alternating inversion recovery (FAIR) was employed to investigate brain activation during both encoding and retrieval tasks. Data processing and analysis were performed using FSL, with the bilateral frontal lobes as the region of interest.

RESULTS
Brain activation was found in bilateral frontal cortex and the anterior cingulate cortex (ACC) in AD in response to both encoding and retrieval tasks. Increased activation was found during retrieval compared to encoding, which was also seen in the bilateral dorsolateral prefrontal cortex (DLPFC) and the ACC (Figure 1). Moreover, than the normal controls in the bilateral prefrontal cortex including the DLPFC and the ventrolateral prefrontal cortex (VLPFC) (especially in the left DLPFC) as well as in the ACC (Figure 2).

CONCLUSION
Hyperactivation, as measured using ASL perfusion fMRI, was found in bilateral frontal cortex in subjects with early AD during memory tasks, suggesting possible neurocompensatory response.

CLINICAL RELEVANCE/APPLICATION
Perfusion based functional changes may provide a sensitive measure to benefit early AD diagnosis.

SSE16-05 • Significance of Cerebellar Activity in the Attention Network in MCI
Zhigang Qi (Presenter) ; Kuncheng Li MD

PURPOSE
Once cerebellum was a structure specialized for motor processing, while recently, it is also considered to be involved in cognition, here we want to investigate its meanings in the evaluation of mild cognitive impairment (MCI).

METHOD AND MATERIALS
Eighteen MCI and twenty normal elderly were recruited from a community investigation. Demographics of MCI patients and healthy elderly, including age, sex, and education years, were matched between the two groups. The age of participants was equally distributed between the two diagnostic groups (t=0.55, p=0.28 two-sample two-tailed t-test) with similar medians and ranges. However, the groups were significantly different with regard to MMSE scores (t=2.18, p<0.05). All imaging was performed with a 3T Siemens Trio system. Functional MR images were acquired while at rest.

Functional connectivity analysis: Taking left temporal parietal junction (TPJ) area and left inferior parietal lobule (IPL) as seed, functional connectivity was performed between the seed and whole brain with a voxel-wise manner.

RESULTS
Ventral attention network was verified with functional connectivity to left TPJ. And dorsal attention network was verified with functional connectivity to left IPL. The between-group differences were detected through two sample t-test. No significant difference was detected in ventral attention network between MCI and healthy elderly. While in dorsal attention network, significant differences were detected between MCI and healthy elderly. Decreased functional connectivity to left IPL was observed in right cerebellar lobule VIIa Crus II, in addition to bilateral frontal cortex, right precuneus, right temporal cortex. And increased functional connectivity to left IPL was observed in right cerebellar lobule VI, right cerebellar VIIa Crus I, left cerebellar lobule VI, in addition to bilateral precuneus.

CONCLUSION
TPJ and IPL is the core of ventral and dorsal attention network. Changes of functional activity were observed in dorsal attention network in MCI. And cerebellum may play an important role in this process.

CLINICAL RELEVANCE/APPLICATION
(Dealing with cerebellar activity) cerebellar activity was verified in the dorsal attention network and may be significant in evaluation of changes of cognitive function of mild cognitive impairment.

SSE16-06 • Detecting Microstructural Abnormality in Gray and White Matter of Alzheimerâ€™s Disease Using Diffusional Kurtosis Imaging
Nan-Jie Gong (Presenter) ; Chun-Chung Chan ; Lam-Ming Leung ; Chun-Sing Wong

PURPOSE
Newly introduced method of diffusional kurtosis imaging (DKI) is able to delineate non-Gaussian diffusion, which is beyond the scope of conventional diffusion tensor imaging (DTI). Clarifying whether the more accurate approach can improve imaging diagnosis of Alzheimer’s disease (AD) is of intense interests.

METHOD AND MATERIALS
DKI data were collected from a 3T scanner with 3 b values (0, 1000, 2000 s/mm2) and 32 diffusion directions. Using SPM, we conducted two sample t-test of DKI parametric maps voxel-by-voxel between two groups of 11 ADs, 20 normal controls (NCs). Statistical maps were thresholded at p<0.001 and clusters with at least 500 edge-connected voxels were labeled.

RESULTS
In AD patients, compared with NC, significantly lower fractional anisotropy were observed in right frontal cortex and gyrus, right temporal cortex and gyrus. In addition, significantly higher mean diffusivity were observed in right temporal white matter, and significantly lower mean kurtosis in right inferior frontal gyrus, left parietal and right temporal cortex, left and right inferior longitudinal fasciculus.

CONCLUSION
Adding to the traditional DTI metrics, DKI metric like mean kurtosis can provide new regional contrast between AD and NC.

CLINICAL RELEVANCE/APPLICATION
Therefore, DKI may potentially improve detection of early disease.

Neuroradiology (Stroke and Cerebrovascular Reserve)
Monday, 03:00 PM - 04:00 PM • N228
SSE17-03 • Developmental Trajectories of Cerebrovascular Reactivity in Healthy Children and Young Adults

Jackie Leung (Presenter); Andrea Kassner PhD

PURPOSE
The capacity for cerebral blood vessels to dilate plays a critical role in the autoregulation of cerebral blood flow (CBF), which is responsible for delivering oxygen and nutrients to the tissue bed. Non-invasive imaging strategies have been developed to assess vessel distensibility by measuring the increase in CBF after the administration of a vasoactive stimulus. The resulting measure is expressed as cerebrovascular reactivity (CVR) and has become a valuable tool in the assessment of neuropathologies such as cerebral vasculopathy and gliomas. However, research in CVR is still in its early stages. To date, there is no reference to the development of hemodynamic trajectories of CVR. The purpose of this study was to determine how CVR changes with age in healthy individuals.

METHOD AND MATERIALS
Eighteen healthy volunteers (9 males and 9 females) age between 9 and 30 years were recruited for this study. A 3.0T clinical MRI system was used to acquire blood-oxygen level-dependent (BOLD) CVA data, as well as high resolution T1 anatomical images. To modulate CBF during BOLD imaging, precise concentrations of a vasoactive stimulus (CO2) gas were delivered to the subject via a breathing mask. The stimulus was cycled between low (40 mmHg) and elevated (45% elevated) CO2 concentrations in an 8 minute block design paradigm. CVR maps were generated by correlating the BOLD signal change to the end-tidal CO2 waveform on a voxel-by-voxel basis. The maps were coregistered to the T1 images and mean CVR values were calculated based on grey and white matter segmentation.

RESULTS
CVR averaged over the grey matter and white matter demonstrated a biphasic trend in both males and females, as illustrated in Figure 1. There is a definite increase in CVR up to the mid-teens, followed by a gradual downwards slope and plateau with increasing age. The observed effect is far more prominent in females.

CONCLUSION
The dependence of CVR can confound interpretation of results, especially during childhood and adolescence when significant cerebrovascular changes take place. Our finding is in agreement with previous report in the evolution of CVR with age in healthy subjects. Additional data will be collected to further substantiate this finding as well as extend the age range for a more comprehensive understanding of how CVR is affected.

CLINICAL RELEVANCE/APPLICATION
The effect of age is a major consideration in the interpretation of fMRI findings in children.

SSE17-02 • Quantitative Measurement of Cerebrovascular Reserve in Unilateral High Grade Carotid Steno-occlusion by Acetazolamide-challenged CT Perfusion: Correlation with Symptom and Type of Collateral Circulation

Doran Hong MD (Presenter); Younghen Lee MD; Hyung Suk Seo; Sang-Il Suh; Nam J Lee MD; Hae Young Seol MD; Jung Hyuk Kim

PURPOSE
CT perfusion with acetazolamide (CTP-ACZ) is introduced as a useful method to evaluate the cerebrovascular reserve (CRV). In patients with severe carotid stenosis, assessment of CVA and collateral circulation is essential for treatment strategy. However, the hemodynamic contribution of collateral circulation is uncertain. Therefore, we correlated CVR in adult patients with unilateral high grade intracranial steno-occlusion with their symptoms, angiographic findings by CTP-ACZ.

METHOD AND MATERIALS
A retrospective analysis of prospectively collected 35 patients (M:F=22:13, mean age, 51.9±14.5 years) with unilateral internal carotid artery (ICA) or middle cerebral artery (MCA) high grade steno-occlusion (severe stenosis> 70%: occlusion=7:28) were performed. They underwent CTP before and 20 minutes after intravenous administration of ACZ . We manually drew regions of interest in the cortical flow territories of the MCA at the level of basal ganglia and centrum semiovale in each hemisphere; recorded CTP parameters (cerebral blood flow (CBF), mean transit time (MTT)). We compared the percentage change (PC) of CBF and MTT difference by calculating CBF and MTT measured before and after ACZ infusion, regarding to (1)symptomatic (n=17) VS. asymptomatic (n=18) (primary (n=8) VS secondary (n=20)), by SPSS multivariate analysis. Degree of stenosis and presence of collateral circulation were assessed by cerebral angiography (n=22), CT- or MR- angiography (n=35).

RESULTS
Compared to the contralateral hemisphere supplied by non-stenotic ICA, PC of CBF and MTT difference obtained by CTP-ACZ were significantly lower in hemisphere ipsilateral to high grade stenosis (p CONCLUSION
Because CTP parameters measured by CTP-ACZ might be variable in high grade carotid stenosis depending on the location of ROI, optimization of CTP-ACZ must be needed for clinical relevance.

CLINICAL RELEVANCE/APPLICATION
Because CTP parameters measured by CTP-ACZ might be variable in high grade carotid stenosis depending on the location of ROI, optimization of CTP-ACZ must be needed.

SSE17-03 • Correlation of Multi-echo Vessel-encoded Arterial Spin Labeling and Hypercarbic Blood-oxygenation Level Dependent Reactivity MRI for Quantification of Hemodynamic Compensation in 70 Patients with Cerebrovascular Disease

Daniel Arteaga BA (Presenter); Megan K Strother MD; Travis R Ladner MD; Robert Singer MD; Carlos Faraco PhD; Manus Donahue PhD

PURPOSE
The purpose of this work is to develop and clinically implement a MRI protocol for quantifying the relationship between hemodynamic compensation mechanisms including cerebrovascular reactivity (CVR), baseline cerebral blood flow (CBF), CVR reactivity, and CBF territory dynamics in patients with cerebrovascular disease. In many patients at risk for stroke with compromised cerebral perfusion pressure, the critical barrier to stratifying stroke risk based on this information rests with a lack of (i) methodology for measuring multiple hemodynamic parameters in a clinically relevant timeframe and (ii) knowledge of how changes in such parameters should be interpreted for prognosis.

METHOD AND MATERIALS
Methods: Changes in end-tidal CO2 (TECO2) were monitored and CVR was assessed using blood oxygenation level dependent (BOLD) MRI (TR/TE=2000/35 ms; spatial resolution = 3.5x3.5x3.5 mm3) in conjunction with 180s/180s off (room air) / on (5%/95% CO2/O2) breathing. Baseline CBF was assessed using a pseudo-continuous (pCASL) approach (TR/TI/TE=4000/1650/13 ms; spatial resolution = 3x3x3 mm3). Hemodynamic compromise was correlated with extent of vascular stenosis. For Moyamoya subjects, MRI hemodynamic data were compared with clinical disability scores and modified Suzuki Scores (mSS), calculated from angiography.

RESULTS
At TE=35 ms, the spin labeling contributes minimally relative to BOLD weighting. This finding demonstrates that moderate temporal resolution (TR=4500 ms cannot be achieved for sensitivity in a functional VE-ASL approach. Clinical findings varied with underlying etiology. In patients with Moyamoya disease, BOLD CVR was significantly (P=0.017) higher in low mSS hemispheres (zstatistic= 5.0±2.5) compared to high mSS hemispheres (z-statistic=3.7±1.7), implying that regions with less advanced stages of Moyamoya disease have higher reactivity. All study participants are monitored longitudinally to understand the relationship between hemodynamic imaging and stroke risk.

CONCLUSION
A clinical 3T head MR protocol was expanded and clinically implemented for simultaneous measurements of CBF, baseline CBF, CVR reactivity, and CBF territory mapping using a novel 15 min ME-ASL approach.

CLINICAL RELEVANCE/APPLICATION
Hemodynamic MRI can demonstrate cerebrovascular impairment noninvasively, and may be useful in the longitudinal evaluation of stroke risk in patients with intracranial stenosis.

SSE17-04 • Combined Evaluation Using Noncontrast CT ASPECTS and CT Angiography Collaterals Improves Clinical Detection of Large DWI Infarcts

Farhad Mehrkhani MD (Presenter); Shervin Kamalian MD, MMedSc *; Livia T Morais MD; Michael H Lev MD *; Albert J Yoo MD *

PURPOSE
DWI is the most accurate technique for delineating acute infarct core. Large DWI infarct volume (>70cc) is associated with poor outcome despite treatment, and has been used as a treatment exclusion criterion. CT is more widely available than MRI, but suffers from poor sensitivity for infarct detection. We sought to determine whether a combined approach using noncontrast CT (NCCT) and CT angiography (CTA) improves prediction of large DWI infarcts.

METHOD AND MATERIALS
In a single-center, retrospective study, we identified consecutive acute ischemic stroke patients with anterior circulation proximal artery occlusions who underwent both CT and MRI. Patients were categorized into two groups based on DWI lesion volume (= vs. >70 cc). Because patient exclusion from treatment requires high certainty for the presence of a large infarct, we utilized thresholds previously reported to have high (>95%) specificity for DWI infarct volume >70cc for NCCT ASPECTS (scores 0-4) and CTA collateral evaluation (malignant collateral profile: absent collaterals in >50% of MCA M2 division territory). We
**Intracranial Intraplaque Hemorrhage: Prevalence and Association with Infarction in a Population-based Study**

Yuan Yuan Xie MD, BEng (Presenter); Ye Qiao; Nariman Nezami MD; Jarunee Intrapriromkul MD; Saeedeh Mirbagheri MD; Zeeshan Anwar; Li Liu; Bruce A Wasserman MD

**PURPOSE**

Carotid intraplaque hemorrhage (IPH) is a well-recognized risk marker for cerebrovascular ischemic events. It can be reliably identified on MRI using MPRAGE, a 3D T1-weighted sequence, due to the short T1 of blood products. Although it is an important target in imaging extracranial carotid plaque, little is known about its occurrence in intracranial plaque. Our aim was to determine the prevalence of IPH in middle cerebral artery (MCA) plaques, in a US community-representative population (the Atherosclerosis Risk in Communities Neurocognitive Study [ARIC-NCS]), and investigate its association with ischemic infarcts.

**METHOD AND MATERIALS**

1,141 ARIC-NCS participants (mean age, 76 (67 - 90); 42% male; 84% white, 15% black) underwent brain MRI scans that included 3D MPRAGE (resolution 1mm³, TR/TE 3s, TI 900ms, flip angle 9), 3D time-of-flight (TOF) MRA, and 3D black blood [1] sequences. MCA plaques were identified on TOF MRA and confirmed on black blood MRI. Signal intensity (SI) was measured at the corresponding location on MPRAGE and IPH was considered present if this SI exceeded that measured in the pterygoid muscle. T1-, T2-, and diffusion-weighted images of the brain were interpreted for ischemic infarcts by a radiologist blinded to vascular imaging (i.e., presence of plaques and IPH). IPH presence was correlated with ischemic infarcts in the corresponding MCA territory. If multiple plaques were identified in one MCA, IPH was considered present if it was identified in any plaque.

**RESULTS**

In 1,141 exams, 89 MCA plaques were identified in 71 (6.2%) participants (mean age 80). There were 18 (1.6%) cases with bilateral MCA plaques, 28 (2.5%) cases with right MCA plaques, and 24 (2.1%) cases with left MCA plaques. Out of 89 MCA plaques, there were 57 plaques (64%) in 45 (3.9%) participants with IPH. 13 plaques had infarcts in the territories of the plaques, and IPH was present in 12 (92%). 46 plaques showed IPH without corresponding infarcts, and 30 plaques showed neither IPH nor infarcts. IPH was associated with territorial infarcts (odds ratio, 7.83 [CI = 0.97-63.4, p = 0.05]; marginally significant).

**CONCLUSION**

Although the prevalence of IPH in this population is infrequent, its association with ischemic events suggests its identification might have important clinical relevance. 1. Qiao Y et al. JMRI. 2011

**Clinical Relevance/Application**

Identifying intracranial IPH on T1 sequences might provide insight on risk of stroke.

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**Stroke Rehabilitation Using Brain-computer-Interface Technology with Multi-modal Neurological Feedback: Brain Activation Changes Associated with this Interventional Therapy**

Brittany Young (Presenter); Jie Song MS; Leo Walton; Svyatoslav Vergun; Veena A Nair PhD; Mitch Tyler; Justin Sattin; Dorothy Farrar-Edwards; Justin Williams; Vivek Prabhakaran MD, PhD

**PURPOSE**

Brain-computer interface (BCI) is an emerging technology for stroke rehabilitation, but little is known about neuroplastic changes associated with its use. We examine changes in brain activity during imagined (MI) and executed (ME) hand motor tasks associated with BCI-based interventional therapy.

**METHOD AND MATERIALS**

Anatomical and functional images were collected on 16 subjects (8 stroke patients; 8 healthy controls) on a GE 3T MR scanner. Functional images were acquired during MI and ME finger tapping or squeezing of each hand. Not all subjects completed all tasks. Patients had right upper extremity impairment and confirmed on black blood MRI. Signal intensity (SI) was measured at the corresponding location on MPRAGE and IPH was considered present if this SI exceeded that measured in the pterygoid muscle. T1-, T2-, and diffusion-weighted images of the brain were interpreted for ischemic infarcts by a radiologist blinded to vascular imaging (i.e., presence of plaques and IPH). IPH presence was correlated with ischemic infarcts in the corresponding MCA territory. If multiple plaques were identified in one MCA, IPH was considered present if it was identified in any plaque.

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**CONCLUSION**

Although the prevalence of IPH in this population is infrequent, its association with ischemic events suggests its identification might have important clinical relevance. 1. Qiao Y et al. JMRI. 2011

**Clinical Relevance/Application**

Identifying intracranial IPH on T1 sequences might provide insight on risk of stroke.
CONCLUSION

The change ratio of DK value in CR group was significantly lower than non-CR group (0.78±0.13 vs 0.93±0.05, P < 0.05). The concordance between B-mode and Color of nodules in reducing negative cytology rates. The concordance between B-mode, color and FNAC was 81% which after ARFI the concordance with FNAC increased to 89%.

In this study however we obtained a significant statistical correlation of intermediate hardness in predicting thyroiditis, odds ratio of 9.22 (95% confidence interval from 3.09 to 27.45) (p value Multi nodular goiter and Thyroiditis nodules can remain indeterminate after B-mode and Color .

In our study we found that tissue hardness assessment obtained by ARFI helped in categorization of such nodules and reducing negative cytology rates. In this study however we obtained a significant statistical correlation of intermediate hardness in predicting thyroiditis, odds ratio of 9.22 (95% confidence interval from 3.09 to 27.45) (p value

CLINICAL RELEVANCE/APPLICATION

Adjunctive bimodal histogmal analysis of ADC values can be helpful when conventional MRI and 18F-FDG PET/CT failed to detect occult PTSCCs.

RESULTS

The sensitivity and positive predictive value of BRAF V600E mutation in CNB specimens were 66.3% and 100%, respectively. Of 32 nodules with previously non-diagnostic results, CNB showed 81.3% (26/32) of conclusive results with 6 cases of AUS and no cases of non-diagnostic results. There was no additional value of CNB+ARFI mutation analysis. Of 97 nodules with previously AUS results, CNB showed 93.8% (91/97) of conclusive results with 5 cases of AUS and 1 case of non-diagnostic results. There was 3.1% (3/97) additional value of CNB+BRAF V600E mutation analysis.

CONCLUSION

CNB of the thyroid nodule demonstrate high rates of conclusive diagnoses in patients for whom previous FNA results are non-diagnostic or AUS. The CNB + BRAF V600E mutation analysis may be helpful for patients with previously AUS results.

CLINICAL RELEVANCE/APPLICATION

This is an initial report to demonstrate the feasibility and usefulness of CNB with BRAF V600E mutation combined analysis in thyroid nodules.
Nuclear Medicine (Quantitative Imaging)

Monday, 03:00 PM - 04:00 PM • S504CD

SSE19-06 • Intravoxel Incoherent Motion MR Imaging: Emerging Applications for Nasopharyngeal Carcinoma at the Primary Site

Shui Xing Zhang MD (Presenter) ; Qianjun Jia MD ; Zhong-Ping Zhang ; Chang Hong Liang MD ; Wen-Bo Chen BArch ; Qian-Hui Qiu

PURPOSE
To compare pure molecular diffusion, D, perfusion-related diffusion, D* and perfusion fraction, f, determined from diffusion-weighted (DW) magnetic resonance (MR) imaging on the basis of the intravoxel incoherent motion (IVIM) theory in patients with nasopharyngeal carcinoma (NPC) at the primary site.

METHOD AND MATERIALS
This prospective study was approved by the appropriate ethics committee, and written informed consent was obtained from all patients. Between December 2011 and October 2012, 35 consecutive patients (22 men, 13 women; mean age, 49 years; age range 16–69 years) with suspected of having NPC were examined on a 3.0T MR scanner. DW imaging was performed by using a single-shot echo-planar sequence with 13 b-values (0, 10, 20, 30, 50, 80, 100, 150, 200, 300, 400, 600, 800 sec/mm²). MR imaging was compared with endoscopy and biopsy for the detection of NPC. Mean interval between MR imaging examination and subsequent nasopharyngeal biopsy was 3 days (range, 0–11 days). The initial study population comprised of 21 patients with newly diagnosed NPC (13 men, 8 women; mean age, 55 years) and 14 patients with adenoids enlarge (9 men, 5 women; mean age, 35 years). The lesion D, D* and f were measured and compared in patients with primary NPC and benign hyperplasia.

RESULTS

IVIM DWI is a feasible technique for investigating primary NPC although limited in 11.4% patients due to susceptibility artifacts around the skull base. D is significantly decreased in primary NPC. The elevation of D* reflects increased blood vessel generation and parenchymal perfusion in primary NPC, indicating that D* can provide insight into the physiological activities related to the disease.

CLINICAL RELEVANCE/APPLICATION

Intravoxel incoherent motion (IVIM) can differentiate benign and malignant head and neck disease, and differentiating certain histological types of malignancy.

SSE19-01 • Integration of Automated Quality Control Using Image Classification into a CAD System for Bone Scan Lesion Detection

Keith W Henkel MS, BEng (Presenter) * ; Matthew S Brown PhD * ; Jonathan G Goldin MBChB, PhD ; Grace Kim MD ; Katherine Yang * ; Bharath Ramakrishna ; Greg Chu ; Richard Pais

PURPOSE
The aim of this research is to develop an automated bone scan image classifier for quality control as a pre-processing step prior to application of a CAD lesion detection system. As quantitative image analysis of bone scans becomes increasingly useful in clinical trials, so does the need to define quality bone scans in such a way that it predicts images’ usability for an automated lesion detection system.

RESULTS

Based on review of the CAD segmentation, 35.5% of the 833 images were usable. In the test data set, images were split by those performed on ADAC machines (n=30), and those performed on other machines (n=803). To confirm the algorithm identified in the training set, its sensitivity and specificity were compared against the usability predictive power of the individual parameters. Overall, the manufacturer (ADAC vs. not ADAC) appeared to have a low classification accuracy, but there was not enough data in the ADAC dataset reach a firm conclusion. In the other machine group, pixel spacing also showed a low classification accuracy (sensitivity of 0.889, specificity of 0.702). The image type most commonly associated with usable images (ORIG/ PRIMARY / WHOLE BODY / EMISSION) had a very high classification accuracy with a sensitivity of 0.918 and a perfect specificity (no false negatives) of 1.000. Image Type (WHOLE BODY / EMISSION) had a very high classification accuracy with a sensitivity of 0.985 in predicting image usability, the largest individual parameter sensitivity.

The combination of manufacturer, image type, and image size provide the best criteria for identifying quality bone scans: a sensitivity of 0.973 and a perfect specificity of 1.000. Further classification of images by pixel spacing (the last step of the algorithm identified in the training data set) actually had no further effect on the sensitivity and specificity. Images incorrectly identified as usable (n=7) were not usable due to extravasation/hinging anatomic segmentation or due to missing anatomy with two notable exceptions: a pair of blood pool NM images. Including all images performed on ADAC scanners, for which the sample size was too small to identify an association, 56 of 833 images (6.7%) would require review via a non-automated process to determine usability of an image.

CONCLUSION

The question of how to approach quality control of medical images for use in automated systems appears to have an answer in traditional image classification. Close regulation of consistent scanner use, delay times from injection of radiotracer to acquisition of image, and varying doses received across time points, though not completely irrelevant, are not as significant factors in identifying quality images as simple Dicom header values like image type, image size, and manufacturer. Based on the efficacy of including pixel spacing as a step in classifying the images of the test set, further evidence will be sought to determine if including the parameter is redundant or not.

METHODS

Acceptable bone scan image quality was defined in terms of usability for processing by a CAD lesion detection system currently in use in clinical trials (see Brown et al. Computer-aided quantitative bone scan assessment of prostate cancer treatment response. Nuclear Medicine Communications. 33(4):384–394, April 2012.). The CAD system atlas-based segmentation of anatomic landmarks and normal bone has been observed to fail when non-standard and/or non-whole body Dicom images are acquired, i.e., for secondary screen captures, spot views, tomos, key images, etc. Such images are unusable by CAD processing required in clinical trials and are thus considered of unacceptable quality. From a training set of over 3,000 images (Phase 2 multi-center clinical trial of VEGFR-2 inhibitor in prostate cancer), four technical imaging parameters from the Dicom header were identified as features to classify image quality as acceptable or not: (1) image size, (2) image type, (3) pixel spacing, and (4) manufacturer. In the training data set, the best correlations with usability were found by differentiating by manufacturer first, then by a combination of image type, image size, and pixel spacing. While additional factors such as radiotracer dosage and timing may affect the quality of a bone scan, they are not consistently available within the Dicom header and are prone to manual entry error, and therefore have been excluded from analysis.

To test the imaging parameter features, 833 images from 25 patients across 23 sites were analyzed from a different multi-center Phase 2 prostate cancer clinical trial. A pair of the images was processed by the CAD lesion detection system, and usability was determined as defined above. Statistically, sensitivity and specificity are reported to test the association between classified image quality and CAD usability.

SSE19-02 • QIBA2 FDG PET Reading Study: Variability of Liver FDG Uptake Measurements across Different Sites

Joo Hyun O MD (Presenter) ; Edward A Elkan MD ; Jaime L Montilla-Soler, ; Paul E Kinahan PhD * ; James M Moutz MD, PhD ; Eric Perlman ; John Sunderland PhD ; Heather Jacene MD ; Nathan C Hall MD, PhD * ; Michael V Knopp MD, PhD ; Abdel K Tahari MD, PhD ; Ronald
METHOD AND MATERIALS
Baseline and post-therapy FDG PET/CT images of a single patient were distributed digitally to 15 sites in North America, Europe, Africa, Asia and Australia in an IRB approved study. Readers at each site measured the background activity by placing a 3 cm diameter spherical volume of interest (VOI) in right side of the liver. Workstation software from 8 different vendors were used for the quantification. The standard uptake value (SUV) and SUV corrected for lean body mass (SUL) were measured using local standard approaches.

RESULTS
The liver background SUV ranged from 1.47 to 2.19 at baseline with standard deviation (SD) of 0.16; and ranged from 1.80 to 2.96 (SD 0.26) at follow-up. The liver SUV measurements ranged from 0.91 to 1.56 (SD 0.12) at baseline; and from 1.20 to 2.02 (SD 0.17) at follow-up.

CONCLUSION
SUV and SUV measurements of the normal liver derived from the same set of FDG PET/CT images showed generally similar, but not consistently the same, values. The cause of the variance of liver measurements is likely due to both human VOI selection methods and software differences.

CLINICAL RELEVANCE/APPLICATION

SSE19-03 Impact of 4D PET-CT on SUV Quantification in Lung Tumors: How Many Phase-bins?
Carlo Cavedon DPhil (Presenter); Emanuele Zivelonghi; Stefania Guariglia; Maria Grazia Giri; Daniela Grigolato; Michele Zuffante; Marina Cucca; Marco Ferdeghini MD

PURPOSE
To find the optimal number of phase bins in respiratory-gated PET-CT (4D PET-CT) in order to improve SUV quantification in lung tumors while preserving signal-to-noise ratio.

METHOD AND MATERIALS
28 patients with lung tumors were studied with 18F-FDG 4D PET-CT. Only patients that showed respiratory-induced tumor motion greater than 5 mm were enrolled. 4D PET-CT was performed by means of a Philips Gemini BigBore TOF scanner and the Varian RPM respiratory gating system. 3.0 MBq/kg, 2 min/bed and retriggers were used for both PET and CT modalities were used. Images were reconstructed using 1 (no sorting) up to 10 phase bins. SUVmax values within the liver were estimated as a function of the number of phase-bins. The lower number of phase bins that allowed SUV quantification no smaller than 90% compared to the gold standard (10 phases) was considered as optimal. Lesion volumes were estimated by three different segmentation methods: fixed SUV=2.2 threshold, 40% of SUV max isocontour and gradient-based method. These volumes were also studied as a function of the number of phase bins.

RESULTS
SUVmax measured at max exp was on average 63.2% higher in the gated acquisition (10 phases) compared to the non-gated case (range 11.5%-328.3%). The underestimation of SUV in non-gated PET-CT was strongly dependent on lesion volume and location, small lesions in the lower lung region being the most affected. When comparing 4D PET-CT in 4 and 10 phases, the underestimation reduced to 12.3% (range 2.0%-37.7%). The corresponding value for 6 and 10 phase bins was 6.9% (range 0.0%-23.3%). Volumes estimated by the fixed-threshold method increased with the number of phase bins, SUVmax percentage-based volumes decreased and gradient-based volumes did not show a unique trend.

CONCLUSION
4D PET-CT offers an advantage in 18F-FDG SUV quantification for tumors that move with respiration. The balance between acquisition/reconstruction time, SNR and accuracy of SUV estimation seems to be achievable by using 4 to 6 phase bins, depending on lesion volume and location. SUV-based volume quantification obtained by multiple segmentation methods is less prone to inconsistent results when respiratory gating is used. 

CLINICAL RELEVANCE/APPLICATION
4D PET-CT can improve SUV quantification in tumors that move with respiration. This might be especially useful when metabolic data are used to help delineate reference volumes in Radiation Oncology.

SSE19-04 Impact of a New Respiratory Amplitude-based Gating Technique (HD-Chest) in Evaluation of Subdiaphragmatic PET Lesions
Axel Van Der Gucht (Presenter); Benjamin Serrano; Florent Hugonnet; Benoit Paulmier; Nicolas Garnier; Marc Faraggi

PURPOSE
PET acquisition requires several minutes which can lead to respiratory motion blurring, partial volume effect and SUV under-estimation. To avoid these artifacts, conventional 10-minute Phase-Based Respiratory Gating (PBRG) can be performed but is time-consuming and difficult with a non-compliant patient. HD-Chest is an amplitude-based gating method which keeps 35% of the counts at the end of expiration to minimize respiratory motion. We estimated the impact of HD-Chest on sub-diaphragmatic lesion detectability and quantification.

METHOD AND MATERIALS
Our study consisted of 30 patients for a total of 76 hepatic and 26 perihepatic lesions. Each patient underwent 3 acquisitions on a Siemens Biograph mCT (4 rings and time-of-flight): a Standard free breathing Whole Body (SWB, 5 to 7 steps / 2.5 min per step, 3.3 ± 0.4 MBq/Kg of 18F-FDG, a 10-min PBRG with six bins and a 5-min HD-Chest. All gated acquisitions were performed with an ANZAI respiratory gating system. SUVmax and Target to Background Ratio (TBR, expressed as SUVmax of lesions / SUVmean in healthy liver) were compared.

RESULTS
All 93 lesions in SWB images were detected in the gated images. PBRG and HD-Chest respectively revealed 5 and 9 new lesions and relocated 7 and 8 lesions. Localization remained uncertain for 2 lesions in both 2 gated methods. Four lesions revealed by HD-Chest were missed by PBRG in 3 non-compliant patients. Compared to SWB, TBR but not SUVmax increased significantly with PBRG (respectively 40 ± 62%, p < 0.001) and HD-Chest (respectively 40 ± 67%, p < 0.001).

CONCLUSION
A better detection rate, a better coregistration, a higher contrast, a reduction of the acquisition time by up to 50% compared to PBRG make HD-Chest the first choice respiratory-gated PET protocol in the evaluation of sub-diaphragmatic lesions.

CLINICAL RELEVANCE/APPLICATION
Compared to phase-based respiratory gating, HD-Chest enhances detectability, image quality and reduces acquisition time without compromising quantification in evaluation of sub-diaphragmatic lesions.

SSE19-05 Quantification of Treated Volumes and Correlation with Functional and Morphologic Target Volume Estimation in SIRT of the Liver
Michael P Wissmeyer MD (Presenter); Valentina Garibotto; Pietro Mjano MD; Romain Breguet MD; Christoph D Becker MD; Osman Ratib MD, PhD *; Sylvain Terraz MD

PURPOSE
To quantify treated volumes and compare them with morphologic and functional target volume estimation algorithms in patients undergoing SIRT.

METHOD AND MATERIALS
We evaluated 28 consecutive patients scheduled for SIRT due to hepatocellular carcinoma or liver metastases from other tumors into this pilot study. Treated liver volumes were calculated using a threshold based semi-automatic delineation technique on post-interventional Y-90 SPECT-CT. The pre-interventional target volumes and Y-90 activities were estimated by manual delineation on contrast enhanced CT and on pre-therapeutic Tc-99m-MAA SPECT-CT by two experienced observers. Additionally, the expected lung dose was determined on the base of the lung shunt fraction as derived from planar whole-body MAA-images. Treated and target volumes, Y-90 activities and lung doses were compared using correlation coefficients (cc) and a paired two sided t-test.

RESULTS
7 patients were excluded because of too high hepato-pulmonary shunt fractions. In 7 other patients with bilobar treatment, functional target volumes could not be drawn on the MAA-SPECT/CT due to technical reasons. In the remaining 14 patients, estimated mean±SD treated liver volume was 1247±533ml using a threshold of 24.2±9.1% of maximum counts for semi-automotive volume estimation. Absolute counts were not useful for threshold selection. Estimated target volumes (ml), calculated Y-90 activities (GBq), and lung doses (Gy) were 1344±524, 3.62±1.37, and 13.03±8.35 for CT, compared to 1352±664, 3.62±1.64 and 12.95±7.54 for MAA-SPECT/CT. Overall, morphologic (cc=0.88; p= 0.185) and functional (cc=0.92; p=0.177) target volumes correlated well with treated volumes, with a slight but not statistically significant advantage for the functional approach (p=0.125).

CONCLUSION
The 3D SPECT/CT-mixed-reality based SN navigation is feasible for groin and pelvis, and has the potential to guide SN localization in areas of complex anatomy. FHS real-time generated 3D imaging may complement navigation.

**CONCLUSION**

The integrated color scale PET/CT representation can be a helpful tool to quickly judge and approximately quantify tumor response to therapy, especially in cases difficult to assess by current methods.

**METHOD AND MATERIALS**

25 consecutive patients (59.1 ± 16.3 years, range 32-88) suffering from vulvar cancer were examined by both conventional lymphoscintigraphy and SPECT/CT. After injection of four peritumoral subcutaneous deposits, anterior and lateral static views were obtained for planar lymphoscintigraphy, followed by a SPECT/CT scan without reinjection of the radiopharmaceutical. The presence of sentinel lymph nodes and additional downstream lymph nodes on conventional lymphoscintigraphy and on SPECT/CT was analyzed qualitatively, and compared. All sentinel lymph nodes were mapped to obtain a relative distribution pattern for lymph nodes in vulvar cancer.

**RESULTS**

Conventional planar imaging suggested 46 sentinel nodes in the studied 25 patients. SPECT/CT visualized these lymph nodes, and 12 additional sentinel lymph nodes in eleven patients. The mean number of visualized sentinel nodes was 1.8 ± 0.5 (range, 1-3) for conventional technique, and 2.4 ± 0.7 (range, 1-4) for SPECT/CT. Conventional scintigraphy detected 19 downstream lymph nodes in all patients, but correct localization was challenging from planar views. The mean number of visualized downstream lymph nodes was 0.8 ± 0.9 (range, 0-2) for conventional technique. SPECT/CT detected 66 downstream lymph nodes in all patients. The mean number of visualized downstream lymph nodes was 2.6 ± 2.1 (range, 1-7) for SPECT/CT. SPECT/CT depicted additional sentinel nodes in 44% of the patients, and additional downstream lymph nodes in 76% of the subjects. The detected sentinel nodes were predominantly Nll. inguinales superiores mediales, followed by Nll. inguinales superiores inferiores.

**CONCLUSION**

SPECT/CT is superior to conventional planar lymphoscintigraphy in the detection of both sentinel lymph nodes and downstream lymph nodes in vulvar cancer.

**Clinical Relevance/Application**

SPECT/CT may contribute to a more comprehensive lymph node mapping in vulvar cancer and might facilitate surgical exploration in difficult cases.
SSE20-03 • Feasibility of SPECT/CT on Interpretation of Bone Scans in a Supra-regional Oncology Centre

Umme Sara Zishan MBBS (Presenter); Hamish Richardson MD, PhD (Presenter); Zubair Khan MBBS, FRCR

PURPOSE
To evaluate the impact of single photon emission computed tomography/computed tomography (SPECT/CT) in assessment of indeterminate uptake on planar bone scans compared with prior practice.

METHOD AND MATERIALS
Retrospective comparative study. Data was collected from reports available on radiology information system. First data set included bone scans from June 2009- June 2010 when planar whole-body images were referenced to other available structural imaging. After installing hybrid scanners in late 2010, SPECT/CT was used as a problem solving tool in patients with indeterminate/ suspicious lesions on planar imaging.

RESULTS
First data set from 2009/10 included 1422 reports, while 1617 reports were included in the second data set. The latter also included 737 reports with added SPECT/CT.

In 2009/10, 16.5 % (234/1422) of the scans showed bony metastatic disease, 8.8 % (125/1422) were indeterminate requiring further investigations and 1.8% (26/1422) showed incidental findings.

In 2011/12, 23% (372/1617) of overall bone scans showed bony metastatic disease. There was reduction in the number of referrals for further investigations to 7.8% (126/1617). There was increased pick up of incidental findings both benign and malignant conditions to 13.5% (219/1617).

CONCLUSION
SPECT/CT had a significant impact in improved detection of bone metastatic disease, better characterisation and reduction in onward referrals. There was increased detection of incidental pathology (benign and malignant), some of these required further investigation.

CLINICAL RELEVANCE/APPLICATION
SPECT/CT is a powerful cost effective tool providing accurate diagnosis of indeterminate uptake on planar bone scan.

SSE20-04 • Localization of Parathyroid Adenomas by Tc99m Sestamibi SPECT-CT, Contrast-enhanced Multi-phase CT (4D-CT) and Combination of SPECT-CT and 4D-CT

Franklin C Wong MD, PhD (Presenter); Thinh H Vu MD; Stephen T Wong PhD; Dawid Schellingerhout MD; Hubert H Chuang MD, PhD; Nandita Guha-Thakurta MD; Edmund E Kim MD; Srinivas C Kappadath PhD*; Nancy Perrier MD; Eric M Rohren MD, PhD *

PURPOSE
This study was designed to compare the abilities of Tc99m Sestamibi (MIBI) SPECT-CT, dynamic contrast enhanced CT (4D CT) and combination of both modalities to identify parathyroid adenomas.

METHOD AND MATERIALS
A retrospective study was conducted under an IRB-approved chart review for patients undergoing parathyroid adenoma resection in Jan 2010-June 2010. Parathyroid SPECT-CT was conducted after the patient received 20 mCi of Tc99m MIBI. 4D CT was conducted within 2 days from MIBI. All images were displayed in planar digital displays. Three teams of nuclear physicians and radiologist were assigned to interpret anonymized imaging studies without clinical or pathologic information. The surgical pathology is used as the gold standard. An A-F type location scheme was applied to identify the location of the lesions.

RESULTS
A total of 41 evaluable patients were collected. Histopathology reported 46 lesions with 21 in the left and 25 in the right size. SPECT-CT correctly lateralized 36 lesion and identify 21 correct surgical types; 4D CT also lateralized 36 lesions but correctly identify 18 lesion types while combination of both correctly lateral 37 lesions and identified 24 lesion types.

CONCLUSION
The combination of 4D CT and MIBI SPECT CT may have additional diagnostic values for identification of parathyroid adenomas.

CLINICAL RELEVANCE/APPLICATION
The use of combination of 4D CT and MIBI SPECT-CT may enhance the accuracy of pre-surgical identification of lesions for treatment planning.

SSE20-05 • The Value of Routinely Post Radioiodine Therapy Scintigraphy with SPECT CT Imaging Diagnosis in Clinic

Yu Wen Chen MD, MA (Presenter); Pi Jung Hsio MD; Yung Chang Lai

PURPOSE
The fusion imaging of SPECTCT will improve diagnostic quality. In here, we collect thyroid cancer patients with high dose radioiodine therapy and post therapy scintigraphy with SPECTCT diagnosis during prior one year. The value of SPECTCT in imaging diagnosis will be disclosed in this article.

METHOD AND MATERIALS
During prior one year (Aug 2011 to Aug 2012), we collect sixty-five patients received high dose radioiodine therapy and post radioiodine scintigraphy with SPECTCT imaging. Forty patients who were newly diagnosed as advanced differentiated thyroid cancer (DTC) and received bilateral total thyroidectomy with central nodal dissection. The other twenty five patients were diagnosed as recurrence during follow-up. The mean age of patients is 51.2 year-old (19 to 76) and ratio of female to male is 54 to 11. After high dose radioiodine administration, the imaging was performed at the following 5th and 8th day respectively.
RESULTS
Among newly diagnosed forty DTC patients, almost remnants are detectable, except one patient. Based on SPECTCT localization, pyramidal and contralateral tubercle are the most common sites of remnant exist. Twelve patients (30%) are demonstrated as N1b after post radioiodine therapy SPECTCT diagnosis. There is no detectable distal lung or bone metastasis among this group of patients. The SPECTCT imaging provides differential diagnosis for low grade of radioiodine avid pulmonary nodule in an old lady with tuberculosis history. For the twenty five patients with recurrent thyroid cancer, remnants are near not detectable, except two young age females (8%). Five patients (25%) are demonstrated as N1b nodal involvement on SPECTCT. Three patients are diagnosed as lung metastasis on WBS and SPECTCT imaging. The SPECTCT provides pulmonary nodular pattern in the two patients.

CONCLUSION
Routinely post radioiodine therapy scintigraphy with SPECTCT imaging provides exact nodal stage and remnant distribution.

CLINICAL RELEVANCE/APPLICATION

SSE21-01 • Association of Magnetic Resonance Imaging (MRI) Findings and Initial Presenting Symptoms in Infants with Non-accidental Mild Traumatic Brain Injury

Paggie Kim MD (Presenter) ; Mona Tafti MD ; Barbara A Holshouser PhD

PURPOSE
To investigate association between a child’s initial presenting symptom and subsequent additional MRI findings after non-accidental mTBI.

METHOD AND MATERIALS
A retrospective single-center review of the emergency room and radiology records of 151 infants, who presented to the Loma Linda University Medical Center Pediatric Emergency Department for evaluation of suspected NAT from 2001 to 2008, was conducted. Inclusion criteria included infants less than 3 years of age with an initial GCS score of 13-15 (i.e., mTBI) who had both a CT and a MRI brain examination available for review. Records were examined for the occurrence of initial symptoms and the presence on imaging of intracranial abnormalities. Association between initial presenting symptoms and additional MRI findings were examined by calculating odds ratio using 95% confidence interval.

RESULTS
Of the 151, 67 met our inclusion criteria. The mean age was 6.8 months (+/- 7.4 months) and the mean initial GCS score was 14.6 (+/- 0.6). The most common initial presenting symptoms and findings were retinal hemorrhage (39%) and vomiting (33%). The most frequent additional MRI findings not seen on CT were subdural hemorrhage (39%), ischemia/infarction (27%), subarachnoid hemorrhage (29%) and atrophy (27%). Statistically significant associations were found between the initial presenting symptoms of seizure, and additional MRI findings of ischemia/infarct and SDH.

CONCLUSION
Compared to CT, MRI provides clinically useful data in children less than 3 years of age with NAT/mTBI, particularly with evidence of ischemia/infarction. Although children in our study presented with mild symptoms and GCS scores of 13-15, the association between the additional MRI findings and the initial presenting symptoms may help in creating an algorithm to determine when a child must have an additional MRI examination. This will, in turn, help in reducing or even preventing long term risk of neurodevelopmental disabilities following mTBI/NAT.

CLINICAL RELEVANCE/APPLICATION
Association between the child’s initial presenting symptoms and subsequent additional MRI findings can help predicting if a child must have an MRI prior to discharge from the hospital.

SSE21-02 • A Multimodal Imaging Approach to the Super-acute Phase of Mild Traumatic Brain Injury: A Pilot Study

Lidia M Nagae MD (Presenter) ; William C Gaetz PhD ; Mark Zonfrillo MD, MSc ; Jeffrey Berman PhD * ; Kory Heiken ; Erin S Schwartz MD ; Timothy Roberts PhD *

PURPOSE
There has been emerging interest in the acute phase of mild traumatic brain injury (mTBI), with the possibility of early medical intervention targeting presumed underlying metabolic dysfunction. The purpose of our study is to perform a pilot study of multimodal advanced imaging, including gamma-aminobutyric acid MR spectroscopy (GABA-MRS), diffusion tensor imaging (DTI), quantitative arterial spin labeled perfusion imaging (ASL), and magnetoencephalography (MEG), to evaluate super-acute phase of mTBI.

METHOD AND MATERIALS
Subjects in the super-acute phase of mTBI (first 96 hours of injury) and controls between 14-18 years of age were recruited. Subjects and controls with normal clinical routine MRI (including diffusion, susceptibility, and qualitative evaluation of ASL perfusion) were evaluated at a 3.0 Tesla scanner, utilizing a multimodality approach including GABA-MRS (left precentral gyrus area, bi-frontal, and bi-occipital regions), DTI, ASL, and MEG. Only subjects with normal clinical MRI sequences were included.

RESULTS
Seven patients with mTBI and 5 controls were evaluated. Overall, on MEG, significant increase in delta and theta activity z-scores was found in the left motor region, a trend was seen for decrease in ADC (p CONCLUSION
These preliminary results demonstrate the feasibility of our multimodal evaluation of super-acute mTBI. Comparison with MEG is suggestive of functional changes in similar anatomical areas in patients, despite the mechanism of injury, which could be speculated as a potential diffuse reaction of the brain to trauma.

CLINICAL RELEVANCE/APPLICATION
Early identification of possible injury by any of the imaging modalities utilized could aid as objective identification of mTBI, and serve as a potential tool for follow-up if medical intervention.

SSE21-03 • MRI Features of Cortical Venous Injury in Abusive Head Trauma (AHT)

Arabinda K Choudhary MBBS (Presenter) * ; Krishnamoorthy Thamburaj MD ; Mark Dias MD ; Danielle K Boal MD

PURPOSE
1. To assess evidence of direct intracranial venous injury in AHT
2. To assess evidence of indirect features of intracranial venous injury in AHT
3. To assess for thrombosis of cortical veins and sinuses in AHT

METHOD AND MATERIALS
We identified patients between 0-3 years with AHT managed at our institute from 2001-2012. MRI and MRV were evaluated by two experienced neuroradiologists for evidence of subdural hemorrhage, parenchymal abnormalities and thrombosis. Detailed evaluation of veins and sinuses included evidence of direct venous injury with blood clot adherent to the bridging cortical veins (Lollipop sign) terminating in the region of subdural hemorrhage, secondary features of venous injury with compression (compression sign) of cortical veins by the subdural hemorrhage.

RESULTS
A total of 45 studies were reviewed. The median age was 3 months with 62% males. 41/45 children (91%) had SDH. On MRV, 14/45 cases (31%) had no evidence of venous compression, including 10 with, and 4 without SDH. The remaining 31/45 cases (69%) had imaging evidence of cortical vein and/or sinus
**SSE21-04** • A Diffusion Tensor Imaging (DTI) Study of Brain White Matter and Neuropsychiatric Abnormalities in Attention Deficit/Hyperactivity Disorder (ADHD) Children

Lizhou Chen (Presenter); Xinyu Hu; Yi Liao; Lanting Guo; Qiyong Gong; Xiaoliu Huang MD; Ning He; Fei Li MD

**PURPOSE**

ADHD is highly prevalent in school-age children with impaired cognitive functions. Diffusion tensor imaging (DTI) owns a unique advantage of detecting microstructural changes in cerebral white matter and might be useful to detect cognitive abnormalities in ADHD. In present study, we aim to examine the whole-brain fractional anisotropy (FA) difference between drug-naïve ADHD children and healthy controls (HC) in a relatively large sample size and also to explore the correlation of FA value with neuropsychiatric measurements.

**METHOD AND MATERIALS**

47 ADHD children (mean age=10.1, male=41) and 48 HC (mean age=10.9, male=35) were recruited. All participants underwent a set of neuropsychological tests including Stroop test (ST), visual memory test (VMT), verbal fluency test (VFT) and Wisconsin Card Sorting test (WCST). The DTI measures were acquired via 3-T MRS system using EPI sequence with 20 directions. FA map was generated by FSL after eddy current and brain extraction, and put into SPM8 for normalizing and smoothing. Voxel-wise comparison was done by two sample t-test with age and sex as covariates, threshold at P<0.05.

**RESULTS**

Comparing with HC, the ADHD group demonstrated increased FA in the body of corpus callosum extending to bilateral middle cingulum/peak coordinates[-12,2,38], T=4.27 (see Figure), while no decreasing cluster was detected. The cluster displayed a positive correlation with VMT scores for 30-minute delay intervals (r=0.32, p=0.029), VFT scores for total numbers (r=-0.46, p=0.001) and right numbers (r=0.45, p=0.001), ST scores for right numbers (r=0.31, p=0.02), while negatively correlated with ST scores for wrong numbers (r=-0.36, p=0.028) and total time (r=-0.37, p=0.01).

**CONCLUSION**

Our study found elevated FA value in the group of ADHD children which correlated with multiple cognitive functions. We postulated there might be a compensatory mechanism for increased information translation between hemispheres in ADHD children.

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**SSE21-05** • 1H Magnetic Resonance Spectroscopy Assessment of Metabolic Brain Maturation in Attention Deficit Hyperactivity Disorder

Arturo R Alvarado MD (Presenter)

**PURPOSE**

To evaluate aged-related biochemical changes in Frontal Lobe White Matter (FLWM) using 1H Magnetic Resonance Spectroscopy (MRS) in children diagnosed as Predominantly Inattentive Type Attention Deficit Hyperactivity Disorder (ADHD).

**METHOD AND MATERIALS**

Forty right-handed male children (5 years old) diagnosed as ADHD according to the Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV) criteria participated in the study after their parents’ consent and the Local Ethics Committee authorization was obtained. Psychological/behavioral treatment was performed via 3-MARK course of the investigation avoiding medications’ use. MRS studies were performed on a 3.0 Tesla scanner (Signa Excite®, GE) with a standard head coil using Point-Resolved Spectroscopy (PRESS) localization with automated shim and water suppression. Parameters were fixed at TR= 1500 ms, TE= 35 ms and 256 FID. T1, T2 and T2 FLAIR MR images in axial, coronal and sagittal views were acquired before MRS examination and single voxel of 4.00 cm³ (2.0 cm x 1.0 cm x 2.0 cm) was placed in each FLWM and Occipital WM used as internal reference pattern. All children were examined every 12 months in a date close to the birthday during 4 consecutive years. Metabolic signals of N-Acetylaspartate (NAA), Creatine (Cr), Choline (Cho), Glutamine-Glutamate complex (Glx) and myo-Inositol (mI) were detected and NAA/Cr, Cho/Cr, Glx/Cr and mI/Cr ratios were calculated. Analysis of Variance (ANOVA) was applied to the results. Student-Newman-Keuls test for multiple comparisons were assessed in order to verify the differences among ratio means. Analysis of Covariance (ANCOVA) was used to evaluate the relationship between the neuropsychological test scores and metabolites ratios result.

**RESULTS**

Significant age-dependent decreases in Glx/Cr ratio was observed in FLWM at both sides as well as in Cho/Cr ratio in right FLWM (p<0.05).

**CONCLUSION**

These findings suggest that Glx/Cr and Cho/Cr ratios are increased in FLWM of children with ADHD and the age-dependent reduction might constitute a brain maturation marker in ADHD.

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**SSE21-06** • Medication Naïve Attention-deficit/Hyperactivity Disorder Subjects Have Low Brain Iron Levels as Detected by Magnetic Field Correlation Imaging

Vitria Adisetiyo PhD (Presenter); Rachael Deardorff MS; Ali Tabesh PhD; Els Fieremans PhD; Kevin M Gray MD; Adriana Di Martino; F. Xavier Castellanos MD; Jens H Jensen PhD; Joseph A Helpern PhD *

**PURPOSE**

Stimulant medication reduces symptoms in attention-deficit/hyperactivity disorder (ADHD) through indirectly increasing dopamine (DA) levels in the striatum. Hence, it is suspected that reduced DA levels are part of ADHD pathology. However, both increased and decreased DA markers have been detected in ADHD. Interestingly, reduced DA markers have been consistently found in medication naïve patients while increased markers have been found in patients with a history of medication use, suggesting increased DA markers may reflect an adaptive response to medication. Here we assess the relationship between medication history and brain iron levels in children and adolescents with ADHD compared to typically developing controls (TDC). As brain iron is required for DA synthesis, assessing iron levels with MRI may provide non-invasive indirect measures of DA.

**METHOD AND MATERIALS**

27 TDC, 12 ADHD-naïve and 10 ADHD-medication were recruited. As indices of brain iron, magnetic field correlation (MFC) and relaxation rates (R2, R2* and R2') were used. All are affected by tissue iron but differ in their sensitivities and specificities. MFC was estimated with MFC imaging, R2 with a multiple spin echo sequence and R2* with a multiple gradient echo sequence. R2 = R2' - R2. The globus pallidus (GP), caudate nucleus (CN), putamen (PUT) and thalamus (THL) were chosen as regions of interest because of their suspected role in ADHD in addition to having high iron content. Serum iron measures were also collected.

**RESULTS**

The ADHD-naïve subgroup had significantly lower MFC than either TDC or the ADHD-medication subgroup in 3 of the 4 brain regions studied (FDR corrected). ADHD-naïve vs. TDC: GP (p = 0.005, d = 1.0), CN (p = 0.003, d = 1.1) and THL (p = 0.012, r = 0.4); ADHD-naïve vs. ADHD-medication: PUT (p = 0.002, d = 1.5), CN (p = 0.004, d = 1.4) and THL (p = 0.021, r = 0.5). TDC and the ADHD-medication subgroup did not significantly differ in MFC. In contrast, no significant group differences were detected using the R2, R2*, R2' or serum measures.

**CONCLUSION**

Similar to other DA marker measures, lower brain iron levels (indexed only by MFC) are observed in medication naïve ADHD and appear to normalize with medication.

**CLINICAL RELEVANCE/APPLICATION**

Reduced brain iron in medication naïve ADHD is a promising biomarker. MFC imaging’s ability to non-invasively detect these aberrant levels may help improve ADHD diagnosis and guide optimal treatment.
Although epidural masses detection is often accomplished using MRI, the more routine use of CT imaging makes early detection in this modality

**PURPOSE**

Independent combination of multiple readers for the detection of lung nodules in chest radiographs should be used as measure for achievable CAD performance. The recently completed LIDC/IDRI database provides by far the largest public resource to assess the performance of algorithms for the detection of pulmonary nodules in thoracic CT scans. We report the performance of two detection systems, and address the issue of completeness of the reference standard.

**RESULTS**

The 890 scans contained 775 positive findings. At 1, 2, and 4 FP/scan, Herakles had a sensitivity of 69%, 75%, and 79%, respectively. For ISICAD this was 51%, 63%, 72%. We analyzed the FPs of Herakles at an operating point of 2 FP/scan. Of these, 31% were annotated by at least one radiologist as a nodule >3mm. An additional 17% were indicated by at least one radiologist as a nodule.

**CONCLUSION**

The LIDC/IDRI data set is an excellent benchmarking tool for nodule detection algorithms. Automated detection can identify pulmonary nodules that have not been annotated in an extensive reading process with blinded and unblinded review by four human observers.

**CLINICAL RELEVANCE/APPLICATION**

Algorithms for automatic detection of pulmonary nodules can be compared and improved through the availability of a common database for benchmarking.

**SSE2-04**  
Computer-aided Detection of Epidural Masses in Computed Tomography Using a Constrained Gaussian Mixture Model

**PURPOSE**

An independent combination of multiple readers for the detection of lung nodules in chest radiographs should be used as measure for achievable CAD performance.

**METHOD AND MATERIALS**

With IRB approval and informed consent, DBTs were acquired from human subjects using a GE prototype DBT system. The data set was divided into a training set (127 views from 64 breasts with MCs) and an independent test set (104 views from 52 breasts with MCs and 76 views from 38 breasts without MCs). The biopsy-proven cluster location was marked by an MQSA radiologist. DBT volume is reconstructed using our recently developed simultaneous algebraic reconstruction technique (SART) with multiscale bilateral regularization that reduces noise, enhances MCs, and preserves the sharpness of tissue structures. A planar projection (PPJ) image is generated by selectively extracting the high-frequency information including potential MCs from the 3D volume and projecting it to a plane. Cluster centroid objects and individual seed points are then detected from the PPJ image using iterative adaptive thresholding in combination with segmentation guided by the local contrast-to-noise ratio (CNR). The cluster centroid objects are further screened using a neural network trained for recognizing true signals and false positives (FPs). Dynamic clustering embedded with machine learning rules based on CNR, size and number of signals is used to detect MC-FPs clusters are further reduced using the size, skewness and kurtosis properties of the CNR histogram of the cluster. The detection on PPJ images was compared with that in the 3D volumes using jackknife free-response receiver operating characteristic (JAFROC) analysis.

**RESULTS**

For the test set, the FP rate decreased by 50% at 85% sensitivity for both the view-based and case-based performance (0.81 and 0.54 FPs/view, respectively) on the PPJ images compared to that in the 3D volumes (1.92 and 1.01 FPs/view). The case-based sensitivity reached 95% at 0.82 FPs/view in the PPJ images. JAFROC analysis showed a significant improvement with a figure-of-merit of 0.65 and 0.58 for PPJ and 3D, respectively (p-value = 0.005).

**CONCLUSION**

Computerized MC detection on PPJ images performs better in 3D reconstructed volumes. Further study is underway to improve the PPJ method.

**CLINICAL RELEVANCE/APPLICATION**

CADe can be an adjunct to radiologist reading and has the potential to improve detection of subtle microcalcification clusters and increase the workflow in DBT interpretation.

**SSE2-04**  
Computer-aided Detection of Epidural Masses in Computed Tomography Using a Constrained Gaussian Mixture Model

**PURPOSE**

Although epidural masses detection is often accomplished using MRI, the more routine use of CT imaging makes early detection in this modality
advantageous. Our preliminary Computer-Aided Detection (CAD) framework addresses the dearth of work focusing explicitly on the detection of epidural masses. We supply a spatially-constrained Gaussian Mixture Model (CGMM), using tissue classes informed by the spinal canal composition, to localize candidate detections and reduce false positives.

**METHOD AND MATERIALS**

40 patients with chest-abdomen-pelvis CT scans were examined. 23 patients were selected with MRI reports confirming an epidural mass. 17 patients without epidural masses were randomly selected to serve as controls. Two radiologists manually demarcated the centroids of each epidural mass identified in the CT scans to serve as ground truth. The CAD system segments the whole spine using a watershed algorithm and directed graph search. It isolates the spinal canal using a four-part vertebra medial model, boundary dilation, and intensity thresholding. Four tissue classes were generated using K-means clustering to represent normal intradural tissue, fat/vasculature, the epidural mass, and a partial volume region between the bone and soft tissue. CGMM was employed to refine classification, taking advantage of both spatial and intensity parameters. Detections were limited to masses extending from the canal boundary. These detections were then submitted for feature extraction and support vector machine classification (SVM).

**RESULTS**

Before classification with SVM, our CAD system detected 44 out of 47 detections. Missed detections resulted from undersegmentation of the canal in the L5-S1 regions. A sensitivity of 80% with 7.2 false positives per patient was attained following classification and ten-fold cross-validation, which compared favorably with the sensitivity of 76% with 7.4 false positives per patient attained by restricting CAD to intensity based K-Means clustering.

**CONCLUSION**

Our CAD system lays the groundwork for detection of epidural masses in CT scans and points to the importance of using a combination of spatial and intensity based parameters to localize masses in the canal.

**CLINICAL RELEVANCE/APPLICATION**

Epidural masses in the spinal canal can cause pain or paralysis and can indicate metastasis. Alerting radiologists of the presence of these masses in CT can speed response to underlying pathologies.

**SSE22-05 • A Fully Automatic Registration Algorithm for Multiparametric Prostate MRI**

Valentina Giannini (Presenter); Anna Vignati; Simone Mazzetti; Filippo Russo MD; Christian Bracco PhD *; Michele Stasi; Daniele Regge MD

**PURPOSE**

Multiparametric (mp) MRI has been proposed as a potential alternative screening method for prostate cancer (PCa) diagnosis. One of the most challenging problems is to correctly align different types of images so that features coming from different sequences can be extracted from the same group of pixels. The aim of this study is to present a fully automatic registration system capable of correcting for movements generated during the dynamic acquisition (DCE) and for DW image distortion.

**METHOD AND MATERIALS**

The dataset includes 21 men with histologically proven PCa (age 65 [7], mean [SD]) that underwent endorectal 1.5T MRI with the following scanning protocol: axial T2-w, DW imaging (b-values 0,600, 1000 and 1400 s/mm²) and a 13-s time resolution DCE sequence. All patients underwent radical prostatectomy within 3 months from MRI. A radiologist manually outlined regions of interest on the T2-w images in areas corresponding to the tumoral foci at histology and in a non-tumoral region located in the contralateral peripheral zone (PZ). First a multi-resolution rigid registration algorithm, based on the mutual information similarity measurement, corrected misalignment between T2-w and DCE images. Afterwards, a linear deformation field decaying along the vertical axis was applied on the DW images. Pharmacokinetics and ADC parameters coming from registered and non-registered images were fed into a Bayes classifier, and the area under the receiver operating characteristic curve (AUC) was computed before and after registration. The one-tailed paired t-test was used to evaluate differences between AUC, sensitivity, and specificity obtained by the classifier before and after registration.

**RESULTS**

With registration AUC and sensitivity increased from 0.59(0.15) (mean [SD]) to 0.88(0.11) (p<0.05).

**CONCLUSION**

This study demonstrated the feasibility of a fully automatic registration framework on a MRI prostate CAD system. The proposed method seeks to have all the MRI dataset registered to the T2-w image, thus allowing a more reliable multiparametric analysis.

**CLINICAL RELEVANCE/APPLICATION**

An automatic registration algorithm, integrated in a CAD for PCa, can reduce observer variability and reading time, and can be used to guide targeted prostate biopsy directly on the suspected region.

**SSE22-06 • Computer-aided Detection of Prostate Cancer Based on Automatic Multi-parametric Magnetic Resonance Image Analysis**

Simone Mazzetti (Presenter); Valentina Giannini; Anna Vignati; Filippo Russo MD; Michele Stasi; Daniele Regge MD

**CONCLUSION**

The application of a CAD system based on mp-MRI information that automatically highlight cancer suspicious regions will improve the diagnostic accuracy of the radiologist, reducing reader variability and speeding up the reading time.

**Background**

Prostate cancer (PCa) is the most common malignancy affecting men in the world and represents the third cause of cancer death in industrialized countries. Diagnosing PCa using multi-parametric (mp) magnetic resonance imaging (MRI) is increasingly being used in the diagnostic pathway, also in combination with computerized tomography (CT) scan, in order to automatically detect and localize the disease.

**Aim of this study**

To present a CAD system based on T2-w imaging, diffusion (DW) and dynamic contrast-enhanced (DCE) acquisitions to produce a pixel-wise malignancy probability map of the prostate gland.

**Evaluation**

The dataset included 20 men, with PSA > 4 ng/ml and confirmed PCa by transrectal ultrasonography guided biopsy. Patients underwent MRI at 1.5T using an endorectal coil and prostatectomy within 3 months of imaging. The pathologist contoured foci of cancer on prostate sections, to create the standard of reference. Then a radiologist compared imaging with histopathology and reported both malignant and benign regions of interest (ROI) on the T2-w images. The first step for the CAD system was the registration between T2-w, DW and DCE-MRI. Then each pixel belonging a ROI was represented as a vector containing values of T2-w signal intensity, of the apparent diffusion coefficient and of quantitative physiological parameters (e.g. kep, Ktrans) from DCE. Selected features were fed into a support vector machine classifier in order to provide a classification that maximized the detection of true positives, minimizing the false positive cases.

**Discussion**

The AUC, sensitivity and specificity were calculated on the ROC curve.

**SSE23-01 • Design and Evaluation of an Interactive MPR Viewer for Real-time Filtering of Large High-resolution Breast CT Data**

Ronny Hendrych *; Marcel Beister (Presenter) *; Willi A Kalender PhD *

**PURPOSE**

In clinical breast CT it is of interest to calculate low-noise CT volumes for soft-tissue lesion (STL) detection from noisy high-resolution (HR) images for micro-calciﬁcation diagnosis to avoid multiple reconstructions. A viewer for multi planar reformating (MPR) was developed and evaluated to offer a continuous adjustment of spatial resolution, to reduce the time necessary for the diagnostic procedure and to improve the workflow.

**METHOD AND MATERIALS**

- **Design and Evaluation of an Interactive MPR Viewer for Real-time Filtering of Large High-resolution Breast CT Data**
- **SSE23 + AMA PRA Category 1 Credit ™:1 • ARRT Category A+ Credit:1**
- **SSE23-01 • Design and Evaluation of an Interactive MPR Viewer for Real-time Filtering of Large High-resolution Breast CT Data**
- **Moderator**
  - Xiangyang Tang, PhD *
  - Stanislav Zabic, PhD *
- **SSE23-01 • Design and Evaluation of an Interactive MPR Viewer for Real-time Filtering of Large High-resolution Breast CT Data**
  - Stanislav Zabic, PhD *
  - Xiangyang Tang, PhD *
  - Ronny Hendrych *; Marcel Beister (Presenter) *; Willi A Kalender PhD *
Simulations of mathematical breast phantoms were performed (ImpactSim, CT Imaging GmbH, Erlangen, Germany) with average glandular dose levels varying from 1.5 up to 6 mGy. Furthermore, a breast CT prototype (CT Imaging GmbH, Erlangen, Germany) was used to scan an ACR Phantom (CIRS, Norfolk, VA, USA). Volumetric images were reconstructed in HR mode and subsequently 3D filtered using the following techniques: Gaussian, median and box filters and an iterative impulse detector using a weighted median filter. The visibility of lesions was assessed by calculating the effective contrast-to-noise ratio (CNR_eff), combining the usual CNR with the diameter of the lesion in question.

RESULTS

The MPR viewer allowed for continuous interactive real-time filtering of large HR volumes in an interactive fashion. In the simulated breast CT volumes the applied filters improved the CNR for lesions of 2 mm from 1.4 unfiltered in the HR volumes up to 39.2, 23.7, 40.5 and 8.5 for box filter, median, Gaussian and impulse detection, respectively. For the ACR phantom the Gaussian filter achieved the best results with an increased CNR_eff from 7.6 to 51.4 for the smallest lesion. Thereby all filters help to surpass the Rose criterion which states that values of 5 or higher are necessary to distinguish objects from the surrounding area.

CONCLUSION

The MPR viewer eliminates the need for multiple reconstructions in breast CT. It allows adjusting interactively the spatial resolution and thereby changing the effective CNR continuously.

CLINICAL RELEVANCE/APPLICATION

MPR viewers may help to avoid multiple image reconstructions, increase the effective CNR of lesions and improve the workflow for breast CT exams.

SSE23-02 • Evaluation of Sinogram Affirmed Iterative Reconstruction Using the XCAT Phantom in a Model Observer Study

Fatma Elzahraa A Elshahaby (Presenter); Benjamin Tsui PhD **; Matthew K FuId PhD **; Pamela T Johnson MD *; Elliot K Fishman MD *; Jingyan Xu PhD

PURPOSE

The study was designed to compare the performance of Siemens' Sinogram Affirmed Iterative Reconstruction (SAFIRE) and the Weighted Filtered BackProjection (WFBP) reconstruction methods using realistically simulated CT images from the 3D Extended Cardiac-Torso (XCAT) phantom and the Channelized Hotelling Observer (CHO) in a lesion detection study.

METHOD AND MATERIALS

Five simulated spheres (dia. =5mm, attenuation ratio of sphere:background= 1%) were placed at 5 locations in the liver of the XCAT phantom. Noisy CT projection data, 50 sets of lesion-present and 50 lesion-absent, at 11.5 mGy/rotation were generated using the DRASIM/XCAT simulation software. They were reconstructed with a Siemens Definition Flash scanner using WFBP with kernels B31F, B41F, B50F, B70F, and SAFIRE at strengths 1, 3, 5, and each with kernels 131F, 141F, 150F, 170F. A total of 250 lesion-present and 250 lesion-absent images were generated for each reconstruction + kernel combination. The central 64x64 pixels centered on the lesion was extracted and processed using 5 octave-wide rotationally symmetric frequency channels. 125 CT images were used for CHO training and 125 images for CHO testing. The receiver operating characteristic (ROC) curve and the area under the curve (AUC) from each reconstruction + kernel combination, and the statistical significance of the AUC difference were analyzed by LABROC4 and CLABROC programs.

RESULTS

The mean AUC did not change much for different kernels of WFBP, but it varied for SAFIRE especially at strengths 3 and 5. Using the sharp kernel 170F, the AUC decreased as the images became noisier which reduced the lesion detectability. For this detection task, the kernels giving the highest AUCs were B50F for WFBP and B31F for SAFIRE. The AUC for SAFIRE-1 was highly correlated with human observer performance for the detection and localization of low contrast lesions, as indicated by the lesion location in each image, and scored their confidence for the detection/localization task on a 6-point scale, from which localization ROC curves were generated. The same images were analyzed using a CHO with Gabor channels. Internal noise was added to the decision variables for the model observer measurements using a non-parametric approach for both human and model observers. The correlation between the performance of human observers and the CHO model observer was calculated.

CONCLUSION

By appropriate choices of the filter strength and kernels, SAFIRE outperformed the WFBP method in a lesion detection task using realistically simulated CT images. The results remain to be confirmed using clinical data.

CLINICAL RELEVANCE/APPLICATION

The advanced Sinogram Affirmed Iterative CT reconstruction (SAFIRE) method has the potential to improve lesion detectability in the clinical setting.

SSE23-03 • Quantitative Assessment of Metal Artifact Reduction in C-arm Cone-beam CT Guidance of Neurovascular Interventions

Carolina Cay (Presenter); Marta Wells; Adam S Wang PhD *; Jeffrey H Siewersdse PhD **; Tina Ehtiati PhD *; Christopher Rohkohl *; Bernhard G Scholz MD **; Martin G Radvany MD *

PURPOSE

To evaluate the performance of a metal artifact reduction (MAR) algorithm in C-arm cone-beam CT guidance of neurovascular interventions.

METHOD AND MATERIALS

Preclinical studies were conducted using a robotic C-arm (Artis Zeego; Siemens AG) for 3D imaging and MAR prototype developed by the manufacturer. The MAR algorithm is based on semi-automatic segmentation of metal components, sinogram correction, and 3D image reconstruction. A head phantom was developed involving a natural skull in tissue-equivalent plastic and the intracranial space filled with brain-equivalent gelatin. Plastics representing low-contrast brain, vessels, and CSF were incorporated along with a 3D prototype vascular tree and aneurysm (~9 mm diameter). Metal components were successively introduced: tantalum, and tungsten spheres (3.2, 6.4, and 12.8 mm diameter); an internal stent (Enterprise; DePuy); and coils (Deltaxa; DePuy) – the last two with and without iodine contrast in the vascular tree. 3D images were reconstructed with and without MAR, and artifact magnitude was quantified in terms of the voxel value standard deviation from streaks in a region about the metal component.

RESULTS

The MAR algorithm demonstrated strong reduction in artifact in each scenario and restored image quality to a level sufficient for visualization of the metal component and surrounding structures. Artifact magnitude without and with MAR was, respectively: 427 vs 35 HU (3.2 mm steel); 506 vs 44 HU (6.4 mm steel); 384 vs 49 HU (12.8 mm steel); 451 vs 35 HU (coil only); and 455 vs 50 HU (stent + coil). Similar improvement (~8 – 13x reduction in artifact magnitude) was evident in Ti and W spheres (3.2 – 12.8 mm). Even under the most severe scenario examined, MAR restored visualization of the component and did not visibly degrade the fidelity of surrounding structures.

CONCLUSION

The MAR algorithm provided excellent reduction of artifact magnitude even under challenging scenarios of large and multiple metal components. This quantitative performance assessment indicates that the method warrants investigation in clinical studies. Ongoing work includes streamlining the semi-automatic segmentation step and analysis of tolerance to MAR parameters.

CLINICAL RELEVANCE/APPLICATION

3D imaging in neurovascular intervention is challenged by artifacts arising from stents, coils, and clips. The MAR algorithm diminishes such artifacts for improved guidance and verification.

SSE23-04 • Diagnostic Performance Assessment of an Iterative Reconstruction Algorithm Using a Model Observer: Correlation with Human Observers for a Low Contrast Detection Task with Unknown Lesion Locations

Shuai Leng PhD (Presenter); Lifeng Yu PhD; Yi Zhang; Michael R Brusewitz; Thomas J Vrieez RT; Cynthia H Mccollough PhD *

PURPOSE

To investigate the ability of a Channelized Hotelling Observer (CHO) to predict human observer performance for the task of low contrast lesion detection for unknown lesion locations, where CT images were reconstructed using an iterative reconstruction (IR) algorithm.

METHOD AND MATERIALS

Two cylindrical rods (3 mm and 5 mm diameters) were placed in a 35 x 26 cm torso-shaped water phantom to simulate lesions with -15HU contrast at 120 kV. The phantom was scanned 100 times yielding a 128-slice CT scanner at each of 4 dose levels (CTDvol = 22.8, 17.1, 11.4, and 6.0 mGy). Images were reconstructed using Siemens’ IR algorithms (SAFIRE, Siemens). A total of 100 signal-present images were generated by placing regions of interest (ROIs) around each lesion and 50 background images were generated from images without lesions, with each ROI containing 128x128 pixels. The location of the lesion in each ROI was randomly distributed by moving ROIs around each lesion. Three trained observers identified the presence or absence of lesions, indicated the lesion location in each image, and scored their confidence for the detection/localization task on a 6-point scale, from which localization ROC (LROC) curves were generated. The same images were analyzed using a CHO with Gabor channels. Internal noise was added to the decision variables for the model observer measurements using a non-parametric approach for both human and model observers. The correlation between the performance of human observers and the CHO model observer was calculated.

RESULTS

The performance of human and model observers was highly correlated at all dose levels for both lesion sizes, with Pearson’s product-moment correlation coefficients of 0.994 and 0.994 for 3mm and 5mm diameter lesions, respectively.

CONCLUSION

The performance of CHO with Gabor channels was highly correlated with human observer performance for the detection and localization of low contrast lesions with uncertain locations in CT images reconstructed with the SAFIRE IR algorithm.
An Evolutionary Algorithm for the Optimization of Parameters in Radiation Beam Profile Modeling for the CyberKnife X-band Linear Accelerator

SSE24-02

The ability of a CHO to objectively assess the performance of iterative reconstruction algorithms for detection tasks may provide an efficient mechanism for optimizing CT image quality and dose.

SSE23-06 • A Novel Iterative-reconstruction Algorithm for Metal Artifact Reduction: Comparison with Filtered Back Projection and Linear-interpolation

Siva P Raman MD (Presenter) ; Pamela T Johnson MD * ; Matthew K Fuld PhD * ; Elliot K Fishman MD *

Purpose
Iterative reconstruction algorithms offer a new option for the reconstruction of images with decreased metal-related artifacts. The goal of this study is to quantitatively and qualitatively compare CT scans performed in patients with metallic hardware when reconstructed with three different reconstruction algorithms: (1) Traditional weighted filtered back-projection (WFBP), (2) a novel iterative reconstruction algorithm (IR-MAR) designed for metal artifact reduction (Siemens, Germany), and (3) a linear interpolation metal artifact reduction algorithm (LI-MAR).

Method and Materials
20 different consecutive pelvic CT scans in patients with unilateral or bilateral metallic hip arthroplasties were identified. These data sets were reconstructed in the axial plane using the three different reconstruction algorithms (WFBP, IR-MAR, and LI-MAR). An abdominal radiologist with 2 years of experience evaluated the images (on a scale of 1-10) with regards to image quality, providing separate scores for the overall image and individual appearances of the bladder, prostate/uterus, and pelvic side walls. ROI analysis was performed of the bladder lumen and subcutaneous fat (ipsilateral to hardware) with mean Hounsfield attenuation values and standard deviation (as a surrogate for noise) recorded.

Results
Subjective quality ratings for the overall image (p

Conclusion
A novel metal artifact reduction algorithm based on iterative reconstruction offers significant improvements in subjective image quality compared to both traditional filtered back-projection and older linear interpolation algorithms. Moreover, quantitative decreases in image noise are at least equivalent to linear interpolation MAR algorithms.

Clinical Relevance/Application
A novel iterative reconstruction algorithm (IR-MAR) offers considerable qualitative and quantitative advantages over older reconstruction techniques when dealing with metal artifacts on CT.

Physics (Image-guided Radiation Therapy I)

Monday, 03:00 PM - 04:00 PM • S404AB

SSE24-01 • PET Image-guided Dose Escalation Study for Cervical Cancer Patients Receiving HDR Brachytherapy

James W Anderson PhD (Presenter) ; Krystyna D Kiel MD ; Yixiang Liao ; Rui Yao PhD ; Damian Bernard PhD ; Julius Turian ; James C Chu ; PhD *

Purpose
To study the feasibility and benefit of boosting dose to active regions of cervical cancer identified by positron emission tomography (PET) imaging during brachytherapy.

Method and Materials
5 patients imaged with both MRI and PET/CT were retrospectively studied. An experienced physician contoured the GTV and HR-CTV using the MRI scan alone, and then contoured the region of PET-hot activity using a PET/CT image. The MRI and PET/CT images where then fused, and a PET-HR-CTV volume was constructed from the union of the HR-CTV and PET-GTV.

Each patient had been treated using a Syed or TandR applicator with 4-20 interstitial needles. Two new plans were optimized using Oncentra's IPSA package with the following objectives: 1) a plan using only the MRI contours in which the HR-CTV-D90 received the prescription dose (Rx), and 2) a plan where the HR-CTV D90 received the PET-GTV boost to 150% of the Rx dose in the PET-only plans—two other cases were those in which the PET-GTV volume extended the most outside of the HR-CTV.

Results
Significant differences were seen between the MRI-GTV and PET-GTV contours (average size difference 21.8cc, average overlap 50%, see Figure 2). The PET-GTV boost to 150% was possible in four out of five cases, with the last case reaching 127% before reaching the rectal D2cc limit (Table 1). In 3 of the test cases, the PET-GTV also received about 150% of the Rx dose in the MRI-only plans—the two other cases were those in which the PET-GTV volume extended the most outside of the HR-CTV.

Conclusion
PET imaging modality has the potential to identify residual cervical cancer otherwise not visible on MRI and CT studies. This work has found that MRI target contouring regularly does not include regions of PET activity, and PET-based planning can lead to improved coverage over plans using MRI alone without sacrificing OAR sparing.

Clinical Relevance/Application
PET/CT scans for cervical brachytherapy planning provide more accurate GTV contours and allow increased dose to regions of active tumour.

SSE23-05 • Do We Need to Model the Ray Profile in Iterative Clinical CT Image Reconstruction?

Christian Hofmann (Presenter) ; Michael Knap PhD ; Marc Kachelriess PhD

Purpose
To find out whether clinical CT images benefit from modeling the geometric properties of each x-ray.

Method and Materials
Iterative image reconstruction promises to reduce image noise (and thereby patient dose), to reduce artifacts, or to improve spatial resolution. Among vendors and researchers, however, there is no consensus of how to best achieve these aims. We here focus on the aspect of geometric ray profile modeling (RM) which is realized with some algorithms while others model the ray as a straight line. To independently evaluate whether RM is of advantage we implemented several iterative reconstruction algorithms without RM (SART, OSC, OSEM) and with RM (SART-RM, OSC-RM, OSEM-RM). In all cases noise was matched to be able to focus on comparing spatial resolution. A thorax phantom with additional bar and circular resolution patterns was simulated using the geometry of a typical clinical CT system (0.6 mm detector element size at iso-center, 1024 projections per rotation). The size of the focal spot ranges from realistic 0.5 mm to unrealistic 5.0 mm. To quantify image quality we analyze line profiles through the resolution patterns to define a contrast factor (CF) for contrast-resolution plots, and we compare the normalized cross-correlation (NCC) with the ground truth for the circular resolution patterns.

Results
For the unrealistic case of 5.0 mm focal spot the CF can be improved by a factor of 2 due to RM: the 4.2 lp/cm bar pattern, which is the first bar pattern that cannot be resolved without RM, can be easily resolved with RM. For the realistic case of a 0.5 mm focus all results show approximately the same CF. The NCC shows no significant differences between with and without RM when the source width is smaller than 2.0 mm (as in clinical CT). From 2.0 mm to 5.0 mm improvements can be observed with RM, increasing with increasing focus size.

Conclusion
Geometric RM in iterative reconstruction helps to improve spatial resolution if the ray cross-section is much larger than the ray sampling distance. In clinical CT, however, the ray is not much thicker than the distance between neighboring ray centers. Therefore RM appears not to be necessary in clinical CT.

Clinical Relevance/Application
Geometric RM is of high computational cost. Clinical CT will benefit if the focus of iterative reconstruction is noise, dose and artifact reduction rather than resolution improvement.
This article introduces a novel SBRT technique, LED-SBRT, which exploits the LED phenomenon to reduce normal lung dose levels and permit tumour dose escalation with respect to the conventional plan. Despite escalated tumour dose levels, normal lung dose was still decreased. For example, the mean lung dose and V20 decreased by ~10 Gy.

The LED-optimized plan produced a ‘hot spot’ at the tumour center equal to 169 Gy, which was approximately twice as large as the maximal dose found within the extent of tumour motion over the patient’s breathing cycle. All dose results were normalized such that at least 95% of the PTV received at least 54 Gy (i.e. 18MV(3x1cm²) beam parameters). A planning target volume (PTV) was generated by considering the new limits indicated by the new limits for a stem correction factor, but several ionization chamber of both design types showed significantly different stem correction factors in the presence of a magnetic field.

Clinical Relevance/Application
Certain designs of ionization chambers seem unaffected by a magnetic field and are suitable for use with the first MRI-IGRT machine.

SSE24-04 • Effect of a Low-strength Magnetic Field on Ionization Chamber Reference Dosimetry
Eric Pepin PhD (Presenter) ; Olga Green PhD *

Purpose
To evaluate the impact of a 0.32-Tesla magnetic field present in the first commercial MRI-IGRT system on various ionization chamber dosimetry correction factors and to discover any directional dependency thereon.

Method and Materials
Various ionization chambers were evaluated to determine polarity, ion recombination, and stem effect correction factors using a Cobalt-60 MRI-IGRT system. Correction factors were determined using techniques outlined in the AAPM Task Group 51 report and various other publications. Correction factors were determined as a function of ion chamber orientation in the magnetic field and compared to readings taken on a linear accelerator in the absence of a magnetic field.

Results
The various ionization chambers with a central anode were within prescribed tolerance limits for P10 and P20 in the presence of a magnetic field. Parallel plate ionization chambers exceeded tolerance limits for P10 and P20, but were within tolerance for P10 in the presence of a magnetic field. There are no established tolerance limits for a stem correction factor, but several ionization chamber of both design types showed significantly different stem correction factors in the presence of a magnetic field compared to when not in a magnetic field. All ionization chambers showed a directional dependency in the stem correction factor in the presence of a magnetic field.

Conclusion
The ability of central anode ionization chambers to satisfy TG-51 correction factor tolerance limits seems uninhibited by the presence of a magnetic field, however parallel plate chambers were strongly affected by the presence of a magnetic field. Chambers of all design types may require bi-directional commissioning due to variations in the stem correction factor when in the presence of a magnetic field.

SSE24-05 • Analysis of Predictive Maintenance of Linear Accelerator Beam Uniformity Using Statistical Process Control
Charles M Able MS (Presenter) ; Alan Baydush PhD * ; Michael T Munley PhD *

Purpose
PDm monitoring of beam uniformity using a new method for determining SPC control limits is more effective than using traditional control limits. SPC false alarms are reduced thereby eliminating unwarranted service intervention. We are working to develop code that will provide an SPC evaluation using the new formula.

Background
The focus of this study is to determine the effectiveness of revisions to statistical process control (SPC) chart limits for linear accelerator steering coil current (beam uniformity) predictive maintenance (PDm) monitoring.

Evaluation
We have re-evaluated the calculation of the limits for steering coil current (SCC) SPC charts based on our observations that the changes in SCC required for 1% change in measured beam uniformity will generally exceed the traditional limits calculated using the standard deviation of the subgroup values alone. Using empirical data obtained from controlled experiments varying the SCC while measuring the beam uniformity, we have developed a formulation that incorporates a scaling factor (Cm) in the calculation of control limits.

Discussion
SCC monitoring of an 18 MV photon beam using the new method in the transverse position coils operating current 2 weeks prior to multiple EXQ2 fault and unscheduled downtime. A change in beam uniformity of greater than 3% was found once the beam was scanned using a computerized water phantom and ion chamber. SCC charts of this steering coil using traditional limits would have resulted in 5 false positives prior to the first positive alarm indicated by the new limits.

SSE24-06 • Forcing Lateral Electron Disequilibrium to Spare Lung Tissue: A Novel Technique for Stereotactic Body Radiation Therapy of Lung Cancer
Brandon Dishner (Presenter) ; George Hajdok ; Stewart Gaede ; Matthew Mulligan ; Jerry J Battista

Purpose
Stereotactic Body Radiation Therapy (SBRT) is a treatment option for inoperable early stage lung cancer patients. SBRT uses tightly conformed megavoltage (MV) x-ray beams to ablate the tumour in only a few treatment sessions. Small MV x-ray fields may cause lateral electron disequilibrium (LED) to occur within lung tissue, which can reduce the dose to the tumour to a variable extent. These dose effects may be challenging to predict using commercially-available dose calculation algorithms. To avoid LED, previous authors suggested using low energy, tohtoton and larger fields for lung cancer patients. We propose a new form of SBRT, named LED-optimized SBRT (LED-SBRT), which utilizes RT parameters designed to exploit LED to advantage. It will be shown that LED-SBRT can be used to reduce the dose within healthy lung tissue while enabling escalation of tumour dose levels.

Method and Materials
The DOSXYZNMC Monte Carlo software was used to calculate dose within a typical SBRT patient. To mimic a 3600 SBRT arc, 36 equally weighted fields were focused onto the small tumour (~1 cm). 6 or 18 MV x-ray energies were used to simulate different plans of various field sizes. The LED-optimized plan, 18MV(3x1cm²), was compared to a clinical standard arc using 6MV(3x3cm²) beam parameters. A planning target volume (PTV) was generated by considering the extent of tumour motion over the patient’s breathing cycle. All dose results were normalized such that at least 95% of the PTV received at least 54 Gy (i.e. D95).

Results
The LED-optimized plan produced a ‘hot spot’ at the tumour center equal to 169Gy, which was approximately twice as large as the maximal dose found within the conventional plan. Despite escalated tumour dose levels, normal lung dose was still decreased. For example, the mean lung dose and V20 decreased by ~ 0.5 Gy and 1.1%, respectively, comparing the LED-optimized plan to the clinical standard.

Conclusion
This article introduces a novel SBRT technique, LED-SBRT, which exploits the LED phenomenon to reduce normal lung dose levels and permit tumour dose escalation with respect to the conventional plan. Despite escalated tumour dose levels, normal lung dose was still decreased. For example, the mean lung dose and V20 decreased by ~ 0.5 Gy and 1.1%, respectively, comparing the LED-optimized plan to the clinical standard.
Dual Payload Molecular Radiotherapy against Malignant Brain Cancer

James R Ewing PhD (Presenter) ; Madhava Aryal PhD ; Tavarekere Nagaraja PhD ; Swayamprava Panda PhD ; Stephen L Brown

PURPOSE
To study acute post-radiation changes in the tissue-vascular interface in a rat model of cerebral glioma.

METHOD AND MATERIALS
25 rats were implanted with U251 cells intracerebrally and irradiated 21 days later. Radiation was 20 Gy delivered using 6 MV photons, 8 Gy/min. A 4 mm dia. circle covered the 95-100% isodose extending in a single anterior-posterior direction. Vascular parameters were measured using dynamic contrast enhanced MRI (DCE-MRI) in a Varian 7T, 20 cm bore system. Two DCE-MRI studies were conducted for each animal, 24 hrs apart. S groups, 5 animals per group, were studied, with 2, 4, 8, 12 or 24 hrs between radiation and the second DCE-MRI. A dual-echo gradient echo (2GE) sequence, with 4 s resolution between image sets was run to acquire a trace of the change in R1 (1/T1) vs time, and thus estimate contrast agent (CA) concentration vs time. The CA Magnevist was injected as a bolus (0.1 mM/kg) at image 15. Spin-echo arterial spin labeled tumor blood flow TBF estimates were acquired in a single central slice.

RESULTS
TBF decreased in the 2 hrs post-irradiation group by 70 to 80% of pre-irradiation levels, followed by a steady increase in later groups, until, at 24 hrs post-irradiation, TBF exceeded pre-irradiation levels by 40%. The interstitial volume fraction, ve, negative throughout the study, pointed to a significant loss of interstitial volume (i.e., cell swelling). At 2 hrs after radiation, ve was 30% below pre-irradiated values. ve temporarily increased to near pre-irradiated values 4 hrs after radiation and subsequently decreased to 30% below pre-irradiated levels at 24 hrs post-irradiation. The vascular permeability, Ktrans, demonstrated a bimodal response, increasing at 4-8 hrs, reaching 35% above pre-irradiated values, followed by a decrease at 24 hrs to 20 to 40% below the pre-irradiation level.

CONCLUSION
To our knowledge, this is the first measurement of changes in ve and/or TBF in the hours immediately following 20 Gy irradiation. Since vascular changes have profound implications for the delivery of adjunct therapies, these findings provide direction for the optimization of combined therapies.

CLINICAL RELEVANCE/APPLICATION
Post-RT changes in the tissue-vascular interface in a model of cerebral glioma were measured. Knowledge of acute vascular dynamics can help optimize radiation combined with adjunct therapies.

Evaluating Response to Spine Radiosurgery with DCE-MRI Perfusion Parameters

Kiran A Kumar (Presenter) ; Kyung K Peck PhD ; Sasan Karimi MD ; Eric Lis MD ; Mark Bilsky MD * ; Andrei I Holodny MD * ; Yoshiya Yamada MD *

PURPOSE
Dynamic contrast enhancement MR imaging (DCE-MRI) offers noninvasive characterization of the vascular microenvironment and hemodynamics. In this study, we hypothesize that DCE-MRI can be used to evaluate treatment response and predict tumor recurrence in patients with spinal metastases undergoing high dose radiotherapy (RT).

METHOD AND MATERIALS
We conducted a retrospective study of 30 patients with spinal metastases who underwent DCE-MRI before and after RT. 20 patients received single-fraction SRS (24 Gy), while 10 received hypofractionated SRS (27-30 Gy total). Kaplan-Meier analysis was used to estimate the actuarial local recurrence rates, which were compared using a log-rank test. Two compartment model-based perfusion parameters (Ktrans; vascular permeability and Vp; plasma volume) were measured for each metastasis, relative to normal-appearing bone marrow. Percent change in parameter values from pre- to post-treatment were calculated and statistically compared.

RESULTS
At 20-month median follow-up, 5/30 (17%) patients had pathological evidence of local recurrence (LR). 3/10 (30%) patients treated with hypofractionated SRS had LR, while 2/20 (10%) patients treated with single-fraction SRS had LR. 1- and 3-year actuarial local recurrence rates were 24% and 44% for the hypofractionated SRS group vs. 5% and 16% for the single-fraction SRS group (p=0.20). The average change in Vp and Ktrans for patients without LR vs. those with LR was -76% (range, -99% to -12%) and -66% (range, -99% to -9%) vs. +28% (range, -19% to +102%) and -14% (range, -50% to +84%) (p<0.05).

CONCLUSION
We demonstrated that changes in perfusion, particularly Vp, reflect tumor responses to high dose RT in spinal bone metastases. Additionally, these changes predicted local tumor recurrence on average >6 months earlier than standard imaging did.

CLINICAL RELEVANCE/APPLICATION
The ability of DCE-MRI to detect early treatment response and predict local recurrence has the potential to improve patient care and outcome.

Dual Payload Molecular Radiotherapy against Malignant Brain Cancer

Van T Nguyen PhD ; Gilberto Zulato ; Jesse M Conyers BS ; Dongqin Zhu ; Waldemar Debinski ; Akiva Mintz MD, PhD (Presenter) *

PURPOSE
Our overall goal is to therapeutically exploit a novel ligand-based delivery system that targets IL13Rα2, a tumor-restricted biomarker that we discovered to be overexpressed in majority of Glioblastoma Multiforme (GBM) as well as other tumors. Our hypothesis is that we can efficiently target GBM in vivo using a dual payload molecular strategy that exploits our novel delivery system to target IL13Rα2-Targeted Quadruple Mutant of IL13 (TQM13). We therefore created a single TQM13-targeted agent that simultaneously delivers both a therapeutic radionuclide and an active bacterial toxin specifically to GBM tumors expressing IL13Rα2.

METHOD AND MATERIALS
We designed TQM13-cytotoxin (CTX) using the cDNA of TQM13 in frame with a modified form of Pseudomonas Toxin (PE4E). Protein was produced using a bacterial system. We used a cell-based cytotoxicity assay to test potency/specificity of TQM13-CTX to GBM cells that express IL13Rα2. To test in vivo efficacy, we stereotactically implanted GBM cells intracranially in nude mice and monitored tumor formation with bioluminescent imaging. 7-10 days post-implantation, groups of mice (n=9) were injected as a bolus (0.1 mM/kg) at image 15. Spin-echo arterial spin labeled tumor blood flow TBF estimates were acquired in a single central slice.

RESULTS
We demonstrated that TQM13-CTX only killed GBM cells that express IL13Rα2. This killing was potent and in direct proportion to the number of IL13Rα2 binding sites. To test the in vivo efficacy of [131I]-TQM13-CTX, we radiolabeled TQM13-CTX with [131I] and treated groups on mice (n=9) with a single dose of either (i) [131I]-TQM13-CTX, (ii) unlabeled TQM13-CTX mixed with untreated [131I], or (iii) saline. At the completion of the experiment (day 80), 100% of the [131I]-TQM13-CTX treated group was cured, compared to only 67% of the group treated with the unlabeled active TQM13-CTX (mixed with untreated [131I]) and 0% in the saline control group.

CONCLUSION
This work confirms the potency of our dual payload molecular strategy that uses both radioimmunoantherapy and an active bacterial cytotoxin to target the IL13Rα2 GBM-associated biomarker.

CLINICAL RELEVANCE/APPLICATION
GBM is an invariably fatal malignancy. We therapeutically exploited a dual payload molecular radiotherapy strategy that targets GBM via a novel molecular delivery system that we developed.
SSE25-04 • Dosimetric Implications of Setup Error in Craniospinal Irradiation with Volumetric Modulated Arc Therapy

Ben Durkee MD, PhD (Presenter); Blaire Hargens MS; Fred Van Den Haak; Jennifer L Shah MD; Sarah S Donaldson MD

PURPOSE
1. To demonstrate the dosimetric advantages and drawbacks of volumetric modulated arc therapy (VMAT) planning for craniospinal irradiation (CSI).
2. To demonstrate that small errors in setup are dosimetrically acceptable for CSI with VMAT.

METHOD AND MATERIALS
A single pediatric patient was simulated in the supine position on a Styrofoam board. The head was immobilized by a custom headrest and thermoplastic mask. No specific patient were taken to immobilize the spine or pelvis. Craniospinal therapy was prescribed to a dose of 23.4 Gy using 3D conformal radiotherapy (3D CRT) and VMAT. The two plans were compared with attention to coverage of the target volume and dose to normal tissue. Normal structures examined included thyroid, heart, lungs, kidneys, bowel and whole body. A small setup error was simulated by applying 3 mm and 5 mm lateral shifts to the dosimetric map. The plan was re-analyzed by the same metrics as above.

RESULTS
Both plans resulted in good coverage of the target and met our pre-defined constraints for normal tissue. VMAT was superior to 3D CRT in minimizing dose to normal tissues near the midline, including thyroid (mean 11.4 Gy versus 22.2 Gy) and small bowel (V15).

CONCLUSION
Dosimetric implications of resultant setup errors must be considered when using highly conformal techniques such as VMAT. VMAT for CSI can spare dose to normal tissues near the midline, but at the expense of low-dose spill to large volume structures such as lungs and whole body. Long-term implications, including risk for secondary malignancies, should be considered in patients selected for VMAT craniospinal irradiation. Planning with VMAT appears to be relatively resistant to small errors in setup, making it an appropriate modality for use in carefully selected children.

CLINICAL RELEVANCE/APPLICATION
Craniospinal irradiation with highly conformal techniques such as VMAT is relatively resistant to small errors in setup, and is appropriate for thoughtfully selected pediatric cases.

SSE25-05 • Pancreatic-sparing Cranio-spinal Irradiation (CSI) for Medulloblastoma: Dosimetric Comparison of Proton and Photon Modalities to Reduce the Risk of Diabetes Mellitus (DM)

Jeffrey Brower (Presenter)

ABSTRACT
Purpose/Objectives:
A recent multi-institution study demonstrated that radiotherapy dose >10 Gy to the pancreatic tail (PT) predicted an 11-fold increased risk of DM in childhood cancer survivors. These findings highlight the potential radiosensitivity of pancreatic islet cells responsible for insulin secretion. Cadaic human studies have shown that up to 65% islet cells are located outside PT. These data suggest the importance of including the whole pancreas (P) as an organ-at-risk (OAR) during radiation planning for pediatric tumors, such as CSI for medulloblastoma given its relatively favorable prognosis. This study compares CSI techniques of proton beam therapy (PBT), conventional photon fields (3D CRT), and helical tomotherapy (HT) to investigate their differential capacity for pancreatic sparing.

Materials/Methods:
5 average-risk medulloblastoma patients who received CSI to 23.4 CGE using PBT at a single institution were identified. P and PT had not been considered OARs during PBT planning. 3D CRT plans using opposed lateral cranial fields and posterior spinal fields were generated. P and PT were delineated as OARs on the PBT planning CT scan, and multiple HT plans were developed for each patient. HT plans delivering the lowest dose to P and PT were used without compromising target coverage were selected. Endpoints included mean dose (Dmean), maximum dose (Dmax), and volume receiving 10 Gy (V10). Comparisons were made using t-test; statistical significance was assigned to p values < 0.05.

Results:
All three modalities covered the PTV with the 95% isodose line.

Endpoint | 3DCRT | PBT | HT
--- | --- | --- | ---
### Whole Pancreas (P)
Dmean (Gy) | 11.97 ± 1.81 | 0.172 ± 0.14 | 5.06 ± 0.54
Dmax (Gy) | 21.36 ± 0.23 | 11.96 ± 6.8 | 13.47 ± 1.24
V10 (%) | 59.06 ± 9.56 | 0.3 | 61.48 ± 1.9

### Pancreatic Tail (PT)
Dmean (Gy) | 8.2 ± 2.49 | 0.09 | 0.01 ± 4.41 | 0.78
Dmax (Gy) | 20.86 ± 0.32 | 6.89 | 1.71 ± 9.17 | 1.08
V10 (%) | 39.28 ± 13.13 | 0 | 0.41 | 0.92

Dmean to P and PT to V10 were higher with 3DCRT as compared to PBT or HT (p=0.01 for 3DCRT vs. PBT for Dmean to P; p<0.05 for Dmax to P). PBT and HT provided significantly lower Dmean and V10 than 3DCRT. However, PBT provided even better pancreatic sparing compared to HT, reducing Dmean to max to P and PT and V10 to P. Thus, PBT for CSI may be associated with the lowest risk of long-term DM in pediatric medulloblastoma survivors.

SSE25-06 • Feasibility of Simultaneous Integrated Boost Gamma Knife Planning For Malignant Gliomas and Brain Metastases

Nevine M Hanna MD (Presenter)

ABSTRACT
Purpose: Simultaneous integrated boost (SIB) in Gamma Knife planning defines and prescribes differential doses to the gross target volume (GTV) and the surrounding region of peritumoral infiltration or edema. The purpose of this is to report our preliminary assessment of the concept of the simultaneous integrated boost (SIB) applied to Gamma Knife radiosurgery in the treatment of recurrent gliomas and brain metastases.

Methods: 8 lesions in 6 patients underwent SIB Gamma Knife planning for recurrent glioma or resected brain metastases with a residual tumor nodule (2 lesions). SIB Gamma Knife planning was performed using Gamma Plan 8.2 according to a technique developed by the authors to differentially treat targeted volumes. The gross target volume (GTV) was defined by the contrast enhancing lesion as seen on the T1 contrast-enhanced SPGR sequences and a lower, volume-appropriate dose to the typically larger planning target volume (PTV-m) consisted of a margin of the T2 or FLAIR abnormal region or a metastasis surgical resection cavity. All patients were treated on the Gamma Knife Perfexion. Volume appropriate doses were prescribed; for the recurrent gliomas, 12-16 Gy to the GTV and 8 Gy to PTV-m. For the resected brain metastasis, 18-27 Gy was given to the residual tumor nodule (GTV) and 16-17 Gy to the cavity (PTV-m).

Results: Average age was 53 years (46-71). Brain lesions treated included malignant gliomas as well as metastases secondary to melanoma and squamous cell carcinoma. Average GTV dosage was 17.1 Gy (12.2-27) at 17.1 Gy (12.2-27) at 17.1 Gy (12.2-27). Mean coverage at prescription was 85% (70-100) and mean treatment volume was 5.1 cc (0.31-10.1). Mean PTV-m volume was 24.5 cc (7.0-57.9). Prescribed dose was 18 Gy to PTV-m. Mean PTV covering 85% (95-100) and mean PTV-m treatment volume was 86 cc (4.2-86). Mean number of shots was 29 (5-54) and mean on-beam time was 76 minutes (23.7-158.6). Median post-treatment follow up after treatments is 22 weeks (4-59) with 3 patients deceased and 3 patients alive without evidence of complications at last follow up. Further radiological response is being analyzed.

Conclusions: We conclude from this preliminary study that SIB Gamma Knife planning with target and treatment volume adjusted GTV and PTV-m doses are feasible for Gamma Knife radiosurgery. The lack of toxicity and the preliminary clinical outcomes suggest the potential future utility of the SIB concept for Gamma Knife radiosurgical treatment planning.

Vascular/Interventional (Biliary/GI/Interventions)

Monday, 03:00 PM - 04:00 PM • N226
Eun Young Kim (Presenter); Ho-Young Song MD; Sun Il Kim PhD; Jung-Hoon Park RT; Eun Jun Jung PhD; Young Chul Cho BS

**PURPOSE**
To evaluate the efficacy of siRNA targeting MMP-9 in suppressing granulation tissue formation caused by bare metallic stent placement in a rat urethral model.

**METHOD AND MATERIALS**
All experiments were approved by the committee of animal research. In 20 Sprague-Dawley male rats (weight range, 300–350g), a self-expanding metallic bare stent was inserted in the urethra under fluoroscopic guidance. One group of 10 rats (group A) was treated with MMP-9 siRNA/BPEI-ICG, while the other group of 10 rats (group B) received control siRNA/BPEI-ICG treatment. All rats were sacrificed at 4 weeks. The therapeutic efficacy of the MMP-9 siRNA/BPEI-ICG complex was assessed by comparing the two results of retrograde urethrography, histological examination, and quantification of MMP-9 by zymography and western blot analysis between the two groups.

**RESULTS**
Stent placement was successful in all rats without a single case of migration over follow-up. Retrograde urethrography performed four weeks after stent placement demonstrated significantly larger luminal diameters of the urethra within the stents in group A compared to those in group B (P = .011). Histological analysis revealed that the average percentage of granulation tissue area (P < .001), average number of epithelial layers (P < .001), and average thickness of submucosal fibrosis (P < .001) were significantly decreased in group A compared to group B. Meanwhile, the average density of inflammatory cell infiltration did not significantly differ among the two groups (P = .384). Quantitative analysis disclosed MMP-9 levels to be lower in group A relative to group B indicating positive inhibition of MMP-9 by MMP-9 siRNA/BPEI-ICG.

**CONCLUSION**
MMP-9 siRNA/BPEI-ICG is effective for inhibiting granulation tissue formation after bare metallic stent placement in a rat urethral model.

**CLINICAL RELEVANCE/APPLICATION**
Local therapy using MMP-9 siRNA/BPEI-ICG could be utilized to decrease stent-related tissue hyperplasia.

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**SSE26-03 • Bioabsorbable Biliary Stent Implantation in the treatment of Benign Bilioplastic-refractory Biliary Strictures: Preliminary Experience**

Giovanni Mauri MD (Presenter); Caterina Michelozzi; Dario Poretti MD; Francesco Sardanelli MD *; Fabio Melchiorre MD; Luca Maria Sconfinenza MD, PhD; Gianpaolo Cornalba MD; Vittorio Pedicini MD; Marco Tramarin MD; Luigi Solbiati MD

**PURPOSE**
Benign bile duct stricture represent a non-negligible complication of several surgical procedures around the biliary tree. A novel percutaneous-implantable bioabsorbable stent has been recently developed. Our purpose was to evaluate feasibility, safety, and outcome of patients treated with a bioabsorbable biliary stent for benign biliary stenosis refractory to other treatments.

**METHOD AND MATERIALS**
RESULTS
Stent implantation was feasible in all cases. No immediate major or minor complications occurred. In all patients, 48 hour cholangiographic control demonstrated the good positioning of the stent, and resolution of the stenosis. In a median follow-up time of 16.5 months (25th-75th percentiles = 11-20.25 months) no further invasive treatment was needed in any patient. Three patients experienced transient episodes of cholangitis. Neither restenosis nor dilatation of the bile tree was documented at the follow up ultrasound studies. No stent was visible at the 6 months follow-up.

**CONCLUSION**
Percutaneous placement of bioabsorbable biliary stents represents a new option to treat benign bile stenoses refractory to treatment with bilioplasty. Such a technique seems to be feasible, effective, and free from major complication. Further investigations are warranted to confirm our preliminary results.

**CLINICAL RELEVANCE/APPLICATION**
Percutaneous placement of bioabsorbable biliary stents is feasible, effective, and free from major complications. The main advantage is that they do not need to be removed after implantation.

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**SSE26-04 • Intrabiliary Radiofrequency Heat-enhanced Local Chemotherapy of Cholangiocarcinomas Monitored by Dual-modality Imaging**

Xiuxiu Wu (Presenter); Feng Zhang MD, PhD; Thomas X Le MD; Han Wang MD; Tong Zhang MD; Yanfeng Meng MD; Baogei Wei MD, PhD; Stephanie Soriano MD; Patrick Willis; Xiaoming Yang, MD, PhD

**PURPOSE**
Patients with biliary malignancies have a poor prognosis. We developed a new technology, named "intrabiliary radiofrequency heat (RFH)-enhanced chemotherapy," for efficient management of biliary malignancies.

**METHOD AND MATERIALS**
To establish "proof-of-principle," serial in-vitro studies with GFP-labeled human cholangiocarcinoma cells and serial in-vivo studies with GFP-positive cholangiocarcinomas on mice were performed. The cells and tumors were treated by: (a)combination therapy with chemodrugs (gemcitabine and 5-fluorouracil (5-FU)) plus RFH; (b) chemodrugs-only; (c)RFH-only; and (d) phosphate-buffered saline. Cells proliferation was quantified by MTS assay, and tumor changes on mice monitored by 14.0 Tesla MR imaging and optical imaging overtime. To further validate the feasibility of this new technique, intrabiliary local delivery of gemcitabine and 5-FU were performed with RFH (8 pigs) or without RFH (6 pigs). Chemodrug deposit doses in bile duct walls were quantified by high-pressure liquid chromatography.

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**SSE26-01 • BPEI-ICG-delivered siRNA Targeting MMP-9: Suppression of Granulation Tissue Formation after Bare Metallic Stent Placement in a Rat Urethral Model**

Eun Young Kim (Presenter); Ho-Young Song MD; Sun Il Kim PhD; Jung-Hoon Park RT; Eun Jun Jung PhD; Young Chul Cho BS

**PURPOSE**
To evaluate the efficacy of siRNA targeting MMP-9 in suppressing granulation tissue formation caused by bare metallic stent placement in a rat urethral model.

**METHOD AND MATERIALS**
All experiments were approved by the committee of animal research. In 20 Sprague-Dawley male rats (weight range, 300–350g), a self-expanding metallic bare stent was inserted in the urethra under fluoroscopic guidance. One group of 10 rats (group A) was treated with MMP-9 siRNA/BPEI-ICG, while the other group of 10 rats (group B) received control siRNA/BPEI-ICG treatment. All rats were sacrificed at 4 weeks. The therapeutic efficacy of the MMP-9 siRNA/BPEI-ICG complex was assessed by comparing the two results of retrograde urethrography, histological examination, and quantification of MMP-9 by zymography and western blot analysis between the two groups.

**RESULTS**
Stent placement was successful in all rats without a single case of migration over follow-up. Retrograde urethrography performed four weeks after stent placement demonstrated significantly larger luminal diameters of the urethra within the stents in group A compared to those in group B (P = .011). Histological analysis revealed that the average percentage of granulation tissue area (P < .001), average number of epithelial layers (P < .001), and average thickness of submucosal fibrosis (P < .001) were significantly decreased in group A compared to group B. Meanwhile, the average density of inflammatory cell infiltration did not significantly differ among the two groups (P = .384). Quantitative analysis disclosed MMP-9 levels to be lower in group A relative to group B indicating positive inhibition of MMP-9 by MMP-9 siRNA/BPEI-ICG.

**CONCLUSION**
MMP-9 siRNA/BPEI-ICG is effective for inhibiting granulation tissue formation after bare metallic stent placement in a rat urethral model.

**CLINICAL RELEVANCE/APPLICATION**
Local therapy using MMP-9 siRNA/BPEI-ICG could be utilized to decrease stent-related tissue hyperplasia.
RESULTS
Combination therapy induced significantly lower cell proliferation than chemodrug-only and RFH-only treatments (0.39±0.13 vs 0.87±0.10 and 0.73±0.15, p<0.0009 and 0.001, respectively). Combination therapy resulted in smaller tumor volume than chemodrug-only and RFH-only treatments (0.65±0.03mm³ vs 1.37±0.05mm³ and 1.3±0.021mm³, p=0.003). Only in the combination therapy group, both MRI and optical imaging demonstrated remarkable decreases of diffusion coefficients and fluorescent signals on tumor masses immediately after the treatments. Chemodrug quantification showed higher average drug deposit dose in pig bile duct walls with intrabiliary RFH than that without RFH (Gemcitabine: 0.32±0.033mg vs 0.269±0.030mg and 5-FU: 0.664±0.060mg vs 0.52±0.050mg, p

CONCLUSION
Intrabiliary RFH can enhance the chemotherapeutic effect on cholangiocarcinomas, which can be accurately monitored by diffusion-weighted MRI and optical imaging.

CLINICAL RELEVANCE/APPLICATION
This technical development may open new avenues to efficiently manage biliary malignancies using intrabiliary MRI and RFH-integrated therapies.


Massimo Venturini MD (Presenter) ; Giulia Agostini ; Gianpaolo Balzano ; Francesco A De Cobelli MD ; Stefano Cappio MD ; Alessandro Del Maschio MD

PURPOSE
Despite the improvement in technique/expertise, pancreatic surgery remains burdened with a high complication rate. Our aim was to report our 10-year single-centre experience about the clinical relevance and the interventional-radiological management of the postoperative complications (treatment/prevention) on 1292 patients submitted to pancreatic surgery.

METHOD AND MATERIALS
In 2000-2012, 1292 patients were submitted to pancreatic surgery (total pancreatocotomy, duodenoc-pancreatico-pancreatocotomy, distal pancreatocotomy). Patients were classified on the basis of the complication severity in 2 classes (Clavien-Dindo classification): 0-none, class1-2=conservative treatment, 3a-endooscopic/radiological interventional, 3b=surgery, 4=intensive care, 5=death. Interventional-radiological management consisted of: PTC/biliary drainage in case of biliary fistula ( bile in surgical drainage, normal bilirubin levels/undilated biliary ducts at US) under US/fluoroscopic guidance (right approach, puncturing along the course of the sixth-segment portal branch (Chiba needle 21G), or left approach if aerobilia/adequate volume of left hepatic lobe); embolization (microsols/PVA-particles) or covered-stenting (Viabahn-Gore) in case of bleeding; percutaneous drainage (US/CT-guidance) in case of liquid/infected collection. Percutaneous intra-portal iat-tumors MARTUDENT (PIPIAT) was performed in case of total pancreatico-tumors MARTUDENT to prevent diabetes.

RESULTS
Patients were classified as follows: 524/1292 (40%) class 0; 210/1292 (16%) class 1; 361/1292 (28%) class 2; 79/1292 (6%) class 3a; 55/1292 (4%) class 3b; 24/1292 (2%) class 4; 39/1292 (3%) class 5. Among the 79 class 3a-patients, 74/79 required radiological-interventional management, 5/79 endoscopic management. The 74 interventional procedures were the following: 32 drainages of liquid/fluid infected collections, 30 biliary drainages, 12 bleeding management (9/12 embolization; 3/12 covered-stenting). 25/1292 underwent PIPIAT.

CONCLUSION
In centres of excellence pancreatic surgery has a low rate of complications, usually successfully managed and prevented by interventional-radiological procedures. In particular PIPIAT is an advanced, non invasive technique in the prevention of postsurgical diabetes.

CLINICAL RELEVANCE/APPLICATION
In centres of excellence, interventional-radiological procedures take part in the management/prevention of the complications of pancreatic surgery, reducing the morbidity/mortality.

SSE26-06  ●  Percutaneous Cholecystostomy: New Route for Percutaneous CBD Stone Removal

Younggyung Shin (Presenter) ; Gyoo Sik Jung MD ; Yong Joo Kim ; Hee Kang MD

PURPOSE
To evaluate the technical feasibility and clinical efficacy of percutaneous cholecdocholithotomy through the percutaneous cholecystostomy tract in patients with common bile duct (CBD) stones.

METHOD AND MATERIALS
From September 2009 to February 2013, 73 consecutive patients (43 men, 30 women; age range, 30–95 years; mean age, 74 years) with CBD stone underwent percutaneous stone removal via cholecystostomy tract and cystic duct cannulation. Thirty seven patients had acute cholecystitis and thirty six patients had chronic cholecystitis. All patients could not tolerate immediate surgery due to cardiac problem (n = 35), previous cancer operation (n = 14), or poor medical condition including sepsis (n = 6), pulmonary dysfunction (n = 4), diabetes mellitus (n = 13), or liver cirrhosis (n = 1). The stones were extracted through the 12-Fr sheath using a Wittich nitinol stone basket under fluoroscopic guidance. Large or hard stones were fragmented using the basket fragmentation technique. The technical and clinical success rates, as well as complications were evaluated during the follow-up period.

RESULTS
CBD stones were successfully removed in 70 patients (92%) of 73 patients. Complete stone removal was obtained with one session in 41 patients. In 9 patients, second session was required due to multiple stones (n = 8) or migration of the fragmented stone to the CBD level (n = 1). In 23 patients, stone removal via cholecystostomy tract was failed due to failure of cystic duct cannulation (n = 14), multiple CBD stones (n = 4), proximal migration of CBD stone (n = 4), and low insertion of cystic duct (n = 1). Twenty two patients required additional PTBD for successful stone removal, and the remaining one refused further procedure. Stone removal was performed in the same session or within a maximum of 12 days (mean 3 days) after the percutaneous cholecystostomy procedure under conscious sedation. The mean time for removal of cholecystostomy catheter after successful stone extractions was 4.6 days. During the mean follow-up of 131 days, no procedure related complications were seen and no symptomatic or radiologic recurrences occurred.

CONCLUSION
Fluoroscopy-guided percutaneous CBD stone removal through the percutaneous cholecystostomy route seems to be technically feasible and clinically effective.

CLINICAL RELEVANCE/APPLICATION
In CBD stone patients, percutaneous cholecystostomy tract can be a new route for CBD stone removal.
Learning Objectives
1) Accurately assess and avoid pitfalls on hepatic MRI exams. 2) Identify common conditions despite atypical appearances on imaging. 3) Differentiate a variety of benign and malignant hepatic tumors on MRI.

Abstract
The mentored case review provides the opportunity for the attendees to learn the image acquisition, post-processing, and diagnosis for a wide variety of cardiac diseases commonly encountered in CT.

Learning Objectives
1) Identify and evaluate coronary plaques and stenosis. 2) Identify and characterize common incidental extracardiac findings on coronary CT angiography.

Learning Objectives
1) To understand the clinical indications for retrospective ECG gated cardiac CT. 2) To illustrate methods to assess myocardial function from cine cardiac CT images. 3) To illustrate methods to assess normal and abnormal valvular function from cine cardiac CT images.

Abstract
Molecular Imaging Symposium: Molecular Brain Imaging: From Research to Clinical Applications
Monday, 03:30 PM - 05:00 PM • S406B

Learning Objectives
1) To discuss molecular brain imaging technologies that have been translated from research developments to clinical applications.

Abstract
1) Pathophysiological background: Role of amyloid-aggregation in the development of Alzheimer's disease. Concept of modern anti-amyloid therapy options. Time course of amyloid-aggregation as compared to the appearance of clinical symptoms. Value of amyloid-imaging as compared to other biomarkers of Alzheimer's disease. 2) Methodological principles of amyloid imaging: Development, mechanism, available tracers. Proof of concept, in vivo versus ex vivo histopathological confirmation. 3) Clinical value and interpretation of amyloid-imaging results, pitfalls and artefacts, value of amyloid-imaging with regard to early diagnosis, differential diagnosis and therapy monitoring. 4) Amyloid imaging in comparison to other imaging biomarkers (MRI, FDG-PET), value of multimodal imaging.

How Molecular Imaging Contributes to Movement Disorders? Current and Future
Kirk A Frey, MD, PhD (Presenter) *
LEARNING OBJECTIVES
View learning objectives under main course title.

MSM24C • Quantitative Analysis and Interpretation of Molecular Brain Imaging
Satoshi Minoshima MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) To explain various quantification methods applied in the field of molecular brain imaging. 2) To discuss how such quantification methods can be used in clinic.

MSM24D • Making Molecular Brain Imaging Available in the Clinic: FDA and CMS
Peter Hirschovitch MD (Presenter)

LEARNING OBJECTIVES
1) To discuss new molecular brain imaging techniques that are available in the clinic. 2) To explain how basic research has been translated to clinical applications. 3) To discuss approval processes that are necessary to establish clinical molecular brain imaging.

Carestream Health: How to Future Proof Your X-ray and Health IT Purchases with Modular Systems
Monday, 03:45 PM - 04:30 PM • South Building Hall A Booth 3314

EPT04 Global Healthcare IT Product Marketing Director
Cristine Kao
Global X-ray Product Marketing Director
Helen Titus

LEARNING OBJECTIVES
This session will showcase examples of x-ray and health IT purchases that are modular to enable growth and expansion as technology and clinical needs change. The presentation will include current clinical users illustrating their experiences.

Using IHE Profiles to Plan for Medical Imaging
Monday, 04:30 PM - 06:00 PM • S401CD

ICIA24 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Kinon Ho *
David A Clunie, MBBS *
Christopher Lindop *
Kinon Ho *
John T Donnelly, MBA, MS *

LEARNING OBJECTIVES
1) Value of IHE with content and vendor neutral integration. 2) How content neutral clinical information is managed with a Vendor Neutral Archive (VNA). 3) Planning for a Vendor Neutral Archive (VNA) or expand upon an existing VNA system to support both imaging and non-imaging content and systems. 4) The benefit of using IHE Imaging profiles for cross-enterprise and cross-community image sharing*.

ABSTRACT
Integrating the Healthcare Enterprise (IHE) is a joint initiative of healthcare professionals and industry vendors to improve the way clinical systems in healthcare share information. IHE promotes the coordinated use of established standards such as webservices, DICOM and HL7 to address specific clinical need in support of optimal patient care. Established in 1997, the IHE Radiology Committee, a development domain of IHE, has profiled the clinical use cases to develop a framework of interoperability, known as the IHE Integration Profiles. Integration Profiles are developed specifically to be 'Vendor Neutral'. The first Integration Profile developed by IHE is known as Scheduled Workflow. It specifies how imaging departmental workflow can operate seamlessly between vendors. The Integration Profiles are maintained and published by IHE in the IHE Technical Framework. With the introduction of Cross-Enterprise Document Sharing (XDS) in 2005, IHE has extended the definition of 'Neutral' to include non-imaging content storage in healthcare. This course will specifically deliver and review the IHE Integration Profiles developed by IHE Radiology and the other IHE domain committees profile which can be used by healthcare professionals and the industry for the interoperability specification, procurement and installation of a 'Content' Vendor Neutral Archive (VNA).

Meaningful Use for Radiology IT Vendors: What Your Customers will Demand, and Your Competition will Provide
Monday, 04:30 PM - 06:00 PM • S501ABC

ICII24 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
David E Avrin, MD, PhD *
Keith J Dreyer, DO, PhD *

LEARNING OBJECTIVES
Even with Phase II rules of Meaningful Use, the fit with Radiology remains a challenge. The focus of the federal agencies remains on the primary care practices of internal medicine, family practice, and pediatrics. However, with recent refinement of the US Federal Health IT rulings for Meaningful Use (MU), it is hoped that some MU requirements will be eligible for substantial CMS incentives. Collectively, these incentives could total over $1 billion for radiologists alone. Up to $44,000 is available per qualifying Eligible Provider. As important, incentives may turn to penalties within a few years. MU was initially targeted towards primary care specialties, but under certain circumstances could apply to diagnostic radiology. Eligibility for MU will depend upon the individual radiologist's practice scenario. Some technology will come from existing infrastructure (including RIS, PACS, Reporting Systems) and others will come from new purchases (including Decision Support, Data Mining, Image Sharing and Patient Portals). In this lecture, the presenters will describe ways to analyze your existing portfolio of products to determine which MU measures they should be eligible for, and to define a pathway toward MU certification of these modules. Further, we will discuss the ability to determine what additional functionality might be added to your existing products to expand your MU certification offerings. Finally, we will explore ways for your company to provide all remaining MU measures, beyond your existing product portfolio, so that your existing and future customers can achieve Meaningful Use. We will also review results of an RSNA sponsored survey to propose a set of criteria that more appropriately define true MU for radiology to affect future federal rule setting when they move beyond primary care specialties.

Using RSNA Clinical Trial Processing (CTP) Software for Clinical Trials and Research Applications
Monday, 04:30 PM - 06:00 PM • S401AB

ICIW24 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
John Perry
Justin Kirby

LEARNING OBJECTIVES
1) Learn how to install, configure, and use the RSNA's CTP software for clinical trials and reseatch dataset processing. 2) Learn about the the unique challenges of DICOM image de-identification and how to utilize CTP to implement the Attribute Confidentiality Profile (DICOM PS 3.15: Appendix E) to properly de-identify DICOM images. 3) Learn how to customize CTP to process and transfer imaging studies according to the requirements of common research study scenarios. Additionally, participants will receive an overview of the unique challenges associated with de-identifying DICOM images and learn about using CTP to implement the DICOM standard's guidance for how best to ensure removal of PHI without...
LEARNING OBJECTIVES
1) The participant will be introduced to a series of radiology case studies via an interactive team game approach designed to encourage "active" consumption of educational content. 2) The participant will be able to use their mobile wireless device (tablet, phone, laptop) to electronically respond to various imaging case challenges; participants will be able to monitor their individual and team performance in real time. 3) The attendee will receive a personalized self-assessment report via email that will review the case material presented during the session, along with individual and team performance. This interactive session will use RSNA Diagnosis Live™. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

ABSTRACT

Special Interest Session: Image Wisely®: Update on Issues in Adult Radiation Protection

Monday, 04:30 PM - 06:00 PM • E351

LEARNING OBJECTIVES
1) To understand the use and value of dose index registries. 2) To understand what patients want to know about their radiation exposure from medical imaging examinations. 3) To explore how best to work with payers on radiation protection programs. 4) To identify issues related to state regulations and accreditation for the use of ionizing radiation with medical imaging.

LEARNING OBJECTIVES
View learning objectives under main course title.

S P S I 2 1 A • Image Wisely® Update
James A Brink MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

S P S I 2 1 B • Dose Registries: Rationale and Implementation
Richard L Morin PhD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

S P S I 2 1 C • What Patients Want to Know before Their Radiologic Exams
Andrew T Trout MD (Presenter) ; Jay K Pahade MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

S P S I 2 1 D • Working with Payers on Radiation Protection Programs
Christoph Wald MD, PhD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

S P S I 2 1 E • CT Dose Issues: State Regulations, Accreditation, and Real-life Scenarios
Robert K Zeman MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

S P S I 2 2 A • Options for Radiologist Peer Review
David B Larson MD (Presenter) *

LEARNING OBJECTIVES
1) Understand the importance of a non-punitive approach to peer review. 2) Understand elements required to create a non-punitive environment. 3) Understand the limitations of using peer review for individual performance measurement. 4) Be able to implement a non-punitive peer review program locally.

S P S I 2 2 B • Peer Review of Procedural Radiologists
Joseph R Steele MD (Presenter) *

LEARNING OBJECTIVES
1) Understand the status of the SIR Quality Registry. 2) Be able to design an IR peer review system using the SIR Quality Registry. 3) Learn how to drive quality improvement using regular feedback from a national quality registry.

S P S I 2 2 C • Peer Review as your PQI Project
Bettina Siewert MD (Presenter)
LEARNING OBJECTIVES
1) To be familiar with the elements of a PQI project. 2) To identify peer review data suitable for a PQI project. 3) To perform a gap analysis of one’s own peer review data. 4) To formulate a practical plan to achieve performance improvement. 5) To monitor improvement.

ABSTRACT
In this course we will discuss the PQI process, including necessary elements of a PQI project. We will start by identifying peer review data that is suitable for a project. A classification system for errors will be introduced that allows us to group errors, streamline our analysis and develop performance improvement measures. We will focus on individual and group projects, outline the differences in how these projects are performed and help the radiologist decide which type of project is best suited to her/his practice. We will define how an improvement plan can be put in place and how improvement can be measured. We will demonstrate the timeline and necessary documentation.

URL
LEARNING OBJECTIVES
1) To understand the mission and goals of RSNA's "Radiology Cares: The Art of Patient-centered Practice" and ACR's "Imaging 3.0" campaigns. 2) To assess your radiology practice model and realign it to focus on value over volume. 3) To learn tactics to put the concepts of patient-centeredness and value vs. volume into practice.

BOOST: Head and Neck Hands-on Contouring (In Cooperation with ASTRO)

Monday, 04:45 PM - 06:00 PM • S104B

Co-Director
Fergus V Coakley, MD
Co-Director
Bruce G Haffty, MD
Suresh K Mukherji, MD
Sung Kim, MD

LEARNING OBJECTIVES
The intent of this course is to provide direct "hands-on" education regarding contouring of head and neck cancer. Participants will be given the opportunity to contour head and tumor of the nasopharynx and larynx. Their contours will be compared to contours drawn by experts in head and radiation oncology and radiology. The session will emphasize various techniques approaches that enhance the participants ability to accurately contour tumor and prevent geographic misses. The session will also discuss important anatomic landmarks and patterns of spread for cancers at these sites.

ABSTRACT
The intent of this course is to provide a hands-on contouring session for head adn neck cancer. This session will be presented by a radiologist and radiation oncologist.
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