### Sunday, December 01, 2013

<table>
<thead>
<tr>
<th>Time</th>
<th>Room</th>
<th>Session Title</th>
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<tbody>
<tr>
<td>10:30-12:00 PM</td>
<td>VSDP11</td>
<td>Pediatric Radiology Series: Pediatric Neuroimaging I</td>
</tr>
<tr>
<td>10:45-12:15 PM</td>
<td>SSA02, SSA07</td>
<td>Gastrointestinal (Rectal Carcinoma Imaging)</td>
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<td>10:45-12:15 PM</td>
<td>SSA13</td>
<td>Gastrointestinal (Hepatic Fibrosis Imaging)</td>
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<tr>
<td>10:45-12:15 PM</td>
<td>SSA14</td>
<td>Musculoskeletal (Shoulder I)</td>
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<tr>
<td>10:45-12:15 PM</td>
<td>SSA15</td>
<td>Gastrointestinal (Tumor I)</td>
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<tr>
<td>10:45-12:15 PM</td>
<td>SSA17</td>
<td>Neuroradiology (Parkinson’s Disease)</td>
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<tr>
<td>02:00-03:30 PM</td>
<td>RC109</td>
<td>Gastrointestinal: Liver (An Interactive Session)</td>
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<tr>
<td>02:00-03:30 PM</td>
<td>RC129</td>
<td>Interactive Game: MR Imaging Innovations for the Oncological Practice: Case-based Instruction</td>
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<tr>
<td>02:00-03:30 PM</td>
<td>RC150</td>
<td>MR Imaging-guided Breast Biopsy (Hands-on Workshop)</td>
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<tr>
<td>02:00-03:30 PM</td>
<td>RC151</td>
<td>Introduction to Cardiac MR: Infarcts, Cardiomyopathies and Masses (How-to Workshop)</td>
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### Monday, December 02, 2013

<table>
<thead>
<tr>
<th>Time</th>
<th>Room</th>
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<tbody>
<tr>
<td>08:30-10:00 AM</td>
<td>MSCM21</td>
<td>Case-based Review of Magnetic Resonance: Musculoskeletal (An Interactive Session)</td>
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<tr>
<td>08:30-10:00 AM</td>
<td>S203</td>
<td>Imaging for Electrophysiology</td>
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<tr>
<td>08:30-10:00 AM</td>
<td>RC217</td>
<td>KNEE IMAGING: MRI ART</td>
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<tr>
<td>08:30-10:00 AM</td>
<td>RC229</td>
<td>Should I Scan That Patient? A Very Interactive Session on MR Safety and Regulations (An Interactive Session)</td>
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<tr>
<td>08:30-10:00 AM</td>
<td>S221</td>
<td>Arie Crown Theater: Breast Series: Breast MR Imaging</td>
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<tr>
<td>08:30-10:00 AM</td>
<td>VSMK21</td>
<td>Musculoskeletal Radiology Series: Knee Imaging</td>
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<tr>
<td>10:30-12:00 PM</td>
<td>MSCM22</td>
<td>Case-based Review of Magnetic Resonance: Neuroradiology (An Interactive Session)</td>
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<tr>
<td>10:30-12:00 PM</td>
<td>SSC01</td>
<td>Cardiac (Coronary CT/MR II)</td>
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<td>10:30-12:00 PM</td>
<td>SSC02</td>
<td>Cardiac (Anatomy and Function I)</td>
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<td>10:30-12:00 PM</td>
<td>SSC03</td>
<td>Cardiac (Quantitative Imaging)</td>
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<td>10:30-12:00 PM</td>
<td>SSC05</td>
<td>Gastrointestinal (Hepatocellular Carcinoma Imaging)</td>
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<td>10:30-12:00 PM</td>
<td>SSC10</td>
<td>Gastrointestinal (Interventional I)</td>
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<td>10:30-12:00 PM</td>
<td>SSC25</td>
<td>Neuroradiology (Imaging Genomics and New Techniques in Brain Tumors)</td>
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<tr>
<td>10:30-12:00 PM</td>
<td>SSC14</td>
<td>(MRI Techniques I)</td>
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<tr>
<td>01:00-03:00 PM</td>
<td>MSCM23</td>
<td>Case-based Review of Magnetic Resonance: Woman’s Imaging (An Interactive Session)</td>
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<tr>
<td>03:00-04:00 PM</td>
<td>SSE01</td>
<td>Arie Crown Theater: Breast Imaging (MRI Interpretation)</td>
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<tr>
<td>03:00-04:00 PM</td>
<td>SSE04</td>
<td>Cardiac (Nonischemic Cardiomyopathy)</td>
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<td>03:00-04:00 PM</td>
<td>SSE08</td>
<td>Gastrointestinal (Oncology: Staging and Distant Metastases)</td>
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<tr>
<td>03:00-04:00 PM</td>
<td>SSE09</td>
<td>Gastrointestinal (Cirrhosis and Portal Venous Hypertension)</td>
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<tr>
<td>03:00-04:00 PM</td>
<td>SSE11</td>
<td>(Intervention in the GU Tract)</td>
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<tr>
<td>03:00-04:00 PM</td>
<td>SSE16</td>
<td>Neuroradiology (The Aging Brain and Neurodegenerative Diseases)</td>
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<tr>
<td>03:00-04:00 PM</td>
<td>SSE21</td>
<td>Pediatric (Neuroimaging)</td>
</tr>
<tr>
<td>03:30-05:30 PM</td>
<td>MSCM24</td>
<td>Case-based Review of Magnetic Resonance: Abdomen and Pelvis (An Interactive Session)</td>
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### Tuesday, December 03, 2013

<table>
<thead>
<tr>
<th>Time</th>
<th>Room</th>
<th>Session Title</th>
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<tbody>
<tr>
<td>10:30-12:00 PM</td>
<td>SSG04</td>
<td>Chest (Functional Lung/Perfusion)</td>
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<tr>
<td>10:30-12:00 PM</td>
<td>SSG06</td>
<td>Gastrointestinal (Hepatic Steatosis Imaging)</td>
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<tr>
<td>10:30-12:00 PM</td>
<td>SSG09</td>
<td>Molecular Imaging (Subspecialties)</td>
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<tr>
<td>10:30-12:00 PM</td>
<td>SSG11</td>
<td>Neuroradiology (Advances in Intracranial CT and MR Angiography)</td>
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<tr>
<td>03:00-04:00 PM</td>
<td>SSG11</td>
<td>Gastrointestinal (Stomach)</td>
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<tr>
<td>03:00-04:00 PM</td>
<td>SSJ11</td>
<td>(Imaging of Pregnancy and Its Complications)</td>
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<tr>
<td>03:00-04:00 PM</td>
<td>SSJ12</td>
<td>Gastrointestinal (Diagnosis of Benign Gynecologic Processes, Tubal Occlusion)</td>
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<tr>
<td>03:00-04:00 PM</td>
<td>SSJ16</td>
<td>Musculoskeletal (Shoulder II)</td>
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<tr>
<td>03:00-04:00 PM</td>
<td>SSJ17</td>
<td>Musculoskeletal (Cartilage, Arthritis)</td>
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<tr>
<td>03:00-04:00 PM</td>
<td>SSJ18</td>
<td>Neuroradiology (Cognitive and Psychiatric Disorders)</td>
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<tr>
<td>03:00-04:00 PM</td>
<td>SSJ19</td>
<td>Neuroradiology (Epilepsy)</td>
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<tr>
<td>03:00-04:00 PM</td>
<td>S228</td>
<td>Cardiac PET/CT and PET/MR</td>
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<tr>
<td>03:00-06:00 PM</td>
<td>RC404</td>
<td>Imaging of the Shoulder: Rotator Cuff and Glenohumeral Joint Instability including Normal Variants, Pli...</td>
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<tr>
<td>04:00-06:00 PM</td>
<td>RC409</td>
<td>Gastrointestinal: Tumor Response Assessment</td>
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<tr>
<td>04:00-06:00 PM</td>
<td>RC412</td>
<td>Advanced Vascular Imaging Techniques and Applications</td>
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<tr>
<td>04:00-06:00 PM</td>
<td>RC417</td>
<td>Quantitative CT and MR Perfusion Imaging</td>
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<tr>
<td>04:00-06:00 PM</td>
<td>RC425</td>
<td>Quantitative Imaging: Dynamic Contrast Enhanced MRI (DCE-MRI)</td>
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<tr>
<td>04:00-06:00 PM</td>
<td>RC451</td>
<td>MRI Safety Update (An Interactive Session)</td>
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<tr>
<td>04:00-06:00 PM</td>
<td>RC451</td>
<td>Imaging in Practice: DWI in the Abdomen and Pelvis (How-to Workshop)</td>
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### Wednesday, December 04, 2013

<table>
<thead>
<tr>
<th>Time</th>
<th>Room</th>
<th>Session Title</th>
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<tbody>
<tr>
<td>07:15-08:15 AM</td>
<td>SPSC40</td>
<td>Controversy Session: MRI Contrast Use: Have Quality and Safety Collided?</td>
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<tr>
<td>07:15-08:15 AM</td>
<td>SPSH40</td>
<td>Hot Topic Session: Indicators for MRI versus Low Dose CT in Congenital Heart Disease</td>
</tr>
<tr>
<td>08:30-10:00 AM</td>
<td>RC504</td>
<td>Bone and Cartilage Injury: Traumatic and Stress-related Chondral, Osteochondral and Subchondral Failure with E...</td>
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<tr>
<td>08:30-10:00 AM</td>
<td>RC529</td>
<td>Abdominal MRA Update</td>
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<tr>
<td>08:30-10:00 AM</td>
<td>RC551</td>
<td>Imaging in Practice: MRI of the GIT (How-to Workshop)</td>
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<tr>
<td>10:30-12:00 PM</td>
<td>MSE452</td>
<td>Essentials of Musculoskeletal Imaging</td>
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<tr>
<td>10:30-12:00 PM</td>
<td>SSK06</td>
<td>Gastrointestinal (Focal Liver Lesions and Metastases)</td>
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<tr>
<td>10:30-12:00 PM</td>
<td>SSK07</td>
<td>Gastrointestinal (Pancreas Benign Disease)</td>
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<tr>
<td>10:30-12:00 PM</td>
<td>SSK08</td>
<td>Musculoskeletal (Prostate Cancer: Multimodality Diagnosis and Staging of Disease)</td>
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<tr>
<td>10:30-12:00 PM</td>
<td>SSK09</td>
<td>Musculoskeletal (Tumor II)</td>
</tr>
<tr>
<td>10:30-12:00 PM</td>
<td>SSK13</td>
<td>ISP: Musculoskeletal (Knee)</td>
</tr>
<tr>
<td>10:30-12:00 PM</td>
<td>SSK14</td>
<td>Musculoskeletal (Tumor I)</td>
</tr>
<tr>
<td>10:30-12:00 PM</td>
<td>SSK16</td>
<td>Neuroradiology (Advanced Neuroimaging of Alzheimer's Disease)</td>
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Beyond Conventional Diagnostics: The Emerging Role of Quantitative Magnetic Resonance in Breast Cancer Prognostication and Treatment Response Prediction

**Purpose/Aim**
1. Review the emerging role of quantitative MR biomarkers in breast cancer prognostication and prediction of therapy response and the implications for personalized breast cancer management
2. Review the pathologic variables associated with breast cancer prognosis
3. Review the classifications of treatment response

**Content Organization**
1. Case-based examples will be used to illustrate how quantitative MR techniques can contribute to prognostication and treatment response prediction.
   a) DCE-MRI (volume, kinetics and texture)
   b) DWI-MRI (ADC measures)
   c) 1H-IMR (water:fat ratio and choline SNR)
2. Histopathologic correlates will be used to illustrate:
   a) Tumor characteristics associated with prognosis
   b) Partial and complete pathologic treatment response
   c) Predictive models that integrate pathology and imaging will be shown to illustrate clinical implications of emerging MR biomarkers

**Summary**
MRI of the breast is widely used clinically for breast cancer diagnosis. Yet, its role in disease prognostication and assessment of treatment response remains an area of active investigation. Here, we review the emerging role of different quantitative MR biomarkers in breast cancer prognostication and prediction of treatment response. As demand for tailored treatment options grows, quantitative imaging biomarkers may become essential to aid in this process.
Magnetic Resonance Imaging of Late Periprosthetic Fluid Collections in Patients with Silicone Breast Implants: An Illustrative Case Series

PURPOSE/AIM
Breast augmentation with silicone implants has become increasingly popular since its introduction in 1962. Though rare, late complications have been reported associated with augmentation. Magnetic resonance imaging is the most accurate imaging test for preoperative evaluation, but it is often difficult to distinguish between periprosthetic fluid collections including seroma, hematoma, infection and intracapsular silicone due to similar features. We present three cases of delayed periprosthetic fluid collections in patients with silicone breast implants that appear similar on preoperative MR imaging but have different etiologies discovered intraoperatively.

CONTENT ORGANIZATION
1. Review appearance of silicone breast implants on MR
2. Review late complications of silicone breast augmentation
3. Illustrative case series of periprosthetic fluid collections

SUMMARY
Major teaching points of this exhibit are: 1. Delayed periprosthetic fluid collections can occur after routine silicone breast augmentation. 2. Though MR imaging is the most sensitive and specific test for preoperative evaluation, periprosthetic fluid collections are often difficult to differentiate. 3. It is important to maintain a broad differential diagnosis for delayed periprosthetic fluid collections.

Magnetic Resonance Imaging Features of Mucinous Breast Cancer: Pictorial Essay with Histopathological Correlation

PURPOSE/AIM
To illustrate and discuss the variety of Magnetic Resonance Imaging (MRI) features of mucinous breast cancer and correlate with pathologic findings.

CONTENT ORGANIZATION
Mucinous Breast Cancer - Definition / Pathology - Epidemiology - Conventional imaging findings - Histological subtypes (pure vs. mixed form) MRI Features - Shape - Margins - T2 signal - Enhancement Pattern - Diffusion-Weighted Imaging - PET/MRI fusion - Correlation with
The major teaching points of this exhibit are:

- Clinical and imaging features of mucinous breast cancer may suggest benign lesions and delay the correct diagnosis and treatment.
- On MRI, these tumors have varied presentations, with typical findings of benign lesions, such as high signal on T2-weighted sequence and high ADC values in the diffusion-weighted sequence (DWI).
- The pattern of post-contrast enhancement can range from no enhancement to heterogeneous or peripheral enhancement, usually with type 1 kinetic curves.
- The variation in MRI presentation is related to the histological subtype. While the pure form is commonly associated with benign findings, the mixed form most often presents signs of malignancy.

**Magnetic Resonance Imaging Features of Mucinous Breast Cancer: Pictorial Essay with Histopathological Correlation**

**LL-BRE1150**
Almir Bitencourt, MD
Luciana Graziano, MD
Juliana A Souza
Elvira F Marques
Camila Guatelli
Mirian R Poli, MD
Rubens Chojniak, MD, PhD

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Mucinous Breast Cancer - Definition / Pathology - Epidemiology - Conventional imaging findings - Histological subtypes (pure vs. mixed form) MRI Features - Shape - Margins - T2 signal - Enhancement Pattern - Diffusion-Weighted Imaging - PET/MRI fusion - Correlation with Pathology

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- The variation in MRI presentation is related to the histological subtype. While the pure form is commonly associated with benign findings, the mixed form most often presents signs of malignancy.

**Current Concepts on Preoperative Breast MRI: Useful or Useless?**

**LL-BRE2424**
Su-Ju Lee, MD *
Mary C Mahoney, MD *

**PURPOSE/AIM**
1. To familiarize radiologists with current indications and controversies of preoperative breast MRI. This will enable them to discuss the subject effectively at multidisciplinary breast tumor board.
2. To illustrate current indications of preoperative breast MRI with imaging.

**CONTENT ORGANIZATION**
Literature supporting preoperative breast MRI
1. Staging and extent of disease:
   a) Tumor size
   b) Additional sites of disease
   c) Pectoralis muscle and chest wall
   d) Nipple and skin
   e) Lymph Nodes
2. Subsets of patients likely to benefit:
   a) Dense breast tissue
   b) Invasive lobular carcinoma
   c) Posterior breast cancer
   d) Planned partial breast irradiation
   e) High risk patients

Literature against preoperative breast MRI:
1. Delay in definitive therapy
2. Re-excision rate
3. Mastectomy rate
4. Survival impact

**SUMMARY**
1. MRI is the most accurate modality for assessment of tumor size and extent of disease.
2. Findings of multifocal, multicentric, and contralateral tumors help guide surgical planning and decisions on adjuvant therapy.
3. MRI is particularly beneficial in women with dense breast or invasive lobular cancer.
4. Many studies show preoperative breast MRI reduces re-excision rate.
5. No increased survival with preoperative breast MRI has been demonstrated.

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5. No increased survival with preoperative breast MRI has been demonstrated.
**Assessing Response to Neoadjuvant Chemotherapy: How Well Can Breast MRI Perform the Task?**

**PURPOSE/AIM**
- To illustrate the various aspects of breast cancer at MRI before and after neoadjuvant chemotherapy, and to discuss the limitations of breast MRI in the assessment of pathologic response.

**CONTENT ORGANIZATION**
1. Imaging aspects of invasive breast carcinoma at MRI: variations with pathologic and molecular subtypes of cancer.
2. Neoadjuvant chemotherapy: what regimens for which tumors? what is the probability of response?
3. How well does MRI differentiate and assess pathologic response? Through imaging vignettes, the different patterns of tumor response will be illustrated, and discussed in light of cancer subtype and probability of response.

**SUMMARY**
- Neoadjuvant chemotherapy is indicated as a first-line treatment approach for some women with invasive breast cancer, with the goal of reducing tumor burden to ensure disease control and hopefully offer breast-conserving surgery.
- Clinical indications for neoadjuvant chemotherapy are now more frequent: the rapid development of new treatment regimens targeted for the wide range of invasive carcinoma offers new hopes for women with breast cancer.
- Breast imagers, as part of the clinical team, have an important role in assessing tumor burden and pathologic response. While MRI is the best imaging tool available for this task, it remains imperfect. Understanding of its strengths and limitations should improve overall patient care.

---

**Spectrum of Edemas on T2-weighted Images: Pearls and Pitfalls for Diagnosis on Breast MR Imaging**

**PURPOSE/AIM**
- To review breast MR findings of edemas on T2WI.
- To learn three different types (peritumoral, prepectoral, subcutaneous) of edema on T2WI.
- To describe the spectrum of edemas on T2WI in various breast lesions providing pathologic findings.
- To identify three different edemas as clinical clues for differential diagnosis.

**CONTENT ORGANIZATION**
1. Introduction
2. Review of the definition of three different types (peritumoral, prepectoral, subcutaneous) of edema on T2WI
3. Understanding of importance of three different edemas showing a close relationship with the clinical-pathological conditions of breast cancers
4. Illustrative cases: Review of the spectrum of edemas on T2WI in various breast lesions providing pathologic findings
5. Discussion
6. Summary

**SUMMARY**
- Peritumoral edema is defined as high signal intensity on T2WI in the breast tissue around the tumor. The increased vascular permeability is one of the factors contributing to the presence of peritumoral edema. Prepectoral edema is indicative of extensive lymphovascular invasion and high axillary lymph node positivity. Subcutaneous edema usually follows prepectoral edema when lymphovascular invasion progresses. Three different edemas on T2WI can show a close relationship with the clinical-pathological conditions of breast cancers.
Assessing Response to Neoadjuvant Chemotherapy: How Well Can Breast MRI Perform the Task?

Isabelle Trop, MD, MPH
Mona M El Khoury, MD
Lucie Lalonde, MD
Maude Labelle, MD
Julie David, MD
Jean-Francois Boileau, MD, MSc *
Carolyn Nessim

PURPOSE/AIM
To illustrate the various aspects of breast cancer at MRI before and after neoadjuvant chemotherapy, and to discuss the limitations of breast MRI in the assessment of pathologic response.

CONTENT ORGANIZATION

SUMMARY
Neoadjuvant chemotherapy is indicated as a first-line treatment approach for some women with invasive breast cancer, with the goal of reducing tumor burden to ensure disease control and hopefully offer breast-conserving surgery. Clinical indications for neoadjuvant chemotherapy are now more frequent: the rapid development of new treatment regimens targeted for the wide range of invasive carcinoma offers new hopes for women with breast cancer. Breast imagers, as part of the clinical team, have an important role in assessing tumor burden and pathologic response. While MRI is the best imaging tool available for this task, it remains imperfect. Understanding of its strengths and limitations should improve overall patient care.

Breast Magnetic Resonance Diffusion Does Not Lie: Correlation between ADC and Histologic Findings in Breast Lesions

Vicente Martinez De Vega, MD *
Susana Linares Gonzalez, MD
Carolina K Otani
Manuel Recio Rodriguez
Javier Carrascoso Arranz
Raquel Cano Alonso

PURPOSE/AIM
1. Show the correlation between ADC values and histologic findings in breast lesions. 2. Show false positives (benign lesions with low ADC values) and correlate with pathologic findings. 3. Show false positives (malignant lesions with high ADC values) and correlate with pathologic findings.

CONTENT ORGANIZATION
General description of the diffusion technique in breast MRI. Benign lesions with low ADC values: abscess, hemorrhagic cyst, intramammary lymph node, papilloma, fat necrosis, radial scar, fibroadenoma, sclerosing adenosis, benign lesions of small size. Malignant lesions with high ADC values: cystic or necrotic cancer, colloid cancer, lobular invasive cancer, ductal carcinoma in situ, cancer with recent percutaneous biopsy.

SUMMARY
Diffusion has been shown to decrease in tissues with high cellularity. Malignant tumors in general have a higher cellularity than benign lesions. ADC is a sensitive and specific parameter that can help to differentiate benign and malignant breast lesions. Although diffusion MRI is a powerful tool to discriminate between benign and malignant lesions, it is important to recognize false positives and false negatives of this technique. The correlation with pathologic examination can help to understand the reason for the discordant results.

Assessment of Treatment Response of Locally Advanced Breast Cancer to Neoadjuvant Chemotherapy: A Multiparametric Approach

Richa Bansal, MD

PURPOSE/AIM
Preoperative chemotherapy has lately become the treatment of choice in patients with locally advanced breast cancer. Monitoring of response to neoadjuvant chemotherapy can be done by clinical and various imaging modalities. This exhibit aims to present different imaging parameters used to predict and monitor response to neoadjuvant chemotherapy.

CONTENT ORGANIZATION
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Richa Bansal, MD

**PURPOSE/AIM**
Preoperative chemotherapy has lately become the treatment of choice in patients with locally advanced breast cancer. Monitoring of response to neoadjuvant chemotherapy can be done by clinical and various imaging modalities. This exhibit aims to present different imaging parameters used to predict and monitor response to neoadjuvant chemotherapy.

**CONTENT ORGANIZATION**
1. Study the usefulness of clinical and imaging parameters in assessment of residual disease after chemotherapy.
2. Different MRI parameters used such as reduction in tumor volume, changes in enhancement kinetics, Increase in intratumoral ADC values and changes in spectroscopic characteristics. 3. Emphasize the role of MRI in assessing the chemosensitivity of the tumor and therefore identification of treatment nonresponders early in the course of treatment.

**SUMMARY**
Neoadjuvant chemotherapy is increasingly used in patients with locally advanced breast cancer thereby expanding the option of breast conservation surgery. Different clinical and imaging parameters are used to assess treatment response in these patients. MRI has an edge over other modalities since it helps in distinguishing between responders and non responders by detecting changes in the physiological environment of the tumor before actual reduction is seen in the tumor volume.

What Radiologists Should Know about Preoperative Systemic Therapy for Breast Cancer: Personalization of Biological Subtypes Based on the St. Gallen International Expert Consensus

Naoko Mori
Chiaki Takasawa
Hideki Ota, MD, PhD
Kei Takase
Mika Watanabe, MD, PhD
Takanori Ishida, MD
Shoki Takahashi, MD

**PURPOSE/AIM**
Breast cancer subtypes can be defined clinicopathologically using the estrogen receptor, progesterone receptor, HER2, and Ki-67. For each subtype, personalized therapy is recommended, including neoadjuvant systemic therapy. This exhibition seeks to better understand current therapeutic trends in breast cancer and evaluation by magnetic resonance imaging (MRI) after therapy according to the subtype.

**CONTENT ORGANIZATION**
2. Description of the methods for evaluating the histological therapeutic response.
3. Discussion of the problems with each method.

**SUMMARY**
Neoadjuvant systemic therapy has become the standard of care not only for locally advanced inoperable breast cancer but also for operable breast cancer, and there is increased opportunity for radiologists to evaluate MRI data on the response to therapy. We provide key information on the clinical implication for neoadjuvant therapy and present methods for evaluating MRI.

The Role of Breast MR on the Assessment of Ductal System Abnormalities
The Role of Breast MR on the Assessment of Ductal System Abnormalities

PURPOSE/AIM
To discuss the utility of breast MR on the assessment of patients with ductal system abnormalities such as nipple discharge or duct ectasia with intraluminal component on ultrasound. Many patients with unilateral nipple discharge have normal ultrasound, mammography, and negative cytology. In some cases, the ultrasound shows duct ectasia filled with echogenic material that can obscure or simulate some vegetating lesion. Considering percutaneous biopsy of duct lesion is controversial, most patients proceed to excisional biopsy. Thus, MR can be helpful to distinguish an intraluminal vegetant lesion from secretory component.

CONTENT ORGANIZATION
The MRI findings with histopathologic correlation in patients with ductal abnormalities will be presented. The following topics will be illustrated and discussed: 1 Ductal anatomy and normal MR appearance 2 Duct ectasia 3 Duct enhancement lesion on MR: a. Intraductal papilloma b. Papillary carcinoma c. Intraductal carcinoma d. Infiltrating ductal carcinoma

SUMMARY
Papillomas, papillary carcinoma, intraductal carcinoma and infiltrating ductal carcinoma usually present enhancement on MR and can be distinguished from the duct ectasia filled with fluid. Breast MRI can help in the diagnostic management of patients with ductal abnormalities, avoiding surgical biopsies.

Breast Reconstruction Complications: MRI Diagnostic Features

PURPOSE/AIM
To describe abnormal patterns and complications due to surgical breast reconstruction.

CONTENT ORGANIZATION
MRI is the gold standard for studying breast implants integrity, allowing the assessment of prosthesis integrity, the detection of their abnormalities and evaluation of glandular parenchyma. Different complications after surgical breast reconstruction were observed according to the type of analysis carried out: time from surgery (early versus late complications), type of rupture (intra- versus extra-capsular rupture). Among early post-operative complications haematoma and infections were founded. Rupture and capsular contracture were most frequent long term complications. The classical sign of rupture known as "linguine sign" is seen in the first generation implants, but it is extremely rare in most recent silicone gel implants that are made of cohesive viscous silicone gel. Therefore the latter prosthesis have often an uncollapsed rupture. Extracapsular implant rupture entails silicone leakage outside the fibrous capsule.

SUMMARY
Although the first step for evaluation of breast prosthesis includes the use of sonography and mammography, non-contrast enhanced MRI is recommended to confirm or exclude rupture in case of high index of suspicion and its role is relevant in distinguishing normal variants from pathology.
extremely rare in most recent silicone gel implants that are made of cohesive viscous silicone gel. Therefore the latter prosthesis have often an uncollapsed rupture. Extracapsular implant rupture entails silicone leakage outside the fibrous capsule.

SUMMARY
Although the first step for evaluation of breast prosthesis includes the use of sonography and mammography, non-contrast enhanced MRI is recommended to confirm or exclude rupture in case of high index of suspicion and its role is relevant in distinguishing normal variants from pathology.

Metaplastic Breast Carcinoma: Review of a Rare but Aggressive Form of Breast Cancer with an Emphasis on MR Imaging Appearance with Histopathologic Correlation

LL-BRE2491
Lauren A Hollowell , MD
Elissa R Price , MD
Yunn-Yi Chen , MD
Ronald Balassanian , MD
Bonnie N Joe , MD, PhD

PURPOSE/AIM
CONTENT ORGANIZATION
SUMMARY

Imaging Changes Following Radiation Therapy in Breast Cancer: How to Differentiate between Tumor Recurrence and Treatment Related Changes

LL-BRE2498
Ashkan A Malayeri , MD
Amanda J Walker , MD
Fariba Asrari , MD
Elliot K Fishman , MD *
Ihab R Kamel , MD, PhD *
Susan C Harvey , MD

PURPOSE/AIM
1. To review expected imaging changes following radiation therapy for breast cancer.
2. Discuss limitations of mammography and ultrasound in distinguishing between treatment effect and breast cancer recurrence.
3. Discuss how functional imaging can help differentiate between post-radiation change and breast cancer recurrence.

CONTENT ORGANIZATION
1. Review various expected imaging changes after radiation therapy for breast cancer.
2. Compare radiation induced imaging changes with imaging findings in proven breast cancer recurrence. Include case examples with pathology.
3. Discuss emerging data regarding alternative MRI sequences and their potential future role in helping to distinguish radiation induced changes and tumor recurrence.
   a. Diffusion
   b. Perfusion
   c. Spectroscopy
4. Quiz: Three cases will be presented. The corresponding images will be displayed and discussed in regards to appropriate next steps in management.

SUMMARY
Differentiating radiation induced changes from breast cancer recurrence is an ongoing challenge in breast imaging and oncology. Methods to differentiate the two are critical in providing appropriate non-invasive management and are an important area of continued investigation.
4. Quiz: Three cases will be presented. The corresponding images will be displayed and discussed in regards to appropriate next steps in management.

SUMMARY
Differentiating radiation induced changes from breast cancer recurrence is an ongoing challenge in breast imaging and oncology. Methods to differentiate the two are critical in providing appropriate non-invasive management and are an important area of continued investigation.

Functional MRI in Neoadjuvant Chemotherapy-Does It Function at All?

Rupa Renganathan, Venkatesh Kasi Arunachalam, MD, Pankaj Mehta, MD, Mathew Cherian, MD, Sreenidhi Sediguli, MBBS

PURPOSE/AIM
1. To discuss the basic physics of spectroscopy. 2. Assessment of postchemotherapy response using various modalities. 3. Role of spectroscopy in prediction of response to neoadjuvant chemotherapy in breast cancer.

CONTENT ORGANIZATION
1. Basic physics of spectroscopy. 2. Indications of chemotherapy in advanced breast malignancy. 3. Role of clinical examination and various imaging modalities in assessment of chemotherapy response. 4. Role of conventional MR imaging techniques in advanced breast malignancy and in assessment of chemotherapy response. 5. Role of single voxel spectroscopy in early identification of responders to neoadjuvant chemotherapy. 6. Advantages of spectroscopy over conventional imaging techniques. 7. Sample cases. 8. Multivoxel spectroscopy - emerging technique.

SUMMARY
MR spectroscopy is superior to conventional MR imaging techniques in prediction of chemotherapy response in breast cancer patients and has a definite role in early identification of responders.

Characterization of Malignant Lymph Nodes in the Axillary Region: Basis and Application of Diffusion-weighted (DWI) and Mean Diffusivity (ADC) Magnetic Resonance (MR) Imaging

Francisco Carrillo Paredes, MD, Paola Gonzalez Balboa, MD, Yeni Fernandez De Lara Barrera, MD, Juliana Benavides, MD, Arturo Arrieta Pacheco, Maria C Cadena, MD, Jorge Vazquez-Lamadrid, MD

PURPOSE/AIM
The purpose of this exhibit is: 1) Know the anatomic topography of lymph nodes in the axillary region by MR imaging. 2) Understand the importance of DWI and ADC for the study of malignant axillary lymph nodes. 3) Identify the imaging features of malignant axillary lymph nodes by MR, DWI, and ADC. 4) Determine the current role of MR imaging in the study of breast cancer spread to lymph nodes in the axillary region.

CONTENT ORGANIZATION
1. General aspects of characterization of malignant lymph nodes in the axillary region.
   a. Current definition
   b. Etiology and pathophysiology
   c. Clinical presentation
   d. Treatment and prognosis
2. Imaging features of malignant axillary lymph nodes by MR, DWI and ADC.
3. Characteristic imaging findings that may help in differential diagnosis of malignant lymph nodes in the axillary region.

SUMMARY
1) Determining lymph node involvement in breast cancer staging plays an important role as one of the main indicators in cancer survival and its surgical approach. 2) Certain MR imaging findings may help characterize malignant axillary lymph nodes. 3) MR imaging contributes beneficial advantages as a diagnostic tool in the characterization of malignant lymph nodes in the axillary region.
Review of Perforator Flap Imaging with High Resolution MRA

PURPOSE/AIM
1. Educate the reader regarding various autologous-based tissue flap reconstructions, an increasingly common surgical technique, particularly in head and neck and breast surgeries.
2. Discuss the general MRI protocol for imaging donor flaps and to highlight the differences related to each specific flap.
3. Review the associated imaging findings, reporting of pertinent vascular anatomy, and common pitfalls for each donor flap that are relevant to the surgeon.

Advances in Breast MRI: Multiparametric Approach to Diagnosis of Breast Lesions

LL-BRE2504
Riham H El Khoulı, MD, PhD
Katarzyna J Macura, MD, PhD *
Ihab R Kamel, MD, PhD *
David A Bluemke, MD, PhD *
Michael A Jacobs, PhD

PURPOSE/AIM
1. To demonstrate the application of multiparametric MRI (with morphologic and metabolic assessment, diffusion and perfusion, and tissue strain imaging) in diagnosis and characterization of breast cancer.
2. To discuss the advantages and limitations of the newest breast MRI techniques.
3. To illustrate case examples demonstrating the multiparametric breast MRI approach

CONTENT ORGANIZATION
2. Case examples demonstrating the multiparametric approach to diagnosing breast lesions

SUMMARY
The use of multiparametric breast MRI provide a comprehensive assessment of the vascular, anatomical, and metabolic status of the tumor microenvironment and surrounding breast tissue in one setting. Current MRI scanners, new pulse sequences and coil technology can image both breasts simultaneously in the axial plain and with high temporal resolution. These technical improvements allow for dynamic contrast imaging and enabling sophisticated pharmacokinetic analysis of breast lesions. Also, recent advances introduce techniques such as Diffusion Weighted Imaging, 1H Spectroscopy, and MR Elastography (SENC) to the breast imaging field. The multiparametric approach in breast cancer diagnosis improves the specificity of breast MRI while maintaining high sensitivity.

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Review of Perforator Flap Imaging with High Resolution MRA

LL-VIE1298
Alexander C Kagen, MD *
Rydhwana Hossain, MD
Erez Dayan, MD
Soumya Maddula, BA
William Samson, MD
Joel Sh Dayan, MD
Mark Smith

PURPOSE/AIM
1. Develop the reader regarding various autologous-based tissue flap reconstructions, an increasingly common surgical technique, particularly in head and neck and breast surgeries.
2. Discuss the general MRI protocol for imaging donor flaps and to highlight the differences related to each specific flap.
3. Review the associated imaging findings, reporting of pertinent vascular anatomy, and common pitfalls for each donor flap that are relevant to the surgeon.
CONTENT ORGANIZATION

Types of Flaps:
- DIEP (deep inferior epigastric perforator)
- GAP (gluteal artery perforator)
- TDAP (thoracodorsal artery perforator)
- TUG (transverse upper gracilis)
- Fibular Flap
- ALT (anterolateral thigh)

MRI Technique and Findings:
- General and Specific Perforator Flap Protocols
  - DIEP
  - GAP
  - TDAP
  - TUG
  - Fibular Flap
  - ALT

Reporting:
- Variant vascular anatomy
- Incidental and relevant prior surgical anatomy
- Artifacts and other pitfalls

SUMMARY
Major teaching points of this exhibit:
1. Review of different types of donor flaps used in breast and head and neck surgeries.
2. Acquisition of high-resolution MRA images to identify relevant perforator vessels.
3. Understanding of how variant vascular anatomy, remote surgical history and common artifacts affect accurate interpretation.

Review of Perforator Flap Imaging with High Resolution MRA

 LL-VIE1298
Alexander C Kagen, MD *
Rydhwana Hossain, MD
Erez Dayan, MD
Soumya Maddula, BA
William Samson, MD
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Mark Smith

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Emerging Noncontrast MRA Techniques for the Body Imager

 LL-VIE2928
Anup S Shetty, MD
Jeffry C Maxwell, MD
Kathryn J Fowler, MD *
Motoyo Yano, MD, PhD

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Emerging Noncontrast MRA Techniques for the Body Imager

LL-VIE2928
Anup S Shetty, MD
Jeffry C Maxwell, MD
Kathryn J Fowler, MD *
Motoyo Yano, MD, PhD
Nael E Saad, MBCh *
Constantine A Rapitis, MD
Vamsi R Narra, MD,FRCR *

PURPOSE/AIM
1. Review the MR physics principles underpinning noncontrast MRA techniques. 2. Discuss technical considerations, potential benefits and pitfalls of these techniques. 3. Review cases applying these techniques to imaging of the aorta, renal arteries, portal vein and peripheral arteries.

CONTENT ORGANIZATION
Introduction Rationale for noncontrast MRA (renal insufficiency, risk of nephrogenic systemic fibrosis, contrast allergy) MR physics principles of bright blood, black blood, time-of-flight, phase-contrast, fresh blood and quiescent interval steady state imaging Technical considerations, advantages and disadvantages of both vendor-agnostic and vendor-specific noncontrast MRA using the above techniques. Sample cases of these techniques imaging the aorta, renal arteries, portal vein, and peripheral arteries. Future directions in noncontrast MRA.

SUMMARY
While MR angiography offers the advantages of absence of ionizing radiation and nephrotoxicity over CT or catheter-based angiography, patients with severe renal insufficiency pose a challenge regardless of modality. Noncontrast MRA provides the body imager with another tool for evaluating the arterial and venous vasculature in these patients. This exhibit aims to characterize and provide examples of emerging noncontrast MRA techniques in body imaging applications.

Comprehensive Contrast-enhanced Magnetic Resonance Venography with Gadofosveset Trisodium

LL-VIE2950
Larry A Kramer, MD
Alan M Cohen, MD *
Jerry Wolinsky, MD *
Jared H Heimbigner, DO
Khader M Hasan, PhD, MSc
Andrew Barreto, MD
William K Carson, MD
Staley A Brod, MD *
Ponnada A Narayana, PhD

PURPOSE/AIM
Magnetic Resonance Venography (MRV) often utilizes non-contrast 2D time-of-flight (TOF) sequences due to sensitivity to slow flow, however, flow related artifacts due to turbulence, vortical flow and in-plane saturation effects can limit accuracy. Contrast-enhanced MRV with 3D Turbo Field-Echo (TFE) sequences minimizes these artifacts but may only be effective for a single acquisition. However, with the advent of the intravascular agent, gadofosveset trisodium, prolonged steady-state enhancement of venous system extends MRV acquisition to multiple sequences without significant signal decay. The goal of this exhibit is to present the technique of comprehensive MRV evaluation of the intracranial and extracranial venous system using gadofosveset trisodium with comparison with catheter venography and non-contrast 2D TOF.

CONTENT ORGANIZATION
A. 3D contrast-enhanced MRV acquisition technique B. Processing considerations C. Normal examples D. Non-contrast 2D TOF sequences versus contrast-enhanced MRV E. Catheter venography versus contrast-enhanced MRV

SUMMARY
Contrast-enhanced MRV with gadofosveset trisodium allows steady-state imaging of the venous system over a prolonged interval permitting acquisition of multiple anatomic compartments with minimization of flow related artifacts and in-plane saturation effects commonly present in 2D TOF technique.

Comprehensive Contrast-enhanced Magnetic Resonance Venography with Gadofosveset Trisodium

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A. 3D contrast-enhanced MRV acquisition technique B. Processing considerations C. Normal examples D. Non-contrast 2D TOF sequences versus contrast-enhanced-MRV E. Catheter venography versus contrast-enhanced-MRV

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Contrast-enhanced MRV with gadofosveset trisodium allows steady-state imaging of the venous system over a prolonged interval permitting acquisition of multiple anatomic compartments with minimization of flow related artifacts and in-plane saturation effects commonly present in 2D TOF technique.


default

Pediatric Radiology Series: Pediatric Neuroimaging I

Sunday, 10:30 AM - 12:00 PM • S100AB

VSPD11 • AMA PRA Category 1 Credit ™:3.75 • ARRT Category A+ Credit:4
Moderator
Marvin D Nelson, MD
Moderator
Sanjay P Prabhu, MBBS

VSPD11-01 • MR Imaging of the Neonatal Brain

Marvin D Nelson MD (Presenter)

LEARNING OBJECTIVES
1) To review the common disorders and reactions to such in the fetal and neonatal brain. 2) To demonstrate the use of various imaging techniques for assessing acquired fetal and neonatal brain lesions. 3) To highlight the importance of the placenta on normal brain development.

VSPD11-02 • Impaired Preoperative Global and Regional Cerebral Perfusion in Newborns with Complex Congenital Heart Disease

Usah D Nagaraj MD (Presenter); Jordan Evangelou DPhil; Mary Donofrio; Gilbert Vezina MD; Catherine Limperopoulos PhD

PURPOSE
To compare global and regional cerebral perfusion in neonates with congenital heart disease (CHD) versus healthy controls using arterial spin labelling (ASL) MRI.

METHOD AND MATERIALS
ASL is a non-invasive technique for evaluating cerebral perfusion without the use of an exogenous contrast agent. We performed brain MRIs in 73 newborns (30 with complex CHD, 43 controls) prior to open heart surgery on a 3T scanner. 3D FSE Pseudo-continuous ASL sequence was utilized. Post-acquisition image processing was undertaken on a Linux workstation using FSL software. All cases were reviewed by a board certified radiologist (UN) who was blinded to clinical parameters and case/control status. Mean whole brain cerebral blood flow (CBF) was calculated using the scanner software and recorded in mL/100g/min. CBF ASL images were linearly co-registered to the axial T2 images for anatomic delineation and selection of regions of interest to further evaluate regional blood flow using ITK-SNAP software. Areas studied included the frontal white matter, posterior white matter, thalamus and basal ganglia.

RESULTS
Mean gestational age at MRI of the neonates studied was 40.9 weeks. Mean birth weight in reported neonates was 3174 grams. Affected newborns represented a variety of CHD diagnoses including hypoplastic left heart syndrome, tetralogy of Fallot, transposition of the great vessels, and ventricular septal defects. Average whole brain CBF in the controls (20.1 +/-4.6 mL/100g/min.) was significantly higher than in the newborns with CHD (17.4 +/- 4.1 mL/100g/min, p=0.01). Average regional perfusion in the occipital white matter of the controls (13.9 +/- 5.1 mL/100g/min) was also significantly higher than in the patients with CHD (11.3 +/- 3.8 mL/100g/min, p=0.02). Regional CBF in the frontal white matter, thalamus and basal ganglia did not demonstrate a statistically significant difference between the controls and CHD newborns.

CONCLUSION
ASL MRI demonstrates differences in cerebral perfusion between newborns with CHD versus normal healthy controls. Our data suggests that newborns with CHD may have decreased whole brain perfusion and a regional vulnerability in the occipital white matter prior to open heart surgery.

CLINICAL RELEVANCE/APPLICATION
ASL MRI is a promising non-invasive tool for evaluating changes in cerebral perfusion resulting from abnormal hemodynamics in neonates with complex congenital heart disease.

VSPD11-03 • Abnormal Glutamatergic Metabolism during Cooling Correlates with Poor Outcome in Neonates Undergoing Hypothermia Therapy

Jessica L Wisnowski PhD (Presenter); Tai-Wei Wu; Ida Ashoori; Marvin D Nelson MD; Istvan Seri MD, PhD *; Ashok Panigrahy MD; Stefan Blumi PhD

PURPOSE
To study glutamatergic metabolism in neonates undergoing hypothermia therapy (HT) for suspected hypoxic-ischemic injury (HII)

METHOD AND MATERIALS
RESULTS
Neonates with poor outcome had lower creatine (? 24%), N-acetyl-aspartate (? 27%) and myo-inositol (? 11%) and higher lactate (Lac; ? 285%) and glutamine (Gln; ? 184%) during HT (see Figure). Glutamate (Glu) concentration during HT did not distinguish outcome groups; however, after HT, Glu was lower in neonates with poor outcome. Finally, as predicted from models, Glu concentration was lower (? 20%) during HT compared to after.

CONCLUSION
HII affects 3-5/1000 neonates and nearly half face death or severe disability despite therapy. Glutamate excitotoxicity in the setting of energy failure is widely hypothesized to be a key mechanism of cell death following HII. We found elevated glutamine in the neonates with poor outcome, and it is possible that this is indicative of excitotoxic injury as well as some ongoing capacity for astrocytes to detoxify excessive glutamate, albeit ultimately at a level insufficient to prevent poor outcome. However, it is important to consider that glutamine is not only synthesized from glutamate in astrocytes, but also that glutamine can be used as an energy metabolite. More research is needed to map the metabolic fate of glutamate and glutamine in neonates with HII.
RESULTS

1) signal intensity of inferior olivary nucleus (ION) 2) dimensions of ION (normal, enlarged, atrophic) 3) signal intensity along the dentato-rubro-olivary pathway (red nucleus, dentate nucleus, central tegmental tract, inferior and superior cerebellar peduncles) that could explain HOD. 4) evidence of haemorrhagic lesions. Findings were correlated with time interval between surgery and MR examination.

CONCLUSION

Our findings support the theory that reduction of PCFV plays an important role in developing cerebellar tonsillar herniation but other factors like foramen magnum diameters, supraocciput and basiocciput lengths, and supracallosal and more affected in TSC subjects with seizure disorder in the left internal capsule than in subjects without seizure disorder.

CLINICAL RELEVANCE/APPLICATION

Effects of new therapies for TSC are being evaluated by changes seen on neuroimaging. Thus, understanding how specific patient characteristics differentially affects neuroimaging in TSC is recommended.

VSPD11-05 • Longitudinal Changes in Diffusion Properties in White Matter Pathways in Patients with Tuberous Sclerosis Complex

Jae W Song MD, MS (Presenter); Fiona Baumer MD; Paul D Mitchell MS; Rudolph Pienaar PhD; Mustafa Sahin MD, PhD; Ellen Grant MD; Emi Takahashi PhD

PURPOSE

The purpose of this study was to identify predictors of longitudinal changes in diffusion properties of white matter tracts of projection, association and commissural fibers in patients diagnosed with Tuberous Sclerosis Complex.

METHOD AND MATERIALS

Structural and diffusion magnetic resonance imaging was carried out in 17 subjects diagnosed with Tuberous Sclerosis Complex (TSC) (mean age, 7.2 ± 4.4 years, range: 2 ± 17.5 years) and with at least 2 scans (mean number of days between the 2 scans 419.4 days ± 105.4 days, range: 309 ± 741 days). There were 10 males and 7 females; 5 of whom had autism spectrum disorder (ASD); and 10 of whom had seizure disorder. A coordinate-based tractography atlas was used to guide ROI placement to delineate the internal capsule/corona radiata, cingulum, and corpus callosum. These ROIs were then co-registered using FLIRT to each subject's second scan. The outcomes were mean change in apparent diffusion coefficient (ADC) and the mean change in fractional anisotropy (FA).

RESULTS

Multiple linear regression analyses showed gender to be a significant predictor of mean change in ADC in TSC subjects in the left internal capsule, right and left cingulum, and corpus callosum, adjusting for initial ADC scan measures. Gender was only a significant predictor of mean change in FA in the corpus callosum. Adjusting for initial ADC or FA scan measures, seizure disorder also emerged as a significant predictor of mean change in ADC, but not for mean change in FA, in the left internal capsule. ASD did not emerge as a significant predictor in either the mean change in ADC or FA in the studied white matter tract pathways.

CONCLUSION

Gender and seizure disorder were independent predictors of mean change in ADC or FA in some white matter tract pathways in TSC subjects. What makes microstructural integrity was more affected in males than in females in the left internal capsule, right and left cingulum, and corpus callosum and more affected in TSC subjects with seizure disorder in the left internal capsule than in subjects without seizure disorder.

CLINICAL RELEVANCE/APPLICATION

The outcomes were mean change in apparent diffusion coefficient (ADC) and the mean change in fractional anisotropy (FA).
with variable time delay from surgery (from 1 to 5 months). In 2 cases of bilateral HOD we observed hyperintensity on T2w images in both superior cerebellar peduncles. DWI and contrast enhanced T1w images did not show alterations of ION.

CONCLUSION
1) Hyperintensity on T2w MRI images in the ION was the most common finding in HOD, and was often associated to lesions in contralateral dentate nucleus. 2) Enlargement of ION was not always present and time interval between surgery and its MRI evidence was variable. 3) The low incidence of ION enlargement could be related to the absence of hemorrhagic lesions in our population.

CLINICAL RELEVANCE/APPLICATION
MRI changes in HOD were frequently assessed after posterior fossa surgery for pediatric tumors.

VSPD11-07 • MRI of Pediatric White Matter Disease
Sanjay P Prabhu MBBS (Presenter)

LEARNING OBJECTIVES
1) To become familiar with the spectrum of white matter disease in children including demyelination, dysmyelination and neurometabolic disorders. 2) To provide a step-wise algorithm for approaching imaging studies with white matter abnormality and use a pattern-recognition approach to narrow the differential diagnosis. 3) To illustrate examples of conditions with characteristic imaging findings and elaborate use of advanced imaging techniques in refining the diagnosis.

ABSTRACT

Cardiac (Coronary CT/MR I)

Sunday, 10:45 AM - 12:15 PM • SS502AB

SSA02 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Vincent B Ho, MD, MBA *
Moderator
Gisela C Mueller, MD *
Moderator
Lisa Diethelm, MD

SSA02-01 • Diagnostic Accuracy of 320-detector Computed Tomography Angiography in Evaluating In-stent Restenosis of Coronary Artery
Yung-Liang Wan MD ; Sophie Chan MD (Presenter) ; Zhonghua Sun PhD ; Yu-Hsiang Juan MD ; I-Chang Hsieh ; Ming-Shien Wen

PURPOSE
To study the sensitivity (SN), specificity (SP), accuracy, positive predictive value (PPV) and negative predictive value (NPV) of 320-detector CT angiography (CTA) in diagnosing in-stent restenosis (ISR) on the bases of invasive coronary angiography (ICA) as a golden standard.

METHOD AND MATERIALS

RESULTS
ISR was found in 18 (9.5%) of 189 patents and in 25 (7.9%) of 318 stents. On stent level, the SN, SP, accuracy, PPV, and NPV of CTA in detecting ISR were 92%, 96%, 96%, 66% and 99%, respectively. On patient level, the corresponding figures were 94%, 96%, 96%, 74%, and 99%, respectively. The number of implanted stents in patients with ISR was significantly higher than that in those without ISR (2.56 ± 1.38 vs. 1.59 ± 0.92, p = 0.009). ISR was significantly more frequently found in 12.7% (14/96) of RCA stents, 10% (5/45) of LAD stents, and in 3.8% (6/149) of LCX stents, and in 3.8% (6/149) of LAD stents (p = 0.027).

CONCLUSION
On both stent and patient levels, the SN, SP and accuracy of 320-detector CTA in diagnosing ISR is high, ranging from 92% to 96%. However, the PPV is is 66% on stent level, and 77% on patient level.

CLINICAL RELEVANCE/APPLICATION
The advanced technique 320-detector CTA plays a potential and promising role in assessing ISR of coronary arteries, it is especially useful in excluding ISR with a high NPV of 99%.

SSA02-02 • Value of Super-resolution Technique in Detection of Coronary Artery Stenoses on Whole-heart Coronary MRA
Mio Uno MD (Presenter) ; Ryoehei Nakayama PhD ; Masaki Ishida MD, PhD ; Tatsuro Ito MD ; Yoshitaka Goto MD ; Motonori Nagata MD, PhD ; Kakuya Kitagawa MD, PhD ; Hajime Sakuma MD *

PURPOSE
Coronary MRA provides noninvasive detection of coronary artery disease without exposing the patient to radiation. However, the image resolution of coronary MRA is limited. In the conventional coronary MR images, resolution enhancement is usually performed with bicubic interpolation. Recently, Super-Resolution (SR) technique has been proposed to increase resolution of brain MRI. The purpose of this study was to demonstrate the value of SR technique for the detection of coronary artery stenoses on whole-heart coronary MRA as compared with conventional bicubic interpolation.

METHOD AND MATERIALS
Whole-heart coronary MRA was acquired with 32-channel cardiac coils in 36 patients at 1.5 T (n=16) and 3.0T (n=19). We have newly developed a SR technique optimized for whole-heart coronary MRA by modifying the existing SR method. Receiver operating characteristic (ROC) analysis was performed to evaluate the diagnostic performance of SR technique and conventional bicubic interpolation to detect coronary stenoses of ≥50% on coronary angiography. In the observation study, the cases were displayed in a random order with a custom-made viewer, and three observers independently rated the likelihood of the presence of coronary artery stenoses using a continuous scale from 0 to 1. Two reading sessions were conducted with 3-day interval.

RESULTS
For all observers, the areas under the ROC curves (AUCs) were improved by using SR technique. The mean AUC was 0.861 for SR technique, being significantly higher than that for conventional bicubic interpolation (0.797, P = .024). Interobserver variability was reduced from 0.170 to 0.164 by using SR technique instead of conventional bicubic interpolation. Interclass correlation coefficient was 0.855 by SR technique and 0.812 by conventional bicubic interpolation, respectively.

CONCLUSION
High-resolution whole-heart coronary MRA using a Super-Resolution technique permits noninvasive detection of coronary artery stenoses with significantly improved image quality as compared to conventional bicubic interpolation method.
SSA02-03 • Mechanical Deformation of Coronary Stent Detected by Cardiac CT: Morphological Predictors and Clinical Implication

**M1 Sun Chung** MD (Presenter) ; **Dong Hyun Yang** MD ; **Joon-Won Kang** MD ; **Young-Hak Kim** ; **Tae-Hwan Lim** MD, PhD

**PURPOSE**
To evaluate the features and morphologic predictors of mechanical deformities of coronary stents and the effect of mechanical deformities on in-stent restenosis (ISR) using cardiac CT.

**METHOD AND MATERIALS**
We retrospectively reviewed coronary CT angiography to evaluate mechanical deformities of coronary stents. A total of 864 coronary stents from 584 patients (mean age, 62.8 years; male:female=447:137) were enrolled consecutively in our hospital. The presence of mechanical deformities of coronary stent (partial or complete fracture, longitudinal compression [LC; distortion or shortening of a stent in the longitudinal axis], and radial compression [RC; focal decrease of stent diameter in radial axis]), ISR (>50% stenosis of stent on cross-sectional image) and aneurysm were evaluated. Morphologic predictors of mechanical deformation included stent location, stent length, stent overlap by two or more stents, bifurcation lesion stent, excessive tortuosity, and side branch ballooning procedure. Multiple logistic regression analyses were performed to find predictors of mechanical deformation, ISR, and aneurysm.

**RESULTS**
Of 864 stents, proportions of any fracture, complete fracture, LC, and RC were 12.3%, 3.9%, 2.8% and 7.2%, respectively. Stent fracture and RC of stent were significantly higher in stent with excessive tortuosity (fracture 27.1% vs. 11.2%, p < 0.001), RC (45.1% vs. 17.7%, p < 0.001). In total, 166 stenoses were found in 96 coronary arteries. Seven patients with 17 stenoses in 11 coronary arteries showed myocardial ischemia. In total, 166 stenoses were found in 96 coronary arteries. Seven patients with 17 stenoses in 11 coronary arteries showed myocardial ischemia on APMRI. Baseline characteristics did not differ between patients with and without myocardial ischemia. For anatomical stenoses, there was no significant difference in the decrease in CCO across the coronary artery between vessels with or without stenosis (0.064±0.121 vs. 0.049±0.103; P=0.50). Difference in CCO across a coronary stenosis was significantly larger in patients with myocardial ischemia than in those without (0.101±0.097 vs. 0.048±0.110, respectively; P<0.05). In cardiac asymptomatic patient, there is a significant correlation between the decrease in CCO across CT-detected coronary stenosis and ischemia on APMRI. Decreases in CCO across the coronary artery and across stenosis were calculated, and compared with presence of ischemia on APMRI.

**CONCLUSION**
There is a significant correlation between the decrease in CCO across CT-detected coronary stenosis and ischemia on APMRI. Decreases in CCO across the coronary artery and across stenosis were calculated, and compared with presence of ischemia on APMRI.

**CLINICAL RELEVANCE/APPLICATION**
Cardiac CT may be an effective modality to evaluate mechanical deformities and their complications associated with stent fracture.

SSA02-04 • Evaluation of Hemodynamic Significance of Coronary Stenosis by Vessel Attenuation Measurement on CT: Comparison with Adenosine Perfusion MRI

**Martijn A Den Dekker** MD, MS ; **Gert Jan Pelgrim** MSc ; **Rozemarijn Vliegenthart** MD, PhD (Presenter) ; **Edwin R Van Den Heuvel** MD, PhD ; **Gabija Punzhiute** MD, PhD ; **Matthys Oudkerk** MD, PhD ; **Kevin G Ike** MD, PhD

**PURPOSE**
Correlation between CT-detected coronary stenosis and myocardial ischemia is poor. Corrected contrast opacification (CCO) calculation is a new technique based on coronary CT angiography (cCTA) data, that estimates the effect of stenosis on coronary flow. The purpose of this study is to evaluate the association between CT-derived CCO and ischemia by adenosine perfusion magnetic resonance imaging (APMRI) as reference standard.

**METHOD AND MATERIALS**
Sixty vascular patients without cardiac complaints (mean age 64.4±7.7 years; 78% male) underwent cCTA and APMRI for cardiac risk assessment. The study was approved by the local medical ethical committee. cCTA was performed using a first-generation dual-source CT scanner. On cCTA, coronary luminal attenuation values (in Hounsfield units) were measured at 4 locations from proximal to distal coronary artery; 4 extra measurements were performed in vessels with >50% lumen stenosis. CCO was calculated by dividing coronary CT attenuation by descending aorta CT attenuation at equal level. A 1.5T MRI scanner was used for APMRI, with an inducible perfusion defect under adenosine considered indicative of myocardial ischemia. Decreases in CCO across the coronary artery and across stenosis were calculated, and compared with presence of ischemia on APMRI.

**RESULTS**
In total 166 stenoses were found in 96 coronary arteries. Seven patients with 17 stenoses in 11 coronary arteries showed myocardial ischemia on APMRI. Baseline characteristics did not differ between patients with and without myocardial ischemia. For anatomical stenoses, there was no significant difference in the decrease in CCO across the coronary artery between vessels with or without stenosis (0.064±0.121 vs. 0.049±0.103; P=0.50). Difference in CCO across a coronary stenosis was significantly larger in patients with myocardial ischemia than in those without (0.101±0.097 vs. 0.048±0.110, respectively; P<0.05). In cardiac asymptomatic patient, there is a significant correlation between the decrease in CCO across CT-detected coronary stenosis and ischemia on APMRI. Decreases in CCO across the coronary artery and across stenosis were calculated, and compared with presence of ischemia on APMRI.

**CONCLUSION**
There is a significant correlation between the decrease in CCO across CT-detected coronary stenosis and ischemia on APMRI. Decreases in CCO across the coronary artery and across stenosis were calculated, and compared with presence of ischemia on APMRI.

**CLINICAL RELEVANCE/APPLICATION**
Corrected contrast opacification, based on common cCTA data, is a promising non-invasive method to assess the functional significance of CT-detected stenosis.

SSA02-05 • Iterative Image Reconstruction Improves Accuracy of Automated Plaque Burden Assessment in Coronary CT Angiography: A Comparison to Intravascular Ultrasound

**Stefan Puchner** MD (Presenter) ; **Maros Ferencik** MD ; **Akiko Maehara** ; **Paul Stolzmann** MD ; **Shixin Ma** ; **Synho Do** PhD * ; **Hans-Ulrich Kauczor** MD * ; **Gary Mintz** ; **Udo Hoffmann** MD ; **Christopher L Schlett** MD, MPH

**PURPOSE**
To determine whether iterative image reconstruction algorithms improve the accuracy of coronary CT angiography (CCTA) for (semi-)automated plaque burden assessment as compared to intravascular ultrasound (IVUS).

**METHOD AND MATERIALS**
CCTA and IVUS data were acquired from seven coronary arteries in an ex-vivo setting. CT images were reconstructed by using filtered-back projection (FBP), adaptive-statistical (ASIR) and model-based (MBIR) iterative reconstruction algorithms. Cross-sectional images of the arteries were co-registered between CCTA and IVUS in 1-mm increments. In CCTA, a fully-automated (without manual corrections) and a semi-automated (allowing manual corrections of vessel-wall boundaries) plaque burden assessment were performed for each of the reconstruction algorithms using commercially available software in IVUS, plaque burden was measured manually. Agreement between CCTA and IVUS was determined with Pearson correlation coefficients.

**RESULTS**
A total of 173 corresponding cross-sections were included. The average plaque burden by IVUS was 63.39±10.63%. By CCTA, it was 54.9±11.7/53.3±13.1/55.4±12.2% for FBP/ASIR/MBIR using fully-automated and 54.9±11.8/53.4±12.9/57.1±11.1% using semi-automated assessment, respectively. Manual corrections in the semi-automated assessment were performed in 39% of all cross-sections and improved the plaque burden correlation with IVUS, independent of the reconstruction algorithm (p<0.05). Using MBIR algorithm in CCTA with a semi-automated assessment enables more accurate measurement of plaque burden as compared to ASIR and FBP using IVUS as the reference standard.

**CLINICAL RELEVANCE/APPLICATION**
Model-based reconstruction algorithm could further enhance the role of coronary CT angiography as a non invasive risk stratification tool.
A high-definition computed tomography coronary angiography (HDCTCA) scanner, with improved in-plane spatial resolution of 230 μm, has recently been developed. The aim of this study is to compare the diagnostic accuracy by HDCTCA with standard definition 64-slice scanner (SDCTCA) by using ICA as the reference method.

METHOD AND MATERIALS
One-hundred-forty consecutive patients (mean age 65±8 years, male 105) scheduled for ICA were randomized to SDCTCA (n= 70, group 1) or HDCTCA-scan protocol (n= 70, group 2) (Discovery CT 750 HD scanner, GE Healthcare, Milwaukee, WI) before ICA. The scanning parameters were: slice acquisition 64x0.625 mm, gantry rotation time 330 msec and prospective ECG-triggering. We evaluated the Likert image quality score (1: non-diagnostic to score 4: excellent), overall feasibility (Fe), the sensitivity (Se), specificity (Sp), negative predictive value (NPV), positive predictive value (PPV) and accuracy (Ac) versus ICA in a segment-based model and comparing the diagnostic performance between group 1 and group 2.

RESULTS
The 2 groups were homogeneous in terms of baseline characteristics. Group 2 showed a higher mean image quality score (3.8 vs 3.1, p<0.0001). The present study showed an improved overall feasibility, positive predictive value and accuracy mainly in calcified coronary artery lesions in HDCTCA in comparison with SDCTCA due to the better spatial resolution and the consequent reduced blooming effect.

CONCLUSION
HDCTCA offers a possible and alternative solution to the problem of heavily calcified coronary arteries reducing the overestimation of calcium volume by nearly half.

Comparative analysis of 256-slice dual source CT angiography (DSCTA) and catheter coronary angiography (CCA) in evaluation of coronary arteries (CA) in patients with clinical suspicion of coronary artery disease (CAD) and to study its effectiveness at higher heart rates (HR) without using beta blockers.

METHOD AND MATERIALS
This prospective study was conducted on patients (n=40) with suspected CAD using ECG triggered 256 slice DSCT (Somatom Definition Flash, Siemens). Patients were sub grouped according to HR (Group 1: 85-100) and (Group 2: 101-115 bpm). 22 patients had HR of 85-100 bpm while 18 patients had HR 101-115 bpm. All patients were scanned with retrospective spiral scan protocol. Coronary artery segments were analyzed for image quality (IQ) on a 4 point scale (1 is worst while 4 is best) by two independent readers who were blinded to patients details. Accuracy to detect significant luminal stenosis was correlated with CCA (gold standard). Statistical significance of study was determined by chi-square test.

RESULTS
A total of 545 coronary artery segments were analyzed. The mean IQ score and standard deviation in group 1 and 2 were 3.45 ± 0.26 and 3.03 ± 0.36 respectively. Inter-observer agreement analysis was performed using Kappa analysis to determine consistency between DSCTA readers. The Kappa values for group 1 and 2 were 0.838 and 0.808 respectively. The sensitivity, specificity, PPV, NPV and accuracy for detecting significant stenosis in group 1 and group 2 were 97.3%, 98.6%, 100%, 98.7%, 98.9% and 91.3%, 96.9%, 95.4%, 95.6%, 96.9% respectively.

CONCLUSION
256 slice DSCTA is a reliable technique with high sensitivity, specificity, PPV and NPV for assessment of coronary arteries even at higher HR without using beta blocker to reduce the HR.

CLINICAL RELEVANCE/APPLICATION
256 slice dual source CT can be used effectively for patients with suspected coronary artery disease irrespective of their heart rate and without any premedication to lower the heart rate.

Iterative Reconstruction Algorithms in Coronary CT Angiography for the Characterization of Coronary Atherosclerotic Plaque-A Comparison with Histology

Stefan Puchner MD (Presenter) ; Maros Ferencik MD ; Pal Maurovich-Horvat MD ; Masataka Nakano ; Fumiyuki Otsuka ; Hans-Ulrich Kauczor MD * ; Renu Virmani ; Udo Hoffmann MD ; Christopher L Schlett MD, MPH

PURPOSE
To evaluate whether iterative reconstruction algorithms improve the accuracy of coronary CT angiography (CTA) for coronary plaque characterization as compared to histology.

METHOD AND MATERIALS
CTCA and histological data were acquired from coronary arteries of 3 ex-vivo hearts. CT images were reconstructed using filtered-back projection (FBP), adaptive-statistical iterative (ASIR) and model-based iterative (MBIR) reconstruction algorithms. First, cross-sectional CTCA images were co-registered between all three reconstruction algorithms and second CTA triplets were co-registered with histology. Plaque area 2007m and circumference >60μ, as well as a cap thickness

RESULTS
In total, 173 FBP/ASIR/MBIR triplets by CTCA were co-registered with histological cross-sections, where lipd-core plaque (LCP) was presence in 26 locations based on histology. Plaque area

CONCLUSION
Plaque area

CLINICAL RELEVANCE/APPLICATION
Model-based reconstruction algorithm further enhances the accuracy of coronary CT angiography as a non-invasive tool for the detection and characterization of vulnerable plaque

CT Coronary Artery Opacification Gradients Using Different Iodinated Contrast Injection Protocols

Dimitris Mitsouras PhD (Presenter) ; Kanako K Kumamaru MD, PhD ; Chi Wai S Cheung MBBS ; Amir Imanzadeh MD ; Michael L Steigner MD * ; Frank J Rybicki MD, PhD * ; Elizabeth George MBBS ; Julie Miller MD * ; Hiraku Kumamaru

PURPOSE
To evaluate differences in coronary contrast opacification gradients, also known as TAG or Transluminal Attenuation Gradients, between biphasic and triphasic coronary CTA injection protocols.
Gastrointestinal (Rectal Carcinoma Imaging)

Sunday, 10:45 AM - 12:15 PM • E450A

SSA07 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Michael E Zalis, MD *
Moderator
Marc J Gollub, MD
Moderator
Byung Ihn Choi, MD, PhD *

RESULTS
While gradients showed strong to excellent linear-fit (Pearson r values = 0.64 - 0.91) for each injection protocol, the different protocols introduced variability in normal coronary artery gradients. However, the gradients computed from biphasic injection protocol in LAD arteries with >50% stenosis were significantly (p-values: from 0.001 to 0.01) different from each other.

CONCLUSION
Coronary contrast opacification gradients vary with respect to a biphasic versus triphasic injection protocols, with both showing differences between normal and abnormal coronary arteries.

CLINICAL RELEVANCE/APPLICATION
To date, gradients have been validated using only biphasic protocols; these data suggest that both biphasic and triphasic injections can be used to differentiate normal and abnormal coronary arteries.

METHOD AND MATERIALS
Contrast opacification gradients from 320 x 0.5 mm detector row CT were computed for two populations: 32 patients with normal coronary arteries plus 12 patients with left anterior descending (LAD) coronary artery stenosis (>50%) scanned with biphasic injection protocol, and 11 normal patients scanned at a separate institution with a triphasic injection protocol. Linear regression determined correlation between mean Hounsfield Unit and distance from the coronary ostium, lumen cross-sectional area, and lumen short axis diameter. For each gradient (regression slope), multivariate regression model adjusting for BMI analyzed differences found between the two patient cohorts.

RESULTS
The mean tumor fractional water content was 0.88 (range: 0.74 - 0.95). Fractional water content did not correlate significantly with ADCmean (rs = 0.358, p=0.310) and SUVmean (rs = -0.030, p=0.934). Fractional water images underwent texture analysis using a filtration-histogram method. Filtration highlighted image features ranging between approximately 2mm and 7mm diameter. Histograms of filtered images quantified as standard deviation (SD) and proportion of positive pixels (PPP) were correlated against SUVmean and ADCmean using Spearman Rank Correlation.

CONCLUSION
Texture analysis of Dixon images can potentially assess tumor water distribution. Tumor ADCmean and SUVmean measurements may be related to tumor water distribution in colorectal cancer.

CLINICAL RELEVANCE/APPLICATION
Texture analysis of Dixon images in colorectal cancer can potentially provide information about tumor biology with possible applications in personalized medicine.

SSA07-02 • CT Manifestations of the Mesorectal Fascia Invasion of Rectal Carcinoma

Chen Nan MD (Presenter); Kuncheng Li MD

PURPOSE
The total mesrectal excision (TME), which is the surgical removal of rectal tumor and the surrounding mesorectum along the mesorectal fascia (that is circumferential resection margin, CRM), has become the standard surgical method of rectal cancer which originated from the section below the pelvic peritoneum reflection. Therefore, to preoperatively comprehensively evaluate the state of mesorectal fascia is very important an impact on the decision of potential for TME surgical removal as well as whether neoadjuvant therapy should be administered. So, our Purpose is to evaluate the CT manifestations of the mesorectal fascia invasion of rectal carcinoma.

METHOD AND MATERIALS
Seventy-eight patients with rectal carcinoma which originated from the section below the pelvic peritoneum reflection underwent preoperative CT examinations and the operations were performed with TME method in 72 resectable tumor. Compared the CT characteristics of mesorectal fascia invasion of rectal carcinoma with the pathologic findings.

RESULTS
In 78 cases, 51 cases rectal carcinoma had penetrated through the rectal wall present patching-like, lining or mass shadows distributed within the perirectal fat tissue on CT. Among them, none of rectal fascia was thicken on CT in 27 cases. In these cases, no tumor cells infiltrating was found in the CRM proved by pathology. The thickenings of the rectal fascia present even or irregularly thickened was found in 24 cases on CT. In these cases, the invasion outside of rectal fascia into the pararectal space on CT and the CRM involvement proved by pathology was 11 cases and 13 cases, respectively. The e values was 0.818 and the p

CONCLUSION
CT is valuable in identifying tumor invasion mesorectal fascia. The state of mesorectal fascia on CT is excellent agreement with the pathologic findings of CRM.

CLINICAL RELEVANCE/APPLICATION
It is very important for preoperative determination of resectability, surgical approach and prognosis of rectal carcinoma.
SSA07-03 • The Correlation of Radiologic Serosal Involvement in Rectal Cancer to Pathologic Assessment, and Comparison of Impact on Survival, Local Recurrence and Metachronous Peritoneal Carcinomatosis

Michael R Torkzad MD, PhD (Presenter) *; Faoz Dranichnikov; Hakan Ahlstrom; Peter Nygren; Lars Pahlman; Haile Mahteme MD, PhD

PURPOSE
To investigate the correlation between radiologic and pathologic assessment of serosa involvement in patient with rectal cancer, and also compare the impact of serosa involvement on survival, local recurrence and metachronous peritoneal carcinomatosis (MPC).

METHOD AND MATERIALS
100 consecutive patients diagnosed with T3 and T4 primarily rectal cancer between 2007 and 2008 made the basis of this study. Detailed radiologic analysis of magnetic resonance imaging (MRI) of rectum at the time of diagnosis of rectal cancer was performed by an experienced radiologist blinded to the clinical data. T4s was defined as tumor growing locally into the serosal layer; rT4s was when the radiologist made such an assessment and pT4s when the pathologist made such assessment. The clinical data at the time of diagnosis and surgery, and 4-5 years postoperative follow-up regarding survival and adverse outcomes (cancer-related mortality and recurrence) and development of MPC were recorded.

RESULTS
94 patients had complete clinical data of which 63 had MRI prior to treatment. 11 patients showed radiologic signs of local peritoneal involvement (rT4s), while 6 patients showed this at pathology (pT4s). Only two of these were assessed as T4s by both the radiologist and the pathologist. Cancer-related mortality and local recurrence rate were higher among rT4s patients than pT4s (55% vs. 33% and 58% vs. 17%, respectively with odds ratio of 1.67 and 3.49). The only two cases of MPC were seen among rT4s patients. Step-wise multivariate regression showed higher impact by rT4s than pT4s classification on survival, recurrence rate and MPC with adjusted correlation coefficients (R2) of 0.04, 0.15 and 0.14. rT4s staging was the only factor with adjusted R2 > 0.03 for development of MPC.

CONCLUSION
There seems to be a large discrepancy between rT4s and pT4s though the latter was usually after neoadjuvant therapy. rT4s showed higher impact on development of MPC, local recurrence and even cancer-related survival.

CLINICAL RELEVANCE/APPLICATION
Involvement of serosal layer in rectal cancer denotes a higher risk for metachronous development of peritoneal carcinomatosis, local recurrence and cancer-related mortality than pathologic assessment.

SSA07-04 • Diffusion Weighted Imaging for Evaluating Lymph Node Eradication after Neoadjuvant Chemoradiation Therapy in Locally Advanced Rectal Cancer

Kyong Hwa Ryu MD (Presenter); Seung Ho Kim MD; Jung Hee Yoon MD; Yedaun Lee MD; Yun-Jung Lim; Choong K Eun MD

PURPOSE
To evaluate the added value of the diffusion-weighted imaging (DWI) for evaluating lymph node (LN) eradication after neoadjuvant chemoradiation therapy (CRT) in patients with locally advanced rectal cancer (LARC).

METHOD AND MATERIALS
Institutional review board approved this retrospective study and waived informed consent. Ninety-five consecutive patients (64 men, 31 women; mean age: 59 years, range: 32-82 years) with LARC (≥T3 or LN metastasis) who underwent CRT and subsequent surgery, were enrolled in this study. All patients underwent pre-and post-CRT T2WI first and then the combined image set of the T2WIs and pre-and post-CRT DWI with a four-week interval and recorded their confidence score for LN eradication with a 5-point scale on a per-patient basis. The diagnostic performances were compared between the two reading sessions for each reader by using pair-wise comparison of receiver operating characteristic curves. Histopathology reports served as the reference standard for LN eradication.

RESULTS
Study population consisted of LN-eradicated group (n=65) and non-eradicated group (n=30). The diagnostic performances did not significantly differ between the two reading sessions for both readers (AUC, for reader 1, 0.770, 0.774, p=0.8155; for reader 2, 0.794, 0.798, p=0.8588). The sensitivity, specificity and accuracy for LN eradication were stationary after adding DWI for both readers (for reader 1, from 88%, 63% and 80% to 88%, 73% and 83%, respectively; for reader 2, from 77%, 77% and 77% to 77%, 80% and 78%, respectively).

CONCLUSION
Adding DWI to T2WI provides no additional diagnostic benefit for evaluating LN eradication after CRT in patients with LARC.

CLINICAL RELEVANCE/APPLICATION
Adding DWI to T2WI provides no additional diagnostic benefit for evaluating LN eradication after CRT in patients with LARC.

SSA07-05 • Magnetic Resonance Imaging of Tumor Initiation and Progression, and Response to Vitamin D in a Mouse Model of Colitis and Colitis-associated Colon Cancer

Devkumar Mustafii PhD (Presenter); Urszula Dougherty MS; Erica Markiewicz BA; Xiaobing Fan PhD; Marc Bissonnette MD; Gregory S Karczmar PhD *

PURPOSE
Colon cancer is a leading cause of cancer deaths in the US. Ulcerative colitis is causally linked to colitis-associated neoplastic progression but is difficult to detect and monitor non-invasively. Goals of this study were to determine MRI characteristics of early colitis-associated colon cancer and to assess vitamin D chemopreventive efficacy.

METHOD AND MATERIALS
This study included CF1 female control mice (n=12), and mice treated with azoxymethane i.p. and dextran sulfate sodium in the drinking water (n=25) to induce colitis and colon cancer. Mice were fed a Western diet or Western diet supplemented with vitamin D (500 â€¢g/kg chow). Western diets are relatively deficient in vitamin D and calcium. Mice were studied serially using anatomic and dynamic contrast enhanced MRI (DCEMRI) with a Gd-based contrast agent in vivo MR and ex vivo histological images were co-registered using an agar based color-coded phantom in a flexible tube (2 mm o. d.) that was inserted via the rectum to the cecum. The phantom provided visual and MRI-detectable reference markers to co-register in vivo and ex vivo images.

RESULTS
We demonstrated that: 1) a visible reference marker could be used to successfully co-register MRI abnormalities with histological features identified in HandE stained sections; 2) T2 values distinguished normal colon from colitis, and from focal neoplastic lesions (trans values assessed by DCEMRI (a measure of perfusion/capillary permeability) reliably distinguished normal colon from tumor (0.12±0.01 min−1 vs. 0.61±0.05 min−1, respectively, p3-fold larger adjacent to early colonic tumors compared to vessels in control mice, suggesting that MRI might be used to detect dilated blood vessels as biomarkers of early colorectal cancer; 5) Vitamin D reduced the number of colonic tumors and degree of inflammation detected by MRI (p CONCLUSION
A novel technique was successfully developed to co-register MR and histological images. Several reliable image-based markers for colitis and colon cancer were identified. These MRI methods could monitor the chemopreventive efficacy of vitamin D in this model in real time and without sacrifice.
Most Accurate Selection of Complete Responders After Chemoradiation for Rectal Cancer with a Combination of T2-weighted MRI, Diffusion-weighted MRI and Endoscopy

Monique Maas MD (Presenter); Doenja M Lambregts MD, PhD; Luc Heijnen; Milou Martens; Jeroen Leijtens; Karel Hulsewe; Geerard L Beets MD, PhD; Regina G Beets-Tan MD, PhD

**PURPOSE**
Chemoradiation (CRT) for rectal cancer leads to complete tumour response (CR) in 15-25% of the cases. Accurate identification of a CR is necessary to allow for less invasive treatments (e.g. local excision or wait and see). Standard imaging cannot accurately identify a CR due to incorrect overestimation of fibrosis as residual tumour. Aim was to evaluate what is the best strategy to identify patients with a CR by use of T2W MRI, DWI and endoscopy.

**METHOD AND MATERIALS**
49 patients underwent CRT and restaging consisting of T2W-MRI, DWI and endoscopy 8 weeks after completion of CRT. One reader scored the T2W images followed by immediate evaluation of the DWI images with the T2W images at his disposal. A second reader scored the endoscopy images. Readers were blinded for histology and each others’ results. Scoring was performed with a confidence level score (0=definitely residual tumour, 4=definitely CR).

**RESULTS**
Of the 49 patients, 18 had residual tumour and 31 had a CR. The AUCs for T2W-MRI, T2+DWI and endoscopy were 0.71, 0.78 and 0.88, respectively. Corresponding sensitivities and specificities were 39% and 87% for T2W, 39% and 93% for T2+DWI and 67% and 97% for endoscopy. When a combination of MRI (T2W and DWI) with endoscopy was used the highest accuracy was reached: 0.91.

**CONCLUSION**
The combination of endoscopy, T2W-MRI and DWI leads to a very high accuracy for the identification of patients with a CR after CRT for rectal cancer. Endoscopy corrects for overestimation of fibrosis as residual tumour with MRI. MRI provides a low risk for missing residual tumour and thus guarantees a safe selection process. It is therefore highly recommendable to use this combination of endoscopy and T2W-MRI with DWI to select patients with a CR after CRT, particularly now less invasive treatment is increasingly being considered as an alternative for standard TME.

**CLINICAL RELEVANCE/APPLICATION**
Use of endoscopy with T2W MRI, DWI and endoscopy 8 weeks after completion of CRT leads to a high accuracy and is recommended for restaging when considering less invasive treatment instead of TME.

Diffusion-weighted MRI Imaging for the Follow-up of Patients after Primary Surgical and Non-surgical Treatment for Rectal Cancer

Doenja M Lambregts MD, PhD (Presenter); Max Lahaye MD, PhD; Luc Heijnen; Monique Maas MD; Milou Martens; Regina G Beets-Tan MD, PhD

**PURPOSE**
Detection of local recurrences after primary treatment of rectal cancer is crucial in order to allow for timely surgical intervention. Standard imaging is known to experience difficulties in differentiating between post-treatment effects (inflammation/fibrosis) and recurrent tumor. Diffusion-weighted MRI (DWI) has in various studies shown to be a powerful tool for the detection of tumors. Hence, DWI may also be a promising tool for follow-up (FU) after treatment. Aim of this study was to evaluate the diagnostic value of DWI for the FU of patients after primary surgical or non-surgical treatment for rectal cancer.

**METHOD AND MATERIALS**
The study group consisted of 117 patients who had previously undergone rectal cancer treatment, consisting of either standard surgical resection +/- neoadjuvant (chemo-)-radiotherapy (n=36), a local transanal excision (n=40, of which 15 after chemoradiotherapy), or a non-operative wait-and-see policy (n=41). During clinical FU all patients underwent one or more FU-MRIs (1.5T) including DWI (highest b-value b1000), as part of routine FU or because of a suspected local recurrence (e.g. clinical complaints or rising CEA levels) after surgery. Two readers in consensus evaluated each MRI and scored the b1000 DWI-images as: no high signal, high signal suspected of recurrence or not adequately assessable due to artefacts.

**RESULTS**
Patients underwent a mean number of 3 FU-scans (range 1-11) with a mean FU-time of 44 months (4-144). 27/117 patients developed a
Intravoxel Incoherent Motion Magnetic Resonance Imaging of the Liver: Diagnostic Accuracy in Classifying the Severity of Liver Fibrosis

CSilla Balassy MD (Presenter) ; Diana S Feier MD ; Friedrich Wrba ; Stephan Witoszynskyyj ; Gert Reiter * ; Ahmed Ba-Ssalamah MD

PURPOSE
To assess the effect of echo-sampling on the accuracy of magnetic resonance (MR) susceptibility-weighted imaging (SWI) to detect and stage liver fibrosis in patients with chronic liver diseases (CLD), using histology as reference standard.

METHOD AND MATERIALS
This prospective study was approved by the local ethics committee. All subjects gave written informed consent. Sixty-eight consecutive patients (mean age 55.86 years; 60% males) with CLD and histologically proven liver fibrosis were included. Liver fibrosis was evaluated according to the Metavir scoring system. SWI MRI sequences were performed on a 3 Tesla unit and data were collected at two different echo times (TE), 2.5 ms and 10ms. Signal intensity (SI) of the liver and spinal muscle was defined using region-of-interest measurements and liver-to-muscle signal intensity ratios (2.5TE LMR and 10TE LMR) were calculated. The diagnostic performance of both echo times (TE), 2.5 ms and 10ms for evaluation of CLD was assessed through AUROC analysis.

RESULTS
Histology resulted F0 (n=13, 19.4%), F1 (n=6, 9%), F2 (n=8, 11.9%), F3 (n=12, 17.9%), F4 (n=28, 41.8%). Both 2.5TE LMR and 10TE LMR correlated strongly with liver fibrosis (r=-0.74, p<0.001). Both diagnostic performances using both echo times were also strongly correlated (AUROC = 0.98). SWI correlated significantly with histology (r = -0.74)

CONCLUSION
SWI is a promising non-invasive tool to detect and stage liver fibrosis in CLD patients, having increased accuracy with higher TE values.

CLINICAL RELEVANCE/APPLICATION
Implementation of imaging parameters as assessed in our study will enable improved and accurate assessment of liver fibrosis in patients with CLD using SWI.
Liver MR elastography is more accurate than liver biopsy specimens in liver fibrosis staging and can be serve as biopsy in clinical practice.

CONCLUSION

The liver stiffness and fECS of the study population ranged from 1.68kPa to 8.6kPa and 17.5% to 40.1% respectively. There was good correlation between MRE measures of liver stiffness and equilibrium phase measures of fECS (Pearson’s correlation coefficient r=0.86, 95% CI, 0.73-0.93, p<0.001). The liver stiffness and fECS of the study population were also well correlated with the METAVIR liver fibrosis staging system (Spearman’s correlation coefficient rs=0.72, 95% CI, 0.61-0.81, p<0.001).

RESULTS

The liver stiffness and fECS of the study population were also well correlated with the METAVIR liver fibrosis staging system (Spearman’s correlation coefficient rs=0.72, 95% CI, 0.61-0.81, p<0.001). The liver stiffness and fECS of the study population were also well correlated with the METAVIR liver fibrosis staging system (Spearman’s correlation coefficient rs=0.72, 95% CI, 0.61-0.81, p<0.001).

CONCLUSION

Liver MR elastography is more accurate than liver biopsy specimens in liver fibrosis staging and can be serve as biopsy in clinical practice.

SSA08-05 • Automated Technique for Hepatic MR Elastography Analysis: Comparison to Skilled Human Interpretation

Bogdan Dzyubak BS (Presenter); Armando Manduca PhD *; Joel P Felmlee PhD; Kevin J Glaser *; Sudhakar K Venkatesh MD, FRCR; Richard L Ehman MD *

PURPOSE

To test the performance of an automated technique for the analysis of clinical MR Elastography (MRE) images.

METHOD AND MATERIALS

In a retrospective analysis of 64 MRE cases performed for fibrosis screening, the performance of an automated algorithm (A) was compared to that of clinical readers (R), with gold standard (G) measurements provided by a radiologist highly experienced with MRE. The algorithm presented here has been developed to fully automate MRE ROI selection and yield a standardized stiffness measurement. First, a crude outline of the liver was found by using the known relative positions and intensities of the dominant tissue types in the abdominal images (abdominal fat, lung, liver, and other). A Random Walker segmentation was subsequently run on the MRE magnitude images to capture liver tissue and exclude vessels, and then again on the reconstructed stiffness images to remove partial-volume effects. The average stiffness from the ROIs was then calculated.

To test the ability of the algorithm to reproduce manual measurements, a conventional diagnostic threshold of 2.93 kPa was used to separate patients into normal (below) and fibrotic (above) based on the results of the three analysis methods, and the diagnostic
Ultrasound Elastography with Concomitant Liver Biopsy: Comparison of Acoustic Radiation Force Impulse (ARFI) Measurement with Histopathological Grading

Minal C Jagtiani MBBS, MD (Presenter) ; Philip J Shorvon FRCP, FRCPC ; Paul Bassett ; Kesavan Kandiah ; Paul Tadrous ; David J Sherman

PURPOSE
To correlate ultrasound elastography stiffness measurements in chronic liver disease patients with concomitant liver biopsy histopathological scores of fibrosis.

METHOD AND MATERIALS
Patients from January 2010 through January 2013 (n= 161; 84 males) who underwent ultrasound guided liver biopsy for chronic liver disease, performed by an Attending Radiologist with a specialist interest in liver imaging, were assessed prospectively. All patients also underwent ultrasound elastography for liver stiffness immediately prior to the biopsy by the same Attending Radiologist. Elastography measurements (ARFI method shear velocity m/sec; mean of 10 measurements) were obtained in the same anatomical region of the liver as the biopsy. All histopathology reports were scored by a specialist Attending Pathologist. Ishak and Metavir fibrosis scores were then correlated with the ARFI measurements using Spearman’s rank correlation. A sub-group analysis was also performed to compare these variables in patients with viral hepatitis.

RESULTS
Data for 159 patients (mean age 49 ± 14 years) were available. The mean elastography measurement was 1.7 ± 0.7 m/sec. The results demonstrated statistically significant associations between higher histological grading and increasing ARFI measurements in all analyses. Significant correlation was obtained between the ARFI measurement and both the Ishak (r value= 0.58; p value < 0.001) and Metavir scores (r value= 0.58; p value < 0.001) in all comers. For the subgroup of patients with viral hepatitis (n= 85), the correlation coefficient for Ishak and Metavir scores were 0.51 and 0.53 respectively with p values < 0.001 in both groups.

CONCLUSION
To the best of our knowledge, this is the first study with a large cohort to assess ARFI elastography measurements and liver biopsy taken concomitantly and validating its accuracy in ‘all-comers’. It has demonstrated a highly significant statistical correlation between elastography measurements by the ARFI method and the histological grading of fibrosis.

CLINICAL RELEVANCE/APPLICATION
This study demonstrates that ARFI elastography can be performed as part of a routine ultrasound study of the liver to aid in the assessment of liver fibrosis thus optimising patient pathway.

Accuracy of Shear-wave Elastography to Determine the Degree of Liver Fibrosis in Patients with Hepatitis C Virus Infection

Anand Rattansingh (Presenter) ; Hosein Amooshahi MSc ; Sandra Fischer MD ; Morris Sherman * ; Richard Kirsch MD, PhD ; Mostafa Atri MD

PURPOSE
The purpose of this study was to determine the accuracy of shear-wave elastography in grading fibrosis in patients with Hepatitis C virus (HCV) infection.

METHOD AND MATERIALS
105 patients (85 Men and 20 women), mean age 56 (range23-74) with HCV infection underwent US guided random core biopsy and shear-wave elastography on the same day. Elastography was performed on a SupersonicS machine using a 3.5 MHz probe. Five samples were obtained from the right lobe of liver of each patient and averaged to determine stiffness measured as kilo-Pascal (kPa). The same pathologist reported all pathology specimens using Metavir fibrosis scoring 0 to 4. Student’s t-test was used for comparison of continuous variable, and ROC curve to calculate Area Under Curve (AUC).

RESULTS
There were 82 patients with no to moderate fibrosis (Metavir 0 to 2) and 23 with severe fibrosis or cirrhosis (Metavir 3and4) with the prevalence of severe fibrosis or cirrhosis being 22% (23/105). Stiffness ranged from 3.2 to 26.4 (mean 9.6) kPa. Stiffness of livers with no or moderate fibrosis on pathology ranged from 3.2 to 26.4 (mean 9.1) kPa and for severe fibrosis and cirrhosis 6.2 to 24.3 (mean 12.2) kPa (p=0.01). ROC curve showed an AUC of 0.78 (CI: 0.68-0.89) (p < 0.0001).

CONCLUSION
Shear-wave elastography has the potential to discriminate between = moderate liver fibrosis and severe liver fibrosis or cirrhosis in patients with HCV infection.

CLINICAL RELEVANCE/APPLICATION
Ultrasound shear-wave elastography has the potential to assess parenchymal stiffness of the liver with good correlation to degree of fibrosis.

Comparison of Liver Stiffness Measurement by Acoustic Radiation Force Imaging (ARFI) and Fibroscan for the Non-invasive Diagnosis of Liver Fibrosis

Victoire Cartier MD (Presenter) ; Derek Bardou ; Jerome Boursier ; Jerome Lebigot MD ; Sophie Michalak ; Isabelle Fouchard-Hubert ; Christophe Aube MD, PhD *

PURPOSE
To compare ARFI and Fibroscan in an intention-to-diagnose (ITD) basis for the non-invasive diagnosis of liver fibrosis in chronic liver disease.

METHOD AND MATERIALS
219 patients with chronic liver disease and liver biopsy were prospectively included. Liver stiffness measurements (m/s) were performed by ARFI (right lobe: ARFI-D, left lobe: ARFI-G) and Fibroscan (right lobe). ARFI-DG corresponded to the median value of all valid measurements obtained in both lobes. Reference for fibrosis was Metavir F staging. Diagnostic accuracy was evaluated using AUROC and Obuchowski index (adjusted AUROC). For ITD analysis, failures of elastographic measurement were replaced by the median value measured in the opposite group of the biopsy diagnosis.
RESULTS
Fibrosis stage prevalence was F=2: 50%, F=3: 26% and F4: 9%. Rate of measurement failure was ARFI-D or ARFI-G: 0.5% versus Fibroscan: 5.9% (p=0.002). In per-protocol analysis, AUROCs of Fibroscan were significantly higher than those of ARFI-D for each diagnostic target (p

CONCLUSION
ARFI and Fibroscan have close and high accuracy for liver fibrosis diagnosis. Due to a higher failure rate, accuracy of Fibroscan decreases in the ITD analysis but remains not significantly different from ARFI accuracy.

CLINICAL RELEVANCE/APPLICATION
The high feasibility and reliability of ARFI could be useful to detect undiagnosed significant fibrosis during any abdominal ultrasound examination, with a high diagnostic accuracy.

SSA08-09 • Simply Combine the Results of Multiple Elastographies and Serum Fibrosis Markers Using Bayesian Prediction for Noninvasive Liver Fibrosis Staging

Utaro Motosugi MD (Presenter) ; Katsuhiko Sano MD ; Hiroyuki Morisaka MD ; Shintaro Ichikawa MD ; Tomoaki Ichikawa MD, PhD *

PURPOSE
Elastography, using ultrasound or MRI, has been applied to liver fibrosis staging, while serum fibrosis marker has commonly been used to predict the fibrosis stage. The combined use of elastographies and fibrosis marker may be a superior method to their individual use. This study was aimed to evaluate the usefulness of Bayesian prediction method to combine the results of elastographies and serum fibrosis marker for noninvasive liver fibrosis staging.

METHOD AND MATERIALS
This study included 20 cases of chronic liver disease. The pathological fibrosis staging were performed with the specimen of partial hepatectomy by using METAVIR staging system in all cases. The use of Bayesian prediction to stage liver fibrosis can provide the possibility of the fibrosis stages on the basis of the results of elastographies or serum fibrosis markers. We used aspartate transferase-to-platelet ratio index (APRI) as a serum fibrosis marker and ultrasound transient elastography (UTE) and MR elastography (MRE) as imaging-based elastographies for liver fibrosis stage estimation. We compared the accuracy of fibrosis staging and the confidence of the Bayesian prediction among the 3 groups; i) APRI only, ii) APRI + UTE, iii) APRI + UTE + MRE.

RESULTS
The most probable stage by Bayesian prediction were accurate in 6 (30%), 8 (40%), and 15 (75%) of 20 cases for APRI only, APRI+UTE, and APRI+UTE+MRE, respectively. The confidence of Bayesian prediction significantly increased by adding UTE and MRE to APRI (mean [SD] confidence of prediction [SD]; APRI only, 42.6 [6.7]%; APRI+UTE, 67.1 [23.0]%; APRI+UTE+MRE, 77.7 [18.0]%).

CONCLUSION
Bayesian prediction is simple and useful method to combine variable methods for noninvasive liver fibrosis staging.

CLINICAL RELEVANCE/APPLICATION
Probability of each liver fibrosis stage for the patient can be estimated with Bayesian prediction which can simply combine the results of multiple elastographies and serum fibrosis markers.

SSA13-01 • The Detour Sign on MR Image for Subluxation of the Long Head of Biceps Tendon with Arthroscopic Correlation

Eun Kyung Khil MD (Presenter) ; Jang Gyu Cha MD ; Hyun Joo Kim MD ; Kyung Dae Min ; Hyun-Sook Hong MD, PhD ; Beom Ha Yi ; Jae Myeong Lee

PURPOSE
To determine whether detour sign at magnetic resonance (MR) imaging is an indicator of subluxation of the long head of the biceps tendon in the shoulder joint.

METHOD AND MATERIALS
This retrospective study evaluated 65 patients (M: F=29: 36; age range: 49-79 years, mean: 58 years) who had shoulder pain and underwent arthroscopic surgery, between January 2012 and February 2013. All patients underwent 3T MR imaging for diagnosis of shoulder diseases, and the MR scans were independently reviewed by two musculoskeletal radiologists. When MR imaging showed a subscapularis tear with biceps pulley lesion (Habermeyer group 4)(criterion 1) or additional detour sign of the biceps (criterion 2) on the axial images, the lesion was considered to be a subluxation of the long head of the biceps tendon (SLBT). After MR imaging, shoulder arthroscopy was performed in all patients for a definitive diagnosis of SLBT. Descriptive statistics were calculated and the sensitivity values were compared by using the McNemar test. A kappa statistic was recorded for interobserver agreement regarding the presence of the detour sign, subscapularis tear, and pulley lesion on MR imaging.

RESULTS
Arthroscopy showed SLBT in 18 patients. When MR imaging diagnosis was based on criteria 1 only, SLBT was diagnosed with a sensitivity of 44.4%, and an accuracy of 80.4%. When MR imaging diagnosis was based on both the criterion 1 and the criterion 2 using detour sign, SLBT was diagnosed with a sensitivity of 83.3% and an accuracy of 81.5%. By adding criterion 2 for diagnosis, 10 patients with SLBT were additionally diagnosed, of which 7 patients had been confirmed SLBT on arthroscopy. There is a significant difference (p

CONCLUSION
The detour sign based on axial MR images may be regarded as an additional anatomical feature that helps improve diagnostic performance for detecting SLBT.

CLINICAL RELEVANCE/APPLICATION
The detour sign will make it easy to detect the lesion with only several images on the axial plane, and may improve the detection rate of SLBT and provide the reasonability for surgery.

SSA13-02 • ABER Position MR Arthrography of the Shoulder: Diagnostic Signs for Capsular Laxity in Patients with Atraumatic Multidirectional Instability

Christoph Schaeffeler MD (Presenter) ; Simone Waldt MD ; Jan S Bauer MD ; Chlodwig Kirchhoff MD ; Bernhard Haller ; Michael Schroeder ; Ernst J Rummeny MD ; Andreas Imhoff ; Klaus Woertler MD
Resonance Arthrography (MRA) among Observers with Varying Levels of Experience with Arthroscopic Correlation

**RESULTS**

21 MR-A were added to the study group, 17 to the control group. Sensitivity for the crescent sign in the diagnosis of MDI was 57/62/48% (observer 1/2/3), specificity was 100/100/94%/ with excellent multirater-agreement (? = 0.813); area under the ROC-Curve (AUC) was 0.786/0.61/0.709. Sensitivity for the triangle sign was 48/57/48%/ with excellent multirater-agreement (? = 0.934); AUC was 0.709/0.756/0.738/0. The presence of at least one of these laxity signs had a sensitivity of 86/91/81%, a specificity of 94/88/94% with an AUC of 0.899/0.894/0.875 (? = 0.842); Intraobserver-agreement was excellent (? = 1.000). Patients with a positive triangle sign showed significantly increased posterosuperior decentration of the HH (? = 0.034).

Considered separately, the crescent and triangle sign showed inappropriate diagnostic performance. However, the presence of either the crescent sign or both on MRA performed arthroscopically of the shoulder allows for accurate diagnosis of capsular laxity in patients with atrumatic MDI.

**CLINICAL RELEVANCE/APPLICATION**

Functional MR-Arthrography of the shoulder including images in ABER position enables the radiologist to accurately assess laxity of the anteroinferior joint capsule by using simple and objective signs.

**SSA13-03 • Correlation of MRI with Arthroscopy for the Diagnosis of Subscapularis Tendon Tears: A Musculoskeletal Division’s Experience**

Soterios Gyftopoulos MD (Presenter) ; John S O’Donnell MD ; Neil P Shah MD ; James S Babb PhD ; Michael P Recht MD

**PURPOSE**

To determine the accuracy of MRI for the diagnosis of subscapularis tendon tears utilizing arthroscopy as the gold standard.

**METHOD AND MATERIALS**

The MR and arthroscopy reports from 286 consecutive patients were reviewed with 3 inclusion criteria: 1) Non-contrast MRI performed at our institution, 2) Arthroscopy (OR) within 6 months of the MRI, and 3) No prior subscapularis surgery. 42 patients were excluded (6 non-specific OR reports, 4 tears of the inferior tendon, 32 MR arthographic studies). The MR and OR reports were reviewed for the presence and degree of tearing (partial (PT)/full-thickness (FT)). Only PT-articular tears were included, as tears that involved only the intrasubstance and/or bursal surface are not typically seen on arthroscopy as per our orthopaedists. Estimates of the accuracy, sensitivity, specificity, and positive and negative predictive values were derived for MRI using arthroscopy as the gold standard.

**RESULTS**

There were a total of 244 patients (161 men/83 women; mean 48 yrs/range 15-83) and 111-1.5T/133-3T MRIs. There were 25 (16 PT/9 FT) tears and 219 intact tendons on arthroscopy. Nineteen of the 25 arthroscopic tears (10/16 PT; 9/9 FT) and 200 of the 219 arthroscopic studies were correctly diagnosed on MRI. One tear was called FT on MRI, but was PT in the OR. There were 18 PT and 1 FT tears identified on MRI that were not seen in the OR as well as 5 PT tears found in the OR, but not on MRI. Without differentiating between PT and FT tears, our analysis demonstrated 80% sensitivity, 91% specificity, 90% accuracy, and 51% positive and 98% negative predictive values. There was 91% accuracy for the diagnosis of PT tears and 99% accuracy for the diagnosis of FT tears. Retrospective review of the false positive cases demonstrated 3 common causes of reader error: volume averaging, misdiagnosis of an intrasubstance tear as an articular tear, and associated underlying advanced tendinosis.

**CONCLUSION**

MRI can be used to accurately diagnose subscapularis tendon tears utilizing arthroscopy as the gold standard.

**CLINICAL RELEVANCE/APPLICATION**

MRI is an effective tool in the evaluation of the subscapularis tendon. Familiarity with common causes of reader error (i.e. volume averaging) will decrease the likelihood of overcalling pathology.

**SSA13-04 • Subscapularis (SSC) Tendon Tears: Diagnostic Performance and Inter-observer Reliability of Direct Magnetic Resonance Arthrography (MRA) among Observers with Varying Levels of Experience with Arthroscopic Correlation**

Eugene Lee (Presenter) ; Jung-Ah Choi MD ; Ju Han Oh MD ; Eugene Joe ; Sujin Kim ; Sung Hwan Hong MD ; Heung S Kang MD

**PURPOSE**

To retrospectively review the diagnostic performance and inter-observer reliability of direct MRA in the diagnosis of articular/bursal-sided partial thickness and full-thickness SSC tendon tears among observers with varying levels of experience.

**METHOD AND MATERIALS**

Preoperative direct MRAs of 297 consecutive patients with arthroscopic confirmation (164 with normal or tendinopathy SSC tendons, 100 with articular/bursal-sided partial thickness tears, and 33 with full thickness tears) were evaluated independently by three radiologists with differing levels of experience in interpretation of musculoskeletal images. Diagnosis was made on T1 axial and/or sagittal images with fat suppression. The following signs were evaluated for each tear (reader 1/reader 2/reader 3): (1) Crescent sign: Presence of contrast agent between the anterior inferior glenohumeral ligament (AIGHL) and the humeral head (HH); (2) Triangle sign: Contrast filled triangular shaped space between AIGHL, HH, and glenoid. Centering of the HH in the glenoid fossa was determined. All images were reevaluated by observer 1 two months after the initial assessment.

**RESULTS**

For full thickness tears, sensitivity was 87.9%/69.7%/66.7% (reader 1/reader 2/reader 3); specificity was 97%/98.5%/89.0%, and accuracy was 78.4%/85.1%/43.1%. For partial thickness tears, sensitivity was 75%/71%/56%, specificity was 81.7%/80.2%/69.0%, and accuracy was 76.7%/64.5%/47.9%. For normal SSC tendons, sensitivity was 79.3%/82.3%/61.6%, specificity was 85.7%/81.2%/78.9%, and accuracy was 87.2%/84.4%/78.3%. The interclass correlation coefficient (ICC) was excellent for reader 1/reader 2 (ICC : 0.7918), good for reader 1/reader 3 (ICC : 0.6959), and fair for reader 2/reader 3 (ICC : 0.5927).

**CONCLUSION**

For diagnosis of SSC lesions on direct MRA, specificity was higher than sensitivity and accuracy for all three observers, especially for partial thickness tears. Accuracy was especially low in less experienced observer. Interobserver reliability varied according to level of experience, lower in observers with less experience.

**CLINICAL RELEVANCE/APPLICATION**

Depending on the level of experience of the radiologist, diagnostic performance of direct MRA in the diagnosis of subscapularis tendon tears varies, especially in diagnosis of partial thickness tears.
To evaluate MR arthographic (MRA) findings and to compare the MR findings with arthroscopic findings of characteristics, anatomical distribution and extent of PASTA (partial articular-sided supraspinatus tendon avulsion) in arthroscopically confirmed patients.

METHOD AND MATERIALS
Sep 2009 to Feb 2013, 62 patients arthroscopically confirmed as PASTA. We excluded one lesion mixed with arthroscopically full-thickness tear. Total 61 patients were enrolled, and all patients underwent MRA with using 3-T MR. Mean interval time between MRA and arthroscopy was 77.3 days. Two musculoskeletal radiologists retrospectively reviewed the MRAs by consensus blind to arthroscopic findings. Decentering was defined as undersurface tendon discontinuity at the footprint with articular side contrast. Anatomical locations were divided by four: anterior, posterior, transition zone, inferior half of the middle facet. Grade 1 vertical extension were 12 (23.5%), grade 2 in 18 (35.3%), and grade 3 in 21 (41.2%). The Pearson correlation test between MR vertical extension grade and surgical percentage was 0.69 (p<0.05).  

CONCLUSION
PASTA lesion is well visualized. MRA as showing contrast filling at the partial articular-sided footprint avulsion at the greater tuberosity. The vertical extension grade was well correlated with surgical grade. In patients with extra-articular contrast leakage, the PASTA lesion could be misdiagnosed on MRA.

CLINICAL RELEVANCE/APPLICATION
PASTA lesion is well diagnosed on MRA and its extent was good correlation with surgical grade.

SSA13-05 • PASTA Lesion of Rotator Cuff Foot Print: Direct MR Arthrographic Findings in Surgically Confirmed Patients

Eun Hae Park (Presenter) ; Ja Young Kim ; Young Han Lee MD ; Sungjun Kim MD ; Ho-Taek Song MD ; Jin-Suck Suh MD

Eun Hae Park (Presenter) ; Ja Young Kim ; Young Han Lee MD ; Sungjun Kim MD ; Ho-Taek Song MD ; Jin-Suck Suh MD

POURPOSE
To evaluate imaging findings related to humeral head denectering as a potential cause of isolated teres minor atrophy.

METHOD AND MATERIALS
We retrospectively reviewed 500 shoulder MRI examinations performed from 2004-2013 to identify patients with isolated teres minor atrophy. We excluded patients with quadrilateral space or Parsonage-Turner syndromes and those with a history of posterior shoulder instability at rest. The images were reviewed by one experienced radiologist and fellow for posterior labral tears, posterior capsular pathology, and humeral head denecting. Additional findings recorded were the presence of a rotator cuff, biceps tendon, and glenohumeral arthritis. An age and sex matched control group of 39 patients was identified in which each patient had a posterior labral tear but no teres minor atrophy.

RESULTS
Of the 61 patients, 51 patients were diagnosed as PASTA (83.6%): anterior in 36 (70.6%), posterior in 10 (19.6%), and transitional zone in 5 (9.6%). There was no involvement inferior half of the middle facet. Grade 1 vertical extension were 12 (23.5%), grade 2 in 18 (35.3%), and grade 3 in 21 (41.2%). The Pearson correlation test between MR vertical extension grade and surgical percentage was 0.69 (p<0.05).  

CONCLUSION
PASTA lesion is well visualized on MRA as showing contrast filling at the partial articular-sided footprint avulsion at the greater tuberosity. The vertical extension grade was good correlation with surgical grade. In patients with extra-articular contrast leakage, the PASTA lesion could be misdiagnosed on MRA.

CLINICAL RELEVANCE/APPLICATION
PASTA lesion is well diagnosed on MRA and its extent was good correlation with surgical grade.

SSA13-06 • Postoperative MR Six Months after Rotator Cuff Surgery: Which MR Finding Is Correlated to Clinical Outcome?

Wool Kim (Presenter) ; Young Cheol Yoon MD ; Sanghee Lee MD

POURPOSE
The purpose of this study is to evaluate the correlation between various post-operative MR findings and clinical score.

METHOD AND MATERIALS
This retrospective study protocol was approved by our institutional review board and informed consent was waived. MRI examinations were performed on 180 shoulders of 178 patients who underwent rotator cuff repair surgery (64 males, 114 females; mean age, 60.2 years; age range, 22-80 years). The mean interval between MR and surgery was 160.6 (120-180) days. Two radiologists who were blinded to clinical score evaluated continuous variables (bone marrow edema-maximum, bone marrow edema-summation, thickness of repaired tendon) independently, and categorical variables (adhesive capsulitis, foot print coverage, subcortical cyst, fatty atrophy of rotator cuff muscles, subacromial edema, subacromial fluid, and signal intensity grade of repaired tendon) with a consensus. Each finding was correlated to American Shoulder and Elbow Surgeons (ASES) score and the Constant-Murley (Constant K) score of clinical outcome. Pearson correlation coefficient was calculated and p value less than 0.05 was regarded as statistically significant. Intraclass coefficients were obtained for continuous values.

RESULTS
Thickness of repaired tendon (p=0.014 for reviewer 1, p=0.001 for reviewer 2 with ASES score; p=0.002 for reviewer 1, p

CONCLUSION
Thickness of repaired tendon and fatty atrophy of rotator cuff muscle were significant findings correlated to clinical outcome at six-months after rotator cuff surgery.

CLINICAL RELEVANCE/APPLICATION
Attention should be paid to thickness of repaired tendon and fatty atrophy of rotator cuff muscle when evaluating post-operative MR after rotator cuff surgery.

SSA13-07 • Decentering Syndrome: An Important Cause of Isolated Teres Minor Atrophy

Scott Lenobel MD (Presenter) ; Michael Olson DO, MBA ; Jason E Payne MD ; Alan Rogers MD ; Erin Shropshire ; Barbaros S Erdal DDS, PhD ; Joseph S Yu MD

POURPOSE
To evaluate imaging findings related to humeral head denectering as a potential cause of isolated teres minor atrophy.

METHOD AND MATERIALS
We retrospectively reviewed 500 shoulder MRI examinations performed from 2004-2013 to identify patients with isolated teres minor atrophy. We excluded patients with quadrilateral space or Parsonage-Turner syndromes and those with a history of posterior shoulder instability. Arthroscopies were divided by four: anterior, posterior, transition zone, inferior half of the middle facet. We included 39 patients with isolated teres minor atrophy. We excluded patients with Parsonage-Turner syndromes and those with a history of posterior shoulder instability at rest. The images were reviewed by two experienced radiologists and fellow for posterior labral tears, posterior capsular anatomy, and humeral head denecting. Additional findings recorded were the presence of a rotator cuff, biceps tendon, and glenohumeral arthritis. An age and sex matched control group of 39 patients was identified in which each patient had a posterior labral tear but no teres minor atrophy.

RESULTS
The incidence of isolated teres minor atrophy is 1.6%. In our group of 39 patients (30 males/9 females; average age 54 years, range 33 to 79 years), 38 (97.4%) had a posterior labral tear, posterior capsular pathology, and humeral head denectering. Posterior labral tears were seen in 32 (82.1 %), 14 (35.9%) had posterior capsular pathology, and 13 (33.3%) demonstrated posterior humeral head subluxation. 33 had a rotator cuff tear, none of which involved the teres minor, 11 had a biceps tear, 32 had an anterior labral tear, 29 had a superior labral tear, and 26 had glenohumeral joint arthritis. In the control group, 7 (17.9%) had posterior humeral head subluxation compared to 19 (48.7%) in the teres minor atrophy group (p value <0.01).

CONCLUSION
Humeral head denectering is a frequent finding in patients with isolated teres minor atrophy in addition to secondary signs of posterior glenohumeral instability suggesting that traction on the teres minor nerve may be integral to this condition. A statistically significant difference in the presence of humeral head denectering was shown between patients with isolated teres minor atrophy compared to patients without isolated teres minor atrophy.

CLINICAL RELEVANCE/APPLICATION
Ours is the first project to identify a statistically significant association between posterior humeral head denectering and isolated teres minor atrophy.

SSA13-08 • Subcoracoid Impingement; Is the Consequence of Narrow(ed) Coracohumeral Interval or Narrow Coracohumeral Angle?
Eser Sanverdi MD (Presenter) ; Ali Oznur MD ; Mehmet Ali Gurses MD ; Safak Salvarli MD

PURPOSE
Subcoracoid impingement (SCI) is one of the most frequent reason of the anterior shoulder pain. Degeneration of subcoracoid muscle tendon secondary to repetitive microtrauma is the main problem. In this magnetic resonance imaging study we aimed to investigate if the angle between the free edge of the coracoid process and the humeral head (CHA), or the distance of the coracohumeral interval (CHD) was causative in the development of SCI.

METHOD AND MATERIALS

RESULTS
CONCLUSION
To our best knowledge, CHA was not assessed as an indicator of SCI until now. In the development of isolated subcoracoid tendinopathy, our findings suggested that CHA is more important than CHD. However, further clinical and radiological studies are needed.

CLINICAL RELEVANCE/APPLICATION
Coracoplasty indications and techniques might be influenced by the course of the coracoid.

SSA13-09 ● Does Reducing the Concentration of Bupivacaine when Performing Therapeutic Shoulder Joint Injections Impact the Clinical Outcome? Our Experience after 1500 Injections

Michael G Fox MD (Presenter) * ; James Patrie MS

PURPOSE
Since the chondrotoxicity of local anesthetics is dose dependent, we reduced the Bupivacaine concentration when performing therapeutic joint injections from 0.5% to 0.25% in 2011. This study determines if this lower Bupivacaine concentration impacted the 10 minute and 1 week post-injection pain scores in patients receiving steroid-anesthetic joint injections.

METHOD AND MATERIALS
This IRB approved HIPPA compliant study included all outpatient fluoroscopic guided glenohumeral injections performed by musculoskeletal (MSK) radiologists and/or MSK fellows between 9/09 and 3/13. Intra-articular placement was confirmed with iodinated contrast or rarely air. Patients received either 2.5 mL of Bupivacaine 0.5% (Group A) or 2.5 mL of Bupivacaine 0.25% (Group B). All injections included 0.5 cc of Kenalog 40mg/mL. Group A included 493 injections (210M:283F) (mean age 57) and Group B included 1049 injections (448M:601F) (mean age 57). The patients' pain level was recorded by someone blinded to the Bupivacaine concentration on a numeric scale of 0-10 (0=no pain and 10=extreme pain) immediately prior to and 10 minutes post-injection (all injections) and 1 week post-injection (877 injections). Orthopedics referred 92.9% of Group A and 95% of Group B injections. Statistical analysis was performed using linear mixed models.

RESULTS
The pre-and 10 minute post-injection mean pain scores (all injections) was 5.5/10 and 1.9/10 for Group A and 5.2/10 and 2.1/10 for Group B. The pre-and 1 week post-injection (877 injections) mean pain scores was 5.7/10 and 3.0/10 for Group A and 5.4/10 and 3.1/10 for Group B. Adjusting for sex, age and pre-pain level, the estimated mean difference in pain reduction between Groups A and B was 0.27 (95% CI:[0.03,0.51] p=0.030) 10 minutes post-injection and 0.46 (95% CI:[0.14,0.78] p=0.005) 1 week post-injection with pain greater reduction in Group A. Mean fluoro time was 20.5 sec in group A and 13.7 sec in Group B (p CONCLUSION
Patients reported statistically greater pain reduction both 10 minutes and 1 week after therapeutic glenohumeral injections when a higher concentration of Bupivacaine was utilized.

CLINICAL RELEVANCE/APPLICATION
Glenohumeral injections using a higher Bupivacaine concentration provided greater pain relief. However, the actual numeric estimated reduction in pain is small and may not be clinically significant.

Musculoskeletal (Tumor I)

Sunday, 10:45 AM - 12:15 PM ● E451B

SSA14 ● AMA PRA Category 1 Credit ™:1.5 ● ARRT Category A+ Credit:1.5
Moderator
Mark D Murphey , MD
Moderator
Jim S Wu , MD *

SSA14-01 ● Diagnostic Performance of Ultrasound Elastography in the Evaluation of Benign and Malignant Soft Tissue Tumors

Se Kyoung Park (Presenter) ; In Sook Lee ; You Seon Song ; Jeung Il Kim MD, PhD ; Hoon Soo Kim

PURPOSE
To evaluate the diagnostic performance of ultrasound elastography for differentiating malignant from benign soft tissue tumors.

METHOD AND MATERIALS
From December 2012 to March 2013, 52 consecutive patients with soft tissue mass lesions underwent ultrasound including elastography by two musculoskeletal radiologists. One radiologist measured quantitatively the size, elasticity ratio between lesion and normal subcutaneous fat layer, region-of-interest (ROI) values and semiquantiatively elasticity score (1-10) by color pattern on obtained cine elastographic images by using Q-Lab software consulting other radiologist. Also two radiologists analyzed the location (5 types according to depth), echogenecity (6 types), margin, the presence or absence of posterior enhancement and vascularity by consensus.

RESULTS
36 patients had benign lesions and 16 had malignant soft tissue tumors. In the cases of benign tumors, mean ROI value, elasticity ratio, and elasticity score were 73.4, 1.53, and 5.25, respectively. In the malignant tumors, those are 52.3, 1.88, and 2.93, respectively. By two sample t-test, the ROI values, the size, the elasticity score and the location were significant factors (p < 0.05). The elasticity ratio, echogenicity, the presence or absence of posterior enhancement and vascularity and margin not affected to differentiate between benign and malignant lesions (p > 0.05). In the measurement of elasticity ratio, intra-class correlation coefficient was 0.896 (p < 0.05) and the difference of measured values was insignificant. Also, the locations of tumors did not affect to the elasticity ratio. By ROC analysis, only the size (AUC, 0.825; SE, 0.0611; 95% confidence interval, 0.694-0.916; p < 0.0001, criterion > 28 mm) was statistically significant.

CONCLUSION
Although the elasticity ratio of the soft tissue mass was not significant, the elasticity score by color pattern was helpful for differentiating between benign and malignant soft tissue tumors. However the elasticity score by color pattern was helpful.
SSA14-02 • Cost-effectiveness of Advanced Cross-sectional Imaging in the Work-up of Newly Discovered Soft Tissue Masses

Sahar J Farahani MBBS (Presenter) ; John Eng MD ; Christian Meyer ; John A Carrino MD, MPH * ; Laura M Fayad MD

PURPOSE
To determine the required accuracy of an advanced imaging modality to be cost-effective over biopsy in the work-up of new soft tissue masses (STMs) that have already undergone a conventional work-up.

METHOD AND MATERIALS
A decision analytic model was developed to estimate quality-adjusted-life (QALY) and costs associated with biopsy and advanced imaging (such as MR spectroscopy) in differentiating between malignant and benign STMs for the first five years after diagnosis. The model incorporated prevalence of malignant and benign STMs at the community level, the performance characteristics of the imaging modality of choice, 1-5 year overall survival rate for the different stages at the time of diagnosis, and costs and effectiveness associated with each strategy. A discount rate of 3% was considered. An incremental cost per QALY gained was compared between two strategies. One-way sensitivity analysis was performed to evaluate the stability of the model to change in the clinically-plausible range for all the variables.

RESULTS
Decision analysis proved the value of advanced imaging as the in

CONCLUSION
Conclusion: For the work-up of new STMs, advanced imaging is a cost-effective non-invasive alternative to biopsy.

CLINICAL RELEVANCE/APPLICATION
For the work-up of new STMs, advanced imaging is a cost-effective non-invasive alternative to biopsy.

SSA14-03 • Detection of Soft Tissue Sarcoma Recurrence: Added Value of Functional MR Imaging Techniques at 3T

Filippo Del Grande MD, MBA (Presenter) ; Ty K Subhawong MD ; Kristin L Weber MD ; Michael R Aro MBBS * ; Charles M Mugera MBCh, MRCP ; Laura M Fayad MD

PURPOSE
To define the added value of dynamic contrast-enhanced (DCE-MR) and quantitative diffusion weighted imaging (DWI) with apparent diffusion coefficient (ADC) mapping to detect recurrence of soft tissue sarcomas (STS) after surgical resection.

METHOD AND MATERIALS
The study is HIPPA compliant and approved by our institutional review board. 58 MR patients referred for post-operative surveillance following STS resection were studied with 3 T MR. The MR protocol included: T1-weighted, fluid-sensitive, contrast-enhanced T1-weighted, DCE-MR, and DWI with ADC map. Two readers independently reviewed for signal and morphologic characteristics on conventional sequence, the presence or absence of arterial enhancement by DCE-MR and ADC measurements of the surgical bed. Mass-like signal abnormality on conventional sequences, arterial enhancement by DCE-MR or a low signal mass on ADC maps were defined as recurrence. The readers reviewed first the conventional sequences, second the addition of DCE-MR, and third the DWI/ADC maps. The diagnostic performance of conventional MR for detecting recurrence was compared to that with the addition of functional sequences.

RESULTS
There were eight histologically-proven recurrences out of 58 studies. The sensitivity and specificity of MR for detecting tumor recurrence were 100% and 48.0%, 60.0% and 93.2%, and 100% and 90.7% for conventional sequences, for addition of DCE-MR, and for addition of DWI/ADC mapping, respectively.

CONCLUSION
The addition of functional MR sequences to a routine MR protocol increase specificity over 90%. In particular DCE-MR alone has a discrimination ability of 95% for distinguishing recurrent sarcoma from post-surgical scarring.

CLINICAL RELEVANCE/APPLICATION
For detecting recurrence, the improved specificity offered by functional sequences has the potential to reduce unnecessary biopsies and patient anxiety.

SSA14-04 • Mural Nodule in a Postoperative Fluid Collection after Soft Tissue Sarcoma Resection at MRI: Not a Sign of Recurrent Tumor

Joshua Lantos MD (Presenter) ; Sinchun Hwang MD ; David M Panicek MD

PURPOSE
To determine the prevalence and clinical significance of nodules within fluid collections at MRI after surgical resection of primary soft tissue tumors.

METHOD AND MATERIALS
This retrospective study includes 175 consecutive patients who underwent resection of primary soft tissue sarcoma at a tertiary cancer center and showed fluid collections at least 1 cm in largest diameter in the surgical bed at postoperative MRI. Images were reviewed to determine the presence of nodules within the collections, defined as a well-defined focus measuring at least 0.7 cm on T1-weighted and fluid-sensitive images. Collections were classified based on signal intensity (homogeneous, heterogeneous), and the presence of septa, blood products (hyperintense T1 signal), and rim (thin, thick, enhancing). The size, signal intensity, and contrast enhancement of nodules were reviewed. Nodules were classified as benign or malignant based on histologic results, or clinical or MRI follow-up.

RESULTS
Collections were present in 75 patients (43%). 43 collections showed homogeneous fluid intensity (57.3%) and 32 were heterogeneous (42.6%). Internal septa were present in 49 (65.3%) and blood products in 16 (21.3%). The majority of collections showed a thin rim (66.6%) and rim enhancement (90.6%). Nodules were present inside six (8%) collections. All collections that contained nodules were heterogeneous, and half showed an enhancing rim. Three (50%) nodules enhanced and two (33%) were T1-hyperintense. At follow-up MRI, three nodules resolved, two were stable in size, and one decreased in size. Nodules in two patients were biopsied, and surgically resected in another; all three nodules were benign. Two other patients had no recurrence at clinical or imaging follow-up, and another died within three months from metastases.

CONCLUSION
Nodules infrequently develop within a fluid collection at MRI after surgical resection of a primary soft tissue sarcoma, and are unlikely to represent local tumor recurrence.

CLINICAL RELEVANCE/APPLICATION
A nodule within a postoperative fluid collection at MRI after soft tissue sarcoma resection generally does not represent tumor recurrence; follow-up MRI is recommended rather than immediate biopsy.

**SSA14-05 • Magnetic Resonance Imaging of Incompletely Excised Soft Tissue Sarcomas**

Anna McNaught MBBS (Presenter) ; Ali M Naraghi ; Ravi Menezes PhD ; Bader Alharqiqi ; Peter C Ferguson MD ; Jay Wunder MD ; Lawrence M White MD *

**PURPOSE**
The aim of this study was to assess the utility of MRI in identifying the presence of residual disease in incompletely excised soft tissue sarcomas.

**METHOD AND MATERIALS**
Following IRB approval, 315 consecutive cases of incomplete excision of soft tissue sarcoma were identified from a surgical database. 237 patients with a positive margin at initial surgery who underwent MRI prior to re-excision were included. Two MSK radiologists, blinded to the final pathological finding at re-operation reviewed all MRIs in consensus. Pulse sequences varied but included axial and longitudinal T1 and T2 fat-suppressed fluid sensitive images in all cases. Post-gadolinium T1 fat-suppressed images were available in some. Imaging features evaluated included lesion morphology, location, fascial penetration, signal characteristics and enhancement. An overall consensus prediction was made regarding the presence of residual disease. The individual findings and the overall prediction were compared to the final pathological findings.

**RESULTS**
There were 98 females and 139 males with an average age of 55 years (range 17-89). The pathological diagnosis was malignant fibrous histiocytoma (n=67), leiomyosarcoma (n=47) and liposarcoma (28). The remaining 96 patients had undifferentiated sarcomas or rare subtypes. 120 patients had residual disease, 48 with microscopic foci and 72 with macroscopic foci greater than 10 mm in diameter. 117 patients had no residual disease on pathology. MRI had a sensitivity of 60%, specificity of 91%, PPV of 87% and NPV of 69%. When a mass was present on pathology, MRI had a high sensitivity (88%) and specificity (88%) and a high NPV (94%). There was a poor sensitivity (19%) in detection of microscopic residual disease.

82 lesions had nodular, 40 plaque and 115 reticular morphology. The presence of a nodule had a high specificity (89%) and PPV (84%) but a low sensitivity (58%). Plaque and reticular morphology had low sensitivities and predictive values.

**CONCLUSION**
MRI performs poorly in identifying those with microscopic disease but has a better performance in the presence of macroscopic disease. The presence of a nodule is the most specific morphologic predictor of residual disease.

**CLINICAL RELEVANCE/APPLICATION**
Many soft tissue sarcomas have positive margins at initial surgery. MRI is the modality of choice for re-evaluation. Further investigation of its utility in predicting disease is of value.

**SSA14-06 • Comparison of 3T Diffusion-weighted MR Imaging and PET/CT in Bone and Soft Tissue Tumors: Quantitative Analysis of ADC and SUV**

So-Yeon Lee MD (Presenter) ; Won-Hee Jee MD ; Il Ryung Yoo ; Joon-Yong Jung MD ; Yang-Guk Chung MD

**PURPOSE**
To retrospectively determine whether the apparent diffusion coefficients (ADC) on 3T diffusion-weighted magnetic resonance imaging (DWI) correlate with the standardized uptake values (SUV) on positron emission tomography (PET)/computed tomography (CT) in bone and soft tissue tumors.

**METHOD AND MATERIALS**
The institutional review board approved this HIPAA-compliant study, and informed consent was waived. This study included 45 patients (30 men, 15 women, mean age 57 years, range 17-90) with pathologically confirmed soft tissue (n = 34) and bone (n = 15) tumors who underwent 3T MR imaging including DWI and whole-body fluorine 18 fluorodeoxyglucose PET/CT before treatment. Maximum (SUVmax) and average (SUAV) SUVs of the tumors were obtained by one nuclear medicine physician. Two musculoskeletal radiologists independently measured minimum (ADCmin) and average (ADCav) ADCs of tumors on the corresponding regions of the tumors where SUVs were obtained. ADC (ADCmus) of normal skeletal muscle was measured on the same axial plane. The ratios ADCmin/ADCmus and ADCav/ADCmus were calculated by ADCmin and ADCav of tumors divided by ADCmus, respectively. The Spearman rank correlation was obtained for statistical analysis. The differences in areas under the receiver operating characteristic curves (AUCs) were assessed.

**RESULTS**
There was significant, inverse correlation between SUVmax and the ratio ADCmin/ADCmus (r = -0.435 for reviewer 1 and r = -0.449 for reviewer 2, respectively, P < .005). SUAV and ADCav/ADCmus showed significant inverse correlations (r = -0.444 for reader 1 and r = -0.440 for reviewer 2, respectively, P < .005). The AUCs of ADCmin/ADCmus and ADCav/ADCmus (0.955 for reviewer 1, 0.959 for reviewer 2, respectively) were significantly higher than those of SUVmax and SUAV (0.820 and 0.777, respectively) (P < .05).

**CONCLUSION**
There was significant correlation between ADC at 3T DWI and SUV at PET/CT in bone and soft tissue tumors and DWI showed better diagnostic performance than PET/CT for diagnosing malignancy.

**CLINICAL RELEVANCE/APPLICATION**
Quantitative DWI at 3T is comparable to PET/CT for evaluating bone and soft tissue tumors.

**SSA14-07 • Dynamic Contrast Enhanced (DCE) Targeted MR-guided Biopsy of Soft Tissue Tumors at 3Tesla: Feasibility, Preliminary Results on Accuracy, and Correlation with Diffusion Weighted Imaging (DWI), and Multivoxel 1H-MR Spectroscopy (1H-MRS)**

Iris-Melanie Noebauer-Huhmann MD (Presenter) ; Gabriele Amann MD ; Martin Krssak PhD ; Joanna Panotopoulos MD ; Christian Czerny MD ; Siegfried Trattnig MD

**PURPOSE**
To test the dynamic contrast enhanced (DCE) sequence of soft tissue tumor staging MR for intralesional targeting with subsequent minimally MR-guided biopsy at 3T, and to compare DCE ◊hotspots◊ with diffusion-weighted imaging (DWI) and multivoxel 1H-MR spectroscopy (1H-MRS).

**METHOD AND MATERIALS**
Fifty-six patients with suspected soft tissue tumors prospectively underwent preoperative staging MR with subsequent MR-guided core needle biopsy at 3T after written informed consent, according to Institutional review board approval. Surgical histology available in 54 patients revealed 53 soft tissue tumors (29m, 24f, mean age 54 years, range 19-90). DCE was conducted in 50/53 patients (contrast agents: Gd-BOPTA, Gd-DOTA, and Gd-D03A-butrol), DWI-MSh FH in 51/53 patients, and 1H-MRS in 37/53 patients. Matching of the most suspicious regions in DWI and 1H-MRS with DCE results was assessed.

**RESULTS**
DCE was heterogeneous in 42 cases, including all malignant tumors. In 2 cases, DWI was additionally used for targeting. In 6 cases appearing homogeneous on all sequences, biopsy was taken arbitrarily. 3 small lesions required no region selection. Diagnostic yield was 98.1% (52/53). The accuracy rates of biopsy were 100% (52/52) in predicting the dignity, 96.2% for definitive tissue diagnosis, and 92.3% for tumor grade. DCE matched with preselected DWI regions in 87.5%, and with 1H-MRS in all assessable regions. The diffusion

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**CLINICAL RELEVANCE/APPLICATION**
The presence of a nodule is the most specific morphologic predictor of residual disease. Many soft tissue sarcomas have positive margins at initial surgery. MRI is the modality of choice for re-evaluation. Further investigation of its utility in predicting disease is of value.

Quantitative DWI at 3T is comparable to PET/CT for evaluating bone and soft tissue tumors.
Differential MRI Diagnosis between Benign and Malignant Bone or Soft Tissue Tumors Using Dynamic Contrast-enhanced and Diffusion-weighted Images

In Sook Lee (Presenter); You Seon Song; Se Kyoung Park; Jeung Il Kim MD, PhD; Hak Jin Kim MD; Jong Woon Song

PURPOSE
to evaluate the diagnostic performance of dynamic contrast-enhanced (DCE) and diffusion-weighted (DW) MR images for differentiation between benign and malignant bone or soft tissue tumors

METHOD AND MATERIALS
Forty-two patients with bone or soft tissue masses prospectively performed DCE and DW MR examinations addition to routine protocols. On DCE images using tissue 4D perfusion software, $K_\text{trans}$ (transfer constant), $K_\text{ep}$ (rate constant), $V_e$ (volume fraction), and iAUC (initial area under curve) were calculated from quantitative analysis. Also, the graphs of VOI (volume of interest) about whole mass and region-of-interest (ROI) within the mass were automatically obtained. The types of graphs were classified into five. On DW and apparent diffusion coefficient (ADC) images, ROIs of masses were measured.

RESULTS
Twenty-three patients had benign tumors and nineteen had malignant tumors. The mean values of $K_\text{trans}$, $K_\text{ep}$, $V_e$, iAUC, and ROI in benign tumors were 0.0596, 0.308, 0.251, 3.761, and 1.801 respectively. Those in malignant tumors were 0.157, 0.476, 0.298, 10.471, and 0.72 respectively. $K_\text{trans}$, iAUC and ROI values were statistically significant ($p < 0.05$) for differentiating benign and malignant tumors. By ROC curve analyses, $K_\text{trans}$ (AUC, 0.8; standard error (SE), 0.0696; 95% confidence interval (CI), 0.648-0.907; $p < 0.0001$, criterion > 0.117), ROI value on ADC (AUC, 1; SE, 0; 95% CI, 0.694-0.916; $p = 0$, criterion = 0.97), $K_\text{ep}$ (AUC, 0.745; SE, 0.0779; 95% CI, 0.588-0.867; $p=0.0016$, criterion > 0.287), and iAUC (AUC, 0.832; SE, 0.0632; 95% CI, 0.683-0.929; $p < 0.0001$, criterion > 4.908) were significant.

CONCLUSION
In the setting of nerve sheath tumors planned for resection, DTI tractography may be useful preoperatively to assess the spatial relationships of tumor to fibers within the nerve of origin and thereby reduce the risk of causing a functional deficit during surgery.

CLINICAL RELEVANCE/APPLICATION
This study is the first to demonstrate the application of DTI tractography in preoperative characterization of the relationship of peripheral nerve sheath tumors to fibers within the nerves of origin.
SSA17-03 • PET/CT

The purpose of the present preclinical study was to investigate dopaminergic neurodegeneration by longitudinal voxel-based morphometry (VBM) and diffusion tensor imaging (DTI) at 7T MRI in the preclinical primate model of PD.

METHOD AND MATERIALS

The common marmosets (n=6) received 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP) at the daily dose of 2, 2 and 1 mg/kg, s.c., respectively, for 3 consecutive days were used for the present imaging study. These marmosets showed long lasting and stable Parkinsonism such as moving tremor, immobility measured objectively as decreased locomotion counts, etc. Before and after several weeks after the MPTP administration, 3D T1WI (isotropic resolution of 200?m) and 2D DTI (in-plane resolution of 200?m and slice thickness of 1mm) were performed. After the acquisitions of longitudinal MRI, ex vivo microscopic DTI (isotropic resolution of 60?m) and histological examination with Klüver-Barrera and tyrosine hydroxylase (TH) staining were also performed to the fixed brains (n=4). VBM and diffusion tensor tractography (DTT) were obtained with SPM8 and TrackVis software, respectively.

RESULTS

Volume decreases in SN were observed by longitudinal VBM with positive correlation with decreased locomotion counts, a central PD sign (P<0.05). Significant signal changes were considered for P<0.001.

CONCLUSION

The present longitudinal MR neuroimaging using DTI and VBM on the nigrostriatal system has an invaluable ability in the preclinical studies for developing new treatments and understanding the mechanism of PD, and possibly in the clinical evaluation of PD patients.

CLINICAL RELEVANCE/APPLICATION

By using voxel-based analysis of longitudinal MRI at 7T, we may have a new noninvasive tool to diagnose the nigrostriatal system for Parkinson’s disease.

SSA17-02 • Longitudinal Monitoring of Intrastriatal Transplanted Retinal Pigment Epithelial Cells Survival In Vivo by 18F-P3BZA PET/CT

LiHong Bu MD, PhD (Presenter); Renfei Li MD, PhD; Hongguang Liu PhD; Bao-Zhong Shen; Zhen Cheng PhD

PURPOSE

To understand the anti-Parkinson’s disease (PD) efficacy of human retinal pigment epithelial (hRPE) cells implantation, we hypothesized that the melanin targeted probe, N-(2-(diethylamino)ethyl)-18F-5-fluoropicolinamide (18F-P3BZA), could be used for monitoring and trafficking the implanted cells because of its high melanin contents.

METHOD AND MATERIALS

18F-P3BZA was prepared by direct radiofluorination of the bromopicolinamide precursor using no-carrier-added 18F-fluoride. In vitro cell uptake assay was performed by incubation 18F-P3BZA with melanotic porcine RPE (pRPE) cells or control ARPE-19 cells for different incubation time. To assess the in vivo brain uptake and clearance of 18F-P3BZA in normal rat, dynamic small animal PET/CT scans were initiated immediately after administration of the probe and terminated 60 min later. To validate the capability of 18F-P3BZA for monitoring the long-term survival of implanted RPE cells in vivo, normal rats were intrastriatally injected with pRPE-GM, control ARPE-19-GM or GM, and longitudinal 10 min-static PET/CT scans were acquired at day 2, 7 and 14 days after implantation. Postmortem analysis was performed subsequently.

RESULTS

Cell uptake studies demonstrated that 18F-P3BZA accumulated effectively in pRPE cells, but not in control ARPE-19 cells. Further melanin assay confirmed that the amount of melanin in pRPE was 6-folder higher than that in ARPE-19 cells. Time-brain activity curve from dynamic PET/CT demonstrated that 18F-P3BZA could pass through blood brain barrier and accumulated in the brain rapidly, and then gradually decreased to background level 17min post injection.18F-P3BZA-PET could clearly visualize the implanted pRPE cells, and the accumulation of the probe in the pRPE-GM was much higher than that of ARPE-19-GM or GM. Furthermore, longitudinal PET/CT scans revealed that little pRPE-GM cells survived long-term after transplantation, as evident by the significant reduced uptake of 18F-P3BZA uptake in the pRPE-GM transplantation sites. Lastly, autoradiography, HandE and Fontana-Masson staining further confirmed the in vivo imaging results.

CONCLUSION

18F-P3BZA-PET/CT could visualize, characterize and detect the long-term survival of implanted RPE cells via melanin targeting mechanism.

CLINICAL RELEVANCE/APPLICATION

This study provides neurologists with high sensitive, high signal to background ratio probe targeting to melanin for tracking the implanted RPE cells.

SSA17-03 • A Preliminary Study of Global Resting-state Activations in PD Patients from Postural Instability and Gait Difficulty Group

Quanquan Gu MD, PhD (Presenter); Peiyu Huang; Min Xuan; Xiaojun Xu; Wei Luo; Minming Zhang MD, PhD

PURPOSE

In Parkinson disease (PD), postural instability and gait difficulty (PIGD) is regarded as a refractory issue because of its bad prognosis. According to these motor signs, PD patients are grouped into PIGD-group and non-PIGD-group. In our study, we used the resting-state fMRI to explore different brain activation patterns of PIGD-group as distinctive to non-PIGD-group patients.

METHOD AND MATERIALS

24 PD patients and 22 healthy controls (HC) were recruited in this study. All the patients were drug-naive or off medications =12 hours, devided into PIGD group (12 patients, F/M=4/8) and non-PIGD group (12 patients, F/M=5/7). Resting-state fMRI imaging and T1-weighted data were performed using a 3T MRI scanner (GE Signa EXCITE HD). All data was processed with SPM8, spatially normalized into the MNI template. Significant signal changes were considered for P<0.001.

RESULTS

As compared to HC, patients from both PD subgroups had a wide-spread increase of activations in bilateral superior frontal and middle gyri, parietal gyri and mid-cingulate cortex, specially dominant in PIGD group(Fig.1A, 1B). Compared to non-PIGD group, PIGD group showed a remarkable activation medial to the left superior frontal gyrus (SFG) ( Fig.1C).

CONCLUSION

PIGD-group showed greater activation than non-PIGD group as referred to HC, mainly covering areas participating in premotor planning, vestibular, attention for action and regulations for skeletonmotor. As to intrasubgroup comparison, left SFG has been found associate to visual hallucination, imaginary motor, self-awareness and sensory organization. Thus, our study indicated that although PIGD-group patients behave abnormal posture and gait, the non-motor mental functions rather than motor functions should be resposible for those clinical performance.

CLINICAL RELEVANCE/APPLICATION

It is indicated that although PIGD-group patients behave abnormal posture and gait, the non-motor mental functions (i.e., vision, cognition, sensory, etc.) rather than motor functions should be noted.
SSA17-04 • Resting-state Causal Connectivity in Parkinson’s Disease with Depression: Aberrant within-network and between-network Pathways

Peipeng Liang (Presenter); Kuncheng Li MD

PURPOSE
Depression is a common problem in patients with Parkinson’s disease, but its neural mechanism is poorly understood. The goal of this study was to examine effective connectivity (EC) in Parkinson’s Disease with Depression (DPD) based on Granger causality.

METHOD AND MATERIALS
Sixteen patients with DPD, twenty patients of PD with no depression (NDPD), twenty-two patients with major depression (MD), and twenty-one healthy controls underwent 8-min fMRI scans while resting quietly. Correlation-purged Granger causality analysis was performed, based on four basic functional networks: default mode network (DMN), dorsal attention network (DAN), motor network (MN), and emotion network (EN), to compare the group differences.

RESULTS
It was found that the causal connectivity in patients with DPD are significantly altered, as compared to NDPD, MD and healthy controls, with some causal pathways decreased (e.g., HyOFC/vACC) and some others increased (e.g., R DLPFC?R IT). Some alterations are significantly correlated with neuropsychological measures.

CONCLUSION
The present study demonstrates the coexistence of causal disconnection and compensation in DPD patients, and suggest that DPD has different neural substrates from NDPD, MD and HC.

CLINICAL RELEVANCE/APPLICATION
These findings might provide insights into biological mechanism of the disease.

SSA17-05 • Fractional Amplitude of Low-frequency Fluctuation Study of Resting-state fMRI in Parkinson’s Disease Patients with and without Resting Tremor

Min Xuan (Presenter); Peiyu Huang; Quanquan Gu MD, PhD; Xiaojun Xu; Wei Luo; Minming Zhang MD, PhD

PURPOSE
Resting tremor (RT) is present in 75-100% of Parkinson’s disease (PD) patients, but the explanation of this symptom still remains poorly known. Here we investigate how the functional changes happen in brains of PD patients with and without resting tremor, and whether these changes relate to the severity of resting tremor.

METHOD AND MATERIALS
15 PD patients with resting tremor (RT group), and 18 gender-, age-, duration-matched patients without resting tremor (non-RT group) participated in the resting-state functional magnetic resonance imaging (fMRI) analysis. We measured the fractional amplitude of low-frequency fluctuation (fALFF) between the two groups and investigated the correlation between RT scores and fALFF in the regions displaying significant group differences.

RESULTS
The RT group demonstrated an increased fALFF in the right supplementary motor area (SMA), and bilateral prefrontal cortex compared to non-RT group. There was no significant correlation between RT rating and fALFF in right SMA.

CONCLUSION
Our results suggest that the generation of resting tremor may be related to the decreased brain activity of right SMA, but the severity of resting tremor may not.

CLINICAL RELEVANCE/APPLICATION
Used to help understand the causes of resting tremor of PD, may eventually contribute to the treatment of this symptom.

SSA17-06 • Alternation of Functional Connectivity and Global Disturbance of FNC of Parkinson’s Disease by Resting-state fMRI

Haibo Xu (Presenter); Yuhui Wang; Dongling Jiang; Cheng Luo; Dan Zhang

PURPOSE
The aim was to estimate the alteration of brain functional connectivity in Parkinson’s disease (PD) during resting state of brain by resting-state fMRI.

METHOD AND MATERIALS
A total of 16 right-handed patients with PD diagnosed according to the UK Parkinson’s Disease Society Brain Bank diagnostic criteria, and 14 gender- and age-matched right-handed healthy controls were carried out on resting-state fMRI for two levels of analyses, that is functional connectivity within resting state networks (RSNs) and functional network connectivity (FNC) analysis. Using group independent component analysis, sixteen RSNs were identified, and selected for assessment of the difference of functional connectivity within RSNs and FNC between groups.

RESULTS
Compared with HC, the patients with PD showed decreased significant functional connectivity within the regions in the putamen network, thalamus network, cerebellum network, attention network and self-referential network in bilateral putamen, bilateral thalamus, left cerebellum, right superior frontal gyrus, left medial frontal gyrus (orbitofrontal area), left anterior cingulated. The execution network was the only one revealing increased functional connectivity in bilateral paracentral lobule (P < 0.01). Furthermore, the results showed significant functional connectivity disturbance inter- RSNs in patients with PD. The PD had a trend to show increased functional connectivity within most of RSNs and decreased functional connectivity within a small part of RSNs. The caudate network showed increased functional connectivity with anterior DMN network and execution network and decreased functional connectivity with cerebellum network. Functional connectivity with execution network was significantly increased in DMN network, motion network, self-referential network and primary auditory network. The posterior DMN network showed decreased functional connectivity with thalamus network.

CONCLUSION
Our findings might suggest that decreased resting state functional connectivity and global disturbance of FNC are two remarkable characteristics of Parkinson’s disease.

CLINICAL RELEVANCE/APPLICATION
The multi-perspective analysis based on RSNs may be a valuable means to understand the underlying neuro-pathophysiological mechanism of PD.

SSA17-07 • Dysfunction of Central Olfactory Network in the Parkinson’s Disease

Kaiyuan Zhang MD (Presenter); Xuemin Wu; Kuncheng Li MD; Qing X Yang PhD; Jianli Wang

PURPOSE
Olfactory dysfunction is prevalent in majority of idiopathic Parkinson’s disease (PD) patients. Even though typical PD pathology, Lewy pathology, has been found in the olfactory structures, the cause of olfactory deficits in PD is still not clear. We hypothesized that in PD patients, the central olfactory network (CON) is deteriorated. In this study, we applied task related and resting state fMRI (rsfMRI) methods to study the functional deficit of the CON in the PD brain.
METHOD AND MATERIALS
Nineteen PD patients (HandY stage 1-4) and ten age-/gender-matched healthy controls (HC) received respiration-triggered olfactory fMRI with lavender odor as the stimulant and rsfMRI on a 3T scanner. The olfactory function was evaluated with University of Pennsylvania Smell Identification Test (UPSIT). The PD patient’s clinical status was evaluated with Unified Parkinson’s Disease Rating Scale (UPDRS). During the imaging protocol, there were no cues provided to the subjects and no tasks for the subjects to do. The olfactory fMRI data were preprocessed with qMRI V2.1 and then analyzed using general linear model approach with SPM8. The rsfMRI data were processed with DPARSF V2.2 for resting state functional connectivity (FC) analysis using the major activation cluster in the primary olfactory cortex (POC) from the HC group as the seed. The FC at the group level was processed with REST V1.8 for the correlation analysis with clinical status.

RESULTS
In response to the odorant stimulation, significant activation was shown in the POC and secondary olfactory structures of the HC brains (e.g., orbitofrontal and insular cortex), but not in the PD brains. Significant decrease of FC with POC was observed in the anterior cingulate and right inferior temporal cortex (two-sample t-test with age effect corrected, p

CONCLUSION
The FC decrease within the CON contributes to the olfactory deficit in PD, and the connectivity change worsens when PD progresses.

CLINICAL RELEVANCE/APPLICATION
The findings in this study improve our understanding of olfactory deficits in Parkinson’s disease and provide a foundation for further clinical research in its diagnosis and treatment.

SSA17-08 • Quantitative Assessment of Iron Deposition in Parkinson’s Disease Using Quantitative Susceptibility Mapping at 3T: An In Vivo MR Study

Minako Azuma (Presenter) ; Toshinori Hirai MD ; Kazumichi Yamada ; Tian Liu PhD ; Yasuyuki Yamashita MD * ; Yi Wang PhD

PURPOSE
To evaluate the usefulness of assessing brain iron deposition in patients with Parkinson’s disease (PD) by quantitative susceptibility mapping (QSM).

METHOD AND MATERIALS
All MRI studies were performed with a multi-echo gradient-echo sequence on a 3.0 T Siemens scanner. We studied 8 PD patients (5 females, 3 males; age range 54-75 years, mean age 67 years) and 8 age-matched healthy controls. For QSM we used both the magnitude and phase components from all TEs in the morphology-enabled dipole inversion method. The mean susceptibility values (MSVs) of the bilateral substantia nigra (SN), red nucleus (RN), caudate nucleus (CN), globus pallidus (GP), and putamen (PT) was measured on QSM images. To place the region of interest (ROI) in the SN while avoiding contamination of the subthalamic nuclei we used coronal planar reconstruction images with reference to the Schaltenbrand and Wahren atlas. Measurements were in the anteromedial and posterolateral (aSN, pSN) areas of the SN. Axial images were used for measurements in the other structures. In each patient, the most and least affected side was identified using the Unified Parkinson’s Disease Rating Scale motor score (UPDRS-III). Measurement differences were assessed with the paired and independent t test; P < 0.05 was considered to indicate a statistically significant difference.

RESULTS
In healthy subjects the MSVs of both hemispheres for the GP, aSN, pSN, RN, PT, and CN were 157 ± 34, 152 ± 49, 94 ± 31, 122 ± 38, 82 ± 24, and 74 ± 14 ppb, respectively. In PD patients the MSVs of the aSN and pSN on the most affected side were 148 ± 54 and 130 ± 60 ppb, and on the least affected side were 126 ± 58 and 185 ± 65 ppb, respectively. On both sides of healthy subjects and on the least affected side of PD patients, the MSV was significantly higher in the aSN than pSN (P < 0.01). There was no significant difference between the aSN and pSN on the most affected side of PD patients. The MSV in the pSN on the least affected side of PD patients was significantly higher than the controls (P < 0.01); the difference was not statistically significant in the other structures between the two groups.

CONCLUSION
Our QSM study suggests that the iron deposition in the SN in PD patients is different from that in healthy subjects.

CLINICAL RELEVANCE/APPLICATION
QSM may provide useful quantitative information for evaluating brain-iron deposition in PD patients.

SSA17-09 • Difference in Phase Value of Putamen on SWI between Parkinsonian Syndrome and Age Matched Control

Jin Hee Jang MD (Presenter) ; Hyun Seok Choi MD ; Bum-Soo Kim MD, PhD ; Kookjin Ahn MD, PhD ; So L Jung ; Bom-Yi Kim MD

PURPOSE
Susceptibility weighted image (SWI) is sensitive to paramagnetic material such as iron. Iron deposition is considered not only as phenotype of neurodegenerative disease but also as normal aging. Decreased uptake of putamen on FP-CIT PET has been known as one of imaging biomarkers of Parkinson disease. The purpose of this study is to evaluate difference in phase value of putamen between patient with Parkinsonian syndrome and age matched control.

METHOD AND MATERIALS
We retrospectively enrolled patients of three groups with idiopathic Parkinson disease (IPD) (n=20), atypical Parkinsonian syndrome or 2ndary Parkinsonism (n=14), and age matched control (n=16). SWI were taken from all the enrolled subjects (n=50). Region of interest (ROI) was drawn to measure phase values of bilateral caudate head and putamen on the axial images at the level of foramen of Monro. Patient with IPD (n=20) and atypical Parkinsonian syndrome or 2ndary Parkinsonism (n=14) underwent F-18 FP-CIT PET/CT. Tracer activity of ROI was measured in caudate, putamen and a reference region of occipital cortex. Statistical analyses were performed to compare phase values and tracer activity between groups.

RESULTS
Mean age was 64.7±8.3 year-old in idiopathic Parkinson disease; 66.1±1.5 year-old, in atypical Parkinsonian syndrome or 2ndary Parkinsonism; and 65.7±6.0 year-old, in control. The mean ages were not different among 3 groups. The phase values of right and left putamen in IPD (0.068±0.038, 0.062±0.031 radian) were higher than those of age matched control (0.030±0.030, 0.037±0.032 radian). The phase values of atypical Parkinsonian syndrome or 2ndary Parkinsonism (0.079±0.039, 0.084±0.039 radian) were higher than those of age matched control. There was no difference of phase value between IPD and atypical Parkinsonian syndrome or 2ndary Parkinsonism. However, normalized FP-CIT tracer activity of right and left putamen in IPD (3.1±0.6, 2.9±0.5) were lower than those of atypical Parkinsonian syndrome or 2ndary Parkinsonism (3.9±1.2, 3.9±1.2).

CONCLUSION
Phase value of Parkinsonian syndrome was higher than that of age matched control. Further investigation of phase value is needed with larger population.

CLINICAL RELEVANCE/APPLICATION
Iron deposition and metabolism of normal aging brain and neurodegenerative disease has been poorly understood. Phase value of SWI is a quantifiable variable which can be obtained from SWI.
Traumatic Brain Injury

LEARNING OBJECTIVES
1) To develop a standardized pattern analysis approach for interpreting imaging studies in patients admitted with head trauma. 2) To become familiar with the different types of traumatic brain injuries and their imaging patterns. 3) To learn about the imaging characteristics of various types of intracranial haemorrhage by CT and MR. 4) To be able to recognize imaging findings that can serve as (surrogate) imaging biomarkers for patient prognosis and outcome.

ABSTRACT
CT and MR examinations constitute an essential part of the diagnostic work-up of patients with head trauma. In the acute setting, imaging findings determine patient management and greatly influence the clinical course. CT remains the first choice technique to determine the presence and extent of injuries, and to guide surgical planning. Multi-detector CT allows simultaneous assessment of head and cervical spine, obviating the need for plain X-rays. A standardized pattern analysis approach will be presented, to obtain a complete inventory of the traumatic brain lesions. From a clinical point of view, it is important to understand the difference between primary and secondary lesions. Primary injuries occur as a direct result of the impact with damage to brain tissue. Examples include fractures, different types of traumatic haemorrhage (epidural, subdural, intracerebral, subarachnoid), cerebral contusion, diffuse axonal injury (DAI). CT-angiography is useful to document traumatic blood vessel injury. Secondary injuries are caused by systemic factors such as increased intracranial pressure, edema, brain herniation, decreased cerebral blood flow, excitotoxicity. These lesions can be documented with multiparametric MRI including diffusion, perfusion, and susceptibility-weighted imaging. Whenever there is a discrepancy between the patient's clinical status and imaging findings, MRI is indicated. Diffusion tensor imaging with fractional anisotropy mapping may show microstructural abnormalities in patients with mild TBI, even when traditional MRI sequences appear normal. Neuroimaging also plays a role in the chronic stage, identifying sequelae, determining prognosis, and guiding rehabilitation. In conclusion, recent technological advances in CT and MRI have greatly improved our understanding of the pathophysiology of craniocerebral trauma and allow us to detect abnormalities, even in patients with mild head trauma, when routine imaging studies appear normal.

RC105B • Concussion: From Head Bumps to Dementia Pugilistica

LEARNING OBJECTIVES
1) The audience will understand the challenges in understanding the concept of minimally traumatic brain injury.

RC105C • DTI of Mild Traumatic Brain Injury

LEARNING OBJECTIVES
1) To understand the potential of magnetoencephalography (MEG) for better diagnosis in mild traumatic brain injury (TBI). 2) To review the current best practices for imaging of sports concussions and the findings of recent imaging research studies of athletes. 3) To provide an overview of blast injury and other special characteristics of TBI in military populations, with the most recent results from imaging studies.

Gastrointestinal: Liver (An Interactive Session)

LEARNING OBJECTIVES
1) Identify and characterize the most common focal liver masses in non-cirrhotic patients and avoid biopsies. 2) Understand the advantages and limitations of CT and MR in characterization of liver lesions.

ABSTRACT
Focal hepatic masses are frequently detected in the non-cirrhotic patients. These lesions are being detected as patients are being imaged more and are often detected incidentally. It is incumbent upon radiologists to try to detect and characterize these lesions. This talk will demonstrate the typical CT and MR appearance of liver lesions in the non-cirrhotic liver including cysts, hemangiomas, focal nodular hyperplasia, adenomas, metastases, cholangiocarcinoma and abscesses. The pathologic characteristics including central scar in focal nodular hyperplasia, the presence of fat in adenomas and hepatomas, and characteristic enhancement pattern of lesions will be discussed. Difficulties and limitations in the diagnosis of these lesions will be discussed. The importance of optimal protocols and newer techniques will be emphasized.

RC109A • Focal Liver Masses in Non-Cirrhotic Patients

LEARNING OBJECTIVES
1) To understand the most common focal liver masses in non-cirrhotic patients and avoid biopsies. 2) Understand the advantages and limitations of CT and MR in characterization of liver lesions.

ABSTRACT
Focal hepatic masses are frequently detected in the non-cirrhotic patients. These lesions are being detected as patients are being imaged more and are often detected incidentally. It is incumbent upon radiologists to try to detect and characterize these lesions. This talk will demonstrate the typical CT and MR appearance of liver lesions in the non-cirrhotic liver including cysts, hemangiomas, focal nodular hyperplasia, adenomas, metastases, cholangiocarcinoma and abscesses. The pathologic characteristics including central scar in focal nodular hyperplasia, the presence of fat in adenomas and hepatomas, and characteristic enhancement pattern of lesions will be discussed. Difficulties and limitations in the diagnosis of these lesions will be discussed. The importance of optimal protocols and newer techniques will be emphasized.

RC109B • Focal Liver Masses in Cirrhotic Patients

LEARNING OBJECTIVES
1) Comprehend why imaging is the key for detection and characterization of liver tumours in a cirrhotic patient. 2) Understand the advantages and limitations of US, CT and MRI. 3) Apply the appropriate protocols for CT and MRI. 4) Be able to give a comprehensive report answering the clinical questions, with the perspective of the different options for treatment and/or follow-up.

ABSTRACT
Focal Liver Masses (FLM) in a cirrhotic patient are challenging for detection and characterization for two reasons: - improvement of potential treatments increases the percentage of patients who are candidate for a specific treatment. However, the cost of these treatments, from systemic chemotherapy to liver transplantation, implies that any medical decision should rely on solid arguments, most of them being provided by imaging - in a cirrhotic liver, a wide spectrum of masses can be observed, from completely benign lesions like focal fatty infiltration or Regenerative Nodules (RN) to highly aggressive Hepatocellular Carcinoma (HCC). More over, there is a continuum between benign and malignant lesions with intermediate lesions like Dysplastic Nodules (DN). Characterization is therefore challenging due to overlapping of imaging features. Ultrasound (US) plays an important role in detection of HCC, and helps also assessing vein patency, ascites and development of collaterals. However, characterization of FLM with plain US is rather limited. CT is an efficient method
for detection and characterization of liver masses, and more often allows a global staging in case of malignant disease. However, there is increasing evidence that MRI is superior to CT both for detection and for characterization of liver masses, at least if the appropriate protocol is used. The role, advantages and limits of every method differ according to the clinical situation (detection, characterization, staging, follow-up). The precise features of nodules (RN, DN and HCC) should be identified and reported by the Radiologist, with the perspective of the appropriate treatment or follow-up. The radiologist should be able to give an adapted report, including all key information for patient management, and taking into account international standards (EASL, AASLD), which greatly help in making a medical decision.

**RC109C • Contrast Media in Liver MRI: From Morphology to Function**

Giuseppe Brancatelli MD (Presenter) *

**LEARNING OBJECTIVES**

1) To discuss the MR protocols typically used with extracellular and liver specific contrast agents. 2) To understand how liver-specific contrast agents can assist in the characterization of focal lesions in the cirrhotic and non-cirrhotic liver. 3) To review the most common pitfalls linked to the use of liver specific contrast agents. 4) To get familiar with the role of liver specific contrast agents in the diagnosis of biliary diseases.

**ABSTRACT**

Interactive Game: MR Imaging Innovations for the Oncological Practice: Case-based Instruction

Sunday, 02:00 PM - 03:30 PM • S404AB

**RC129 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5**

**LEARNING OBJECTIVES**

- Participate. This interactive session will use RSNA Diagnosis Live. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

**RC129A • Whole Body Diffusion-weighted Imaging - Tips, Tricks, and Pitfalls**

Dow-Mu Koh MD, FRCR (Presenter)

**LEARNING OBJECTIVES**

1. Understand the development of whole body diffusion-weighted MRI and its relevance for disease detection, especially in the oncologic practice. 2. Learn how to perform and optimize whole body diffusion-weighted MRI for disease assessment. 3. Recognize common artifacts in whole body diffusion-weighted MRI and how to address these. 4. Review interpretative pitfalls in using whole body diffusion-weighted MRI for disease evaluation.

**ABSTRACT**

Whole body diffusion-weighted MRI (WB-DWI) can be applied for disease detection, tumor staging and the assessment of treatment response. With recent MR hardware and technological innovations, the technique can be performed on most current MR system within 30-40 minutes, without the need for intravenous contrast administration. The technique is most robust when performed at 1.5T, as the technique is more sensitive to artefacts that may arise from magnetic field inhomogeneity at 3.0T. Whole body diffusion-weighted MRI is usually acquired with T1-weighted morphological images for disease evaluation. The high contrast of disease against the signal suppressed background produces "at-a-glance" high-b-value images, which aid disease detection and assessment. However, meticulous technique is required to maximize image signal-to-noise and to minimise artifacts. The WB-DWI high b-value images should be interpreted together with the morphological images and apparent diffusion coefficient (ADC) maps. Knowledge of potential interpretative pitfalls is important to avoid mistakes and establish this relatively new modality within the radiologic practice.

**RC129B • Whole Body Diffusion MRI - Making Sense of the Bone Marrow**

Anwar R Padhani MD (Presenter) *

**LEARNING OBJECTIVES**

1) To illustrate how whole body; MRI with diffusion can address the limitation of conventional imaging of the bone marrow for bone lesion detection, staging and disease follow-up. 2) To show that appearances of the bone marrow diffusion imaging is related to the cellular content of the bone marrow in health and disease. 3) To demonstrate that lesion conspicuity varies by histological type, tumor grade and that lytic bone deposits are better seen than sclerotic lesions. 4) To discuss false positive and negative cases and how to avoid misinterpretations. 5) To inform on the number of patterns that can be seen in progression and with success which are dependent on degree of marrow infiltration, mechanism of action of treatments and underlying response of bone tissue.

**ABSTRACT**

Accurate assessments of skeletal disease burden and response evaluations of patients with bone metastases are notoriously difficult. Current methods of assessing tumor response at skeletal sites do not always enable the positive assessment of therapeutic benefit to be made but instead provide an evaluation of progression, which then guides therapy decisions in the clinic. Whole body DW imaging (WB-DWI) has emerged as a promising bone marrow assessment tool for detection and therapy monitoring of bone metastases. On WB-DWI, lytic skeletal metastases appear as focal or diffuse areas of high-signal intensity on high b-values on a background of lower signal intensity of the normal bone marrow. Metastasis detection with DWI should be done with anatomical MRI; a recent meta-analysis demonstrated high sensitivity of WB-DWI to detect metastases at the expense of specificity. Causes for false-positive findings on WB-DWI include bone marrow edema caused by fractures, osteoarthritis, infection, bone infarcts, vertebral hemangiomas, isolated bone marrow islands and bone marrow hyperplasia. False-negative findings occur when there are low levels of bone marrow infiltration or when background bone marrow hyperplasia obscures metastases. Detection of skeletal metastases may be impaired in areas of body movement and the visibility of skull vault and base infiltrations are impaired because of the adjacent high signal of the brain. False-negative findings also include treated malignant disease and sclerotic deposits. Both high b-value image signal intensity and ADC value changes are needed for therapeutic assessments. A range of imaging findings can be seen depending on the type of therapy and duration of treatment. Diffusion MRI therapy response criteria need to be developed and tested in prospective studies in order to address current, unmet clinical and pharmaceutical needs for reliable measures of tumor response in metastatic bone disease.

**RC129C • MR/PET - Is It Ultimate Cancer Imaging Technique?**

Pablo R Ros MD, PhD (Presenter) *

**LEARNING OBJECTIVES**

1) To discuss technical and work flow challenges of MR/PET in Oncologic applications. 2) To demonstrate MR/PET key clinical performance results in Oncologic imaging. 3) To explore the potential of MR/PET for treatment monitoring and predictions of response to therapy.

**ABSTRACT**

N/A
from non-tumoral masses can be made and, in the case of neoplasms, characteristics suggestive of malignancy can be identified. Echocardiography. Utilizing a combination of MR signal characteristics, mass location and contrast enhancement, differentiation of tumoral versus non-tumoral masses can be made. 4) Provide a narrowed differential diagnosis of various sports injuries in high-performance athletes. 5) Have improved knowledge of implications of sports injuries in the adolescent population. 6) Practice the case of non-ischemic cardiomyopathy using the predominate pattern of delayed contrast hyperenhancement on MR. 5) Analyze the key features in differentiation between tumoral and non-tumoral cardiac masses, and MRI signs favoring malignancy. 6) Integrate the MRI information in the differential diagnosis of cardiac masses according to their location.

**LEARNING OBJECTIVES**

2. Cultivate a working understanding of MR-guided biopsy and needle localization instrumentation and implementation.
3. Understand basic MR-guided biopsy and needle localization parameters and requirements for appropriate coil, needle and approach selection.
4. Consider patient management before, during and after MR-guided breast biopsy.
6. Practice the MR-guided biopsy procedure on phantoms with multiple needle and coil combinations.

**ABSTRACT**

This course is intended to provide both basic didactic instruction and hands-on experience in the application of MR-guided breast biopsy and needle localization. Because of the established role of breast MRI in the evaluation of breast cancer through screening and staging, there is a proven need for MR-guided biopsy and needle localization of the abnormalities that can only be identified at MRI. This course will be devoted to the understanding and identification of: 1) appropriate patient selection 2) optimal positioning for biopsy 3) target selection and confirmation 4) various biopsy technologies and techniques 5) potential problems and pitfalls and 6) practice audits. Participants will spend 30 minutes in didactic instruction followed by 60 minutes practicing MR-guided biopsy with phantoms placed in various combinations of full size state-of-the-art breast MRI coils, biopsy localization equipment and needles.

**Case-based Review of Magnetic Resonance: Musculoskeletal (An Interactive Session)**

**LEARNING OBJECTIVES**

2. Have an improved understanding of the significance of various sports 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

Imaging for Electrophysiology

Monday, 08:30 AM - 10:00 AM • E351

RC203 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

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, and will be tailored to provide the necessary background and overview relevant to the different accompanying 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 aspects of clinical cardiac electrophysiology which can benefit from imaging. - Comparison 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.

RC203B • MRI
Scott D Flamm MD (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

RC203C • Clinical Perspective
Bradley Knight MD (Presenter) *

LEARNING OBJECTIVES
1) To understand the value of intracardiac echocardiography in the EP laboratory. 2) Define the role of MR and CT prior to ablation procedures for atrial fibrillation. 3) Appreciate the indications for TEE guided EP procedures including LAA occlusion.

PET-MR/Hyperpolarized MR

Monday, 08:30 AM - 10:00 AM • S504CD

RC217 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Heike E Daldrup-Link, MD

RC217A • Hyperpolarized 13C MR-A Complementary Method to PET for Imaging in Vivo Metabolism
Daniel M Spielman PhD (Presenter)

LEARNING OBJECTIVES
1) Assess the basic principles of hyperpolarized 13C MRS, including sample preparation, image acquisition, and data analysis. 2) Differentiate metabolic parameters measurable by hyperpolarized 13C MRS from those obtained with PET. 3) Compare PET versus hyperpolarized 13C MRS sensitivities, spatial resolution, and temporal resolution.

RC217B • MR/PET, A New Perspective of Molecular Imaging
Claus D Claussen MD (Presenter)
LEARNING OBJECTIVES
1) To learn about the evolution of MR/PET. 2) To become familiar with current MR/PET imaging strategies. 3) To be informed about clinical applications of MR/PET.

RC217C ● The Emerging Clinical Role of Hyperpolarized $^{13}$C MR in Prostate Cancer Imaging

John Kurhanewicz PhD (Presenter) *

LEARNING OBJECTIVES
1) Understand the clinical need and biochemical rationale for the use of hyperpolarized [1-13C] pyruvate for prostate cancer imaging. 2) Demonstrate a multi-hyperpolarized probe approach for simultaneously measuring prostate cancer metabolism and tumor micro-environment. 3) Demonstrate the utility of hyperpolarized 13C MR for measuring prostate cancer aggressiveness and response to therapy. 4) Demonstrate the safety, clinical feasibility, sensitivity and resolution, and future availability of clinical hyperpolarized 13C MR.

RC217D ● Brain Dedicated PET-MRI -How Far Are We?

Zang-Hee Cho PhD (Presenter)

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, 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.

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.

Breast Series: Breast MR Imaging

Monday, 08:30 AM - 12:00 PM ● Arie Crown Theater

RC217A-MR Image Acquisition

Mitchell D Schnall MD, PhD (Presenter)

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.

VSB21 ● Breast MRI at 7 Tesla: Image Evaluation and Comparison to 3 Tesla

Ryan Brown (Presenter) ; Pippa Storey PhD ; Christian Geppert * ; Ana Claudia Leite ; James S Babb PhD ; Daniel Sodickson MD, PhD ; Graham Wiggins ; Linda Moy

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).

CONCLUSION
The 7T bilateral transmit-receive coil and adiabatic inversion-based FS technique produce image quality that is as good as or better than 3T. The improved SNR can be exploited for high-resolution imaging to improve fibroglandular tissue detail.

CLINICAL RELEVANCE/APPLICATION
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 Plateel 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, Magneton Trio and Skyra) using a 16 channel bilateral breast coil. A bi-temporal protocol was employed, interleafing 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*0.9*2.5 mm, temporal resolution 4.32 seconds). 102 consecutive patients with invasive ductal (IDC) or lobular (ILC) carcinoma 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 point where the lesion started to enhance” minus “the time point where the aorta started to enhance”. For different tumor histology and grade categories the mode 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<0.001). TTE provides a non-invasive method to predict histological grade. Lesions that enhance very rapidly are more likely high grade 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-occulnt 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 (Phillips Achieve 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 66.7 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 MR 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
100 women with breast lesions were examined at 1.5 T (Siemens, Erlangen, Germany), by ultrafast T1-weighted GRE images every 5 s for 30 s after injection of Gd-DOTA (Dotarem, Guerbet, France), followed by 5 spatially-resolved MR image series every 30 s. Images were subtracted; maximum-intensity-projection images were obtained, and images were randomized and reviewed by two blinded readers, who reviewed only the spatially-resolved MR images and gave BI-RADS diagnosis. After one month, they evaluated only the time-resolved MR images and noted the time of first appearance of enhancement.

RESULTS
The patients had 249 enhancing lesions: 66 malignant on histopathology and 183 benign on basis of histopathology or 1-year imaging follow-up. On time-resolved MR imaging, the onset of enhancement occurred 5-10 s after injection in 15 lesions (all malignant), 10-15 s in 23 lesions (21 malignant, 2 benign), 15-20 s in 34 lesions (28 malignant, 6 benign), and 20-25 s in 117 lesions (2 malignant, 115 benign). All malignant lesions enhanced before 25 s. Taking 20 s as the cut-off point, early enhancement had sensitivity of 96.9%, specificity of 95.6%, positive predictive value of 88.8%, negative predictive value of 98.8%, and accuracy of 95.9% for diagnosis of carcinoma. Based on the onset-of-enhancement sign the diagnosis of the spatially-resolved MR imaging has been corrected in 14 lesions (5.6%).

CONCLUSION
Time-resolved ultrafast gadolinium-enhanced MR imaging of the breast demonstrates earlier enhancement of malignant lesions compared to benign lesions. Lesion enhancement within the first 20 s is an accurate sign of breast carcinoma.
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 to distinguish between malignant and benign lesions. DCE-MRI, based on contrast enhancement kinetics and morphologic techniques in morphological evaluations. Based on the ADC threshold of 1.35x10^-3 mm²/s, DWI showed a 100% sensitivity and 100% specificity, had a sensitivity and a specificity of 100%, 96%, respectively in breast lesions diagnostics.

**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. Sixty-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 24s (range 14 - 65s secs) for reader 2 (R2) was 14s (range 3 - 77secs). 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|<0.5) 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.

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

Laura Heacock MS, MD (Presenter) ; Amy N Melsaether MD ; Kristine M Pysarenko 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 T2 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. Sixty-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 24s (range 14 - 65s secs) for reader 2 (R2) was 14s (range 3 - 77secs). 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|<0.5) 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 NMLLE), 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 Trattnig 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.

**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^-3 mm²/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 to distinguish between malignant and benign lesions.
Enhanced Breast MRI?  

**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 scar.

**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 (P = 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.

**VSBR21-11 • Dynamic Contrast Enhanced (DCE) and Diffusion Weighted Imaging (DWI) Breast MRI at 3T: A Road Map of MRI Characteristics for Breast Cancer Histological Subtypes Characterization**

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**
To evaluate the value of multiparametric breast MRI data at 3T (including morphology, DCE MRI and DWI with Apparent Diffusion Coefficient (ADC) mapping) in distinguishing between different breast cancer histological subtypes of pure Ductal Carcinoma In-Situ (pDCIS), Invasive Ductal and Invasive Lobular Carcinoma (IDC, ILC).

**METHOD AND MATERIALS**
Our institutional review board approved the study. Out of 1405 consecutive patients who underwent bilateral breast MRI at 3T, 219 patients with 234 lesions were included in the study (mean age 53+11.5 year). Both high temporal (15 sec) DCE and high spatial resolution (0.5 mm² voxel size) MRI were acquired along with DWI. Regions of interest were drawn on the ADC maps of breast lesions and normal appearing glandular tissue (GT). Morphologic features, DCE-MRI results (kinetic curve type), GT and lesion absolute and normalized ADC values were included in multivariate models for prediction of breast cancer histological subtypes. Area under ROC curve analysis was performed.

**RESULTS**
Of 234 breast cancer lesions, 13.3% of were pDCIS, 31.6% IDC, 31.2% mixed DCIS and IDC, 13.7% ILC, 9% mixed IDC and ILC, and 1.3% were of miscellaneous. Lesion morphology (combining type of lesion with margin/distribution), Kinetic curve type, time to peak enhancement, and GT and lesion absolute and normalized ADC value were univariate predictors of breast cancer histological subtypes with an AUC 0.65-0.78. The multivariate diagnostic model combining lesion morphology, kinetic curve type, and normalized ADC value showed the best diagnostic accuracy (AUC 0.83). Using optimum cutoff value analysis, we developed a 3 category diagnostic model (AUC=0.83) consisting of 2 steps; 1) Differentiating pDCIS rather than invasive cancer if NMLE or smooth mass with a normalized ADC value >0.55, 2) Differentiating ILC rather than IDC for age of patient >59 and GT ADC value

**CONCLUSION**
DWI with normalized ADC map value assessment improves characterization of breast cancer histological subtypes beyond conventional morphological and DCE–MRI at 3T. Therefore, a 3 category Multiparametric Multi-steps MRI diagnostic model provides the potential for breast cancer histological subtypes characterization.

**CLINICAL RELEVANCE/APPLICATION**
Different breast cancer subtypes have different MRI characteristics. We developed multivariate diagnostic model combining morphology, DCE, and DWI to distinguish different breast cancer subtype.

**VSBR21-12 • 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 Helbich 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 were prospectively referred for 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 differences 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.

VSBR21-13 • 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
VSBR21-14 • 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 Avance DMX 400 wide-bore spectrometer. Gene expression levels of associated metabolic enzymes were obtained using qRT-PCR. A tumor metabolism gene expression signature was generated based on these results and used for human association analysis in five microarray datasets from patients with HER2-positive breast cancer.

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=0.013), 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 prognostication.

VSBR21-15 • 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 Helbich MD * ; Wolfgang Bogner MSC ; Siegfried Trattnig MD ; Marek Chmelik MS

PURPOSE
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 ; Zsuzsanna 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 imaging biomarkers such maximum standardized uptake 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-1H-MRSI was available in 62 cancers. 134 patients underwent 18FDG breast PET-CT and SUVmax of tumors was calculated. Standard immunohistochemistry 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

CLINICAL RELEVANCE/APPLICATION

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.

VSB21-17 ● MR Spectroscopy of the Breast at 3 Tesla: A Clinical Experience

Stefania Montemezzi MD (Presenter); Francesca Caumo MD; Ilaria Baglio; Lucia Camera; Gabriele Meliado; 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 0.34-8.0 cm³ (mean 1.33 cm³). MRS used TE=135ms, TR=3000ms, 128 samples, water (window 140Hz) and fat (SPAIR, offset 80Hz) suppression. When 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.

Musculoskeletal Radiology Series: Knee Imaging

Monday, 08:30 AM - 12:00 PM ● E4S1B

VSMK21 ● AMA PRA Category 1 Credit ™:3.25 ● ARRT Category A+ Credit:3.5

Moderator
Lynne S Steinbach, MD

Moderator
Mark W Anderson, MD

VSMK21-01 ● MRI of Meniscal Tears

Lynne S Steinbach MD (Presenter)

LEARNING OBJECTIVES

1) Discuss several meniscal pitfalls. 2) Review types of tears that are frequently missed or overcalled. 2) Provide an update of some recent information and concepts regarding meniscal MR imaging.

ABSTRACT

For several decades, radiologists have been evaluating knee menisci for tears using MRI with high sensitivity, specificity, and positive and negative predictive values. The individual radiologist must have the knowledge of the normal anatomic variants, normal meniscal-ligament interfaces, technical and other pitfalls, and appearances of various types of tears in order to keep up with the standards set by our profession, referring clinicians, and patients. This lecture will review some of those issues and provide an update of recent studies that have focused upon the use of MRI for meniscal evaluation.

VSMK21-02 ● MRI Meniscal Tear Morphology Survey: MSK Radiologist Nomenclature and Potential for Implementation of a Validated Standard

Robert J Ward MD; Allen Prober MD (Presenter); Thomas L Huang MD; Troy H Maetani MD; Shreena Brahmbhatt; Marios Loukas MD, PhD

PURPOSE

Purpose: To evaluate the range of meniscal tear morphology nomenclature on MR knee reports utilized by MSK radiologists, determine if a potential lack of standardization may lead to perceived diminished report clarity, and explore support for potential implementation of a specific validated classification system.

METHOD AND MATERIALS

Methods and materials: 860 surveys were emailed to members of the Society of Skeletal Radiology (SSR). The survey included 14 questions. 2 questions focused on demographics 6 questions on specific tear morphologies with illustrated examples, 1 question on signal classification with an illustrated example, 2 questions on tear localization, 2 questions measuring the frequency of confusion in reading other radiologists reports, and 1 question on whether the participant was willing to utilize a validated arthroscopy classification system.

RESULTS

Results: 250 (29%) responded, 40% academic and 60% non-academic. Approximately 95% had completed an MSK fellowship. Results indicated that differing tear morphologies demonstrate differing degrees of consensus regarding nomenclature. Meniscal signal classification was utilized by only 7% of participants. 60% percentage of MSK radiologists reported that when reading outside studies, tear morphology reporting lead to confusion sometimes. The MSK radiologists responding to the study overwhelmingly (95%) agreed to adopt the International Society of Arthroscopists, Knee Surgery, and Orthopedic Sports Medicine Classification System (ISAKOS).
CONCLUSION
Conclusion: MSK radiologist reporting varies substantially with respect to meniscal tear nomenclature sometimes leading to ambiguity among radiologists. There was overwhelming support for implementation of the ISAKOS classification system for meniscal tear MR reporting.

CLINICAL RELEVANCE/APPLICATION
Non-standardized tear morphology nomenclature creates ambiguity amongst radiologists and potentially clinicians. Implementation of an ISAKOS standard was endorsed by 95% of responding SSR members.

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

ABSTRACT
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; mean 41.8 years, range 18-68) who underwent both arthroscopy 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 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 ACL tears 76%, 83%, 79% 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%, 81% at TE 17, 100%, 95%, 85% at TE 38, 100%, 95%, 84% at TE 58. Interobserver agreements were moderate to almost perfect in the meniscus, ligament and cartilage lesions (r=0.584 to r=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.

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 Alatahawi MD ; Carl S Winalsiki MD *

ABSTRACT
To retrospectively determine if the rMPR extrusion measurements made using radially-oriented multiplanar reconstruction (rMPR) images. Determine location-specific extrusion differences between osteoarthritic 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 OA subcohorts from the Osteoarthritis Initiative. Patients with macerated menisci 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. Medial 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 meniscal 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 deformities 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 were greatest in the body and posteromedial region. Lateral meniscal extrusion should be considered abnormal 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 enthesis 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, 96.2% vs 94.7%, accuracy, 93% vs 91.7%; MM, sensitivity, 84.8% 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
If one or more fat-water-sensitivity sequence is included to routine sequence for the evaluation of bone marrow edema, 3D;IW-FSE;would be better without fat saturation for evaluation of IDK.

VSMK21-07 • MR Imaging of Posterolateral Corner Reconstruction of the Knee by Posterolateral Corner Sling Procedure: Review of 15 Patients with Clinical Correlation
Woo Young Kang (Presenter) ; Kyung-Sik Ahn MD ; Chang Ho Kang MD ; Suk-Joo Hong MD ; Baek Hyun Kim MD ; Dae-Hee Lee

PURPOSE
To describe the postoperative magnetic resonance (MR) appearance of the posterolateral corner (PLC) reconstruction of the knee and to correlate the MR findings with clinical examination.

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 (mean 10 months) after the surgery were retrospectively reviewed. Graft shape, thickness, signal intensity of the anterior and posterior limbs of the sling were recorded. Peroneal nerve thickness and signal intensity were compared with preoperative MR images. The MR findings were correlated with the time since surgery and clinical examination.

RESULTS
All 15 grafts were intact without disruption and had biopsy-confirmed foreign body reaction. Five knees were unstable on physical examination at the time of MR imaging. Anterior limb of the sling appeared as elliptical shape (15 of 15) on axial images with mean thickness of 5.86 (SD ± 3.7) mm and posterior limb as crescent shape (11 of 15) with mean thickness of 3.23 (SD ±1.2) mm. Signal intensity of the overall graft sling was increased in 13 of 15 cases, and posterior limb showed same or higher grade signal increase compared with anterior limb in 10 of 13 cases. Signal increase in posterior limb was more prominent in graft with longer time interval since surgery (p < 0.05).

CONCLUSION
In postoperative MR imaging of PLC reconstruction, increased signal intensity in posterior limb of the PLC sling appears to be related with time interval since surgery but not correlated with clinical stability, and peroneal nerve thickening may be an expected postoperative finding irrelevant to symptom.

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

VSMK21-08 • Postoperative Cartilage Imaging
Humberto G Rosas MD (Presenter)

LEARNING OBJECTIVES
1) Review the postoperative imaging appearances of articular cartilage repair, with an emphasis on MRI.

VSMK21-09 • Pre- and Postoperative ACL Imaging
Mark W Anderson MD (Presenter)

LEARNING OBJECTIVES
1) Describe the normal anatomy of the anterior cruciate ligament and its appearance on MR images. 2) List the primary and secondary MR imaging signs of complete and partial tears of the ACL. 3) Discuss the MR imaging appearances of a normal ACL graft and the most common types of graft complications.

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 well as associated injuries. As such, a solid understanding of ACL anatomy and pathology is essential, and this lecture will review the MR imaging appearances of the normal ACL as well as the spectrum of ligament injury including both complete and partial tears. Surgical options for ligament reconstruction will be reviewed along with the MR appearances of a normal ACL graft and most common graft complications.

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
Anatomical 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
The performance of 3D isotropic IW fast SE without FS is better than with FS to evaluation of cartilaginous defects and meniscus.
In a single cadaveric knee, the tibial attachment of the AHLM root ligament and ACL was imaged on an 11.7 T MR system with a 3D GRE (TR20ms, TE7ms) sequence (112x112x120mm resolution). Two blinded readers retrospectively reviewed 500 consecutive knee MRI examinations (6 month period). Studies were searched for the presence of ACL lesions (degenerative mucoid lesions or traumatic tears), abnormal appearance of AHLMR (degeneration or tear) and increased signal of the BF. Relationship between ACL and AHLMR lesions was assessed and presence of regional synovitis was also noted. Statistical analysis was performed using chi-square tests and kappa coefficient.

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 years. Review of clinical MRI cases showed ACL abnormalities in 42.1% of cases (Kappa=0.867), which included degenerative mucoid lesions (22.3%), traumatic tears (39.3%), and synovitis around distal ACL (38.3%). Root ligament abnormal appearance seen in 35.8% of the cases (Kappa=0.933) included degeneration (85.3%) and tears (14.6%). 28% of cases shown abnormal MR signal of the BF. There were significant associations between ACL and AHLM root ligament abnormalities (p < 0.001).

CONCLUSION
Concurrent abnormalities of the AHLM root ligament and ACL are common and likely due their intimate anatomic relationship through the blended fibers.

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?
Aliroza Zavareh MD, FRCR; Mike Bradley MBChB; James Robinson MBBS; Martin Williams MBChB; Hyeladzira Thahal MBChB, 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 given to two experienced musculoskeletal radiologists in our institution who were blinded of the actual results. Their diagnosis of the single bundle tear were 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 radiological diagnosis. We also recorded the other bone and soft tissue injuries seen on the MRI study to evaluate if these injuries are related to a specific torn bundle.

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 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 evaluating the ACL for single bundle injuries.

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.

VSMK21-12 • 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 factional 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.

VSMK21-13 • 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
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.

RESULTS
Most common type of medial synovial folding of PCL was inferior and short type, 76.4% (n=13), followed by inferior and long type, 11.8% (n=2), and invisible type, 11.8% (n=2). At the gross inspection, medial folds of both inferior short and long types were projected into the medial femorotibial joint. Moreover, invisible type on MRI had also protruding medial synovial folding at the superior aspect of PCL. Histologic examinations showed collagenous tissues which were surrounded by single layer of synovial cells.

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.

VSMK21-14 • 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.

Case-based Review of Magnetic Resonance: Neuroradiology (An Interactive Session)

Monday, 10:30 AM - 12:00 PM • S100AB

MSCM22 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Director
John R Leyendecker , MD

MSCM22A • Brain
Jonathan H Burdette MD (Presenter)

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 neurologic 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 (Coronary CT/MR II)

Monday, 10:30 AM - 12:00 PM • S405AB
SSC01-01  •  Improving the Image Quality of Coronary CTA in High Heart Rates Using a Novel Non-rigid Registration Based Motion Correction Algorithm

Zhilian Zhao  PhD (Presenter) ;  Dongdong Rong ;  Xiangying Du  MD ;  Kuncheng Li  MD

PURPOSE
A novel non-rigid registration based motion correction algorithm (Snap-Shot-Freeze, SSF) has been recently introduced for coronary CTA with 64-row MDCT. The aim of this study was to evaluate the efficiency of SSF in coronary CTA with high heart rates, by comparing the image quality with that of single sector and bi-sector reconstructions.

METHOD AND MATERIALS

RESULTS

CONCLUSION
SSF can effectively improve the image quality of coronary CTA in patients with high heart rates.

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 image 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 simulated 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 ;  Byoung 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 Foundation and American Heart Association 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 CTA and conventional coronary angiography (CCA). We established eligible criteria for CABG based on 2011 American College of Cardiology/American Heart Association practice guidelines: 3-vessel disease, left main coronary artery disease, and proximal left anterior descending artery (plAD) disease with other one major coronary artery disease. Results of CTA and CCA were retrospectively reviewed. SYNTAX scores were obtained based on both CCTA and CCA. Diagnostic performances of CTCA, CTA-based SYNTAX score and combining CTA with 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.

CLINICAL RELEVANCE/APPLICATION
Dual-source CTCA showed comparable diagnostic accuracy for selecting CABG candidates and combining CT-based SYNTAX score with CTCA 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.

METHOD AND MATERIALS
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 a 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 (I2f, I3f, I4f). 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)

RESULTS
There were 69.8% patients in FB, 98.0% in I2f, 98.1% in I3f and 100% in I4f who had good overall CCTA IQS. There were statistical differences in CCTA exam IQS among the 4 image reconstructions (P<.05). The mean effective radiation dose was (1.41±0.45) mSv. 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. I4f shows the best IQS and PDS among the different SAIR strength.

CONCLUSION
SAIR improves non-calcifying plaque delineation and detection, and image quality in CCTA. In high BMI patients, highest SAIR strength I4f 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 (SAIR), as well as subjective image quality score, 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<.05). However, in subgroup of smaller stent (0.05), CCTA 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 patency 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 ; Zhengu 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 (CCTA) obtained with sonogram-affirmed iterative reconstruction (SAIR) with different strengths and filtered back projection (FBP).

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 (80kV), 317±33.68 (100kV), 322.57±70.45 (120kV). That of 80kV group was remarkably lower than the other two groups. The average IQ score was 1.01±0.26 (80kV), 1.00±0.19 (100kV), and 1.14±0.38 (120kV). The IQ score was significantly higher for 120 kV group. No statistical difference was found between 80kV and 100kV groups (P=0.05). The mean effective radiation dose was 0.31±0.04 mSv (80kV), 0.77±0.10 mSv (100kV), and 1.31±0.30 mSv (120kV) respectively. There was statistical difference among them (P=0.00).

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,
Anomalous Origin of the Coronary Artery from the Wrong Coronary Sinus Evaluated with Computed Tomography

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/IV 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, mA) 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 (CTD, DLP) provided the radiation dose. Qualitative statistical analysis and two-tailed P test were performed to compare radiation dose and image quality.

RESULTS
The patients were matched for age, gender and BMI. Radiation Dose: Group A, CTDI = 13.86 ± 5.99 (range 2.8-28mGy), DLP = 188.26 ± 81.60 (range 44.30-391.70 mGy.cm); Group B, CTDI = 10.40 ± 6.17 (range 2.3-22.9), DLP = 136.44 ± 80.65 (range 28.8-288.60 mGy.cm) resulting in a mean CTDI reduction of 25% with AIDR (p=0.019).

SNR: Group A =20.84 ± 5.58 (range 1.19-28.74), Group B = 23.70 ± 7.80 (range 7.56-43.03), an increase of 14% (p=0.062). Visual score: Group A= 3.24±0.64, Group B = 3.27±0.67 (p=0.8466). Number of sub-mSv scans: Group A= 2 (5%), Group B = 10 (25%).

CONCLUSION
CTCA performed using AIDR results in diagnostic image quality with an average dose reduction of 25% compared to an optimized FBP protocol and a five-fold increase in the number of sub-mSv scans.

CLINICAL RELEVANCE/APPLICATION
CTCA accurately detects CAD. Radiation dose concerns restrict widespread use of CTCA but IR algorithms demonstrate significant dose reduction with preservation of diagnostic image quality.

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

Maciej Krupinski (Presenter); Malgorzata Urbanczyk 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 arteries 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), 16 (30%) patients right coronary artery originating from the left coronary artery sinus (ARCA), 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).

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.
vortical blood flow ($t_{vortex}$ in percent of the cardiac interval) in the main pulmonary artery. Relationship between mPAP and $t_{vortex}$ was analyzed by means of regression, Bland-Altman and receiver operating characteristic curve analysis.

RESULTS
Relationship between mPAP and $t_{vortex}$ was excellently (goodness-of-the-fit parameter $R^2 = 0.95$) described as increasing linearly from $t_{vortex} = 0\%$ (mPAP = 16 mmHg) with a slope of 1.6% per mmHg. Employing this relation to estimate elevated mPAP from $t_{vortex}$ 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 $t_{vortex} = 14\%$ of cardiac interval.

Area under the curve was 0.99 (95% confidence interval 0.98-1.00) for $t_{vortex}$-based diagnosis of manifest PH. Applying the cut-off value $t_{vortex} = 14\%$ resulted in a sensitivity of 0.97 (95% confidence interval 0.90-0.99) and a specificity of 0.96 (95% confidence interval 0.89-0.99) for diagnosis of manifest PH.

CONCLUSION
MR-PCI based determination of periods of existence of vortical 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 Adaption 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; 44.1±4.7 years; range 33-51 years) or an inactive control group (n=42; 42.3±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-systolic 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 VOmax (Pearson correlation, 0.609 and 0.588; P<0.05).

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 0.60±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 (0.9±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<0.05).

CONCLUSION
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 Qualitative and Quantitative Assessment of Ungated 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 bSSFP scans (spatial resolution of 2.3mm², 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 binding. 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 endocardial borders (p=0.05), and mitral valve visualization and blood pool contrast with the breathhold method were preferred (p

CONCLUSION
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 breathing 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 MBchB

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, S 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 muscles. Musculoskeletal fat fraction (FF) was quantified using Amare/MRUI. IMCL was also calculated. Axial T1 weighted images at L4–L5 level were acquired for abdominal fat measurement.

RESULTS
CONCLUSION
In population without known cardiac disease, musculoskeletal fat accumulation (lipid fraction) is associated with decreased systolic ejection and diastolic filling (compliance).

CLINICAL RELEVANCE/APPLICATION
Early reduction of cardiac compliance is demonstrated in obesity and correlates with fat accumulation in skeletal muscles.

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 Kuetting; 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 uncritical, 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 whole body scanner directly before and 1h after consumption of a taurine (400 mg/ 100 ml) and caffeine (32 mg/100 ml) containing ED (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 strain (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 quantification of global myocardial function; EF, EDV, ESV, S and LV mass, variables were indexed to BSA.

RESULTS
P 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 1/s ± 0.33; w ED 2.09 1/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 ± 33; LV-EF; w/o ED 64 % ± 4; w ED 66 % ± 8) and vital parameters (HR: w/o ED 63 1/min ± 9; w ED 62 1/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
Early reduction of cardiac compliance is demonstrated in obesity and correlates with fat accumulation in skeletal muscles.

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 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 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
RESULTS

CMR peak radial and circumferential strains demonstrated fair and good correlation with STE (r=0.36 and 0.63, respectively). CMR underestimated (p

CONCLUSION

LV myocardial strain using deformation field analysis on cine SSFP CMR imaging is feasible with excellent and good inter- and intraobserver agreement for 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 MD (Presenter); Grupper Avisahy; Elio Di Segni MD; Eli Konen MD; Ashraf Hamdan MD; Victor Guetta *

Ilan Hai; David Luria MD; Michael Gilkson 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 CCT and minimal diameters were 27±5 and 22±5 mm 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=-0.0.08; p=0.7 and -0.02; p=0.9, respectively). LAA diameter >30 mm (N=5) was associated with adverse device sizing; procedure failure (2/5) and incomplete LAA occlusion (2/5) with regurgitation on echocardiographic follow up.

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 MBBCh, MD (Presenter); Jane M Francis; Paul M Matthews MD, DPhil; Paul B Wordsworth MBBS, FRCPC; Stefan Neubauer; Theodoros D Karamitso

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.
To evaluate peak flow, net flow, vessel diameter and wall shear stress (WSS) in the proximal pulmonary arteries of normotensive controls and patients with pulmonary arterial hypertension (PAH) using 4D flow MRI.

METHOD AND MATERIALS

With IRB approval, 10 patients (age: 57±10, 5 females) and 9 volunteers (age: 40±12, 6 females) were scanned on a 3T MR system. Time-resolved 3D pulmonary flow was measured using 4D MRI with full coverage of the right ventricular outflow tract, pulmonary trunk (PT) and right and left pulmonary branches (RPA and LPA). Net flow and maximum velocity were quantified at the level of PT, RPA and LPA. WSS and vessel diameter were also measured in analysis planes positioned at these three levels in both groups.

RESULTS

Net flow in PAH patients (PT: 52.7±11, LPA: 21.5±5, RPA: 26.2±7 ml/cycle) was significantly lower compared to controls (PT: 68.3±13, LPA: 29.3±4, RPA: 32.7±5 ml/cycle, p-value<0.05). The same pattern was observed for peak velocity in PAH patients (PT: 0.5±0.1, LPA: 0.3±0.1, RPA: 0.4±0.1 m/s) compared to the controls (PT: 0.8±0.1, LPA: 0.7±0.2, RPA: 0.9±0.2 m/s, p-value<0.05). In addition, PAH arteries had a significantly larger diameter (PT: 3.4±0.5, LPA: 2.3±0.3, RPA: 2.4±0.3 cm) compared to the normal population (PT: 2.6±0.2, LPA: 1.8±0.2, RPA: 1.7±0.3 cm, p-value<0.001). As shown in Figure 1, PAH patients had reduced WSS at all three measurement positions, compared to volunteers.

CONCLUSION

4D flow MRI illustrates distinct hemodynamic changes in PAH patients compared to a normal population. The significant reduction in net flow, peak velocity and an increase in PA lumen diameter in patients resulted in decreased WSS values, as compared to normal volunteers.

CLINICAL RELEVANCE/APPLICATION

Pulmonary hypertension is associated with right heart failure, but its effect on arterial diameter and hemodynamic factors (i.e., velocity, flow, WSS) and their role in disease progression is not clear.

SSC03-02 • Serum Biomarkers of Atherosclerosis and Myocardial Remodeling: Correlation with Quantitative Imaging Markers of Coronary Heart Disease at Cardiac CT

Lucas L Geyer MD (Presenter) *; Balazs Ruzsics; Aleksander Krauzinski; Justin R Silverman; Christopher L Schlett MD, MPH; U. Joseph Schoepf MD *; Ulrich Ebersberger MD; Fabian Bamberg MD, MPH *; Maximilian F Reiser MD; Michael R Zile MD

PURPOSE

We aimed at correlating the plasma levels of several novel circulating biomarkers of atherosclerotic disease activity and myocardial remodeling with quantitative imaging markers of coronary heart disease obtained by coronary CT angiography (cCTA).

METHOD AND MATERIALS

In an IRB-approved, HIPAA compliant study, 75 patients with suspected coronary artery disease underwent contrast enhanced, retrospectively ECG-gated coronary dual-source CT angiography. Patients were evaluated for the type of coronary plaque and the presence and severity of coronary artery stenosis on a per patient and per segment basis. Semi-automated software was used for measuring the volume of non-calcified and mixed plaques; lipid-rich and fibrous contents were differentiated. Cardiac function parameters were obtained using cine CT reconstructions across the RR cycle. Plasma samples were collected from each patient and a cytokine and protease profiling panel was performed by multiplex analysis. The plasma concentrations of seven biomarkers with a reported relationship to coronary atherosclerosis and myocardial remodeling were measured: TNF?, IL-6, IL-8, matrix metalloproteinase (MMP)-2, MMP-3, MMP-7, MMP-8. Data were analyzed using Spearman's rank correlation coefficient and Mann-Whitney-U-Test.

RESULTS

Data of 61 men and 14 women (59±10 years) were evaluated. 60/75 patients showed atherosclerotic changes in at least one vessel on cCTA. 34/75 had significant (>50%) stenosis in at least one coronary artery. 46 non-calcified, 129 calcified, and 86 mixed plaques were identified. We found a statistically significant (p<0.05) correlation between MMP-8 and TNF? and between MMP-8 and IL-8.

CONCLUSION

Our study suggests that elevated levels of MMP-8 are associated with greater atherosclerotic plaque volume at cCTA. Moreover, IL-8 and TNF? may indicate more active myocardial remodeling with higher myocardial mass at CT.

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.

SSC03-03 • Coronary Artery Calcification Scoring with CT Scanners from Four Different Vendors Results in Different Scores

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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 with the Friedman test (significance level P<0.05).

RESULTS

Fourteen hearts had coronary calcifications. Agatston scores, calcification volume and mass scores differed significantly (P<0.05, 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

Dependent on the CT vendor of a hospital, differences in coronary calcium scoring may result in different treatment strategies.

SSC03-04 • 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 Dijkstra RT *; Gabriel P Krestin MD, PhD *; Koen Nieman MD
SSC03-05 • 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 and underwent MRI scan with a 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 = k (1 - hematocrit), where k 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 severe 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, 0.245±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% confidence 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 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 • Automatic Quantification of Blood Flow from Real-time Phase-contrast MRI  

Markus Huellebrand (Presenter) ; Anja Hennemuth MS ; Jens Frahm PhD * ; Lennart Tautz

PURPOSE  
2D phase-contrast (PC) MRI is an established technique for the analysis of vascular hemodynamics. A recently developed real-time MRI technique allows for respective acquisitions under free breathing and without the need for ECG synchronization. However, quantitative evaluations become more complicated than for conventional methods because of potential changes in contrast, the management of multiple cycles without manual interference, and the influence of respiratory displacements. In order to overcome such problems, we developed a new method for the automatic analysis of blood flow parameters from real-time PC MRI.

METHOD AND MATERIALS  
Real-time 2D PC MRI of the ascending aorta was performed in 5 healthy subjects (mean age 25 years) were at 3-T (TrioTim, Siemens, Erlangen, Germany). Acquisitions were based on a highly undersampled radial FLASH sequence with and without a bipolar flow-encoding gradient (VENC=200 cm/s, flip angle 10°) and image reconstruction by regularized nonlinear inversion. The spatial resolution was 1.33x1.33x6.0mm2 and the temporal resolution corresponded to 40 ms. The images were analyzed with use of the research software prototype CAIPIRINHA. 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.

RESULTS  
The segmentation results of the three observers and the automatic segmentation (duration 39 ± 4 s) were compared pair-wise. The average dice coefficient between observers and the algorithm was 0.86 ±0.04, the inter-observer comparison was 0.92 ±0.03. The average symmetric absolute surface distance error was 1.09±0.4mm for the algorithm and 0.71±0.22mm for the observers. The mean absolute error of the stroke volume was 4.67±2.28ml for the algorithm and 6.14±3.5ml for the observers.

CONCLUSION  
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.

CLINICAL RELEVANCE/APPLICATION  
Automatic quantification of real-time 2D PC MRI enables analysis of patients with aperiodic heartbeats (e.g. arrhythmias) and monitoring of hemodynamic responses to stress or physiologic maneuvers.

SSC03-07 • Normal Diastolic and Systolic Myocardial T1 Times at 1.5 T: Correlations and Blood Normalization  

Ursula Reiter (Presenter) ; Gert Reiter * ; Katrin Dorr MD ; Andreas Greiser PhD * ; Ralph Maderthaner MD ; Michael H Fuchsjaeger 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-confirmed 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 FBP (0% SAFIRE) as reference.

RESULTS  
The median Agatston score (range) decreased with incremental IR: 163 (0.1 ~ 3393.3), 158.4 (0.3 ~ 3079.3), 137.7 (0.1 ~ 2978.0), 120.6 (0 ~ 2783.6), 102.6 (0 ~ 2468.4), and 84.1 (0 ~ 2186.9) for 0% (FBP), 10%, 20%, 30%, 40%, and 50% SAFIRE, respectively (Figure 1; P = 0.001).  

CONCLUSION  
SAFIRE noise reduction techniques significantly affected the coronary calcium quantification, with potential clinical consequences.
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 basal, mid-ventricular and apical short-axis myocardial T1 maps in systole and diastole. Regional myocardial T1 times were evaluated in segmental and mean myocardial T1 times 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. Means 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 values 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 in case of mean myocardial T1 times) 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 (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 field, streamline and particle trace visualization of time resolved three-dimensional (4D) magnetic resonance phase-contrast imaging (MR-PCI) data and to compare their linear relationship with invasively determined mean pulmonary arterial pressure (mPAP).

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), as 3D streamlines and as 3D particle traces and evaluated for period of existence of vortical blood flow (tvortex in percent of the cardiac interval) in the main pulmonary artery. Dependence of tvortex on visualization and relation to mPAP were analyzed by means of correlation, linear regression and Bland-Altman analysis.

RESULTS
tvortex 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 ±14% for comparison 3D-vector versus streamline visualization and were -3% and ±15% for 3D-vector versus particle trace visualization. In all techniques tvortex 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 I 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 = 1R-1H/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, tibia anterior and soleus muscles. Fat was quantified with Amare/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.
SSC05-01 • ‘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 Cortis MD, MRCS, FRCR (Presenter); Rosa Liotta; Roberto Miraglia MD; Settimio 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 WI/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 WI/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 WI/WO, delayed WO augments sensitivity of HCC characterisation with no significant compromise on the PPV.

CLINICAL RELEVANCE/APPLICATION
This delayed washout phenomenon increases the sensitivity of HCC characterisation when used alongside the cornerstone wash-in/wash-out pattern, with no significant compromise on the PPV.

SSC05-02 • 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 gadolinium-accelerated-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 nodule in the cirrhotic liver on gadoxetic acid-enhanced and diffusion-weighted (DW) magnetic resonance (MR) images.

RESULTS
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 RELEVANCE/APPLICATION
Our proposed criteria of MR images can be a potential alternative to the AASLD practice guideline in diagnosing small HCCs in patients with liver cirrhosis on gadoxetic acid-enhanced and DW 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

Katsuhiro Sano MD (Presenter); Utaro 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 diagnosing 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 image). 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.

CLINICAL RELEVANCE/APPLICATION
In our study, clinical features of HCC showing isointense or hyperintense on hepatocyte-phase of EOB-MR images tend to show good survival rate.

SSC05-04 • 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 single center study. Two sets of images were analyzed independently by 2 readers: HBP/DW-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 (hyperintensity on b500/1000 and low ADC) on HBP/DW-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

CONCLUSION
Initial data demonstrate similar sensitivity, slightly lower specificity and equivalent NPV when using a combination of HBP imaging post gadoxetic acid and DWI compared to AASLD criteria for detection of HCC > 1 cm. This combination has potential for HCC screening.

CLINICAL RELEVANCE/APPLICATION
A fast post-contrast liver MRI protocol consisting of gadoxetic acid injection outside the MR room with DWI can be used for HCC screening, which could provide shorter and possibly less expensive exams

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 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 SSFSE 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, hepatectomy, biopsy, empirical treatment based on the index MRI, and follow-up imaging within 12 months of the index MRI.

RESULTS
There were a total of 49 lesions considered positive for HCC. Inter-reader agreement was substantial for both image sets (?=0.72 for both). Intra-reader agreement was excellent (?=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 85.8%/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 alternative to dynamic conventional MRI for HCC surveillance.

CLINICAL RELEVANCE/APPLICATION
This limited MRI may be an acceptable alternative to dynamic conventional MRI in patients in an MRI surveillance program for HCC.

SSC05-06 • Radiopathological Correlation of Hepatocellular Carcinoma in Transplant Patients. MR Evaluation with Gadoxetic Acid

Nehal Shah MBBS, FRCR (Presenter) ; Raneem Albazaz MBBCh ; Andrew F Scarsbrook FRCR ; Maria B Sheridan MD ; James A Guthrie MBBCh *

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
Gadobenate Dimeglumine (Gd-BOPTA) Enhanced MR Imaging and Multiphasic 64-slice CT

W-LSC and V20 in the groups. We also calculated the optimal W-LSC cut-off value for predicting liver function transit using receiver (mean LSC calculated the liver-spleen contrast (LSC) ratio for each radiation dose area. Then we calculated the weighted LSC (W-LSC) as W-LSC = intensity of the liver parenchyma during the hepatobiliary phase in a circular region of interest by referring to a dose distribution map 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 lesion 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 correlation.

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.

SSC05-07 • Detection of Hepatocellular Carcinoma (HCC) in Liver Transplant Candidates: Intraindividual Comparison of Gadobenate Dimeglumine (Gd-BOPTA) Enhanced MR Imaging and Multiphasic 64-slice CT

Michele Di Martino (Presenter); Rossella Di Miscio; Concetta V Lombardo; Bruna Cerbelli; Sandro Bosco; Maddalena D’Addario; Carlo Catalano MD

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 of MRI. 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 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 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

CONCLUSION
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; Fuminari 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 liver volume exposed to >20 Gy, is usually planned to be.

METHOD AND MATERIALS
We retrospectively studied 18 HCC patients who underwent SBRT; the dose was 48 Gy delivered in 4 fractions. We measured the signal intensity of the liver parenchyma during the hepatobiliary phase in a circular region of interest by referring to a dose distribution map and calculated the liver-spleen contrast (LSC) ratio for each radiation dose area. Then we calculated the weighted LSC (W-LSC) as W-LSC = (mean LSC30Gy x liver volume30Gy + mean LSC90Gy x liver volume90Gy) / total liver volume. We divided the patients into groups A (no change in the Child Pugh score 6 months post-SBRT) and B (increased Child Pugh score 6 months post-SBRT) and compared the W-LSC and V20 in the groups. We also calculated the optimal W-LSC cut-off value for predicting liver function transit using receiver operating characteristic analysis.
RESULTS
Of the 18 patients 13 were in group A and 5 in group B. There was no significant difference in V20 between the groups (10.36% vs 16.45%, p=0.15); in one patient it was below 10%. There was also no significant difference in W-LSC (1.81 vs 1.47, p=0.22), however, in all 5 group B patients it was below 2.0. At the optimal cutoff value for W-LSC (1.98), sensitivity and specificity for predicting liver function transit were 100% and 61.5%.

CONCLUSION
W-LSC may be a more useful quantitative parameter than V20 for predicting liver function transit.

CLINICAL RELEVANCE/APPLICATION
The value of W-LSC should be evaluated before SBRT to avoid radiation-induced liver disease.

Musculoskeletal (Interventional I)

Monday, 10:30 AM - 12:00 PM  •  E450B

SSC10 • AMA 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 (MR, CT)

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 hypoenhanced lesions measuring on average 2.1 cm in maximum craniocaudal dimension. Interestingly, within similar prescribed treatment volumes, the use of 6 as opposed to 4 sonications increased the depth of the transverse intramedullary hypoenhanced 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) ; Geoffroy Farouil ; Lambros C Tsellikas 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 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: metachronous 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 (1 cm) bone metastases.

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 osteomas 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, Boston Scientific - USA). The osteoid osteomas treated with MRgFUS were located in the femur (n.8), tibia (n.3) and in the
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), vertebral body (L3 and L5) and tibial plateau (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 byVAS scale.

RESULTS
All the patients treated with RF termoablation 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 MRI 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 the 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 osteoma 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 using the ExAblate 2100 system (InSightec). 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 follow-up 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 +48.9% at first month follow-up (p<0.001).

CONCLUSION
Our preliminary data showed that incremental ADC values positively correlated with clinical success 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 linear 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 Macciocchi ; 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 April 2012 thirty painful non-spinal osteoid osteomas, diagnosed at imaging (including ce-dynamic CT and MR), were selected for treatment with MRgFUS (3.0-T/1.5-T GE Discovery MR 750/450 + InSightec ExAblate 2000). Treatment success in terms of pain reduction has been evaluated using visual analog scales (VAS). Sonication parameters were recorded. One year clinical and imaging follow-up was performed to evaluate success rate, recurrence and complications.

RESULTS
Thirty osteoid osteomas (26 lower limbs and 4 upper limbs) have been treated using MRgFUS. Complete clinical success rate was 90% (27/30). When 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 anesthesia were spinal (21), peripheral (5) and general (4). The mean energy consumption was 63±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.

CLINICAL RELEVANCE/APPLICATION
The safety and effectiveness of MRgFUS encourages its adoption in treating non-spinal osteoid osteoma. This procedure, differently from any other ablative technique, is totally non-invasive.

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 Schmit 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 2cm 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 (3), pelvis (23; 8 periacetabular, 6 other iliac, 4 pubic, 3 ischial, 2 gluteal), and extremities (8; 5 upper, 3 lower). Among the 64 tumors, 50 (78%) were metastases. 21 different tumor histologies were represented, 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 decreases in the intraoperative MEPs, including 15 (25%) with transient decreases and 4 (7%) with persistent decreases. Two (50%) 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 deficit. 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.

CLINICAL RELEVANCE/APPLICATION
Intraprocedural MEP monitoring minimizes risk of neural injury and may improve patient safety during percutaneous cryoablation of musculoskeletal tumors.

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 that there was concern of impending 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 followup 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 neuropathy 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.

CLINICAL RELEVANCE/APPLICATION
Combined cryoablation and cementoplasty can improve pain and stability in patients with lytic acetabular metastases.

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 Rizzoli 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 (18%), 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 treatment 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, allowing permanent effect and well-controlled procedure. Embolization is less invasive, cheaper, simpler, faster, more secure for skilled operators and it is easily repeatable.

CLINICAL RELEVANCE/APPLICATION
In the past Aneurysmal Bone Cyst (ABC) was treated surgically or with a combination of surgery and embolization. Nowadays the sole embolization with N-2 butyl cyanoacrylate is the gold standard.

SSC10-09 • Clinic Efficacy of CT-guided Iodine-125 Seed Implantation Therapy in Patients with Advanced Vertebral Metastatic
Histogram Analysis of Intravoxel Incoherent Motion in Patients with Recurrent Glioblastoma: Initial Experience

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 vertebral metastatic tumor.

METHOD AND MATERIALS
We retrospectively analyzed 20 cases with vertebral 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 vertebral metastatic tumor and work out the number and the dose rate distribution of 125I seeds. The MPD of 125I seed implantation was 90-130 Gy. 24 Vertebral metastatic tumor were treated by CT-guided radioactive iodine-125 seeds implanted. The median of 19 (range, 4-43) 125I seeds were implanted.

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 vertebral metastatic tumor is a safe, effective, and minimally invasive method.

CLINICAL RELEVANCE/APPLICATION
CT-guided radioactive iodine-125 seeds implantation treatment in patients with vertebral metastatic tumor is a safe, effective, and minimally invasive method.

Neuroradiology (Imaging Genomics and New Techniques in Brain Tumors)

Monday, 10:30 AM - 12:00 PM • N226

SSC11-01 • A Novel 3D MR Sequence Capable of Simultaneous Image Acquisitions with and without Blood Vessel Suppression: Observe Test for Efficacy in Detecting Brain Metastases

Kazufumi Kikuchi MD (Presenter); Takashi Yoshiiura MD, PhD; Akio Hiwataishi MD; Osamu Togao MD, PhD; Koji Yamashita MD; Hiroshi Honda MD; Masami Yoneyama; Makoto Obara

PURPOSE
Post-contrast 3D gradient-echo is the standard for brain metastases, but enhancing blood vessel can be a disturbing factor. Recent studies have shown that blood vessel suppression techniques help detect metastases more efficiently. However, incompletely suppressed vessels may closely mimic metastases, hence can result in false positive results. To solve this issue, we developed a novel 3D sequence named volume isotropic simultaneous interleaved bright- and black-blood examination (VISIBLE), which allows for simultaneous acquisitions of images with blood vessel suppression (Black images) and those without (Bright images) in 5 minutes. Our purpose was to evaluate usefulness of VISIBLE through an observer study.

METHOD AND MATERIALS
In VISIBLE, two sequential phases of TFE acquisition are implemented following a motion-sensitized driven-equilibrium preparation for black-blood imaging. Patients with suspected brain metastasis were prospectively imaged using both VISIBLE and conventional MPRAGE. 34 patients including consecutive 17 patients with 1 to 6 metastases and 17 with no metastasis were selected and used for the observer study. 3 radiologists read VISIBLE and MPRAGE of the 34 patients in the first and second reading session. In reading VISIBLE, each observer was instructed to use Black images to pick up high signal intensity areas as candidates for metastases and Bright images as a second opinion to reject false positives such as incompletely suppressed enhancing vessels. The observers diagnostic performance was evaluated by means of the figure-of-merit (FOM) as an index of diagnostic performance derived from the JAFROC analysis, sensitivity, false-positive per case (FP/case), and reading time.

RESULTS
Compared to MPRAGE, VISIBLE was associated with significantly higher sensitivity (91.7±4.2% for VISIBLE vs. 70.8±11.1% for MPRAGE, P<0.0001).

CONCLUSION
VISIBLE can improve radiologists diagnostic performance in detecting brain metastases.

CLINICAL RELEVANCE/APPLICATION
VISIBLE is capable of simultaneous acquisitions with and without blood vessel suppression and can improve radiologists diagnostic performance in detecting brain metastases.

SSC11-02 • Histogram Analysis of Intravoxel Incoherent Motion in Patients with Recurrent Glioblastoma: Initial Experience

Ho Sung Kim (Presenter); Namkug Kim PhD; Choong Gon Choi MD; Sang Joon Kim MD

PURPOSE
To determine whether the perfusion (f) and true diffusion (D) parameters derived from intravoxel incoherent motion (IVIM) MR imaging can be an imaging biomarker for distinguishing recurrent glioblastoma (RGM) from radiation necrosis (RN) and to compare its diagnostic accuracy with normalized cerebral blood volume (nCBV) derived from dynamic susceptibility contrast MR perfusion imaging.

METHOD AND MATERIALS
Our institutional review board approved this retrospective study. Forty-seven consecutive patients with pathologically confirmed RGM (n=27, 57.4%) or RN (n=20, 42.6%) were assessed using IVIM MR imaging. The 90th and 10th percentile cumulative histogram cutoffs for the f, D, and apparent diffusion coefficient (ADC) (f90, D10, and ADC10) were calculated respectively and then correlated with the final pathology. The best predictor for differentiating RGM from RN was determined by receiver operating characteristic (ROC) curve analyses. The f90 was correlated with nCBV90 using Pearson's correlation analysis.

RESULTS
The mean f90 was significantly higher in the RGM group (0.091±0.014) than in the RN group (0.047±0.019) (p<0.0001). The mean D10 was significantly lower in the RGM group than in the RN group (P=0.021). ROC curve analyses showed f90 to be an excellent predictor for differentiating RGM from RN, with a sensitivity of 93.6% and a specificity of 87.9%. There was a significant positive correlation between f90 and nCBV90 for all cases (r=0.729; P<0.0001).

CONCLUSION
A histogram analysis of IVIM perfusion and diffusion parameters can be a potential, noninvasive imaging biomarker for differentiating...
**RESULTS**

A total of 245 patients met the inclusion criteria. Correlation between the two MRI readers was high, at 95% (kappa 0.87). Correlation between the MRI consensus grade and the histological grade was moderate, at 82% (kappa 0.58). Patients with MRI appearances consistent with a grade IV tumour but lower grade (II or III) histology had significantly worse survival than patients with the same histology but lower grade MRI appearances (p = 0.001 for grade II histology and p = 0.013 for grade III). Taken as a group, the survival of all the patients up-graded from lower grade histology to grade IV based on MRI was equivalent to those patients with grade IV tumours on both histology and MRI (no significant difference, p = 0.896). Therefore, the tumours up-graded to grade IV based on MRI behave as grade IV tumours, and at least some may truly be grade IV tumours under-graded by histology.

**CONCLUSION**

MRI is a better predictor of survival than histopathology for high grade gliomas, with high inter-observer agreement. Incorporating MRI into grading can therefore decrease the risk of under-grading. This has the potential to guide optimal therapy and thus substantially improve patient survival.

**CLINICAL RELEVANCE/APPLICATION**

MRI is currently under-utilised in the management of intracranial astrocytomas. Adding MRI information to the current histopathological grading system allows more accurate grading of astrocytomas.

**SSC11-04 • 2-hydroxyglutarate (2HG) Level Is Associated to Tumor Progression in Gliomas Carrying IDH Mutations**

**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 (MIB) data were obtained from histopathology analysis. Two-tailed Spearman (P) test was applied to see if 2HG levels were associated with tumor progression.

**RESULTS**

Higher 2HG concentrations were found in tumors with higher grades. Higher 2HG level appears associated with the increased tumor volume and MIB 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 enhancing effect in tumors after two years. In comparison, 2HG levels obtained from MRS showed substantially 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 MIB 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 Image Processing Software in Glioblastoma before and after Resection**

**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 protocol has not been developed for a clinically-validated volume rendering software. We applied our volume determination methods to compare the extent of resection (EOR) using 5-ALA-guided resection to EOR of conventional resections. Datasets consisted of high-resolution pre- and post-op MR images (T1w images pre- and post-contrast) from 13 randomized patients in an Emory ALA study and 13 controls matched for tumor location. To tabulate preop tumor volume, a coarse 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...
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 invivo orthotopic xenograft model studies using gain and loss of function. Small animal 7T MRI-T2/FLAIR was used for imaging-genomic validations.

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. MRI-T2/FLAIR signal highly correlated with POSTN levels and the degree of cellular invasion in orthotopic xenograft models. Furthermore, high POSTN and a high POSTN/miR-219 signature resulted in decreased survival and shorter time to progression (P < 0.05).

CONCLUSION
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 through-out 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.

MRI AND PET MEASUREMENTS OF OXYGEN EXTRACTION FRACTION IN PATIENTS WITH BRAIN TUMORS

Parinaz Massoumzadeh PhD (Presenter) ; Dhanashree Rajderkar MD ; Hongyu An DSc ; Jonathan E McConathy 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 participants (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 scans of 3 series with serial inhalation of air with 40-75 mCi radiolabeled carbon monoxide (C13O), 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 implication 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*.

SSC11-09 • 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=0.0145).

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.

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 Natsuaki *; 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 values. 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 in the prostate is sufficiently approximated by high-order polynomials. RR-VFA method computes B1 maps using conventional VFA images without additional scanning. Experiments were performed on 3.0T 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 12 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 resulted 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.
CONCLUSION
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 design, 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 Supera 8x100mm, Cook Medical Zilver PTX 7x80mm, Gore Tigris 6x30mm, 6x40mm, 7x30mm, 7x100mm, TERUMO Mio 8x60mm, 8x80mm, 8x100mm) 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.

SSC14-03 • 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 7B 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 7B 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 gradient 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 = 32ppm/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 7B correction for the frontal regions of the brain. In contrast, with the 7B correction, a R2’ of 2.84±0.75Hz was obtained for the frontonal regions of the brain.

CONCLUSION
Unlike the conventional Z-shimming method, this method can reverse 7B effects without perfectly matching one of the Z-shimming gradients to 7B. Our approach can also be adapted as a rapid (24 sec) standalone 7B mapping method if 7B maps are needed for other DTI or MRl 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.

SSC14-04 • 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 PhD ; 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 MR images from 20 patients and used them as CT atlases. Ten of these patients also had matching MR images of the head and 4 different MR sequences: fluid attenuated inversion recovery (FLAIR), magnetization-prepared rapid acquisition with gradient echo (MPRAGE), T1 weighted (T1), and T2 weighted (T2). The MR-CT pairs were aligned using a rigid and non-rigid registration scheme. The realigned CT images were saved as the rCT images.

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 evaluation, pCT and rCT images were converted to attenuation value and radon transformed to generate sinograms. In these sinograms, the sinogram value was exponentiated for a correction value.

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±0.015, 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
CLINICAL RELEVANCE/APPLICATION
A robust method for deriving CT equivalent information from MRI is needed for attenuation correction in PET/MRI applications.

SSC14-05 • Peripheral Zone Prostate Cancer Sensitivity and Accuracy Using Two Different Receive Coils
Rajakumar Nagarajan PhD (Presenter) ; Daniel J Margolis MD * ; Steven S Raman MD ; Manoj K Sarma PhD ; Robert E Reiter MD ; Michael A Thomas PhD

PURPOSE
Magnetic resonance spectroscopy (MRS) enables recording major prostatic metabolites, such as citrate (Cit), creatine (Cr) and choline (Ch), and it has been shown to significantly improve detection of tumors in the peripheral zone, primarily by improving specificity. The external coil assembly is favored 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.

METHOD AND MATERIALS
Twenty patients (mean age 63.1yo) with prostate cancer (PCa) who underwent endorectal MR 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 consisted of at least 75% peripheral zone tissue, did not include periurethral tissue. Both endorectal coil and external body array metabolite 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 sensitive 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
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.

SSC14-06 • Extending Resolution Limits of Whole-heart Coronary Magnetic Resonance Angiography (MRA) Using Super-resolution Technique
Ryohei Nakayama PhD (Presenter) ; Masaki Ishida MD, PhD ; Motonori Nagata MD, PhD ; Tatsuro Ito MD ; Kakuya Kitagawa MD, PhD ; Hajime Sakuma MD * ; Mio Uno MD ; Yoshitaka Goto MD

PURPOSE
Coronary MRA permits noninvasive assessment of coronary artery stenoses without radiation exposure. However, several technological considerations restrict image resolution of coronary MRA. Conventionally, resolution of MRA is usually enhanced using bicubic interpolation (BCI). Recently, Super-Resolution (SR) technique has been proposed to increase MR image resolution. The purpose of this study was to investigate the value of high resolution reconstruction of coronary MRA using SR technique.

METHOD AND MATERIALS
Whole-heart coronary MRA was acquired with 32-channel cardiac coils in 35 patients at 1.5T (n=16) and 3.0T (n=19). Images with 256x256 matrices were generated as original images by down-sampling the source 512x512 images reconstructed by MR imager. The resolution of original images was restored to 512x512 matrices by using SR technique or BCI. With SR approach, the original images were further downsampled to 128x128 matrices (LR: low-resolution images). Each original and LR image was represented as a set of overlapping patches with the same number using 14x14 matrices for original and 7x7 matrices for LR images. Training dictionaries, which include the relation information in each corresponding pair of patches, were constructed using 5 slices including the target slice in the middle. Using 256x256 original image as a input, high-resolution image was generated by employing 7 pairs of patches that were the nearest neighbors in the feature vector space from training dictionaries. The source 512x512 images were used as gold standard to determine the fidelity of 512x512 images generated by SR approach in comparison with that by BCI.

RESULTS
With BCI, root mean square error, signal to noise ratio, and structural similarity index for 1.5T MRA were 3.12, 20.0dB, and 0.983, whereas those for 3.0T MRA were 3.05, 20.4dB, and 0.985. With SR approach, those for 1.5T MRA were 2.55, 21.9dB, and 0.988, whereas those for 3.0T MRA were 2.50, 22.4dB, and 0.990. The each result was significantly improved (p < .001) by SR technique as compared with BCI.

CONCLUSION
The high resolution reconstruction with SR technique developed in this study achieved highly improved image quality of coronary MRA at both 1.5T and 3.0T.

CLINICAL RELEVANCE/APPLICATION
The high resolution reconstruction generated by our SR technique may be useful for identifying coronary artery stenoses on whole-heart coronary MRA and for reducing the interpretation time.

SSC14-07 • Self-consistent Flip Angle Mapping Using Multi-spectral Synthetic MRI
Hernan Jara PhD (Presenter) ; Stephen W Anderson MD ; Jorge A Soto MD ; Osamu Sakai MD, PhD

CONCLUSION
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.

Background
Quantitative MRI (qMRI) accuracy can be degraded by deviations of the actual flip angles (FA) in the patient relative to the nominal-FA values of the pulse sequence. 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 contrast weighting, in particular the directly acquired (DA) images can be resynthesized and compared to the true DA reference images. If done systematically 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.

Evaluation
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 were processed qMRI algorithms for generating maps of PD, T1, and T2. Our Synthetic MRI contrast navigation
A methodological approach to image interpretation of challenging breast MRIs and improving approach to management of patients with abnormal MRIs was presented. The presentation highlighted improvements in the interpretation of breast MRIs using the new BI-RADS lexicon, providing a practical framework for clinicians to enhance their diagnostic accuracy.

**Learning Objectives**
1. Improve approach to image interpretation of challenging breast MRIs.
2. Improve approach to management of patients with abnormal MRIs.
3. Interpret a variety of MR lesions using the new BI-RADS lexicon.

**Abstract**

The presentation covered the implementation of a methodological approach for interpreting breast MRIs with a focus on improving diagnostic accuracy. It introduced strategies for managing patients with abnormal MRIs and emphasized the importance of using the new BI-RADS lexicon in clinical practice. The discussion included practical applications and case studies to illustrate the effectiveness of the approach.

**References**


**Acknowledgments**

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Arie Crown Theater

**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 ; **Robyn L Birdwell** MD

**PURPOSE**
To 1) 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, 2.5%). Outcomes data was available in 508/570 (89%) lesions, including 408 (72%) 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 • Probably Benign Lesions Detected at Dynamic Contrast Enhanced Breast MRI: Prevalence of BI-RADS III Diagnoses and Malignancy Rate**

**Yunus Alparslan** (Presenter) ; **Simone Schrading** 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 MR-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 BIRADS 3 lesions.

RESULTS
Follow up MR was performed in 87% (93/107) of the 107 patients after a mean time interval of 10 month (median 9.6, range [4;25]). At this follow up exams MR-BIRADS 3 lesions were stable or regressive and downgraded to BIRADS 1/2 in 96% (89/93). MR-guided biopsy was performed by patients request in 7 of these 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 (0/25n), 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 MR-BIRADS III lesions is low. To avoid early invasive tissue sampling, the observation with short-term MR-follow up is a valid approach in the management of these lesions.

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 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 the pathology 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 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 times (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 were evaluated. In patients who also underwent surgical excision, the size of tumors measured on MRI was compared with pathology measurement. Using a paired Student’s t test, differences were considered 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 heterogenous, 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 approved retrospective review identified 712 women diagnosed with unilateral invasive ductal breast carcinoma consecutively
between February 2008 and 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 fibroglanular 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 factors 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 Wassmer 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 cancers (93 invasive; 11 non-invasive cancers) and 76 benign lesions. The prepectoral edema Sign was seen in 2.6 % of benign lesions (2/76), none of the DCIS-cases (0/11) and 25.8 % of malignant lesions (24/93). The prepectoral edema Sign was seen significantly more frequently in poorly-differentiated cancers [(33.9 %; 19/56) vs. (13.9 % (5/36)] as well as in presence of lymphangiosis [(53.8 %; 14/26) vs. (9.8 %; 4/41)], positive lymphnodes [(44.4 %; 12/27) vs. (19.4 %; 12/62)], size of tumor above 2 cm [(47.1 %; 16/34) vs. (13.8 %; 8/58)], pectoralis infiltration [(80.0 %; 4/5) vs. (22.7 %; 20/88)], presence or absence of prominent vessels [(44.4 %; 20/45) vs. (8.3 %; 4/48)] and the presence of the hook sign [(60.9 %; 14/23) vs. 14.5 %; 10/69)]. The prepectoral edema Sign was not statistically associated to tumor-type, presence or absence of additional DCIS, receptor status, number of lesions, margin, form, enhancement pattern and curve-type.

CONCLUSION
The Prepectoral Edema Sign seems to be a highly reliable indicator for tumors with malignant prognosis.

CLINICAL RELEVANCE/APPLICATION
Periocular edema is a very powerful sign towards malignancy in the differential diagnosis of breast lesions in MR-Mammography.
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, eFGR, 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 AR at the pre CMR scan and 90% at the post CMR scan, 38 [IQR 33-57] days after the PVI. The PVA was associated with AR at post CMR 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

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 diffuse 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 Voorasatthakarnkij ; Daniel Verdini MD ; Ashley M Lee BS ; Peerawut Deepprasertkul ; Heidi Lushman ; Manavjot S Sidhu MD, MBBS ; Hector M Medina MD ; Suhny Abbara MD * ; Goldfride 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. Quantitative and qualitative 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 MRI 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 yrs) 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, CEI, 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
Hemodynamic derangement in obstructive HCM is known to impact patients symptoms and disease progression. 3D hemodynamic...
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; Anneline 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 they 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
RESULTS
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. Scars (site, 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 subepicardial 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
- Merged 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
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. In addition, 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%), 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 Guimaraes MD, PhD *; Bruce R Rosen MD, PhD *; Mark Vangel PhD; Marco Catalano; Elisa Varriale; Ignazio Maria Francesco Sordelli; Anna Ferrante; Emanuele Nicolai; Andrea Sorcelli 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) *; Hakan 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 12 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.

CLINICAL RELEVANCE/APPLICATION
Contrast-enhanced CT is sufficient for lymph node staging in squamous cell carcinoma of anorectum and anal verge, decreasing the need for biopsy and PET/CT while MRI without contrast is insufficient.

SSE08-06 • Does PET/CT Derived Tumor Heterogeneity and Glucose Uptake Predict Survival in Primary Colorectal Cancer Patients?

Ming Young S Wan MBChir; Balaji Ganeshan PhD (Presenter) *; Alec Engledow; Daren Francis; Nick Reay-Jones; Manuel Rodriguez-Justo; Vicky J Goh MBCh *; Marie Meagher; Jacquie Peck; Kim Jaggs; Jackie Hayward; Helen Whiteway; Zia Saad; Faira Rizal; Jakub Nalepa *; 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±10.6y). 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 tomography 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.

Gastrointestinal (Cirrhosis and Portal Venous Hypertension)

Monday, 03:00 PM - 04:00 PM • E451A

SSE09 • AMA PRA Category 1 Credit ™:1 • ARRT Category A+ Credit:1

Moderator
Koenraad J Mortele, MD

Moderator
Rendon C Nelson, MD *

SSE09-01 • Hepatic Function Assessment by Quantitative T1 Mapping of the Liver on Gadoxetic Acid Enhanced Magnetic Resonance Imaging

Jeong Hee Yoon MD (Presenter) ; Jeong-Min Lee MD * ; Munyoung Paek ; Berthold Kiefer PhD * ; Joon Koo Han MD ; Byung Ihn Choi MD, PhD *

PURPOSE
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 (291.6±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
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%.

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 form 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 Giraudneau 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
Institutional animal review board approval was received prior to the start of the study. Carbon tetrachloride induced liver cirrhosis was obtained in 21 rats. Nine normal rats were used as control. Dynamic gadoxetate-enhanced MR images of the liver were obtained during one hour after injection of 0.025mmol/kg gadoxetate. Enhancement parameters (maximal enhancement, time to peak and elimination
METHOD AND MATERIALS
Chart review of cirrhotic patients with gadoxetic-enhanced MRI at 1.5T from 2008-2012 was performed. Patients with histologically confirmed hepatocellular carcinoma (HCC) in cirrhotic patients with incidentally discovered T1-w hyperintense lesions.

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). At multiple regression analysis, only the hepatic extraction fraction correlated significantly with the expression of Oatp1a1, hepatobiliary transporter Mrp2, and backflux transporter 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
Supersonic SWE has the potential to assess hepatocyte transporter function in liver cirrhosis.

CLINICAL RELEVANCE/APPLICATION
DHCE-MRI has the potential to assess hepatocyte transporter expression in liver cirrhosis.

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 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 the change of liver stiffness (ΔLS) on the pre and post measurement. 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 ΔLS were strongly correlated with ΔHVPG (r = 0.663 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

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 Elkfief ; Pierre Emmanuel Rautou ; Didier Lebrec ; Laurent Castéra ; 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 included.
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, 12 and a mean time of 59 months 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 at long-term follow-up after a median time of 59 months. The score of overall quality of life increased significantly 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, 12 and a mean time of 59 months are presented.

RESULTS
After MR-guided cryoablation of recurrent prostate cancer (PCa) recurrence after previous radiotherapy. Follow-up consists of a visit to the urologist, PSA-level measurement and a multi-parametric MRI after 3, 6 and 12 months. Successful procedures were technically feasible. Follow-up ranged from 0 to 22 months with a median of 10 months. One patient died 4 months after treatment for reasons unrelated to PCa. In 4/28 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 performed using the Sperman 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.

ISP: Genitourinary (Intervention in the GU Tract)

Monday, 03:00 PM - 04:00 PM • E353B

SSE11-01 • ARAA Category A+ Credit:1

Moderator
Parvati Ramchandani, MD *

Sjoerd Jenniskens, MD
Joyce G Bomers, MSc (Presenter)
Derya Yakar MD
Christiaan G Overduin, MSc
Henk Vergunst MD
Emiel Van Lin MD
Frank De Lange PhD
Erik Cornel MD, PhD
Jelle O Barentsz MD, PhD
Michiel Sedelaar MD, PhD
Jurgen J Futterer MD

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, 12 and a mean time of 59 months are presented.

RESULTS
After MR-guided FUS-treatment of symptomatic uterine fibroids quality of life increased significantly. Symptom relief was seen after 3 and 12 months and especially at long-term follow-up after a median time of 59 months. The score of overall quality of life increased significantly from a median of 46.7 (QR: 28.1-56.3) to 77.6 (QR: 61.4-87.1) after 3 months (p
CONCLUSION
MRgFUS therapy of symptomatic uterine fibroids leads to long-term symptom relief (mean 59 months). 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 Kyo 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 site, linearly blended and IO images 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). In the renal cortex-to-RFA site, the CNR between linearly blended and IO images was 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.

CONCLUSION
DECT can be a useful tool to evaluate the therapeutic response to RFA in patients with RCCs. Moreover, VNC images can be an alternative to TNC images for evaluating the ablation zone after RFA.

CLINICAL RELEVANCE/APPLICATION
As a follow-up tool after RFA, DECT has the potential to be a preferred CT imaging modality in RCC patients, with reducing radiation exposure.

SSE11-05 • 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 Fascetti 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 mininvasive 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 was of 3450 J (minimum value of 1300 J and maximum value of 5600 J). This allowed us to reach the therapeutic temperature also in more vascularized parts of the lesion. In order to treat the peripheral parts of the lesion, we used a shorter spot length (from 4 to 6 mm) and a shorter cooling time between the sonication. All patients were treated once and the longest treatment lasted about 120 minutes.

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).
Neuroradiology (The Aging Brain and Neurodegenerative Diseases)

Monday, 03:00 PM - 04:00 PM • N229

SSE16-01 • 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/anterior corona radiata 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 network (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, 5men and 8women, 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: post-labeling delay = 1500 ms, TR/TE = 4.9/2 ms, voxel size = 1X1X1 mm³. After image acquisition, T1SPGR images were segmented using in-house software. T1SPGR was segmented using SPM8 and registered onto CBF 4632/10.5 ms, voxel size = 2X2X4 mm³. High-resolution T1SPGR images were acquired as well.

RESULTS
Cortical volumes decreased significantly (p < 0.001, FWE=0.05, T=5.33, 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 identify the cortical atrophy in mild Alzheimer’s disease.

SSE16-03 • Arterial Spin Labeling 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
Arterial spin labeling (ASL) was used to investigate the role of vascular impairment in mild Alzheimer’s disease.

METHOD AND MATERIALS
13 mild Alzheimer’s disease (AD, 5men and 8women, 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, pseudo-continuous ASL scanning was conducted with 36 label/control images acquired on a GE750 3T scanner. The acquisition parameters were: post-labeling delay = 1500 ms, TR/TE = 4632/10.5 ms, voxel size = 2X2X4 mm³. High-resolution T1SPGR images were acquired as well.

RESULTS
There were significant differences in Mini Mental Status Exam (MMSE) (mild AD: 21.3±4.97, HC: 28.75±0.93) and between the 2 groups (p < 0.001) but none in age (p = 0.061). Cortical volumes decreased significantly (p < 0.001, FWE=0.05, T=5.33, 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 identify the cortical atrophy in mild Alzheimer’s disease.
RESULTS
There were significant differences in Mini Mental Status Exam (MMSE) (mild AD: 21.3±4.97, HC: 28.75±0.93) and between the 2 groups (p < 0.001) but none in age (p = 0.061).

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.

SSE16-05 • 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=0.56, 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 3 T Siemens Trio system. Functional MR images were acquired while at rest.

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 difference was detected between MCI and healthy elderly. While taking comparison to 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 vermis VI, 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 Alzheimer’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 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.
CLINICAL RELEVANCE/APPLICATION

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.

CLINICAL RELEVANCE/APPLICATION

The Glx/Cr and Cho/Cr age-dependent decrease evaluated through MRS might be useful as a complement of routine ADHD examinations.

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 to assess for 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 compression. Venous compression was most commonly bilateral in 45%. In 17/31 cases (54.8%) only the cortical veins were compressed whereas in 11/31 cases (35.5%) both cortical veins and sinuses were compressed. In 3/31 cases (9.7%) only the sinus was compressed.

Evidence of direct trauma to the bridging vein (lollipop sign) was seen in 44.5% of cases. All veins having a lollipop sign also had evidence of venous compression from an overlying SDH. Among 22/41 children with a small volume SDH, 15/22 (68.2%) had evidence of venous compression and 10/22 (45.4%) had a lollipop sign. Among 19 cases of moderate or large SDH, 16/19 (84.2%) had evidence of venous compression and 10/19 (52.6%) had a lollipop sign (table 1). The four remaining children without SDH had neither venous compression nor a lollipop sign. Thrombosis was found in 2/45 cases of AHT.

CONCLUSION

1. Evidence of displacement and/or compression of cortical veins and sinuses from subdural hemorrhage is present in 69% of cases of AHT.
2. Evidence of direct trauma to the veins can be identified in 44.5% of cases. 3. There were no cases of cortical vein compression or lollipop sign in absence of subdural hemorrhage.

CLINICAL RELEVANCE/APPLICATION

Our study will increase awareness and subsequently improve detection of MVR findings of compression and evidence of direct trauma to the bridging veins.

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; Xiaqi 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-naive 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 MR 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 FWE corrected for multiple comparisons.

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-minutes delay intervals (r=0.32, p=0.028), VFT scores for total numbers (r=0.45, p=0.001) and right numbers (r=0.43, p=0.001), ST scores for right numbers (r=0.31, p=0.032), while negatively correlated with ST scores for wrong numbers (r=-0.32, 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.

CLINICAL RELEVANCE/APPLICATION

Diffusion tensor imaging (DTI) may be a useful technique to help with the evaluation of cognitive abnormalities in ADHD children.

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 eight ADHD 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 during the 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 was observed in FLWM at both sides as well as in Cho/Cr ratio in right FLWM (p<0.001).

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.
Therefore, we recommend its use on ADHD evaluation.

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

**RC317B • Technical Considerations when Performing MR-Guided High Intensity Frequency Ultrasound**

Kim R Butts Pauly PhD (Presenter)

**LEARNING OBJECTIVES**
1) To understand the basic physical principles of focused ultrasound and the considerations for clinical treatments. 2) To understand the basic physical principles of MR thermometry and thermal dose and the consideration for clinical treatments.

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

**RC317C • Transcranial MR-guided High Intensity Frequency Ultrasound**

Jeff Elias (Presenter)

**LEARNING OBJECTIVES**
1) To understand the issues of transcranial sonication, and the technology available to achieve this. 2) To review the current neurological applications for MRI guided focused ultrasound surgery.

**ABSTRACT**
Recent advances in ultrasound transducer technology have now enabled the precise delivery of acoustic energy to deep regions of the brain with MR guidance. The first treatment in humans have demonstrated that MRI-guided FUS is feasible for the treatments in the brain. Clinical trials are currently underway primarily for the treatment of movement disorders, but also for brain tumors, neuropathic pains, and obsessive-compulsive disorder.

**RC317D • Body Applications of MR-Guided High Intensity Frequency Ultrasound**

Wladyslaw M Gedroyc MBBS, MRCP (Presenter)

**LEARNING OBJECTIVES**
1) Where Can FUS be applied. 2) Which patients are most suitable for fibroid FUS. 3) What are the potential complications of fibroid FUS. 4) What are the medium-term results of FUS for uterine fibroids. 5) What requirements does a prostate FUS system require for safe and effective application. 6) What are the potential complications of prostate MR guided FUS. 7) What are the technological requirements necessary to improve MR guided focused ultrasound therapy to the liver. 8) What other areas can MR guided focused ultrasound potentially be applied to in the body.

**ABSTRACT**
The largest area of FUS application has been of uterine fibroids. These benign tumours are extremely common and responsible for huge expenditure each year. FUS can provide a completely non-invasive way of treating women with fibroids in an outpatient manner with negligible complications and very minor post-operative pain. Selecting appropriate patients is vital and will be discussed together with methods of success. Improved technology can now speed up fibroid treatment with ablation spots up to 7 cm in length that can be rapidly moved from one point to another minimizing heating in front of the focal spot whilst treating multiple areas. Current follow-up studies suggest that if a nonperfused volume of greater than 60% is achieved symptomatic response is well over 80% at one year and that the requirement for further fibroid related treatment is 11% at two years. Because of the outpatient non-invasive nature of the procedure FUS becomes highly cost-effective. Percutaneous destruction of liver tumours in a completely non-invasive manner would thus change therapy to the liver radically. FUS holds out such a prospect but the technological improvements required to our current machinery are substantial. The barrier of the FUS absorbing rib cage is hard to overcome and to date MR guided focused ultrasound has only been able to reach lesions that are not covered by ribs. The movement produced by respiration presents a significant problem during treatment, and immediate verification of successful treatment. The results of the pivotal Phase III trial that led to FDA approval of the ExAblate MR guided focused ultrasound device for the palliation of painful metastases to bone will be reviewed. In particular, patient selection, the technical aspects of successful patient treatment, and post-treatment assessment of results will be described. Concepts for future development of this technology with regard to the management of osseous metastatic disease will also be presented.

**Quantitative Imaging: Functional MRI (fMRI)**

**Tuesday, 08:30 AM - 10:00 AM • E353A**

**PhD**

**Director**

Michael F McNitt-Gray , PhD (*)

**RC325 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5**

**RC325A • Quality Assessment and Quantitation of Language and Motor fMRI**

James T Vovodyc PhD (Presenter)

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

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

RC325B • More Quantitative fMRI Paradigms for Presurgical Mapping of the Visual System

Edgar A Deyoe PhD (Presenter) *

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

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

RC325C • BOLD Cerebrovascular Reactivity Mapping as Applied to Brain Tumor fMRI

Jay J Pillai MD (Presenter) *

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

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

HCC Diagnosis Using LI-RADS (An Interactive Session)

Tuesday, 08:30 AM - 10:00 AM • E353B

QA MM GI

RC329 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

RC329A • MRI features

Benjamin M Yeh MD (Presenter) *

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

ABSTRACT

RC329B • LI-RADS Principles

Cynthia S Santillan MD (Presenter)

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

ABSTRACT

RC329C • LI-RADS Cases

Reena C Jha MD (Presenter) *

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

ABSTRACT
RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

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

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

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

PURPOSE

To determine the characteristics of prostate cancer foci missed by multi-parametric MRI.

METHOD AND MATERIALS

A HIPPA-compliant, IRB-approved retrospective study of 122 patients with multi-parametric prostate MRI were compared to whole mount prostate obtained after a radical prostatectomy. A standardized classification system (PI-RADS) was used to characterize the multi-parametric MR features based on Linkert scale (1-5). Chi-square analysis was performed for categorical variable and t-test for continuous variable. A p-value of 0.05 was considered significant.

RESULTS

122 patients had 284 unique prostate tumor foci. 149 (52.5%) prostate cancer foci in 74 patients were missed by MRI. 111 (74.5%) were...
The Role of Imaging in Active Surveillance

Anwar R Padhani MD (Presenter) *

LEARNING OBJECTIVES
1) To provide an overview of the concepts underpinning active surveillance (AS) strategies for low risk prostate cancer patients. 2) To illustrate the ability of multiparametric (mp) MRI (diffusion weighted, dynamic contrast enhanced and spectroscopy) to assess tumor burden.

CLINICAL RELEVANCE/APPLICATION
Our findings has implications for the use of standard systematic prostate biopsies in addition to MR-based targeted biopsy for full characterization of tumor burden.

VSGU31-05 • Staging Prostate Cancer with MRI
Neil M Rofsky MD (Presenter)

VSGU31-06 • Identification of Apparent-diffusion-coefficient (ADC) Cut-off Values for the Detection of Lymph Node Metastasis During DWI-MRI in High-risk Prostate Cancer Patients: Implication for Daily Clinical Practice
Marc Regier (Presenter); Christian Seiwerts; Frank Oliver G Henes MD; Hendrik Kooijman *; Hendrik Isbarn; Markus Graeven; Guido Sauter; Gerhard B Adam MD; Lars Budaus

PURPOSE
Recent investigations have outlined a remarkable potential of diffusion-weighted MRI (DWI) to detect lymph node metastases in various tumour entities. Therefore, the purpose of this study was to determine apparent-diffusion-coefficient (ADC) cut-off values for the differentiation of benign and malignant lymph nodes in patients suffering from prostate cancer in a high-risk constellation.

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

RESULTS
Histopathologic analysis revealed nodal metastases in 35.6% (21/59) of all patients. The mean number of lymph nodes removed was 26 in node negative and 24 in node positive patients (p=0.35). In all patients, lymph nodes >4mm were successfully identified at MRI. In malignant lymph nodes the mean ADC was 0.76 x 10^-3 mm^2/s, whereas in benign lymph nodes the mean ADC was 1.43 x 10^-3 mm^2/s (p=0.99) for the differentiation of benign and malignant lymph nodes.

CONCLUSION
In a high-risk collective, DWI with ADC mapping can be used to assess lymph node metastases prior to prostatectomy. Mean and minimum ADC cut-off values of 0.98 x 10^-3 mm^2/s and 0.74 x 10^-3 mm^2/s allow for the discrimination of benign and malignant lymph nodes with high accuracy.

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

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

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

METHOD AND MATERIALS
400 patients who underwent from June 2010 to January 2013 a Mp-MRI examination of the prostate gland for raising PSA serum levels and who were positive for PC at histology, were independently retrospectively evaluated by the same 2 readers who together previously assessed the PI-RADS scoring system, while in the second reading session PI-RADS was employed.

RESULTS
58 patients out of 400 were originally assessed negative for the presence of morpho-functional changes in both peripheral zone (PZ) and central zone (CZ). In the second reading session R.A identified 25 PI-RADS 1, 21 PI-RADS 2 and 12 PI-RADS 3, while R.B 34 PI-RADS 1, 14 PI-RADS 2 and 10 PI-RADS 3 (K = 0.765, P = 0.134).

145 patients out of 400 were originally assessed doubtful for the presence of PC. R.A in 94 out of 145 patients subsequently considered the lesions PI-RADS 4, in 43 men PI-RADS 5 and in 43 PI-RADS 5, while R.B in 84 patients assumed the altered areas PI-RADS 4, in 5 men PI-RADS 5 and in 56 PI-RADS 3 (K = 0.754, P = 0.254)

In the remaining 197 patients the lesions were esteemed similarly suspicious PC in the previous reading session. In the second reading session R.A deemed 156 altered zones as PI-RADS 5 and the other 41 as PI-RADS 4, on the other hand R.B accounted 141 lesions as PI-RADS 5 and 56 as PI-RADS 4 (K = 0.862, P = 0.383).

All in all the sensitivity and specificity of R.A in evaluating the foci of morpho-functional changes increased respectively from 59% to 94% and from 52% to 94% (P=0.025) and for R.B respectively from 47% to 86% and from 41% to 92% (P = 0.038).

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

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

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

Men with negative findings on initial MRI. Discovery of multiple insignificant cancers that often lead to overtreatment. MRI may be used to triage patients who require invasive prostate cancer evaluation.

PURPOSE

Prostate cancer is currently screened by PSA and digital rectal examinations (DRE), and diagnosed by random biopsy resulting in the inadequate training of radiologists for reporting prostate MR.

PI-RADS reported lesions may help reduce the number of unnecessary biopsies. The strong effect of experience emphasizes the need for adequately trained radiologists to interpret MRI-suspicious regions (mSR).

CLINICAL RELEVANCE/APPLICATION

Experience matters: the number of unnecessary biopsies in PI-RADS 5 lesions is reduced by almost half, according to the PPV change.

CONCLUSION

The PPV and NPV were 0.46, 0.50, 0.61, 0.71 and 0.014, 0.0001 respectively.

RESULTS

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

CONCLUSION

Only PI-RADS 4 and 5 lesions require biopsy; inexperienced and experienced readers have sensitivities of 0.96 and 0.98 at this threshold.

Experience matters: the number of unnecessary biopsies in PI-RADS 5 lesions is reduced by almost half, according to the PPV change from 0.71 to 0.84 between inexperienced and experienced readers.

CLINICAL RELEVANCE/APPLICATION

PI-RADS reported lesions may help reduce the number of unnecessary biopsies. The strong effect of experience emphasizes the need for adequately trained radiologists to interpret MRI-suspicious regions (mSR).

VSGU31-10 • Initial Prospective Evaluation of the Prostate Imaging Reporting and Data Standard (PI-RADS)

Geert Litjens MSc (Presenter) ; Nico Karssemeijer PhD * ; Jelle O Barentsz MD ; Henkjan Huisman PhD *

PURPOSE

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

METHOD AND MATERIALS

A consecutive cohort of 254 patients who underwent a detection MRI in 2012 and a subsequent MR guided biopsy were included. All patients were prospectively reported by 1 out of the 10 reporting radiologists according to the PI-RADS guidelines.

Two radiologists are experts (20 and 15 years of experience) and 8 are inexperienced (3 years of experience or less). The inexperienced and experienced readers reported 146 and 108 cases respectively.

The radiologists reported 436 lesions in these patients of which 339 were biopsied. 190 of these 339 were prostate cancer. 127 tumors had a Gleason 4 or higher component and were considered high-grade cancer, all others were considered low grade.

Each lesion received an overall PI-RADS score between 1 and 5. The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated by thresholding at each of the PI-RADS scores with the biopsy results as ground truth. High-grade cancers with a PI-RADS score above or equal to the threshold are true positives. Non-cancers below the threshold were considered true negatives.

RESULTS

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

CONCLUSION

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

CLINICAL RELEVANCE/APPLICATION

PI-RADS reported lesions may help reduce the number of unnecessary biopsies. The strong effect of experience emphasizes the need for adequately trained radiologists to interpret MRI-suspicious regions (mSR).

VSGU31-11 • Negative Predictive Value of Multiparametric MRI for Prostate Cancer Detection: Outcomes of 5-year Follow Up for Men with Negative Findings on Initial MRI

Ryo Itatani (Presenter) ; Tomohiro Namimoto MD ; Shutohar Atsui ; Kazuhiro Katahira ; Shoji Morishita MD ; Kousuke Kitani ; Yasuyuki Hamada ; Mitsuhiko Kitaoka ; Takeshi Nakaura MD ; Yasuyuki Yamashita MD *

PURPOSE

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

METHOD AND MATERIALS

A consecutive cohort of 254 patients who underwent a detection MRI in 2012 and a subsequent MR guided biopsy were included. All patients were prospectively reported by 1 out of the 10 reporting radiologists according to the PI-RADS guidelines.
Between November 2004 and August 2007, there were 622 men who were suspected of harboring prostate cancer and underwent MRI followed by transrectal ultrasound (TRUS)-guided biopsy in our institution. Among them, 255 men with negative findings on MRI were included in our study and their 5-year outcomes were retrospectively assessed. A positive finding by TRUS-guided biopsy was considered as false negative. Patients with neither increase in PSA value nor positive finding on DRE, MRI and TRUS-guided biopsy for 5-year follow up were considered to be true negative. NPV of multiparametric MRI were calculated. For patients undergone radical prostatectomy who had positive finding in biopsy, mean signal intensity (SI) on T2 weighted imaging and mean apparent diffusion coefficient (ADC) value on ADC map of initial MRI were compared between peripheral-zone cancer and normal peripheral zone based on pathologic maps.

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

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

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

VSGU31-12 • A Global Standard for Prostate MRI Reporting

Jelle O Barentsz MD, PhD (Presenter)

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

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

VSGU31-13 • Discussion and Concluding Comments
ABSTRACT
Since MRI was developed, the scanners have made sound while scanning due to activation and de-activation of the magnetic field gradients. As the gradients have become stronger and faster, the sound has become louder. There are a number of implications of the loud sounds, including reports of transient hearing loss by patients (which can be ameliorated by providing hearing protection to the patients), patient anxiety, difficulty communicating with the patients, difficulty keeping infants asleep during scans, interference with measurements of brain activity when performing fMRI scans, as well as a host of other inconveniences. Recently, methods have been developed that allow MR scans to be performed without producing sound. Silent MR scanning will be described during this session. A variety of sequences (designed for different applications) will be summarized, and images obtained with these sequences will be compared with images obtained using standard sequences.

Chest (Functional Lung / Perfusion)
Tuesday, 10:30 AM - 12:00 PM • S404CD

SSG04-01 • CT- PRM: A Novel Imaging Biomarker of Small Airways Disease in Asthma
Ruth Hartley MBBCch, MRCS (Presenter) ; Sherif Gonem ; Jennifer Boes ; Maria Bule ; Sumit Gupta MRCP, PhD ; Christopher Brightling MRCP, PhD ; Brian D Ross PhD * ; Craig J Galban PhD * ; Salman Siddiqui MRCP

PURPOSE
Asthma is a chronic inflammatory airway disease that is characterised by variable airflow obstruction. The parametric response map (PRM) image analysis technique has recently been utilised to differentiate functional small airway disease (fSAD) from emphysema (using image registration techniques) in patients with chronic obstructive pulmonary disease (COPD) [Galban et al, Nature Med 2012]. It is not known whether fSAD or emphysema are features of asthma, or whether they correlate with the degree of airflow obstruction.

METHOD AND MATERIALS
Fifty-two patients with asthma were recruited and underwent inspiratory and expiratory computed tomography (CT). Images were analysed using the PRM algorithm, and the relative lung volumes exhibiting fSAD and emphysema were determined, as well as the centre of mass of the voxel distribution. Lung function was measured using spirometry, and multiple breath inert gas washout (MBW), a technique for measuring ventilation heterogeneity (VH) in the conductive (Scond) and intra acinar (Sacin) small airways. Data is presented as the mean [standard deviation]

RESULTS
The relative volume of fSAD in patients with asthma was 14.3 [10.7], whereas significant emphysema was not observed in patients with asthma (2.9 [3.0]). The ratio of forced expiratory volume in one second to forced vital capacity correlated negatively with fSAD (R = -0.295, p = 0.01). Functional small airway disease, but not emphysema, occurs commonly in patients with asthma, and correlates significantly with spirometric airflow obstruction. Further studies are required to determine if fSAD as measured by PRM on CT may be used to predict prognosis or response to treatment in patients with asthma.

CLINICAL RELEVANCE/APPLICATION
PRM provides an objective quantitative assessment and visualisation of lung disease extent and discriminates between emphysema and functionally important small airways disease.
**SSG04-04 • 3D Non-contrast-Enhanced Perfusion MRI vs. 3D Contrast-enhanced Perfusion MRI vs. Perfusion Scan: Capability for Postoperative Lung Function Prediction in Non-small Cell Lung Cancer Patients**

**Yoshiharu Ohno MD, PhD (Presenter) *; Shinichiro Seki MD; Mizuho Nishio MD MD; Hisanobu Koyama MD; Maho Tsubakimoto MD; Takeshi Yoshikawa MD; Sumiaki Matsumoto MD, PhD *; Katsusuke Kyotani RT; Nobukazu Aoyama RT; Akiko Kusaka RT; Saori Satou RT *; Yoshimori Kassai MS *; Satoshi Sugiu *; Kazuo Sugimura MD, PhD **

**PURPOSE**
To directly compare the capability for postoperative lung function prediction among 3D non-contrast-enhanced perfusion MRI (non-CE-perfusion MRI), 3D contrast-enhanced perfusion MRI (CE-perfusion MRI) and perfusion scan (Q scan) in non-small cell lung cancer (NSCLC) patients.

**METHOD AND MATERIALS**
Seventeen NSCLC patients (10 men and 7 women) underwent non-CE-perfusion MRI, CE-perfusion MRI, Q scan, surgical treatment and pre- and postoperative FEV1% measurements. All non-CE-perfusion MRIs were acquired with a 3D fresh blood imaging obtained with an EC+ -gated 3D half-fourier fast SE sequence using a 3T scanner. On non-CE- and CE-perfusion MRIs and Q scan, each regional perfusion rate in the resected lobe was determined as signal intensity or radioisotope uptake ratio between resected lobe and total lung. Then, each postoperative FEV1% (poFEV1%) was predicted from preoperative FEV1% and regional perfusion rate in the resected lobe. To determine the capability of non-CE-perfusion MRI for regional perfusion assessment, regional perfusion rate of non-CE-perfusion MRI was statistically correlated with that of CE-perfusion MRI and Q scan. To determine the capability for prediction of postoperative lung function among three methods, each predicted poFEV1% was correlated with actual poFEV1%. Finally, the limits of agreement (mean difference±1.96×standard deviation) between actual and each predicted poFEV1% was also evaluated by Bland-Altman analysis.

**RESULTS**
Regional perfusion rate of non-CE-perfusion MRI had significant and excellent correlations with that of CE-perfusion MRI (r=0.92, p<0.01) and poFEV1% predicted by non-CE-perfusion MRI (r=0.91, p<0.01). Non-CE-perfusion MRI has better capability for postoperative lung function prediction than perfusion scan, and is considered at least as valuable as CE-perfusion MRI in NSCLC patients.

**CLINICAL RELEVANCE/APPLICATION**
Non-CE-perfusion MRI has better capability for postoperative lung function prediction than perfusion scan, and is considered at least as valuable as CE-perfusion MRI in NSCLC patients.

**SSG04-05 • Fluorine-19 MRI: A New Functional Pulmonary Imaging Modality**

**Marcus J Couch MSc, BSc; Iain K Ball; Tao Li; Matthew S Fox; Birubi Biman; Mitchell S Albert PhD (Presenter)**

**PURPOSE**
Fluorine-19 (19F) magnetic resonance imaging (MRI) of the lungs using inhaled inert fluorinated gases can provide images that are similar in quality to hyperpolarized (HP) noble gas MRI. Inert fluorinated gases are nontoxic, abundant, inexpensive, and they have short longitudinal relaxation times. As a result, there is sufficient thermally polarized signal for imaging, and the gases do not need to be hyperpolarized prior to their use in MRI. The purpose of this study was to optimize image acquisition strategies and breathing protocols for imaging of human lungs with inert fluorinated gas MRI.

**METHOD AND MATERIALS**
Imaging was performed using a 3.0T Philips Achieva scanner and a flexible wrap-around quadrature transmit/receive coil (Clinical MR Solutions). Eleven healthy volunteers were enrolled in this study with no history of lung diseases. Breathing protocols were optimized for imaging with an inhaled gas mixture of 79% perfluoropropane (PFP) and 21% O2. 3D 19F images were acquired using ultra-short echo time (UTE) and gradient echo techniques.

**RESULTS**
In one representative subject, the signal-to-noise ratio (SNR) in the center slices was 37±4 for UTE, and 29±6 for gradient echo images. In both cases, the SNR was more than a factor of 2 larger than the SNR reported by Soher et al. (Proc. ISMRM, 2010). Overall, the SNR from UTE images was significantly different from gradient echo images (p=0.02). UTE images had a superior SNR; however, they suffered from poor edge detail due to the nature of the data acquisition.

**CONCLUSION**
Overall, 19F MRI using inert fluorinated gases is a new pulmonary imaging modality that can provide valuable spatially localized and functional information without the need for scarce noble gas isotopes, an expensive polarizer, or ionizing radiation. This preliminary study demonstrates the potential of 19F MRI for visualizing the distribution of ventilation in human lungs, and this may be a viable clinical imaging modality that can provide useful information for the diagnosis of chronic respiratory diseases.

**CLINICAL RELEVANCE/APPLICATION**
Inert fluorinated gas MRI can cheaply and efficiently obtain high quality images of the lungs, and it can potentially be performed on patients with chronic respiratory diseases.

**SSG04-06 • Crus Atrophy: Accuracy of CT in Diagnosis of Diaphragmatic Paralysis**
Thermo-ablation

SSG04-07 • Reproducibility of Breath-hold and Free-breathing Quantitative Pulmonary Perfusion MRI

Daniel Maxien MD (Presenter) ; Michael Ingrisch ; Felix G Meinel MD ; Maximilian F Reiser MD ; Olaf Dietrich PhD ; Konstantin Nikolaou MD *

PURPOSE
Examinations in breath hold (BH) are often difficult for patients suffering from lung diseases. Recently the quantitative assessment of pulmonary perfusion using dynamic contrast-enhanced (DCE)-MRI with a measurement during free breathing (FB) was demonstrated. In this study, we compared the reproducibility of the quantitative assessment of pulmonary perfusion during FB with the reproducibility of the gold standard BH measurements.

METHOD AND MATERIALS
10 healthy, male volunteers underwent DCE-MRI on a 1.5T scanner for the assessment of pulmonary perfusion, using an accelerated 3D view sharing gradient-echo sequence. Each volunteer was examined twice at intervals of one week +/- one day. Of these two examinations included a BH and a FB DCE-MRI acquisition, at intervals of at least 20min. Hence, 40 DCE MRI datasets were acquired in total. Pulmonary plasma flow (PPF) and pulmonary plasma volume (PPV) were determined pixel-wise, using a one-compartment model. For FB and BH measurements, the intra-class correlation coefficient (ICC) and the coefficients of variation (CV) between first and second measurement were calculated to assess test-retest reproducibility. Differences of CV between FB and BH measurements were assessed with a non-parametric, paired two-sided Wilcoxon signed rank test. Reproducibility R of PPF and PPV was calculated as root-mean-square average of CV.

RESULTS
The ICC for both measured quantitative parameters was lower during BH than in FB technique (PPF: 0.37 vs. 0.69; PPV: 0.69 vs. 0.84). Additionally, the R values of the BH measurements were higher than the corresponding R values of the FB measurements (PPF 0.32 vs. 0.16; PPV: 0.18 vs. 0.10). Overall, CV is significantly lower for the FB measurements both for PPF (p=0.008) and PPV (p=0.03). ICC values of PPF and PPV are higher for FB than for BH measurements and test-retest reproducibility is significantly better (p<0.05). A free-breathing measurement of pulmonary perfusion is suitable for the quantification of pulmonary perfusion and leads to parameter estimates with a better reproducibility than the conventionally used measurements during breath hold.

CLINICAL RELEVANCE/APPLICATION
Regarding the reproducibility, this study demonstrates that the desirable quantitative assessment of pulmonary perfusion during free breathing might be superior to the common breath hold technique.

SSG04-08 • Hyperpolarized ³He Magnetic Resonance Imaging Temporal-spatial Maps of Asthma to Guide Endobronchial Thermo-ablation

Sarah Svenningsen BSC (Presenter) ; Miranda Kirby PhD ; Stephen Choy MD ; Andrew Wheatley ; David McCormack MD ; Grace Parraga PhD

PURPOSE
Pulmonary functional imaging using hyperpolarized ³He magnetic resonance imaging (MRI) provides a way to map heterogeneous ventilation abnormalities that are regionally and temporally persistent in asthma. Bronchial thermoplasty is a novel asthma treatment that aims to reduce smooth muscle mass in the lobar and segmental bronchi, with the goal being improved symptoms and asthma control. Currently, treatment is not guided by imaging to specific airway abnormalities. The purpose of this study was to exploit the image-guidance potential of ³He MRI by developing lung function maps that spatially identify airway abnormalities in asthma.

METHOD AND MATERIALS
For a severe asthmatic, temporally persistent ventilation defects were observed on two visits 8 months apart after thermo-ablation therapy was completed. To improve the efficacy of thermoablation and decrease treatment time and cost, we investigated the potential for temporally persistent lung function maps to guide therapy in asthmatics (n=7, 28±9 yr) who were evaluated using hyperpolarized ³He MRI three times, 7±2 days apart. Temporal maps were generated from ventilation images acquired on three occasions by co-registering ³He MRI after segmenting ³He voxel intensities using a modified k-means cluster algorithm. Corresponding, co-registered voxels were classified as 1) persistent defect, 2) intermittent defect, 3) partial ventilation, and 4) persistent ventilation. The temporal map was registered to thoracic CT to enable structure-function comparisons and help guide therapy to specific ventilation defects.

RESULTS
We present a ³He MRI temporal-spatial lung function map co-registered to a CT-derived airway tree for a single asthmatic. Regions-of-interest (ROI) were identified with persistent and intermittent defects as appropriate targets for treatment, whereas ROI with partial or full ventilation were also identified as regions that should be avoided.

CONCLUSION
Personalized temporal-spatial lung function maps of asthma can be generated to display functional abnormalities observed over time and
Gastrointestinal (Hepatic Steatosis Imaging)

Tuesday, 10:30 AM - 12:00 PM • E350

**SSG06 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5**

**Moderator**

Shahid M Hussain , MD *

**Moderator**

Alvin C Silva , MD

**Moderator**

Bachir Taouli , MD *

**Subjects**

Gastrointestinal (Hepatic Steatosis Imaging)

Francesco Molinari MD (Presenter) ; Paul Felloni MD ; Francois Pontana MD ; Nunzia Tacelli MD ; Teresa Santangelo ;
Martine J Remy-Jardin MD, PhD *

**PURPOSE**

To evaluate the characteristics of pulmonary blood volume (PBV) on dual-source, dual-energy chest CT examinations.

**METHOD AND MATERIALS**

Eligibility to this study required (a) the absence of respiratory disease after a diagnostic work-up including a dual-source, dual-energy chest CT angiographic examination; (b) rated with an excellent image quality (i.e., excellent quality of vascular opacification; no respiratory motion artifacts); and (c) obtained on the same CT unit (Definition Flash, Siemens Healthcare). Over a 2 year-period, 42 patients (mean age: 43.05 yr) fulfilled these criteria, enabling analysis of PBV in the following conditions: (a) collimation: 32x2x0.6 mm; rotation time: 0.28 s; pitch: 0.5; caudo-cranial acquisition without modulation of milliampere; (b) administration of 80 mL of a 40% contrast agent followed by 40 mL of a diluted contrast agent (70% NaCl; 30% iodine) at a flow rate of 4mL/s. Qualitative analysis was based on visual assessment. Quantitative analysis measured the (a) iodine concentration per lung (IPIPE software; Siemens) and (b) regional distribution of iodine after semi-automatic division of each lung into 18 areas (OSIRIX).

**RESULTS**

**CONCLUSION**

Distribution of PBV is influenced by physiological gradients and scanning conditions.

**CLINICAL RELEVANCE/APPLICATION**

This study provides quantitative information on lung perfusion in the conditions of standard evaluation of normal subjects.

**SSG06-01 • Slower Hepatic Metabolic Rates in NASH Patients Revealed by the Fast and Localized 31P Saturation Transfer at 7T**

Siegfried Trattnig MD (Presenter) ; Ladislav Valkovic PhD ; Martin Gajdosik MSc ; Stefan A Traussnigg ; Marek Chmelik MS ; Ivan Frollo ; Michael Trauner ; Martin Krssak PhD

**PURPOSE**

Invasive liver biopsy is the only method currently used to distinguish between relatively benign non-alcoholic fatty liver (NAFL) and potentially progressive steatohepatitis (NASH). Phosphorus magnetic resonance spectroscopy (31P-MRS) combined with saturation transfer (ST) enables non-invasive measurement of metabolic activity at rest in vivo, which is indicative for inflammatory liver diseases. Therefore the aim of this study was to test the feasibility of ST at 7T for non-invasive distinction of NAFL and NASH.

**METHOD AND MATERIALS**

In addition to routine MR examination of the liver with dynamic contrast enhancement (Gadoterate meglumine; Dotarem, Guerbet, France) 31P-MRS ST measurements of ten suspected NAFL/NASH patients (6m/4f, a=49.5±13.2y) were performed one day prior the liver biopsy. Additionally four healthy males (a=25.3±2.9y) were measured as controls. Examinations were performed in morning sessions after overnight fasting on a 7T MR system (Siemens Healthcare, Erlangen, Germany) using 1H/31P surface coil. The reaction rate between inorganic phosphate (Pi) and adenosine-tri-phosphate (ATP) was calculated from liver spectra acquired w/o saturation of G-ATP and the apparent longitudinal relaxation (T1app) was measured with inversion-recovery sequence with G-ATP saturation. The forward rate constant (k) and metabolic flux (F) were correlated with histology, regarding disease status and steatosis degree.

**RESULTS**

The patient group was resolved by the histological diagnosis into fatty liver (NAFL; n=4) and steatohepatitis (NASH; n=6) subgroups. The NAFL patients had significantly lower k and F values when compared to NASH (p=0.001) and also to healthy volunteers (p=0.002), with no overlap between the NAFL and NASH subgroups. Furthermore, the forward rate constant of the chemical exchange between Pi and ATP as determined by the ST experiment correlated well with the histologically assessed steatosis degree.

**CONCLUSION**

Liver Pi-ATP exchange, measured in vivo by the ST technique at 7T, is decreased in NASH in comparison to NAFL patients and controls. This is connected to the lower exchange rate constant and might provide a clinical tool for future investigations of the NASH and NAFL disease progression.

**CLINICAL RELEVANCE/APPLICATION**

31P-MRS ST measurement reveals differences in hepatic metabolic rates in patients with steatohepatitis and fatty liver. In the long run this technique may replace invasive liver biopsy.

**SSG06-02 • Quantification of Liver Iron Overload and Steatosis at 3T**

Anne Boulic (Presenter) ; Anita Kiani ; Edouard Bardou-Jacquet ; Bruno Turlin MD ; Herve Saint-Jalmes PhD ; Yves Gandon MD

**PURPOSE**

To evaluate quantification of both liver iron overload and steatosis with a multi-echo gradient echo MR sequence at 3T, compared to liver biopsy as a gold standard.

**METHOD AND MATERIALS**

Following consent, 105 patients (68 men and 37 women, mean age 52 years; range 18-75) needing a liver biopsy mainly for metabolic liver disease were investigated at 3T. A single breath-hold gradient-recalled echo (GRE) sequence (body coil, TR=120 ms, FA=20°) was acquired for each patient with 11 TE multiples of 1.15 ms or 1.23 ms depending on whether an Achieva (Philips) or Verio (Siemens)
system was used. Liver to muscle (L/M) signal intensity ratio and several T2* maps (overall, in-phase, out-of-phase) were calculated. An L/M algorithm based on 5 echoes was defined similarly to the one described at 1.5T. MR Fat fraction (FF) was estimated by the Dixon methods without and with the T2* correction methods. MR results were correlated with biochemical liver iron concentration (LIC) and steatosis METAIVAR grade.

RESULTS
66 patients had liver iron overload ranging from 36.1 to 629 μmol/g and 37 had a steatosis grade above 20%. There was a strong linear correlation (R²=.94) between the L/M algorithm and LIC, including in heavily overloaded livers. An exponential correlation was also observed between LIC and T2* (R²=.84) up to a maximum of 150 μmol/g. Subsequently, under 2 ms, T2* became difficult to assess. FF was better correlated with steatosis grade (R²=.6) when using T2* correction methods which partially reduced the calculation errors observed in the case of combined overload. The correlation was further improved (R²=.77) by selecting patients with LIC below 150 μmol/g.

CONCLUSION
A single breath-hold GRE multi-echo sequence allows simultaneous quantification of LIC and FF. A combined evaluation is essential to avoid calculation errors. Similarly to 1.5T, an algorithm for calculating liver iron concentration at 3T has been developed.

CLINICAL RELEVANCE/APPLICATION
A single breath-hold GRE multi-echo sequence allows simultaneous and accurate quantification of liver iron overload and liver steatosis at 3T.

SSG06-03  A Multiparametric Approach Combining T2-corrected IVIM, MR-DCE Imaging and Fat Volume Fraction Quantification to Evaluate Chronic Liver Diseases at 3.0T

Benjamin Lepora MS (Presenter); Frank Pilleul MD; Jerome Dumortier; Pierre-Jean Valette MD; Olivier Guillaud; Thibaud Lefort; Olivier Beuf PhD

PURPOSE
To evaluate a multi-parametric approach combining T2-corrected IVIM, MR-DCE imaging and a fat content quantification method for chronic liver diseases assessment at 3.0T.

METHOD AND MATERIALS
3 algorithms were developed: (i) a Fat Volume Fraction (FVF) quantification algorithm correcting for relaxation time effects using a disjointed estimation of T1 and T2* of fat and water and accounting for the NMR spectrum of fat; (ii) an algorithm to quantify perfusion parameters including a rigid image registration procedure, an auto-calibrated tracer concentration quantification method based on a T1 precontrast mapping and a modeling step using a non-linear least square fit on a modified IVIM model including liver and blood T2 decays; (iii) an algorithm to quantify IVIM parameters using a non-linear least square fit on a modified IVIM model including liver and blood T2 decays. Validations were performed on a prospective study including 14 patients with chronic liver diseases.

RESULTS
Based on Wilcoxon's test: FVF allowed to distinguish between all histological grade of steatosis. DSlow significantly decrease in patients with steatosis without fibrosis. Hepatic perfusion index allowed to distinguish between non fibrosis, non-advanced fibrosis and advanced fibrosis. Portal and total perfusion, DFast, and mean transit time allowed to distinguish between non-advanced and advanced fibrosis. A significative correlation was found between DFast and portal perfusion or total perfusion (\( R^2 = 0.86 \) and 0.81 respectively; \( p < 0.05 \))

CONCLUSION
Perfusion parameters given by MR-DCE imaging alone are relevant to evaluate fibrosis severity whereas fat overload constitute a confounding factor for fibrosis evaluation using IVIM when NAFLD and chronic hepatitis are mixed. The combination of IVIM and MR-DCE imaging do not bring additional information for fibrosis assessment in a wide spectra of etiologies. Since IVIM can give information about both hemodynamic changes and molecular diffusion restriction associated to liver fibrosis, IVIM could be a useful injection-free method to distinguish between pure steatosis and NASH in patients with NAFLD, combined with a suitable MR quantification method.

CLINICAL RELEVANCE/APPLICATION
Non-invasive chronic liver disease assessment using a MR multiparametric approach.

SSG06-04  Correlation of Quantitative Ultrasound Backscatter with 3T MRI-estimated Proton Density Fat Fraction (PDFF) for Assessment of Hepatic Steatosis

Abdullah T Alturki MD, MBBS (Presenter); Aiguo Han MS; Jessica Lam BS; Jonathan C Hooker BS; Amol Shah BS; Kevin A Zand MD; Michael S Middleton MD, PhD*; William D. O’Brien PhD; Rohit Loomba MD, MSc; Claude B Sirlin MD*; Michael P Andre PhD*

PURPOSE
To correlate quantitative ultrasound (QUS) backscatter coefficient (BSC) with 3T MRI proton density fat fraction (PDFF) as indicators of hepatic steatosis in a cohort of adults with known or suspected non-alcoholic fatty liver disease (NAFLD).

METHOD AND MATERIALS
This single site, cross-sectional, pilot study was IRB approved and HIPAA-compliant. In this study, T1-independent, T2* corrected breath-hold MRI was performed on a 3T GE Signa MR scanner to assess hepatic steatosis. Immediately before or after MRI, QUS measurements were made in the deep portion of liver segments VII-VIII using a right intercostal approach with the subject in a dorsal decubitus position and the subject's right arm at maximum abduction. Ultrasound imaging was performed during shallow breath-hold inspiration using a mechanical index of ~1.7. A Siemens S2000 scanner with 4C1 transducer was used to record raw full-bandwidth RF signals via the research interface for offline post-processing analysis. QUS procedure time was five minutes or less. The frequency range 2.2 - 2.6 MHz was selected to compute BSC for each patient.

RESULTS
CONCLUSION
These early results are encouraging for QUS BSC potentially being able to detect early NAFLD and to monitor its progression using a simple, inexpensive ultrasound technique. Additional recruitment of subjects is anticipated to increase sample size and explore further this interesting preliminary result.

CLINICAL RELEVANCE/APPLICATION
Non-invasive ultrasound that is sensitive to early stage NAFLD and capable of staging progression would be an invaluable tool for clinical care, clinical trials and drug development.

SSG06-05  Accuracy of Spectrally-corrected MRI 2-echo and 6-echo Proton Density Fat Fraction (PDFF) in Measuring Longitudinal Hepatic PDFF Change Using MRS PDFF as Reference

Abdullah T Alturki MD, MBBS (Presenter); Tanya Wolfson MS; Jessica Lam BS; Gavin Hamilton PhD; Claude B Sirlin MD*; Michael S Middleton MD, PhD*

PURPOSE
To measure accuracy of longitudinal differences in 2-TE and 6-TE spectrally corrected MRI hepatic PDFF using MRS differences as reference.

METHOD AND MATERIALS
RESULTS

CONCLUSION
Cross-sectional and longitudinal accuracy were high for both MRI methods with MRS as reference, and PDFF differences between time points for 2-TE, 6-TE, and MRS were comparable.

CLINICAL RELEVANCE/APPLICATION
Since longitudinal 2-TE and 6-TE PDFF differences were comparable, spectrally corrected 2-TE MRI may suffice in some clinical and research settings to assess hepatic steatosis.

SSG06-06 • Quantification of Liver Fat at 3 Tesla: Intraindividual Comparison of Two Modified Dixon Techniques with MR Spectroscopic T2 Relaxometry and Histopathology

Guido M Kukuk MD (Presenter) *; Frank Traeber; Alois Martin Sprinkart MSc; Wolfgang Block; Holger Eggers PhD *; Winfried A Willinek MD *; Verena Sailer MD; Hans H Schild MD

PURPOSE
To assess the accuracy of dual-echo and multi-echo modified Dixon techniques for the in-vivo quantification of liver fat in comparison with MR spectroscopic and histopathologic determination of the fat fraction.

METHOD AND MATERIALS

RESULTS
21/43 patients had a hepatic fat fraction of more than 5% as determined by MRS, with a maximum of 47% and a mean value of 18%. Bland-Altman analysis revealed good agreement between 6-point mDixon and MRS, with a mean difference of only 1.6% and a Pearson correlation of r=0.982 (p<0.000). 2-point mDixon slightly underestimates hepatic fat fraction in comparison to 6-point mDixon, which excellently matches the results from MR spectroscopy and histopathology.

CONCLUSION
The 6-point mDixon method allows accurate in-vivo determination of liver fat contents at 3 Tesla.

SSG06-07 • Comparison of Single Slice Low-dose and Full-dose Nonenhanced CT Protocols for Evaluation of Pathology Proven Hepatic Steatosis

Michael Y Park MD (Presenter); Joon-II Choi; Seung Hwan Lee; Young Joon Lee MD; Seung Eun Jung MD; Jae Young Byun MD

PURPOSE
To determine the effects and adequacy of using a single slice low-dose nonenhanced CT protocol for evaluation of hepatic steatosis.

METHOD AND MATERIALS

RESULTS
The median (IQR; interquartile range) of HAT was 59 (57.00~62.50) HU in the low-dose normal group and 51.33 (48.33~54.84) HU in the full-dose normal group, showing a statistically increased value (P<0.0001) in the low-dose group. The median (IQR) of CTL-S was 7.75 (3.00~11.25) HU in the low-dose normal group and 7.63 (4.50~11.02) HU in the full-dose normal group, and did not show a statistical difference. Using a CTL-S cutoff value of less than or equal to 1 HU resulted in a 100% sensitivity, 86.03% specificity, 24% PVV, and 100% NPV for screening fatty liver patients using low-dose protocols. Using a CTL-S cutoff value of less than or equal to 1.83 HU resulted in a 100% sensitivity, 86.67% specificity, 18.2% PVV, and 100% NPV for screening fatty liver patients using full-dose protocols.

CONCLUSION
CTL-S is a more stable value than HAT for evaluation of hepatic steatosis when using differing CT dose protocols. The threshold value and efficiency for CTL-S to evaluate moderate to severe hepatic steatosis when using single slice low-dose protocols is similar to that of full-dose protocols.

CLINICAL RELEVANCE/APPLICATION
This study shows that using single slice low-dose nonenhanced CT protocols for screening the fatty liver patients were determined.

SSG06-08 • Non Invasive Quantification of Hepatic Steatosis in Living, Related Liver Donors Using Dual Echo Dixon Imaging and Single Voxel Proton Spectroscopy

Sonal Krishan MD (Presenter); Yogesh Bathina

PURPOSE
To evaluate the diagnostic implications of hepatic fat fraction calculated using dual echo Dixon imaging and 1-H MR spectroscopy technique to detect hepatic steatosis in potential liver donors using histopathology as the reference standard.

METHOD AND MATERIALS
106 potential liver donors were included. MRI was performed on a 1.5-T scanner using a three-dimensional dual echo MRI sequence with automated reconstruction of in-phase (IP), out-of-phase (OP), fat-signal-only and water-signal-only images. Hepatic fat fraction was calculated by drawing 15 regions of interest on the IP, OP, fat only and water only images. Single voxel MR spectroscopy was performed at TEs of 30 and 20 in right as well as the left lobe of liver. Liver fat fraction was calculated from water and fat peaks. 106 biopsies were prospectively evaluated for steatosis by a pathologist using traditional determination of the cell-count fraction. MRI and pathology values of steatosis were correlated using the Pearson correlation coefficient. Sensitivity and specificity of each of these methods was calculated using histopathology as gold standard.

RESULTS

CONCLUSION
Combination of dual echo Dixon imaging and proton spectroscopy is a useful tool for the preoperative diagnosis of hepatic steatosis in potential living liver donors. This can help avoid unnecessary biopsies in these patients.

CLINICAL RELEVANCE/APPLICATION
This study provides evidence for the use of noninvasive MRI based methods to assess hepatic steatosis in evaluation of potential liver donors and further avoiding unnecessary liver biopsies.

SSG06-09 • Combined Use of Magnetic Resonance Fat Quantification and Magnetic Resonance Elastography in Liver Living
Donors: Can It Reduce Need for Preoperative Liver Biopsy?

Jeong Hee Yoon MD (Presenter); Jeong-Min Lee MD *; Inpyeong Hwang MD; Joon Koo Han MD; Byung Ihn Choi MD, PhD *

PURPOSE
To determine whether combination of magnetic resonance (MR) fat quantification tools and MR elastography (MRE) can reduce the necessity of preoperative liver biopsy (LB) in living liver donor candidates.

METHOD AND MATERIALS
This retrospective study was approved by institutional review board and informed consent was waived. From January to December 2012, 124 living liver donor candidates (M:F=80:44, age range 16-61 years) underwent MRE at 1.5T and MR fat quantification tools such as 3 point Dixon method and spectroscopy (MRS) at 3T. Among them, 115 patients underwent operations and the others did not for following reasons: deceased donor (n=3); revocation of donation (n= 2); death of potential recipient (n=1); detection of other diseases during work-up (n=3). Sensitivity, specificity, positive predicted value (PPV) and negative predicted value (NPV) were obtained for detecting significant fibrosis (=F2) or significant hepatic steatosis (>10%). On MRE, cut-off values were set as 2.5kPa=, according to the previous study of nonalcoholic steatohepatitis. On liver fat quantification map or MRS, cut-off values were 5%= due to known underestimation of fat quantification on MR.

RESULTS
Combination of MR fat quantification and MRE is a good surveillance tool for determining necessity of LB in living donor candidates.

CLINICAL RELEVANCE/APPLICATION
Combined use of MR fat quantification and MRE could select liver biopsy cases among liver donor candidates, and therefore, can reduce the necessity of biopsy which has potential of morbidity and morta

Molecular Imaging (Subspecialties)

Tuesday, 10:30 AM - 12:00 PM • S504CD

SSG09 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1

Vikas Kundra, MD, PhD *

SSG09-01 • Noninvasive Assessment of Myocardial Inflammation by Cardiac Magnetic Resonance Imaging in a Rat Model of Cardiorenal Syndrome Type IV

Di Chang (Presenter); Sheng Hong Ju MD, PhD

PURPOSE
Cardiorenal syndrome (CRS) type IV is a condition of primary chronic kidney disease (CKD) worsening cardiac function, which in turn further accelerates the failure progression of both. Monocyte-macrophages contribute to the inflammatory progression caused by CKD. The purpose of this study was to detect and quantify macrophage-related inflammation within the inflamed heart in a CRS type IV rat model using magneto-fluorescent nanoparticles (MNPs) enhanced, high-resolution cardiac magnetic resonance (CMR) imaging.

METHOD AND MATERIALS

RESULTS
MNPs enhanced CMR imaging can noninvasively assess myocardial monocyte-macrophages burden and potentially monitor therapy-mediated myocardial changes in CRS type IV.

CLINICAL RELEVANCE/APPLICATION

SSG09-02 • Black Blood 3D DCE-MR to Examine Permeability and Predict Nanoparticle Targeting in Experimental Atherosclerosis

Mark E Lobatto MD (Presenter); Claudia Calcagno PhD; Antoine Millon; MaxSenders; Francois Fay PhD; Phil Robson PhD; Sarayu Ramachandran MS; Erik Store MD, PhD; Zahi A Fayad PhD *; Willem J Mulder MS, PhD

PURPOSE
Atherosclerotic disease is a major cause of global morbidity and mortality that might benefit from targeted therapy to the vessel wall1. Recent studies have shown efficient and local drug delivery with nanoparticles, though the targeting method in atherosclerosis has not been clarified2. In the current study we used in and ex vivo imaging methods to investigate nanoparticle targeting and the role of permeability in a rabbit model of atherosclerosis. 1Tabas I, Glass CK, Science 2013 2Lobatto ME et al. Nat Rev Drug Discovery 2011

METHOD AND MATERIALS
To achieve this we developed a novel black-blood 3D Dynamic Contrast Enhanced (DCE)-MRI technique that allows the assessment of endothelial permeability over a large vascular region, e.g. the infra-renal aorta of an atherosclerotic rabbit. Atherosclerotic rabbits (n=8) were subjected to a DCE-MRI scan on a 3T clinical scanner and injected with nanoparticles labeled with the fluorescent dye Cy7 (Cy7-LN) that we allowed to circulate different time points (½-hour, 6 hours and 24 hours). Next, we injected a fluorescent dye (Evans Blue (EB)) that extravasates at sites with enhanced permeability, after which rabbits were sacrificed. Near infrared fluorescence imaging was then used to quantify both Cy7-LN and EB in excised aortas.

RESULTS
Excellent correlation was observed between the accumulation of Cy7-LN at a ½-hour and permeability determined with EB (r²=0.8,p=0.65, p=0.47,p=0.007; DCE: r²=0.53,p=0.003), but became insignificant after 24 hours (EB: r²=0.08,p=0.33; DCE: r²=0.08,p=0.33). With fluorescence microscopy we found Cy7-LN confined to the vasculature when circulated for a ½-hour, while gradual extravasation from the lumen and neovessels was seen at 6 hours. At 24 hours LN was found diffusely throughout the plaque, clarifying the aforementioned decrease in correlation between LN accumulation and endothelial permeability.

CONCLUSION
3D DCE-MRI allowed the visualization of permeability within atherosclerotic plaques, which similarly correlated with nanoparticle uptake.

CLINICAL RELEVANCE/APPLICATION
As nanoparticles may be employed for local drug delivery to atherosclerotic plaques, 3D DCE-MRI might be a valuable in vivo tool to predict if a subject is amenable to nanoparticle therapy.
Inflammation Imaging Using Molecular Ultrasound in an Acute Terminal Ileitis Model in Swine

**Felix Nensa** MD (Presenter); **Thorsten D Poeppel**; **Karsten J Beiderwellen** MD; **Juliane Schelhorn** MD; **Amir A Mahabadi** MD; **Philipp Heusch** MD; **Kai Nassenstein**; **Michael Forsting** MD; **Thomas W Schlosser** MD

**PURPOSE**
To assess the feasibility of hybrid imaging of the heart with 18F-fluorodeoxyglucose (18F-FDG) on an integrated 3 Tesla PET/MRI system and to discuss its potential clinical impact.

**METHOD AND MATERIALS**
Twenty patients with confirmed acute myocardial infarction underwent 18F-FDG PET/MRI with oral glucose loading within 2-7 days after interventional revascularization. Tracer accumulation in each myocardial segment was compared to regional wall motion abnormalities and to signal intensity in late gadolinium-enhanced (LGE) images with Cohen’s r statistics. The size of the infarction zone was measured on LGE and PET images. In 10 patients additional PET/CT imaging was performed and PET data was visually and semi-quantitatively (SUV$_{max}$) compared between PET/CT and PET/MR.

**RESULTS**
Absolute parallelized scan time was 71±3 min. Categorical inter-method agreement between PET and LGE over all patients and segments was 0.83, and 0.81 between PET and cine imaging. On average 20±17% of the entire left ventricular myocardium was classified as infarcted in PET images and 19±19% in LGE images (p=0.65). Bland-Altman analysis of tracer uptake in PET/MR and PET/CT yielded limits of agreement of -3.04 to 3.65 (SUV$_{max}$: 6.51±3.42 vs. 6.82±3.16; p=0.21), the coefficient of variation was 0.18.

**CONCLUSION**
Cardiac PET/MRI in patients with acute myocardial infarction is feasible on an integrated PET/MR scanner. Comparison of PET images from PET/CT and PET/MRI showed good concordance. A close match between PET and MRI regarding myocardial viability and infarct quantification was demonstrated. Further study will show, if hybrid PET/MRI with 18F-FDG yields added value in patients with ischemic cardiac disease.

**CLINICAL RELEVANCE/APPLICATION**
Cardiac PET/MRI provides quantitative information on metabolic processes that might be incorporated into cardiac MRI protocols to improve risk stratification in acute myocardial infarction.

Non-invasive Assessment of Inflammation in a Murine Model of Chronic Inflammatory Bowel Disease Using Ultrasound Molecular Imaging

**Ferdinand Knieling** (Presenter); **Steven B Machtaler** PhD; **Thierry Bettinger** *; **Richard Luong**; **Huaijun Wang** MD, PhD; **Juergen K Willmann** MD *

**PURPOSE**
Ultrasound (US) molecular imaging has shown promising results in imaging inflammation in murine models of acute inflammatory bowel disease (IBD). The purpose of this study was to evaluate the feasibility of US molecular imaging using a clinically translatable microbubble (MB) targeted to the inflammation markers P- and E-selectin (MBselectin) for monitoring inflammation in a chronic and a chronic flare model of murine colitis.

**METHOD AND MATERIALS**
Acute colitis was established by rectal 2,4,6-trinitrobenzene sulfonic acid (TNBS) administration in 23 mice. Chronic colitis was established by 3 repetitive cycles of oral dextran sodium sulfate (DSS) administration in an additional 23 mice; an acute inflammatory flare in the chronic colitis mice was simulated by rectal TNBS injection. All mice were imaged in contrast mode following i.v. injection of 5x107 MBselectin and control microbubbles (MBcontrol) using a 21 MHz transducer (VisualSonics). In vivo imaging results were correlated with ex vivo immunofluorescence and histology.

**RESULTS**
Selectin-targeted US molecular imaging allows inflammation assessment in acute inflammation and chronic flare models of IBD in mice, which may simulate different disease states seen in patients with IBD.

**CLINICAL RELEVANCE/APPLICATION**
US molecular imaging is a clinically translatable approach to quantitatively assess inflammatory flares in both early and late stage IBD.

Inflammation Imaging Using Molecular Ultrasound in an Acute Terminal Ileitis Model in Swine

**Huaijun Wang** MD, PhD (Presenter); **Stephen A Felt** DVM, MPH; **Ismayil Guracar** *; **Steven B Machtaler** PhD; **Thierry Bettinger** *; **Juergen K Willmann** MD *

**PURPOSE**
To translate ultrasound (US) molecular imaging using a clinical grade contrast microbubble targeted at the inflammation markers P- and E-selectin (MBselectin) to a large animal model of acute terminal ileitis.

**METHOD AND MATERIALS**
An acute terminal ileitis porcine model was established in 9 female pigs using intraluminal 2,4,6-trinitrobenzene sulfonic acid (TNBS) installation. All pigs were imaged before (control), and 48 hours after induction of ileitis. US molecular imaging was performed after i.v. injection of either MBselectin or non-targeted MBcontrol at a dose of 5x10^7/kg b.w. each using a clinical US machine (Acuson Sequoia S12; Siemens) and a clinical transducer (15L8W; 7MHz). Four minutes after MB injection, images were acquired for 10 sec, followed by a 3-sec high power destruction pulse; this was followed by another 10-sec acquisition. Linearized imaging signal was expressed as intensity ratio using MBselectin and control microbubbles (MBcontrol) using a 21 MHz transducer (VisualSonics). In vivo imaging results were correlated with ex vivo immunofluorescence and histology.

**RESULTS**
US molecular imaging of the terminal ileum was feasible in all 9 pigs. Imaging signal intensity ratio using MBselectin was significantly higher (increased by 106%, P=0.005) in acute ileitis compared to normal control ileum. Also, imaging signal in acute ileitis using MBselectin was significantly higher (increased by 103%, P=0.002) compared to MBcontrol. US imaging signal was not significantly different (P=0.06) when using MBselectin or MBcontrol in normal control ileum. Ex vivo analysis on HandE stained tissue samples confirmed strong inflammation in the terminal ileum. Immunofluorescence showed overexpression of selectins on the vasculature of inflamed bowel.

**CONCLUSION**
US molecular imaging with MBselectin can be translated to large animal imaging in an acute terminal ileitis porcine model and molecular US imaging signal correlates well with extent of inflammation on histology.

**CLINICAL RELEVANCE/APPLICATION**
The feasibility of US molecular imaging in large animals with ileitis paves the way towards clinical translation of US molecular imaging for the accurate quantification of inflammation in the abdomen.

Optical Imaging for Real-time Detection of Cartilage Matrix Degeneration in Experimental Osteoarthritis Models

**Shadi A Esfahani** MD, MPH (Presenter); **Andrea Foote**; **Averi A Leahy**; **Li Zeng**; **Umar Mahmood** MD, PhD

**PURPOSE**
To discuss the feasibility of optical imaging for real-time detection of cartilage matrix degeneration in experimental osteoarthritis models.
**SSG09-07 • Arterial Spin Labeling and T1-mapping for Evaluation of Renal Perfusion Impairment and Tissue Edema following Acute Kidney Injury in Mice—Comparison with Histopathology**

Katja Hueper (Presenter) ; Marcel Gutberlet DiplPhys ; Song Rong MD ; Dagmar Hartung MD ; Matti Peperhove MD ; Amelie Barrmeyer ; Michael Mengel ; Hermann Haller MD ; Frank K Wacker MD * ; Martin Meier PhD ; Falkah Gueler MD

**PURPOSE**

Acute kidney injury (AKI) leads to inflammation, decrease of renal perfusion, and loss of renal function. The purpose was to investigate whether arterial spin labeling (ASL) and T1-mapping allow monitoring renal perfusion impairment and acute tissue edema in a mouse model of ischemia induced AKI.

**METHOD AND MATERIALS**

AKI was induced in C57Bl/6 mice by transient unilateral clamping of the right renal pedicle for 35 min (n=10, moderate AKI) or 45 min (n=7, severe AKI). Animals underwent MRI prior to surgery and at different time points thereafter (d1, d7, d14, d21, d28) using a 7 Tesla magnet. Flow sensitive alternating inversion recovery (FAIR) EPI ASL sequences (13 inversion times) were acquired, and maps of renal perfusion and T1 relaxation time were calculated. Kidney volume was determined by segmentation of axial T2-weighted images. Renal pathology in the same animals after 4 weeks was assessed by histology. Statistical analysis comprised ANOVA for repeated measurements followed by multiple comparison with the Sidak method, unpaired t-tests and correlation analysis between MRI parameters, histology and kidney volume loss.

**RESULTS**

Renal perfusion at d7 was significantly reduced to 56±8% after moderate (p

**CONCLUSION**

ASL and T1-mapping allow non-invasive monitoring of renal perfusion impairment and tissue edema after AKI in mice. Changes of renal perfusion and T1 relaxation time are associated with the severity of renal pathology and kidney volume loss.

**CLINICAL RELEVANCE/APPLICATION**

Renal perfusion and T1 relaxation time measured by arterial spin labeling and T1-mapping may serve as non-invasive biomarkers to characterize renal pathology after acute kidney injury.

**SSG09-08 • Visceral Obesity Assessed by 1H-MRS Predicts Cardiovascular Events in Chronic Kidney Disease Patients**

Francesca Bolacchi (Presenter) ; Ettore Squillaci MD ; Fabrizio Chegai MD ; Marco Nezzo MD ; Giovanni Simonetti MD

**PURPOSE**

Cardiovascular disease is the leading cause of death among patients with chronic kidney disease (CKD). Although there is emerging evidence that excess visceral fat is associated with a cluster of cardiometabolic abnormalities in these patients, the impact of visceral obesity evaluated by a gold-standard method on future outcomes has not been studied. We aimed to investigate whether visceral obesity assessed by 1H-MRS was able to predict cardiovascular events in CKD patients.

**METHOD AND MATERIALS**

We studied 48 nondialyzed CKD patients [58% men; 29% diabetics; age 52.4 ± 9 years; body mass index (BMI) 26 ± 4.2 kg/m²; estimated glomerular filtration rate (GFR) 32.7 ± 11.5 ml/min/1.72 m²]. Visceral and subcutaneous abdominal fat were analysed by single voxel magnetic resonance spectroscopy (MRS). The MRS lipid spectrum was analysed and a lipid polyunsaturation index (PUI) was calculated. Fifteen healthy subjects were enrolled as controls. Cardiovascular events including acute myocardial infarction, angina, arrhythmia, uncontrolled blood pressure, stroke and cardiac failure were recorded during 24 months.

**RESULTS**

Cardiovascular events were 3-fold higher in patients with higher PUI index. The Kaplan-Meier analysis indicated that patients with a high PUI index had shorter cardiovascular event-free time than those a normal PUI values (P = 0.031). In the univariate Cox analysis, PUI was associated with higher risk of cardiovascular events (hazard ratio = 3.4; 95% confidence interval = 1.1-10.5; P = 0.03). The prognostic power of PUI for cardiovascular events remained significant after adjustments for sex, age, diabetes, previous cardiovascular disease, smoking, sedentary lifestyle, BMI, GFR, hypertension, dyslipidemia and inflammation.

**CONCLUSION**

Visceral and subcutaneous fat as analysed by 1H-MRS is a valuable tool in predicting cardiovascular events in CKD patients.

**CLINICAL RELEVANCE/APPLICATION**

PUI index assessed by 1-H MRS was a predictor of cardiovascular events in CKD patients.

**SSG09-09 • C5b-9 Targeted Molecular MR Imaging in Rats with Heymann Nephritis: A New Approach in Evaluation of Nephrotic Syndrome**

Wenbo Xiao MD ; Qiang Huang (Presenter) ; Song Wen ; Chuanxun Guo ; Qidong Wang ; Rui Zhang

**PURPOSE**

To determine the feasibility of magnetic resonance imaging in rats with Heymann nephritis (HN) by using membrane attack complex C5b-9 targeted ultrasmall superparamagnetic iron oxide (USPIO).

**METHOD AND MATERIALS**

**RESULTS**

Anti-C5b-9-USPIO, as targeted molecular probe in MRI, could be used in specific imaging of rats with HN. Such a new molecular imaging method would be promising in the study of nephrotic syndrome diagnosis and treatment. [This study was supported by grants from the National Natural Science Foundation of P.R. China (81117388) to W.X. and partly from the Ministry of Health Research Foundation of P.R. China (WK2011-Z-084) to W.X.]
The Clinical Applications of Iodixanol 270mgI/ml in Combination with Spectral CT Imaging in Intracranial CTA

Shan Hu (Presenter) ; Wenzhen Zhu MD, PhD

PURPOSE
To explore the clinical value of intracranial CTA using iodixanol 270mgI/ml in combination with spectral CT imaging mode.

METHOD AND MATERIALS
Forty patients (20 males and 20 females; average age=48±12 yrs; BMI=30) with suspected vascular diseases were randomly assigned into two groups and underwent intracranial CTA (Discovery CT750 HD, GE healthcare). Group A (n=20) was administered iodixanol 370 mgI/ml and 120kVp, 400mA. Group B (n=20) was administered iodixanol 270mgI/ml and spectral CT imaging (fast 80/140kVp switching, 550mA). Both groups were at the same injection volume of 0.8ml/kg, 4.8ml/s of injection rate, 0.5s of rotation time, and a pitch of 0.984. All the source images were transmitted to AW4.5 workstation. The keV images with the best CNR for group B were obtained by GS1 viewer software and used for comparison. CT values and their standard deviations for the anterior cerebral artery, middle cerebral artery, posterior cerebral artery, and basal ganglia as background regions were measured, and CNR and SNR values for the arteries were calculated. These values were statistically compared between the two groups. Three readers evaluated the image quality on VR images with scores 1-5.

RESULTS
The mean CT value, CNR and SNR for Group B (406.24±60.26HU, 5.13±0.75 and 6.25±0.91, respectively) were statistically higher than those for Group A (330.05±40.5HU, 4.70±0.75 and 5.13±0.75, respectively) (all P<0.05). But more terminal branches were displayed for Group B than Group A. Contrast dose was reduced by 27% in group B and CT dose index volume (CTDIvol) was statistically lower for group B than for group A (35.54mGy vs. 72.11±4.3mGy) (p<0.05). The use of iodixanol 270mgI/ml combined with spectral CT imaging in intracranial CTA provided acceptable or better image quality, with contrast dose reduction of 27% and radiation dose reduction up to 50%.

CONCLUSION
The Clinical Applications of Iodixanol 270mgI/ml in Combination with Spectral CT Imaging in Intracranial CTA can achieve acceptable or better image quality and less radiation dose.

Efficacy of Automated Bone Removal Software for Head CT Angiography: Comparison Against Dual Scan Subtraction

Andres Kohan MD (Presenter) *; Christian Rubbert MD *; Leslie Ciancibello RT; Ekta D Dhariaiya MS *; Gina M Anderson; Barbara A Bangert MD *

PURPOSE
Evaluate the efficacy of a single scan bone removal software solution in head CTA studies.

METHOD AND MATERIALS
30 head CTA performed through the dual scan technique (non-contrast scan followed by a contrast-enhanced) on a 256 or a 64 slice CT scanner were retrospectively analyzed. The studies were processed in two ways: 1. Subtraction of the non-contrast scan from the contrast enhanced scan (Group A) and 2. Automated bone removal from a single contrast enhanced scan (Group B). The technologist recorded the time it took to perform each process. The images were also assessed by an experienced neuroradiologist (19y) with regard to success of bone removal, visualization of anterior and posterior vessels, readability, confidence in diagnosis and delineation of the pathology. For this purpose a 4 point Likert scale (1=Non diagnostic, 2=Poor, 3=Acceptable and 4= Good) was used. Reading of group A and B was performed with 2 weeks separation to reduce selection bias. Reading time needed per study was also recorded. Wilcoxon signed-rank test for paired samples was performed for differences in image quality and time between examinations.

RESULTS
The post-processing of images from group A took in average 222±68s while for group B it took 96±17s (p<0.05).
- 50% increased success of bone removal
- 53% better visualization of anterior and posterior vessels
- 53% improved readability
- 63% increased confidence in diagnosis
- 70% improved delineation of the pathology

CONCLUSION
Automatic bone removal from a single scan not only significantly improved the technologist workflow by reducing post-processing times, but has also significantly improved the quality of the studies by removing bone more effectively than the double scan subtraction technique, while maintaining or even improving diagnostic confidence and image quality. The clinical impact of this software relies on its applicability to any scanner and the reduced radiation dose to the patient by avoiding the non-contrast enhanced scan.

CLINICAL RELEVANCE/APPLICATION
The clinical applications of Iodixanol 270mgI/ml in combination with spectral CT imaging mode in intracranial CTA can achieve acceptable or better image quality and less radiation dose.
needle, at a rate of 10 ml/second, which was then flushed out using 25 ml of saline, followed by rotational DSAs. We analyzed data from the rotational DSAs processed by the DynaCT software on the workstation using the maximum intensity projection and volume rendering algorithms. The VIVID and IADSA images were analyzed and compared by 3 experienced radiologists independently. The quality of visualization was graded as non-visualized (0), noncontinuous (1), faint and continuous (2), continuous (3), and intense and continuous (4). The averages of grades of the veins were calculated. Comparison of VIVID and IADSA was made. The grades were assigned by reaching a consensus, following a discussion among the observers.

RESULTS

The average grade between VIVID and IADSA were almost equal in Frontopolar artery, Anterior choroidal artery, Ophthalmic artery, Recurrent artery of Heubner, Cortical vein, Trolard vein, Labbe vein, and Internal cerebral vein (p > 0.05). In Anterior communicating artery, Posterior communicating artery, Inferior sagittal sinus, Septal vein, Basal vein of Rosenthal, and Cavernous sinus, VIVID was higher average grade than IADSA (p < 0.05).

CONCLUSION

VIVID is comparable to IADSA in the detection of the intracranial arteries and veins. VIVID can perform easily and evaluate whole artery and veins and show 3 dimensional anatomy in single examination without severe complications.

CLINICAL RELEVANCE/APPLICATION

Volume intravenous injection digital angiography by using the flat-panel detector angiographic computed tomography CT system is better than IADSA in evaluation of brain vessels anatomy.

**SSG11-04 • Dural Arteriovenous Fistula: Diagnosis and Classification with 4D-CTA and DSA**

**Bing Tian MD (Presenter) ; Bing Xu ; Qi Liu MD, PhD ; Jianping Lu MD**

**PURPOSE**

To compare the utility of 4D-CTA and DSA in assessing the presence, location, and classification of Dural Arteriovenous Fistula (DAVF).

**METHOD AND MATERIALS**

320-Multidetector row 4D-CTA and DSA were applied in 34 patients (mean age, 32 years; range, 18~57 years) with DAVF. 4D-CTA was performed within 2 days before DSA. All the images were independently reviewed by 2 readers for the presence, location, and classification of the DAVF. The result of the DSA was used as the gold standard. The location of DAVF was divided into five areas: Cranial sinuses, sious cavernous, cyclorama, basilar venous plexus, and mediastinum cerebri. The classification of DAVF was according to Borden, et al.

**RESULTS**

34 patients were all diagnosis as DAVF by 4D-CTA and DSA separately. The location of DAVF divided by DSA was cranial sinuses (12), sious cavernous (7), cyclorama (8), basilar venous plexus (6), and mediastinum cerebri (1). There was full agreement for all the patients between 4D-CTA and DSA regarding the location. However, for the Borden classification of DSA, 18 were Borden I, 9 were Borden II, and 7 were Borden II. The classification of 4D-CTA in 32 patients were in accordance with DSA. In the remaining 2 patient, retrograde venous were missed by both readers on 4D-CTA which were classified as Borden I, while as Borden II by DSA.

**CONCLUSION**

4D-CTA seems be a reliable technique in the screening and surveillance of DAVF form the presence, location, and classification aspect in clinical.

**CLINICAL RELEVANCE/APPLICATION**

320-MDCT4D-CTA appears to be a valuable new adjunct in the noninvasive diagnostic work-up, treatment planning, and follow-up of patients with DAVF.

**SSG11-05 • Volumetric Analysis of Cerebral Arteriovenous Malformation Using CT Angiography: Preliminary Results in Adult Patients**

**Donghyun Hong MA (Presenter) ; Karen Buch MD ; Hernan Jara PhD * ; Osamu Sakai MD, PhD ***

**PURPOSE**

Conventionally the assessments of the size of cerebral arteriovenous malformation (AVM) are based on 2D DSA image which makes evaluating the volume of the AVM difficult. The purpose of this study is to measure the volume of AVMs using computed tomographic (CT) angiography to generate a more accurate and realistic measure of abnormality.

**METHOD AND MATERIALS**

We retrospectively enrolled 11 AVM patients (age; 40 ± 17 YO, 6 males) diagnosed by radiologists. Subjects were classified into two groups --Small AVM: < 3cm and Medium AVM: 3~6cm-- based on the Spetzler-Martin grading scale. All patients underwent CT angiography using 64 multi-detector CT (GE, WI). For quantitative volumetric analysis, a program was developed using Mathcad (PTC, MA) in our image-processing laboratory. This image-processing tool generates 3D blood-only images through two segmentation steps: intracranial tissue segmentation followed by pixel value thresholding. From the segmented images with subtracted surrounding brain and meningeal tissues, we calculated the volume of an AVM lesion (the nidus, dilated feeding arteries and draining veins) by calculating the intracranial blood volume difference between both hemispheres. The AVM volume was then correlated with the maximal AVM lesion dimension.

**RESULTS**

Statistically significant differences were observed between the two subject groups. In the comparisons of the volume (cm³) : 12.478 ± 5.743 and 53.963 ± 9.338 (mean ± stdev.) for Small AVMs (< 3cm) and Medium AVMs (3~6 cm) respectively; P < 0.005 for all. Additionally, we found an exponential correlation between the AVM volume and the maximum length of a nidus (trendline: y = 4.4183e⁰.536x with R² = 0.945).

**CONCLUSION**

CT angiograms can be processed to provide a more realistic three-dimensional measures of AVM size with potentially more clinical specificity and higher sensitivity to monitor treatment changes.

**CLINICAL RELEVANCE/APPLICATION**

Volumetric AVM measures have the potential of providing new standards for AVM size classification and could provide a useful tool for monitoring AVM evolution in time and in response to treatment.

**SSG11-06 • Non-contrast-Enhanced High-temporal-Resolution 4D MRA with an Acquisition Window Covering Two Cardiac Cycles: Assessment of Brain Arteriovenous Malformations**

**Helene Raoult MD (Presenter) ; Elise Bannier ; Peter Schmitt PhD * ; Benjamin Robert * ; Jean-Yves Gauvrit MD**

**PURPOSE**

To assess the feasibility, quality and diagnosis performance of a bSSFP NCE 4D MRA ECG-gated sequence with a high temporal resolution to analyse brain arteriovenous malformations (AVM).

**METHOD AND MATERIALS**

After approval from the Institutional Review Board, ten patients presenting AVM and referred for digital subtraction angiography (DSA) were included in the study. Patients underwent NCE 4D MRA on a 3T system (MAGNETOM Verio, Siemens Healthcare), using a 32-ch head array coil. The NCE 4D MRA technique combined arterial spin labeling with an ECG-triggered 3D cine segmented multiphase bSSFP readout. Two sequences were performed, with temporal acquisition window over 1 (1-RR) or 2 (2-RR) cardiac cycles and acquisition...
times of 5-6 or 10-12 min respectively. Imaging parameters for 2-RR NCE 4D MRA were: FOV=220x192x92mm2, 44 slices, 1.5x1.5x1.5mm3 voxel size, TR/TE=59.5ms/2.13ms, variable flip angle evolution, mSENSE 2. For 1-RR NCE 4D MRA, 64 slices achieved similar coverage with a 1x1x1mm3 voxel size. Other sequences performed were: TOF MRA (0.7x0.6x0.6mm3 voxel size) and 4D CE-MRA (0.9x0.8x1.5mm3 voxel size, 1.5s temporal resolution). All patients also underwent DSA with a filming rate of 3 images/s. Images were reviewed with respect to image quality and AVM diagnosis value.

RESULTS
Both NCE 4D MRA sequences were successfully performed in all patients achieving mean temporal resolution of 68.1 ms (±3.1; 20-32 phases) and 69.1 ms (±5.6; 10-16 phases) and mean image quality score of 3.9/5 (±0.7) and 3.9/5 (±0.8), for 2-RR and 1-RR NCE 4D MRA respectively.

All AVM were depicted with their main feeding arteries and global nidus size in agreement with DSA data (fig.1). Venous drainage type was always correctly classified on 2-RR NCE 4D MRA images, but misidentified in five cases on 1-RR NCE 4D MRA. The 2-RR NCE 4D MRA allowed a more accurate delineation of the nidus than combined TOF and CE 4D MRA data.

CONCLUSION
The bSSFP NCE 4D MRA sequence allows brain AVM analysis with a high temporal resolution, offering accurate nidus delineation, target of the treatment. A 2-RR sequence improves depiction of venous drainage, necessary to evaluate hemorrhagic risk.

CLINICAL RELEVANCE/APPLICATION
The bSSFP NCE 4D MRA sequence allows brain AVM analysis with a high temporal resolution, offering accurate nidus delineation, target of the treatment.

SSG11-07 • Evaluation of Brain Arteriovenous Malformations by Using 4D MR Angiography with Arterial Spin Labeling at 3T
Yasuhiro Iryo (Presenter) ; Toshinori Hirai MD ; Masanobu Nakamura ; Minako Azuma ; Yasuyuki Yamashita MD *
PURPOSE
To assess the usefulness of 4D magnetic resonance angiography (MRA) with an arterial spin-labeling (ASL) technique at 3T that yields high spatial resolution and time-resolved hemodynamics without exogenous contrast agents for the evaluation of brain arteriovenous malformations (AVMs).

METHOD AND MATERIALS
Our study included 8 patients (4 men, 4 women; age 7-65 years, mean 39.5 years) with brain AVMs. They underwent 4D ASL-MRA and digital subtraction angiography (DSA). The 4D ASL-MRA imaging was performed on a 3T MRI system; a sensitivity encoding (SENSE) phased-array 32-channel head coil was used. A pseudo-continuous arterial spin labeling (pCASL) preparation scheme with the Look-Locker sampling was employed for spin tagging. Seven phases of labeling and control images were acquired in an interleaved mode. Upon completion of two acquisitions, corresponding temporal phases with identical inversion delay were subtracted. Minimum-intensity-projection (MIP) images were then created for each subtracted data set in three orthogonal directions. The acquisition parameters were: FOV=220x200 mm, matrix=224x162, spatial resolution=1x1x1 mm, flip angle=12°, TR=8.5 ms, TE=4.2 ms, SENSE factor=3.0. Images were reviewed with respect to image quality and AVM diagnosis value. All AVM were depicted with their main feeding arteries and global nidus size in agreement with DSA data (fig.1). Venous drainage type was always correctly classified on 2-RR NCE 4D MRA images, but misidentified in five cases on 1-RR NCE 4D MRA. The 2-RR NCE 4D MRA allowed a more accurate delineation of the nidus than combined TOF and CE 4D MRA data.

RESULTS
On all 4D ASL-MRA studies, the major intracranial arteries were successfully demonstrated at an inflow temporal resolution of 250 ms. Interobserver agreement was excellent for the nidus size (κ=1.0), very good for arterial feeders (κ=0.86) and good for venous drainage (κ=0.80). Intermodality agreement was excellent for the nidus size (κ=1.0), very good for arterial feeders (κ=0.88) and good for venous drainage (κ=0.80).

CONCLUSION
The agreement between 4D ASL-MRA and DSA findings was good to excellent with respect to the AVM nidus size, arterial feeders and venous drainage. Two other readers consensually reviewed the DSA images. Interobserver and intermodality agreement was assessed by ? statistics.

CLINICAL RELEVANCE/APPLICATION
With 4D ASL-MRA at 3T, hemodynamic information on the brain AVMs can be obtained without the use of exogenous contrast agents.

SSG11-06 • 7T versus 1.5T TOF MRA for Assessment of Intracranial Aneurysms: The More Tesla, the Better?
Lale Umutlu MD (Presenter) * ; Karsten Wrede ; Christoph Moenninghoff MD ; Soren Johst ; Philipp Dammann ; Michael Forsting MD ; Marc U Schlaamm
PURPOSE
As rupture of intracranial aneurysms is considered the main cause of subarachnoid haemorrhage, detection and high-quality assessment of aneurysm localization and related features (e.g. parent vessel) is of inevitable value for treatment planning. With 1.5 Tesla MRI being limited in the detection of small aneurysms, ultra-high-field MRI may enable superior examination of intracranial vasculature based on higher spatial resolution due to increased signal-to-noise ratio (SNR). Aim of this trial was to compare the diagnostic ability of 1.5 versus 7 Tesla TOF MRA for assessment of intracranial aneurysms.

METHOD AND MATERIALS
17 subjects were examined on a 1.5 Tesla (Magnetom Aera, Siemens Healthcare) and Time-of-flight MRA with a voxel size of 0.7x0.7x0.7mm3 was obtained. Subsequently all subjects underwent a 7 Tesla examination (7T whole-body MR system; Magnetom 7T, Siemens Healthcare) with a voxel size of 0.2 x 0.2 x 0.2mm3. Two radiologists in consensus assessed the delineation of the (1) aneurysm dome, (2) neck, (3) parent vessel, (4) vessel tissue contrast and (5) image impairment due to artifacts. For qualitative analysis a 5-point scale was used (5= excellent delineation; 1= non-diagnostic). Contrast ratios (CR) of all aneurysms and adjacent parenchyma were calculated. A Wilcoxon rank test was performed for analysis of statistical significance.

RESULTS
According to qualitative analysis 7 Tesla TOF MRA yielded significantly superior delineation of dome (mean 7T/=4.5; mean 1.5T= 3.2; p<0.05). Intermodality agreement was excellent for the nidus size (κ=1.0), very good for arterial feeders (κ=0.88) and good for venous drainage (κ=0.80).

CONCLUSION
Despite slight impairments based on increased signal alterations, 7 Tesla TOF MRA provided superior assessment of the aneurysms and their related vessel-features based on high-quality vessel-tissue contrast and imaging at improved spatial resolution.

CLINICAL RELEVANCE/APPLICATION
Based on improved spatial resolution imaging, high-resolution 7T TOF MRA may bear the potential to overcome known limitations of 1.5 Tesla MRA in the assessment of intracranial aneurysms.

SSG11-09 • Ultra-high Temporal Resolution Vascular Pulsation of Aneurysms: A Novel Dynamic 4-dimensional Time of Flight MR Angiography Technique to Accurately Evaluate Dynamics of Cerebral Aneurysm
Till Illies MD (Presenter) ; Jan Sedlaczik ; Jan-Hendrik Buhk MD * ; Daniel Kutzner ; Jens Fiehler ; Andre Kemmling MD
PURPOSE
Time resolved imaging of pulsatility of cerebral aneurysms has been performed using 4D CT angiography. Assessment of wall motion may be useful for stratification of rupture risk. Aim of the study was to implement a 4D TOF MRA technique to image aneurysm wall motion with high temporal and spatial resolution.
METHOD AND MATERIALS
We performed time resolved MR-TOF angiography in an elastase induced rabbit model of cerebral aneurysm. Dynamic 4-dimensional TOF angiography was achieved with ultra high-temporal resolution of 30 3D-images per cardiac cycle (151 beat/min). Dynamic data sets were reconstructed from ecg-triggered 4D gradient echo TOF images (temporal resolution 75 frames per second, spacial resolution 0.5x0.5x1.0mm, TR 20ms, TE 5.76ms, 32 channel coil system at 3T). The 4D dataset was processed to calculate vessel motion: Voxels were classified as vessels using a semi-automated region-growing algorithm (Analyze 11.0). A relative vessel motility index was calculated using the voxel-wise frequency of a vessel vs. non-vessel classification from 30 time-points over the cardiac cycle.

RESULTS
The aneurysm (5mm diameter) and aortic arch were imaged with diagnostic image quality within 12 min. The temporal resolution of 75 frames/second allowed ready visualization of wall pulsation and vessel displacement in time. The relative vessel motility index showed highest wall motion at the aortic arch and tip of the aneurysm corresponding to qualitative assessment.

CONCLUSION
We successfully implemented a time resolved TOF-MRA-technique allowing 4-dimensional quantification of aneurysmal wall motion at high spacial and temporal resolution (75 frames per second).

CLINICAL RELEVANCE/APPLICATION
Quantification of aneurysm pulsatility may be a valuable pathophysiological marker for assessing rupture risk.

Gastrointestinal (Stomach)

Tuesday, 03:00 PM - 04:00 PM • E450B

SSJ10 • AMA PRA Category 1 Credit™: 1 • ARRT Category A+ Credit: 1

Moderator
William E Torres, MD *

SSJ10-01 • Is Gadodetic Acid-enhanced MR Cholangiography a Useful Tool Predicting the Presence of Bile Reflux Gastritis?

Euddeum Shim (Presenter); Suk Keu Yeom MD; Sang Hoon Cha MD; Jong Jin Hyun; Seung Wha Lee; Hwan Hoon Chung; Baek Hyun Kim MD

PURPOSE
Contrast media excreted from the biliary tract is often seen in the stomach on Gadodetic acid-enhanced MR cholangiography (Gadoxetic-MRC). The aim of this study is to evaluate the relationship between biliary excreted contrast media in stomach and the presence of bile reflux gastritis.

METHOD AND MATERIALS
A total of 111 consecutive patients who underwent both Gadoxetic-MRC and upper gastrointestinal endoscopy from May 2009 to April 2012 were included in this study. Two radiologists performed a blinded review of Gadoxetic-MRC set images consisting of axial and coronal images obtained 60 minutes after IV injection of contrast media. Presence of contrast media in duodenum and stomach was recorded along with the extension grade of reflux if the contrast media was seen in stomach: grade 1, antrum; grade 2, body; and grade 3, fundus. Endoscopic images were reviewed by an expert gastroenterologist blinded to the result of Gadoxetic-MRC. Sydney classification of gastritis was used to categorize gastritis if present.

RESULTS
Among a total of 111 patients, contrast media was present in the stomach on 60 minutes delayed images in 39 patients. Of these 39 patients, 13 patients had bile reflux gastritis and 3 patients showed bile in the stomach without evidence of erythematous mucosal changes. Of the 72 patients who did not show contrast media in the stomach, none of them had bile reflux gastritis and 2 patients showed bile stain in the stomach without evidence of erythematos mucosal changes. Bile reflux gastritis was significantly more frequent in patients with contrast media in the stomach on Gadoxetic MRC (13/39, 33.3%) than those without (0/72, 0%) (p < 0.001). However, there was no significant difference between bile reflux gastritis and the extension grade of reflux (grade 1: 2/12, grade 2: 4/11, grade 3: 7/16) (p = 0.335).

CONCLUSION
About a third of patients with biliary excreted contrast media in stomach had bile reflux gastritis which was more significantly frequent compared to those without. Biliary excreted contrast media in stomach on Gadoxetic-MRC obtained at 60 minutes could be an indication of the presence of bile reflux gastritis.

CLINICAL RELEVANCE/APPLICATION
Biliary excreted contrast media in stomach on Gadoxetic-MRC obtained at 60 minutes could be an indication of the presence of bile reflux gastritis.

SSJ10-02 • A New Sandwich Sign of Borrmann Type 4 Gastric Cancer on Diffusion-weighted MRI: Radiological-histopathological Correlation

Lei Tang MD (Presenter); Xiao-Peng Zhang MD; Ying-Shi Sun MD, PhD; Zi-Yu Li; Jia-Fu Ji; Zhong-Wu Li; Xiaoting Li

PURPOSE
To explore the histopathological basis of a new finding sandwich sign of Borrmann type 4 gastric cancer on diffusion-weighted MRI (DW-MRI).

METHOD AND MATERIALS
The abdominal DW-MRI was performed using SS-EPI sequence with b-factors of 0 and 1000 s/mm2 on a 1.5T scanner, in patients with Borrmann type 4 gastric cancer. Radical gastrectomy was performed in one week after DW-MRI examination. Histopathological analysis of the resected specimens was performed by one pathologist and one radiologist together, with emphasis on the correlation of the DW-MRI signs and the histopathologic findings, by means of layer-to-layer comparison.

RESULTS
DW-MRI was performed on 30 patients with Borrmann type 4 gastric cancer. A three-layer sandwich sign that demonstrated high signal in the inner and outer layer and low signal in the intermediate layer was observed in 73.3% (22/30) of cases on DW-MRI. Through the comparison with pathological large sections, we found that the intermediate low signal on DW-MRI corresponded to the muscularis propria. Further enlargement of the pathological sections demonstrated that the cancer cells were interspersed in the intermuscular space, which cause the decreased restriction of water molecular movement and lower down the signal on DW-MRI; thereby create the three-layer sandwich sign.

CONCLUSION
DW-MRI can highlight the signals of Borrmann type 4 gastric cancer, which often present a characteristic three-layer sandwich sign. The uneven distribution of cancer cells in different layers of cancerous gastric wall maybe the histopathological basis of this unique sign.

CLINICAL RELEVANCE/APPLICATION
Quantification of aneurysm pulsatility may be a valuable pathophysiological marker for assessing rupture risk.
**SSJ10-03 • Preliminary Study of Spectral CT Imaging in the Differentiating Normal and Malignant Residual Stomach Wall Thckening**

He Qing Wang (Presenter); Ailian Liu MD; Ye Ju; Sheng Wang; Shifeng Tian; Longmin Zhang

**PURPOSE**
To investigate the value of spectral CT imaging in the differential diagnosis of normal and malignant residual stomach wall thickening.

**METHOD AND MATERIALS**
32 cases (pathological finding proved 11 cases of residual stomach cancer, long-term clinical follow-up confirmed 21 cases of Stomach normal postoperative change). Nine patients underwent the plain scan, 23 patients underwent both the plain scan and the dynamic enhancement. With dual-kVp spectral CT imaging, monochromatic images (40-140keV) and the iodine and water-based material decomposition images were reconstructed. CT values of 70 keV and effective iodine content (eIC) were measured. One-way analysis of variance was performed for analyzing the resulting parameters, and p

**RESULTS**
There was a statistically significant difference between malignant and normal gastric wall tissue in 40 -140keV 101 monoenergetic images: arterial phase 40keV, 50keV, 60keV, 70keV, material value based water and iodine and portal phase 40keV, 50keV, 60keV, 70keV,80keV, effective monoenergetic spectrum value, material value based iodine. Significant differences were seen in 40-140keV 101 monoenergetic images: arterial phase 40keV, 50keV monoenergetic spectrum value between malignant and normal gastric wall tissue.

**CONCLUSION**
CT Gemstone Spectral Imaging could provide additional imaging information that may improve the differentiation of normal and malignant wall of the residual stomach. Spectral CT curve is expected to be a new non-invasive method to differentiate them.

**CLINICAL RELEVANCE/APPLICATION**
Using spectral CT multiple parameters might be a new noninvasive method to differentiate the normal and malignant residual stomach wall for the conventional polychromatic CT images.

**SSJ10-04 • The Value of Diffusion-weighted MR Image in Diagnosing Metastatic Lymph Nodes in Patients with Gastric Cancer**

Zhuping Zhou (Presenter); Jian He MD, PhD; Song Liu; Bin Zhu; Zhou Z Ping; Zhengyang Zhou

**PURPOSE**
To explore the characteristics of lymph nodes in patients with gastric cancer by diffusion weighted(DW) MR image, and investigate the value of apparent diffusion coefficient (ADC) and short axis measurement in diagnosing metastatic lymph nodes.

**METHOD AND MATERIALS**
This prospective study was approved by local ethics committee and the patient informed consent was obtained. Fifty-five patients (34 male, 18 female) with gastric cancer underwent preoperative DW MR imaging. All the detectable lymph nodes on DW images were divided into metastatic and non-metastatic groups with the reference of post-operative histopathological findings. The ADC values and short diameter of lymph nodes were measured and compared between the two groups. Diagnostic performance of ADC value and short diameter for diagnosing metastasis were compared by receiver characteristic curve(ROC) analysis.

**RESULTS**
ADC value from DW MR imaging is superior to short diameter measurement in diagnosing metastatic lymph nodes in patients with gastric cancer.

**CONCLUSION**
ADC value from DW MR imaging is superior to short diameter measurement in diagnosing metastatic lymph nodes in patients with gastric cancer.

**CLINICAL RELEVANCE/APPLICATION**
DW imaging could be added into routine preoperative MR imaging of patients with gastric cancer to detect and diagnose lymph node metastasis.

**SSJ10-05 • Preclinical Study on CT-optics Hybrid Lymphangiography for Stomach Sentinel Lymph Node Mapping, Labeling and Intra-operative Navigation in a Beagle Model**

Hon Soul Kim MD, PhD (Presenter); Sang Kil Lee; Se Hoon Kim; Soo-Jeong Lim; Woo Jin Hyung MD; Joonseok Lim MD

**PURPOSE**
Multi-modality hybrid imaging of loco-regional lymphatic system would improve preoperative mapping and intra-operative navigation of the sentinel lymph nodes. We assumed that if a reliable method for sentinel lymph node labeling is available, the application of minimally invasive treatment for stomach cancer could be expanded.

**METHOD AND MATERIALS**
Animal experiments were approved by our institutional animal care and use committee. We developed a nano-scale iodine-indocyanine green oil emulsion that can be used for both CT and optical imaging. We endoscopically injected this hybrid contrast agent in the gastric submucosal compartment of 9 beagles. Serial preoperative CT scans were obtained. The degree of lymph node enhancement was qualitatively and quantitatively measured. Each beagle underwent either open laparotomy, laparoscopy-assisted surgery or robot(equipped with integrated infra-red optical camera)-assisted surgery. Specimen CT and near infra-red fluorescence imaging was performed.

**RESULTS**
Our lymphangiography method generated significant contrast effect for both CT and near infra-red range optical devices. Significant and persistent accumulation of the hybrid contrast signal was observed in the draining lymphatic system, which remained throughout the entire experiment (over 3 hours) achieving the effect of lymph node labeling. Preoperative CT provided information on anatomy oriented lymph node mapping. We were able to identify 40 lymph nodes showing enhancement on CT scan in 9 beagles. Optical imaging ensured high resolution visualization of both the draining lymph nodes and intervening lymphatic vessels. In addition, adopting intra-operative compatible optical devices (such as Robot-assisted surgery in this study) enabled real time high resolution imaging during surgery, and therefore considerably enhanced the sensitivity and confidence on sentinel lymph node assessment.

**CONCLUSION**
Our CT-optics based hybrid imaging is a feasible and effective method for lymphangiography, which can be used for preoperative mapping, labeling and intra-operative navigation of sentinel lymph nodes. We believe these advantages can be exploited to design minimally invasive treatment strategies with extended indications.

**CLINICAL RELEVANCE/APPLICATION**
Nano-scale iodine-indocyanine green oil emulsion based hybrid (CT and optical) lymphangiography can be used for sentinel lymph node assessment and non-invasive treatment of early gastric cancer.

**SSJ10-06 • Diagnosis of Esophageal or Duodenal Invasion of Advanced Gastric Cancer: Comparison of CT and Endoscopy**

Yoon Jin Lee MD (Presenter); Young Hoon Kim MD, PhD; Ji Hoon Park MD; Kyoung Ho Lee MD; Hye Seung Lee MD; Do Joong Park; Hyung-Ho Kim MD, PhD

**PURPOSE**

DW-MRI can be a useful method for the clinical evaluation of Borrmann type 4 gastric cancer.
To retrospectively compare the accuracy of CT with that of endoscopy in the diagnosis of esophageal or duodenal invasion of advanced gastric cancer.

METHOD AND MATERIALS
Forty-five patients (26 men, 19 women; median age, 68 years; range, 40-82 years) who underwent gastrectomy and had pathologically confirmed advanced gastric cancer with esophageal or duodenal invasion were included. The preoperative reports of CT and endoscopic exams were compared for the diagnosis of esophageal or duodenal invasion. The longitudinal length of tumor invasion into the esophagus or duodenum was retrospectively measured on CT images and histopathological specimens under microscopy. Other histopathological data were also collected, including the invasion pattern (mucosal or submucosal spread), Borrmann type, and WHO histologic classification. The sensitivity of CT and endoscopy were calculated and histopathological data were evaluated for the association with false negative findings.

RESULTS
The overall accuracy of CT was significantly higher than that of endoscopy (66% [31/47] vs. 38% [18/47], P=.001). CT was significantly more accurate than endoscopy in diagnosing both esophageal (71% [22/31] vs. 45% [14/31], P=.008) and duodenal invasion (56% [9/16] vs. 25% [4/16], P=.013). Longitudinal tumor invasion lengths showed strong correlation between CT (median, 9.4 mm; interquartile range, 5.0-12.8 mm) and histopathologic (median 6.5, interquartile range, 3.3-11.0) measurements (Spearman's rho=0.86, P<0.001).

CONCLUSION
CT is more accurate than endoscopy in the diagnosis of esophageal or duodenal invasion and may be more helpful for the decision of optimal longitudinal surgical extent.

Genitourinary (Imaging of Pregnancy and Its Complications)

Tuesday, 03:00 PM - 04:00 PM • E351

SSJ11 • AMA PRA Category 1 Credit™:1 • ARRT Category A+ Credit:1

Moderator
Mary C Frates , MD

Moderator
Vikram S Dogra , MD *

SSJ11-01 • Presence of a Chorionic Bump May Not Be Associated with a Guarded Prognosis

Elizabeth K Arleo MD (Presenter) ; Robert N Troiano MD

PURPOSE
To prospectively observe the pregnancy outcome of patients with the sonographic finding of a chorionic 'bump,' an irregular, convex bulge from the choroid decidua surface into the first-trimester gestational sac.

METHOD AND MATERIALS

RESULTS
13% (7/53) of the pregnancies with chorionic bump on first-trimester ultrasound were anembryonic. Of the remaining 46 embryonic pregnancies with first-trimester chorionic bumps, 74% (34/46) resulted in live births, all at term with the exception of one set of twins and one set of triplets, who were electively delivered early at 35 weeks and 32 weeks, respectively. There was only one associated anatomic anomaly, a left forearm limb reduction defect diagnosed antenatally in one case. Bump size was not correlated with pregnancy outcome. In most patients, the bump was avascular, but in two cases slow intraluminal flow was noted.

CONCLUSION
The presence of a chorionic bump on first trimester ultrasound is not necessarily a poor prognostic indicator. The likelihood of subsequent first-trimester survival is significantly higher if an embryo is seen at the time of chorionic bump diagnosis. In such a scenario, in this series, the largest to date of such a cohort, the live birth rate (74%) was significantly higher than previously reported in smaller series (live birth rates).

CLINICAL RELEVANCE/APPLICATION
This largest series on chorionic bumps demonstrates that this US finding is not necessarily a poor prognostic indicator and therefore, interpreting radiologists should recommend close interval followup.

SSJ11-02 • Brand-new MRI Finding as Predictor of Placental Invasion: Evaluation of 64 Patients with Clinical and Histopathological Correlation

Yoshiko Ueno (Presenter) ; Kazuhiro Kitajima MD ; Tetsuo Maeda ; Yuko Suenaga ; Satoru Takahashi MD ; Kazuro Sugimura MD , PhD *

PURPOSE
To identify new MR criteria and review established MR criteria for the diagnosis of placental invasion.

METHOD AND MATERIALS
A retrospective review of prenatal MR scans of 64 patients (mean age, 34 years) who underwent MR examination for suspected placental invasion by prenatal sonogram was performed. All MR examinations were performed on a 1.5-T unit with body array coils, including axial, coronal, and sagittal T2 half-Fourier single-shot turbo spin echo imaging and/or a T2 true fast imaging with steady-state precession sequence. According to surgical and/or pathological findings, 14 patients were diagnosed with placenta accreta, placenta increta, or placenta percreta, and 50 were without placental invasion. Two experienced radiologists who were blinded to the pathology and surgery findings reviewed the MRI and evaluated a total of eight MRI features of placenta, including our new finding: the presence of placentain protrusion into internal os. Interrater reliability was assessed using kappa statistics. The features with a kappa statistics >0.40 were evaluated to compare the capabilities for placental invasion assessment with a multivariable logistic regression analysis.

RESULTS
Intraplacental T2 dark bands, Intraplacental abnormal vascularity, uterine bulging, total placental previa, partial placental previa and placental protrusion into internal os had moderate or better interobserver reliability. Using multivariable logistic regression analysis, we found that the findings of intraplacental abnormal vascularity (A) and placental protrusion into internal os (B) had significant odds ratios of an increased risk of placental invasion. (A: odds ratio, 82.7; 95% CI, 4.1 to 5942; p=0.002, B: odds ratio, 83.1; 95% CI, 3.61 to 6329; p=0.0047)

CONCLUSION
In this study, the findings of intraplacental abnormal vascularity and protrusion of placenta into the internal os were good predictors of placental invasion.
SSJ11-03 • Outcome of Cesarean Scar Implantation Pregnancies Diagnosed Sonographically in the First Trimester

Aya Michaels MD (Presenter) ; Erin Washburn MD ; Katherine Pocius MD ; Carol B Benson MD ; Peter M Doublet MD, PhD ; Daniela Carusi MD

PURPOSE
To determine the outcome of cesarean scar implantation pregnancies diagnosed during the first trimester.

METHOD AND MATERIALS
We retrospectively identified all cesarean scar implantation pregnancies diagnosed by ultrasound prior to 14 weeks between 2000 and 2012 at our institution. We reviewed the patients' sonographic images and medical records, and recorded information about sonographic findings and pregnancy outcome.

RESULTS
37 cases met study entry criteria. Gestational age (GA) at diagnosis was 6.8 ± 1.6 weeks (mean ± SD). Anterior myometrial thickness overlying the gestational sac was 2.7 ± 2.2 mm. 11 patients had no embryonic cardiac activity at the time of diagnosis or thereafter, 6 of whom underwent ultrasound-guided D&C or were given systemic methotrexate. Of these 11, only 1 required hysterectomy, which occurred a month after initial diagnosis for persistent bleeding. Among the 26 patients with embryonic cardiac activity, 9 continued the pregnancy, 2 required emergent hysterectomy for dehiscence at the time of diagnosis (GA 10 and 11 weeks), and 15 underwent interruption of the pregnancy during the first trimester by one of several methods: intrasac KCl injection (8 cases); ultrasound-guided D&C (6 cases); laparoscopic resection (1 case). None of the latter 15 interrupted cases subsequently required hysterectomy. Of the 9 uninterrupted pregnancies, 3 had miscarriages (GA 9, 9, and 20 weeks) and 6 had liveborn deliveries, of whom 4 had placenta accreta, 3 requiring hysterectomy.

CONCLUSION
In a woman with a cesarean scar implantation pregnancy and embryonic cardiac activity, allowing the pregnancy to proceed has high risk of subsequent miscarriage (33%). Those pregnancies that continue to delivery of a liveborn infant are at substantial risk of placenta accreta (66%) requiring hysterectomy (50%).

CLINICAL RELEVANCE/APPLICATION
Cesarean scar implantation pregnancies, if untreated, are at high risk for miscarriage and/or serious complications, including uterine dehiscence and placenta accreta requiring hysterectomy.

SSJ11-04 • Placental MR Imaging in Fetuses with Placental Insufficiency

Yoshimitsu Ohygiya MD (Presenter) ; Hiroshi Nobusawa MD, PhD ; Noritaka Seino ; Jumpei Suyama MD, PhD ; Masanori Hirose MD ; Takehiko Gokan MD

PURPOSE
To evaluate morphologic and signal intensity (SI) changes of placental insufficiency on MRI and to assess value of morphologic changes and decreased flow voids (FVs) on T2-weighted RARE imaging for diagnosing placental insufficiency.

METHOD AND MATERIALS
Fifty singleton fetuses with abnormal findings at US underwent MRI that included T2-weighted half-Fourier RARE imaging and T1-weighted FLASH imaging using a 1.5 T MR scanner. Placental insufficiency was diagnosed if fetal weight estimated with US was below the 5th percentile. Histopathologic examinations were available in all placentas. Placental thicknesses, placental areas, placental volumes, placental SI, and amniotic fluid SI were measured on MR images. Two radiologists reviewed T2-weighted RARE images for globular appearances of the placentas and FVs between the uterus and the placenta. A thickened appearance or no tapering edges of the placenta was diagnosed as positive signs of decreased FVs. The t tests and McNemar's tests were used at 5% levels of significance.

RESULTS
Twenty-five of the 50 pregnancies were categorized as having an insufficient placenta. The mean placental thicknesses with placental insufficiency were larger than that without placental insufficiency (p < 0.01). The mean placental areas and the mean placenta to amniotic fluid signal intensity ratio (SIR) with placental insufficiency were smaller than those without placental insufficiency (p < 0.01). There was no significant difference in placental volumes. The sensitivity, specificity, and accuracy were as follows: 76.0%, 80.0%, and 78.0% with globular appearances, 52.0%, 88.0%, and 70.0% with decreased FVs, 88.0%, 76.0%, and 82.0% with globular appearances plus decreased FVs. There is a significant difference in sensitivity between decreased FVs and globular appearances plus decreased FVs.

CONCLUSION
Placental insufficiency is associated with placental areas, placental thicknesses, and placenta to amniotic fluid SIR. Evaluating FVs on T2-weighted RARE images can be useful for detecting placental insufficiency, particularly in placentas without globular appearances on MRI.

CLINICAL RELEVANCE/APPLICATION
T2-weighted RARE imaging can demonstrate morphologic changes of the placentas and decreased flow voids between the uterus and the placenta in placental insufficiency.

SSJ11-05 • Adnexal Masses during Pregnancy: MR Imaging Characterization Using ADNEX MR Score

Isabelle Thomassin-Naggara MD (Presenter) ; Marie-Claude Chevrier MD ; Lamia Jarboui MD ; Audrey Morel MD ; Sophie Dechoux ; Marc J Bazot MD

PURPOSE
To retrospectively evaluate the accuracy of pelvic magnetic resonance (MR) imaging performed to characterize indeterminate sonographic adnexal masses during pregnancy and to test the accuracy and the reproducibility of the ADNEXMR score in this population.

METHOD AND MATERIALS
Institutional ethics committee approved the study and granted a waiver of informed consent. Our study population comprised 31 pregnant women (mean age : 32 (19-42) with a mean gestational age at the diagnosis of 16 weeks (16-26) who underwent MR imaging for characterization of indeterminate adnexal masses in our center. Two radiologists with 1 and 10 years experience retrospectively evaluated MR criteria for characterization of complex adnexal masses and ADNEXMR score was tested using ROC curve analysis and Kappa values. The reference standard was surgical pathology or at least one-year imaging follow-up.

RESULTS
During pregnancy, MR imaging is an accurate tool to differentiate benign form malignant adnexal masses without any cancer missed. ADNEXMR score is as accurate and reproducible as in general population. Thus, our study suggests its potential to improve patient management. Larger multicenter prospective validation of the score is warranted.

CLINICAL RELEVANCE/APPLICATION
MR imaging is highly accurate to characterize adnexal masses during pregnancy and may be helpful to determine the risk with the
SSJ11-06 • Improving the Clinical Utility and Consistency of Placental MRI Reports: Introduction of a Novel Placental MRI Grading Scale to Assign a Confidence Score in Diagnosing Abnormal Placental Implantation

Angela Trinh MD (Presenter); Jeanne M Horowitz MD; Senta M Berggruen MD; Helena Gabriël MD; Adrienne Vargo MD; Frank H Miller MD

PURPOSE
To assess feasibility of a novel MRI grading scale using major and minor imaging criteria to assign confidence in diagnosing abnormal placental implantation (API), and improve the accuracy, consistency, and clinical utility of placental MRI.

METHOD AND MATERIALS
Two board certified radiologists blinded to all reports independently, retrospectively reviewed 20 randomized placental MRI exams (10 with API by surgery and/or pathology and 10 negative cases). Assessment was made for major and minor diagnostic criteria of API, based on MRI signs reported in literature. Major criteria included placental invasion outside the uterus, intraplacental bands, uterine bulging, very heterogeneous placenta, and bladder tenting. Minor criteria included mild/moderately heterogeneous placenta, tortuous flow voids, focal interruption of the myometrial wall and myometrial thinning. Confidence levels (CL) were assigned for the diagnosis of any level of API, including placental accreta, increta, and percreta. CL were: 90% confidence for cases with 2 or more major criteria, 75% confidence with either 1 major criterion or all 4 minor criteria, 50% confidence with 3 minor criteria, 25% confidence with 1-2 minor criteria and 10% confidence if no criteria met.

RESULTS
Between the two radiologists, there was complete agreement on 12 of 20 cases based on CL. 6 cases demonstrated a difference of only one CL. 2 cases demonstrated complete disagreement. When grouping the 90% and 75% CL into high suspicion and the 25% and 10% CL into low suspicion of API, the radiologists agreed on 18 of 20 cases. Of these 18 cases, 7 were high suspicion and 11 were low suspicion. The 7 high suspicion cases and 9 of the 11 low suspicion cases matched the surgical/pathology results. 2 of the 11 low suspicion cases were positive for placenta accreta. This resulted in a sensitivity of 0.7-0.89 and specificity of 0.91-1.0 for detection of API between the radiologists. Accuracy ranged from 0.85-0.91.

CONCLUSION
Utilizing major and minor imaging criteria on MRI to diagnose API can make placental MRI reporting more consistent and accurate and thus aid in surgical planning.

CLINICAL RELEVANCE/APPLICATION
Introducing a placental MRI grading scale with major and minor imaging criteria to assign confidence in diagnosing abnormal placental implantation, improving reports' accuracy and consistency.

Genitourinary (Diagnosis of Benign Gynecologic Processes, Tubal Oclusion)

Tuesday, 03:00 PM - 04:00 PM • E353B

SSJ12 • AMA PRA Category 1 Credit™:1 • ARRT Category A+ Credit:1

Moderator
Julia R Fielding, MD
Moderator
Susanna I Lee, MD,PhD

SSJ12-01 • MR Hysterosalpingography, a Radiation Free Alternative to Laparoscopy in Female Infertility: Our Experience

Natalia T Posadas MD (Presenter); Andres Kohan MD *; Mariana C Kucharczyk MD; Maria N Napoli MD; Nora A Fuentes; Ricardo D Garcia-Monaco MD, PhD; Santiago Gil; Carolina R Chacon MD

PURPOSE
Female infertility workup usually involves ultrasound and hysterosalpingography (HSG) to assess for tubal patency, myomas and endometriosis. However, none evaluates the female pelvis as thoroughly and in a single exam as laparoscopy. MRHSG has been described as a possible one-stop-shop exam with encouraging results. Our purpose is to show our experience in MRHSG.

METHOD AND MATERIALS
37 patients referred to radiology for pelvic MRI were included in this research. MRHSG was performed in a 1.5T MR using a hysterosonogram catheter and an automated pump during routine pelvic MRI. Following a non-contrast exam, images were acquired before, during and after intravascular injection of diluted Gd. Three days later patients were evaluated for complications. Independent assessment of pelvic pathology and tubal patency was done by two experienced radiologists (8y, 11y). Upon discrepancy, agreement was reached by consensus. Descriptive and analytical statistical analyses were performed, and frequencies were calculated. Mann-Whitney U test for independent samples was performed to detect significant differences.

RESULTS
MRHSG showed high acceptability and success rate for tubal patency assessment while simultaneously evaluating and diagnosing relevant diseases in infertility, thus becoming a potential one-stop-shop solution for female infertility.

CLINICAL RELEVANCE/APPLICATION
Female infertility is usually evaluated with many separate imaging studies (US, HSG, MR) or, even worse, laparoscopy. MRHSG could be a one-stop-shop exam for this patient population.

SSJ11-02 • Menstrual Cycle-specific Apparent Diffusion Coefficient of Normal Uterine Zonal Structures in Healthy Reproductive-age Women

Bo Jiang MD, PhD (Presenter); Bitao Pan; Ximin Pan; Meiyu Hu

PURPOSE
To assess the influence of three different physiological phases on the Apparent Diffusion Coefficient of normal uterus during menstrual cycle in healthy reproductive-age women.

METHOD AND MATERIALS
Eighteen healthy reproductive-age women underwent magnetic resonance diffusion-weighted imaging (DWI) at the menstrual, proliferative and secretory phases in a regular menstrual cycle. The apparent diffusion coefficient (ADC) was calculated of endometrium, junction and myometrium in uterine zones with b-values of 0,500 s/mm² and 0,1000s/mm², respectively. The ADC of each uterine zone was compared among the three phases and between two sets of different b value combination as well.

RESULTS
patient to opt for the absence of surgery specifically until childbirth.
In the menstrual, proliferative and secretory phases, the ADC of endometrium was $1.37\pm0.62$, $1.64\pm0.54$, $1.51\pm0.35$ at b valued 0 and 500 ($F=7.83$, p=0.05, respectively) and at b valued 0 and 1000 ($q=4.09$, p=0.05, respectively). The ADC of endometrium in menstrual, proliferative and secretory phases was higher at b valued 0 and 500 than in at b valued 0 and 1000 ($t=2.05$, p=0.05).

**CONCLUSION**

The different physiological phases in menstrual cycle exert significant effect on the ADC of endometrium but less effect on the ADC of both junctional zone and myometrium in healthy reproductive-age women. Higher-b value DWI warrants a more stable ADC.

**CLINICAL RELEVANCE/APPLICATION**

The menstrual cycle could be an important consideration when interpreting the usefulness of ADC of endometrium in reproductive-age women, and an appropriate time window selection for DWI is necessary.

**SSJ12-03 • Comparison between Magnetic Resonance Hysterosalpingography Performed with 1.5 Tesla and 3 Tesla**

**Valentina Cipolla (Presenter); Renato Argiro (Presenter); Daniele Guerrieri MD; Domiziana Santucci; Carlo De Felice MD**

**PURPOSE**

The aim of this study was to compare results of magnetic resonance hysterosalpingography performed with 1.5 Tesla and with 3 Telsa (1.5 T MR-HSG and 3T MR-HSG) for the diagnostic workup of infertile women.

**METHOD AND MATERIALS**

We retrospectively analyzed 326 MR-HSG performed at our institution in a period of 30 month. The MR examination was performed with 1.5-T or 3-T MR unit. In both cases T2-weighted and fat saturated T1 weighted images after intracavitary injection of normal sterile salin were obtained using routine clinical parameters to assess intracavitory and extracavitory abnormalities. For the analysis of tubal patency, fat-saturated T1-weighted gradient echo 3D dynamic sequences were acquired during the hand-injection of a small amount of a contrast solution consisting of gadolinium diluted in normal sterile saline. Contrast solution employed in 3T-MR-HSG was more diluted than 1.5 T MR-HSG. The procedure was repeated for 1, 2 or 3 times depending of the case. Two readers reviewed all examinations and compared the following parameter: visibility of the tubes, failure rate and execution time.

**RESULTS**

One hundred and ten MR-HSG were performed with 1.5 T and 216 with 3 T. Comparative analysis of examination show that intramural and ampullary portions of the tube were visualized in 75.3% of cases with 1.5 T and in 85.7% of cases with 3 T. Failure rate was 5.6% with 1.5 T and 2.5% with 3 T. Mean execution time was 25 min for 1.5T MR-HSG versus 18 min required for 3T MR-HSG. Gadolinium dose was reduced from 2 ml to 0.5 ml with 3T.

**CONCLUSION**

3T MR-HSG achieve a shorter execution time and a lower failure rate and offers a better visualization of the fallopian tubes compared to 1.5-T MR-HSG. Thanks to higher CNR, 3T allow gadolinium dose reduction an potential cost saving. 3T MR-HSG should be considered more accurate and faster single comprehensive examination to be employed in female infertility investigation.

**CLINICAL RELEVANCE/APPLICATION**

3T MR-HSG represent a faster and more accurate imaging approach compared to 1.5T MR-HSG in the diagnostic workup of female infertility.

**SSJ12-04 • Improvement of 3T MR-HSG as 'One-stop-Shop' Imaging Approach to Female Infertility: Our Experience Over the Years**

**Valentina Cipolla (Presenter); Renato Argiro; Daniele Guerrieri MD; Domiziana Santucci; Carlo De Felice MD**

**PURPOSE**

To confirm the improvement over the years of 3 Tesla magnetic resonance imaging hysterosalpingography (3T MR-HSG), as single comprehensive imaging approach to female infertility.

**METHOD AND MATERIALS**

Two hundred and sixteen infertile women underwent 3T MR-HSG. After standard imaging of the pelvis, dynamic study was performed by acquiring T1-weighted 3D time-resolved imaging of contrast kinetics (TRICKS) sequences during manual injection of 4-5 ml of contrast solution consisting of gadolinium (0.5 ml) and normal saline (20 ml). This procedure was carried out 1, 2 or 3 times. Two readers independently analyzed images. Regarding tubal patency, possible diagnoses were: fast tubal patency; delayed tubal patency; asymmetrical tubal patency; loss of regular tubo-ovarian relationship; bilateral tubal occlusion.

**RESULTS**

3T MR-HSG was successfully completed in 97.5%, failure rate was 2.5%. Analysis of morphological sequences revealed extratubal-extracavitary abnormalities in 44.9%, while uterine cavity abnormalities were found in 25% of patients. Overall extratubal abnormalities were detected in 69.9% of cases. Dynamic sequences showed intramural and ampullary portions of the tube in 85.7% while disconnected tubal patency were made indirectly in the remaining 14.3%. Bilateral tubal patency was found in 62%, among which 34.5% presented fast and symmetrical bilateral tubal patency and regular tubo-ovarian relationship. Unilateral tubal patency was found in 25%, among which 14.6% presented fast unilateral tubal patency with regular tubo-ovarian relationship. Bilateral tubal occlusion was detected in 9.4%. Average examination time was 18 min.

**CONCLUSION**

Over the years 3T MR-HSG showed a sensitive improvement in diagnostic accuracy for extratubal abnormalities and tubal visualization, allowing the clear depiction of intratubal spillage of contrast media, despite the very small amount injected. Execution time and failure rate were significantly reduced. After a three years experience, we could affirm that 3T MR-HSG is a simple, fast, safe and well tolerated examination. 3T MR-HSG represents a comprehensive 'one-stop-shop' examination and should be employed as first level imaging technique in female infertility investigation.

**CLINICAL RELEVANCE/APPLICATION**

3T MR-HSG represents a fast and accurate, comprehensive imaging examination for female infertility.

**SSJ12-05 • Pearls and Pitfalls of Essure Microinsert Imaging: Does Abnormal Shape on U/S Predict Complications on HSG?**

**Wendaline M McEachern MD (Presenter); Ian Suchet; John Thiel**

**PURPOSE**

We hypothesize that the shape of the Essure microinsert on ultrasound is able to predict complications evident on hysterosalpingogram (HSG), the accepted gold standard.

**METHOD AND MATERIALS**

From July 2, 2009 to July 2, 2012, 441 women at our institution received Essure microinsert placement for the purpose of permanent sterilization. 2D, 3D and 4D volume contrast imaging-coronal plane (VCI-C) transvaginal ultrasounds were performed three months after Essure microinsert placement. Those patients with complications identified on ultrasound, a non-diagnostic ultrasound or complications from the insertion procedure were referred for HSG. Patients with both HSG and ultrasound performed were retrospectively selected and anonymized. The ultrasounds were prospectively reviewed using previously archived 3D and 4D US volumes by a single, blinded radiologist. The shape of each Essure microinsert was described using a numeric grading system. This numeric descriptor was then recorded and compared to the previously reported HSG result.

**RESULTS**
The sensitivity of Essure microinsert shape on ultrasound in predicting complications, compared with standard HSG, was 94%, with a positive predictive value of 85%; specificity was 95%, with a negative predictive value of 98%.

CONCLUSION
Abnormal microinsert morphology is an excellent predictor of abnormality (sensitivity 94%). The positive predictive value of 85% results in slightly more individuals classified as abnormal, but is safer for patients as it leads to appropriate referral for HSG and recommendation for interim secondary form of contraception.

CLINICAL RELEVANCE/APPLICATION
Ultrasound as a frontline modality for Essure microinsert assessment may contribute to a future FDA label change which mandates HSG post-insertion.

SSJ12-06 • Virtual Hysterosalpingography in 10000 Cases

Patricia M Carrascosa MD (Presenter) *; Javier Vallejos MD; Carlos Capunay MD; Mariano Baronio; Jorge M Carrascosa MD

PURPOSE
To illustrate the typical findings of V-HSG by MDCT in daily practice and the differential diagnosis with other pathologies.

METHOD AND MATERIALS
We evaluated the V-HSG studies of 10000 patients (mean age 35.4 ± 3.5 years) derived from our institution. Studies were performed using 64, 128 and 256 multislice CT scanners. Scanning parameters were: On 64-row CT: slice thickness of 9 mm and a reconstruction interval of 0.45 mm, 120 kV and 100-250 mAs, with an average duration of each scan of 3.6 seconds. On 128 and 256-slice CT: slice thickness of 6 mm and a reconstruction interval of 3 mm, 80 kV and 100-150 mAs, with an average duration of each scan of 1.3 seconds. For visualization of the internal genital organs 10-20 ml of a dilution of low-osmolality iiodinated contrast was instilled into the uterine cavity. Images were analyzed using multiplanar reconstructions, 3D, and virtual endoscopy. The duration of the CT scan, the radiation exposure and the degree of discomfort of the patients were documented.

RESULTS
Using 64-row CT scanners, the mean radiation dose was 0.9 mSv. Using 128 to 256-slice CT scanners the mean radiation dose was 0.3 mSv.

In the cervical region were identified parietal irregularities (26%), thickening of folds (10%), polyps (8%), diverticula (6%), stricture (6%) and adhesions (1%). At the level of the uterine cavity showed polyps (35%), submucous fibroids (9%) and adhesions (4%). In addition changes were observed in the wall of the uterus: fibroids (15%), malformations (3.6%), adenomyosis (6%) and cesarean section (11%). 4% of the uterine tubes were not visualized completely. Unilateral hydrosalpinx was visualized (8%) and bilateral (1.5%). Patients reported no or mild discomfort in 85% of the cases.

CONCLUSION
The Virtual-HSG allowed a proper assessment of the internal genital organs, providing useful diagnostic information on infertility and other gynecological disorders. The technique is painless, well tolerated by patients with low doses of radiation. These advantages place this modality as a valid alternative algorithm study in patients with infertility

CLINICAL RELEVANCE/APPLICATION
CT Virtual Hysteroscopy provides a complete, minimally invasive evaluation of the female reproductive system. Low radiation doses are very important.
SSJ16-02 • Indirect Shoulder MRI Arthrography: A Novel Technique for Young Patients

Azam A Eghbal MD (Presenter); Kerwin Jones MD

PURPOSE
The purpose of this study is to compare the sensitivity of indirect magnetic resonance imaging arthrography (I-MRI) for detecting shoulder labral pathology in patients less than 21 years of age to direct magnetic resonance arthrography replacement (D-MRI). The significance of the study is that shoulder I-MRI may be a reasonable and less invasive alternative to direct magnetic resonance arthrography in this population.

METHOD AND MATERIALS
A retrospective review identified 68 cases of indirect shoulder arthrography performed over a two-year period at a single pediatric institution. Of these patients, 37 had subsequent shoulder arthroscopic findings available for review. The I-MRI reports were compared to the operative images for the presence or absence of labral pathology by an independent pediatric orthopedic surgeon. An independent pediatric radiologist on staff provided the MRI reports. Labral pathology was defined as a labral tear or fraying. All MRI images were also reviewed by a second pediatric radiologist for labral pathology without knowledge of surgical findings. Descriptive statistics were used to analyze data.

RESULTS
Of the 37 cases included in the study, the I-MRI reports correctly identified the presence or absence of labral pathology found during surgery in 32 cases. Compared to arthroscopic findings, the sensitivity of I-MRI for detecting labral pathology was 94%, with a positive predictive value of 90% and a 6% false negative percentage. The sensitivity for the second pediatric radiologist was 100%, with a positive predictive value of 94%, and a 0% false negative percentage.

CONCLUSION
Direct shoulder arthrography is currently the gold standard imaging technique in the diagnosis of labral pathology. However, indirect shoulder arthrography is a less invasive alternative, which is extremely helpful in the young population. In this series, the sensitivity of I-MRI for detecting labral pathology was 94% (100% for the second reader) which is comparable to the historical range reported for D-MRI of 88–96%. It appears that I-MRI may be a reasonable and less invasive alternative to D-MRI in young patients.

CLINICAL RELEVANCE/APPLICATION
Indirect shoulder arthrography is a less invasive alternative to Direct shoulder arthrography with comparable sensitivity.

SSJ16-03 • Usefulness of Pre and Post MR Arthrogram Imaging of the Shoulder in Detection of Unstable Labral Tears

Thomas H Magee MD (Presenter)

PURPOSE
Shoulder surgeons commonly intervene on unstable labral tears (those tears that displace with patient movement). Surgeons can detect unstable tears at surgery. It is difficult to be certain a tear is unstable on a static MR image. We report the benefit of pre and post arthrogram MR imaging in detection of unstable labral tears.

METHOD AND MATERIALS
One hundred fifty consecutive conventional shoulder MR and MR arthrography exams performed on the same patients were reviewed retrospectively by consensus reading of two musculoskeletal radiologists. Both conventional MR and MR arthrogram exams were performed on each patient on the same day. Labral tears were assessed. It was also determined if there was any difference in position of the labral tear comparing pre and post arthrogram images. All patients went on to arthroscopy.

RESULTS
Of these one hundred fifty patients, ninety -four had SLAP (superior labral anterior to posterior) tears, fifty three had posterior labral tears and forty two had anterior labral tears on MR exam. All one hundred fifty patients went on to arthroscopy. All lesions described on MR were described on arthroscopy. Twenty three SLAP tears, sixteen posterior labral tears and seventeen anterior labral tears demonstrated a change in the position of the labral tear on pre versus post arthrogram images. All of these labral tears were considered unstable by the surgeon and all of these patients had surgical tacking performed.

There were five SLAP tears, three anterior labral tears and four posterior labral tears seen on arthroscopy not seen on MR or MR arthrogram examination.

CONCLUSION
In this study, pre and post arthrogram MR imaging of the shoulder was useful in demonstrating unstable labral tears in twenty three patients with SLAP tears, sixteen patients with posterior labral tears and seventeen patients with anterior labral tears. This information was useful in surgical planning.

CLINICAL RELEVANCE/APPLICATION
Pre and post arthrogram MR imaging of the shoulder is useful in demonstrating unstable labral tears. This information is useful in pre surgical planning.

SSJ16-04 • Postoperative CT Arthrographic Features of Superior Labral Anterior-to-Posterior Lesions: Correlation with Functional and Clinical Outcome

Bohwa Choi (Presenter); Na Ra Kim MD; Sung Gyu Moon MD; Jin-Young Park MD

PURPOSE
To assess the presence of a superior labral cleft on postoperative CT arthrography after superior labral anterior to posterior lesion (SLAP) repair and to evaluate whether such superior labral clefts are correlated to functional and clinical outcome.

METHOD AND MATERIALS
Forty six patients (37 men, nine women; mean age, 35 years) were included and underwent CT arthrography of the shoulder after arthroscopic SLAP repair. Two musculoskeletal radiologists reviewed CT arthrographic images for the presence and size of a superior labral cleft demarcated as a detectable contrast material-filled focal discontinuity of the labrum within anchor fixation sites of the glenoid on an oblique coronal image. The extent, direction of curvature, and marginal irregularity of a superior labral cleft were assessed on axial, oblique coronal and oblique sagittal CT arthrographic images. The functional and clinical outcome was evaluated by using the American Shoulder and Elbow Surgeons (ASES) scoring. The mean time interval between surgery and postoperative CT arthrography was 16.9 months (range, 7 to 63 months).

RESULTS
The superior labral cleft was found in 52% (24 of 46). The mean width and depth of the superior labral cleft were 2.0mm ± 1.1 and 2.8mm ± 1.5. When present, the superior labral cleft extended posterior to the biceps tendon in 62.5% (15 of 24), was oriented medially in 91.7% (22 of 24), and had a smooth margin 79.2% (19 of 24). No significant association was seen between the presence, width and depth of a superior labral cleft, and ASES score (P = .569, .633 and .067, respectively). The superior labral clefts were seen more commonly in long time interval between surgery and postoperative CT arthrography (P = .018).

CONCLUSION
Shallow superior labral clefts can be frequently seen after arthroscopic SLAP repair at long-term follow-up. The presence of superior labral clefts do not necessarily correlate with functional and clinical outcome after SLAP repair.

CLINICAL RELEVANCE/APPLICATION

Pre and post arthrogram MR imaging of the shoulder is useful in demonstrating unstable labral tears. This information is useful in pre surgical planning.

SSJ16-03 • Usefulness of Pre and Post MR Arthrogram Imaging of the Shoulder in Detection of Unstable Labral Tears

Thomas H Magee MD (Presenter)

PURPOSE
Shoulder surgeons commonly intervene on unstable labral tears (those tears that displace with patient movement). Surgeons can detect unstable tears at surgery. It is difficult to be certain a tear is unstable on a static MR image. We report the benefit of pre and post arthrogram MR imaging in detection of unstable labral tears.

METHOD AND MATERIALS
One hundred fifty consecutive conventional shoulder MR and MR arthrography exams performed on the same patients were reviewed retrospectively by consensus reading of two musculoskeletal radiologists. Both conventional MR and MR arthrogram exams were performed on each patient on the same day. Labral tears were assessed. It was also determined if there was any difference in position of the labral tear comparing pre and post arthrogram images. All patients went on to arthroscopy.

RESULTS
Of these one hundred fifty patients, ninety -four had SLAP (superior labral anterior to posterior) tears, fifty three had posterior labral tears and forty two had anterior labral tears on MR exam. All one hundred fifty patients went on to arthroscopy. All lesions described on MR were described on arthroscopy. Twenty three SLAP tears, sixteen posterior labral tears and seventeen anterior labral tears demonstrated a change in the position of the labral tear on pre versus post arthrogram images. All of these labral tears were considered unstable by the surgeon and all of these patients had surgical tacking performed.

There were five SLAP tears, three anterior labral tears and four posterior labral tears seen on arthroscopy not seen on MR or MR arthrogram examination.

CONCLUSION
In this study, pre and post arthrogram MR imaging of the shoulder was useful in demonstrating unstable labral tears in twenty three patients with SLAP tears, sixteen patients with posterior labral tears and seventeen patients with anterior labral tears. This information was useful in surgical planning.

CLINICAL RELEVANCE/APPLICATION
Pre and post arthrogram MR imaging of the shoulder is useful in demonstrating unstable labral tears. This information is useful in pre surgical planning.
Iterative metal artifact reduction (IMAR) is a new sinogram inpainting technique to reduce CT metal artifact which adds high frequency data to improve visualization close to metal edges. Our purpose was to compare the image quality and accuracy of attenuation values near hardware of IMAR and standard filtered back projection (FBP) in patients with shoulder arthroplasties (SA).

RESULTS
IMAR1.5 was ranked best for humeral cortex (avg 1.4), glenoid trabeculae (avg 1.36) and glenoid cortex (avg 1.4). IMAR2.5 was ranked best for humeral trabeculae (avg 1.2). IMAR was ranked the best for deltoid muscle (avg 1.2). IMAR1.5 and 2.5 were ranked best for metal-bone interface (avg 1.2). FBP was ranked worst for all structures (avg 3.38–3.49). All readers ranked IMAR1.5 and 2.5 over FBP (p < .05).

CONCLUSION
IMAR, especially with added high frequency data, had superior image quality and more accurate attenuation values near hardware than standard FBP in patients with shoulder arthroplasties.

CLINICAL RELEVANCE/APPLICATION
IMAR is a promising new CT technique to reduce metal artifact that is fully automatic and computationally inexpensive and has the potential to replace standard FBP in patients with hardware.
RESULTS
The thickness index and semi-quantitative histological scores of RT in two groups were increasing gradually post-op, while T2 value index was decreasing. At 3 weeks, the T2 value index of microfracture group was lower than that of joint debridement (P=.000). But at 5 weeks and 7 weeks, it was higher than joint debridement (P=.032 and .013). For microfracture group, the RT was mainly composed of hyaline-like cartilage tissue, with more production of well-organized collagen fibrils and glycosaminoglycan (GAG). However, for joint debridement, RT was mainly composed of fibrous and scar tissue.

CONCLUSION
The study revealed the correlation between MRI and histological performance, which indicated the potential value of using MRI 3D-DESS and T2-mapping as a noninvasive tool to evaluate the process of cartilage repair.

CLINICAL RELEVANCE/APPLICATION
MR 3D-DESS and T2-mapping which can reflex information about thickness and biochemical properties of RT provides a noninvasive and effective tool to evaluate RT condition after microfracture for OCD.

SSJ17-02 • In Vitro Comparative Study of T2 and T2* Mappings of Human Articular Cartilage Using 3-Tesla Magnetic Resonance Imaging: MRI-histologic Correlation after Total Knee Arthroplasty

Tayhee Kim (Presenter) ; Kyu-Sung Kwack MD, PhD ; Hakil Kim ; Xuenan Cui

PURPOSE
Even though many different authors have reported usefulness of T2 and T2* mappings for articular cartilage evaluation, there has been no coherent consensus about the correlation between T2 value, T2* value and histologic grade. The aim of this study were to investigate the correlation between these parameters and to show the diagnostic performance of T2 and T2* mappings in various histological grades of naturally degenerated human articular cartilage.

METHOD AND MATERIALS
Fourteen osteochondral specimens from 13 patients who underwent total knee arthroplasty were examined using a 3T MRI with standard turbo spin echo pulse sequence for T2 mapping and fast field echo pulse sequence for T2* mapping. Eight to ten regions of interest (ROIs) were positioned within articular cartilage of each lateral tibial condyle. A total of 134 ROIs were analyzed. Two readers in consensus assessed the degree of cartilage damage in HaemE and Masson’s trichrome stained histological slides with the David-Vaudey grade. Histological assessment was undertaken in all ROIs to correlate the observations of T2 and T2* mappings. Correlation analysis was performed.

RESULTS
The mean relaxation values for tibial cartilage were 56.6 ± 14.1 ms for T2 and 24.2 ± 14.3 ms for T2*. The mean difference between T2 and T2* values was 31 ± 20.5 ms. Pearson correlation analysis proved a positive correlation between T2 values and histologic grade (correlation coefficient = 0.386, p Conclusion
As previously reported in other studies, T2 mapping is well correlated to histological degeneration of the cartilage and may be good biomarker for osteoarthritis in human articular cartilage. Although T2* value had been known to be decreased with increasing cartilage degeneration, T2* value didn’t show statistical significant correlation in this study. Therefore, T2* mapping may not be appropriate for initial diagnosis of cartilage degeneration.

CLINICAL RELEVANCE/APPLICATION
T2 mapping is superior to T2* mapping for the evaluation of human articular cartilage degeneration. T2* mapping may not be appropriate for initial diagnosis of cartilage degeneration.

SSJ17-03 • Assessment of Morphology, gagCEST and T2 Mapping in Cartilage Repair Tissue after Chondrosphere-based Autologous Chondrocyte Transplantation

Benjamin Schmitt (Presenter) * ; Ferzan Suezer * ; Patrik Zamecnik MD ; Marco Essig MD * ; Siegfried Trattnig MD ; Rainer Siebold

PURPOSE
To compare results from morphological imaging, glycosaminoglycan-dependent chemical exchange saturation transfer (gagCEST) imaging and T2 mapping in a population of 30 patients after a novel chondrocyte-based autologous chondrocyte transplantation in the knee at 3 Tesla.

METHOD AND MATERIALS
Morphological MRI, T2 mapping and gagCEST imaging were performed on a clinical 3T MR scanner. Scan time for 3D gagCEST of one knee was 12-40 min with a saturation module optimized by simulation of Bloch equations, and T2 mapping was performed with a multi-echo spin echo approach. Results from gagCEST and T2 mapping in repair tissue were compared with results from native cartilage in the corresponding area of the contralateral knee as an unbiased reference. Due to regional variations in biological composition of cartilage, results from repair tissue grouped for trochlea, femoral condyles and patella were compared in groups with the native references. Differences between lesions and references were statistically analysed. Morphological scoring was done with the MOCART score.

RESULTS
Morphological imaging showed a total failure of transplants in only 3 cases (MOCART=0). The remaining cases largely presented with morphologically intact transplants, which is also supported by a high median MOCART score of 65 points (interquartile range=15 points). Regarding the entire population, neither gagCEST nor T2 mapping revealed any significant differences between cartilage transplants and reference cartilage in the contralateral knee. Nevertheless, few individual cases showed clear differences between transplant and reference. Analysis of relationships between T2 values and gagCEST signal intensities showed no significant correlation (P=0.536).

CONCLUSION
The high morphologic integrity of the transplants together with no significant differences between transplants and reference cartilage in the high biochemical imaging techniques suggests a high quality of the transplants. Furthermore our study indicates that using the contralateral knee as a reference to assess outcomes of repair tissue is a key element to avoid a bias compared with using a potentially biochemically different native part of cartilage from the same knee.

CLINICAL RELEVANCE/APPLICATION
Functional and morphological imaging showed no differences to reference tissue for the assessed cartilage repair technique indicating better performance than alternative techniques.

SSJ17-04 • The Effect of Initial Methotrexate Therapy on Cartilage Composition in Early Rheumatoid Arthritis: Follow-up with Biochemical MRI of Finger Cartilage

Falk R Miese MD (Presenter) ; Benedikt Ostendorf ; Hans-Joerg Wittsack PhD ; Christoph Schleich ; Christoph Nowak ; Gerald Antoch MD *

PURPOSE
To test for initial status and subsequent recovery of cartilage glycosaminoglycan content in metacarpophalangeal joints (MCP) in patients with early rheumatoid arthritis (eRA) undergoing Methotrexate (MTX) therapy with delayed Gd(DTPA)2- enhanced MRI of the cartilage...
SSJ17-05 • Aiming for a Shorter MR Screening Protocol of the Hand in Early Arthritis: Is there Additional Value of Gadolinium?

Wouter Stomp MD (Presenter) ; Annemarie Krabben ; Desiree M Van Der Heijde MD, PhD ; Tom W Huizinga ; Johan L Bloem MD, PhD ; Annette Van Der Helm-Van Mil ; Monique Reijnierse MD

PURPOSE
Gadolinium contrast enhanced MRI images are used to assess synovitis and tenosynovitis in arthritis. We compared wrist synovitis and tenosynovitis on MRI images without gadolinium (Gd-) with gadolinium-enhanced MRI (Gd+) as the reference method to determine whether contrast administration can be omitted.

METHOD AND MATERIALS
MRI imaging of the wrist was performed in 93 early arthritis patients on a 1.5 Tesla extremity MRI. Sequences included coronal T1, coronal fat-suppressed T2 and post-gadolinium coronal and axial T1 with fat suppression. Additionally a transversal T2-weighted sequence was added to facilitate evaluation. All datasets were scored twice by 2 experienced readers, once using only unenhanced images, and another time using the complete image sets, according the OMERACT RA MRI scoring system (RAMRIS) and a tenosynovitis score.

RESULTS
Intraobserver intraclass correlations between Gd- and Gd+ sequences were 0.76 for synovitis and 0.71 for tenosynovitis for reader 1 and 0.83 and 0.57 for reader 2 respectively. At the individual joint/tendon level, concordance rates for presence or absence of inflammation were 74-77% for synovitis and 84-85% for tenosynovitis. Discordance of more than 1 point in RAMRIS score was rare (1.8% of synovitis scores and 0.3-0.5% of tenosynovitis scores). Without gadolinium contrast, the sensitivity of synovitis depiction in individual joints was 72 and 91% for both readers; the specificity was 52 and 81% for both readers, indicating that without Gd synovitis was inappropriately identified in 19-48% of joints. For tenosynovitis sensitivity was 54 and 67% and specificity 88 and 91% for each reader.

CONCLUSION
When assessing arthritic joints, omitting gadolinium contrast gives suboptimal results. Although total scores show moderate to good agreement, sensitivity and specificity are markedly decreased and therefore it cannot be recommended for clinical evaluation. When only total scores are important, e.g. when monitoring therapy response, it may be considered at the cost of reduced reliability.

CLINICAL RELEVANCE/APPLICATION
Omitting gadolinium decreases invasiveness, lowers costs and shortens imaging time, however our data show that this is achieved at the cost of reduced sensitivity and specificity.

SSJ17-06 • Frequency of Subclinical Axial Inflammation in Skin Psoriasis by Whole-body MRI

Vlad A Bratu MD (Presenter) ; Ulrich Weber MD ; Peter Hausermann MD ; Ulrich A Walker MD ; Thomas Daikeler MD ; Veronika Zubler ; Ueli Studler MD

PURPOSE
Our aim was to assess the prevalence of axial skeletal changes by whole-body MRI (wbMRI) in skin psoriasis patients without clinical evidence of arthritis and in age- and sex-matched healthy controls.

METHOD AND MATERIALS
Twenty-five patients (median age 52; range 20-69) with plaque psoriasis and no history or clinical evidence of arthritis and twenty-five age- and sex-matched healthy controls with no history of inflammatory back pain or skin psoriasis were recruited by the Nordic questionnaire. All patients and controls were clinically examined by the same dermatologist and rheumatologist according to a standardized protocol. All subjects underwent standardized unenhanced 1.5 T wbMRI (coronal and sagittal T1w and STIR). Image sets including both the sacroiliac joints (SIJ) and the entire spine were read in a random order and independently by a radiologist and a rheumatologist blinded to the clinical and demographic parameters. The readers recorded the presence of spondyloarthritis (SpA) by a global assessment of the SIJ and spine images on a confidence scale of 0-10 (0=definitely no SpA, 10=definite SpA). Bone marrow edema (BME), fatty marrow infiltration (FMI) and erosive changes in each SIJ quadrant were recorded by the Morpho module. Spinal BME and FMI of all discovertebral units from C2/3 to L5/S1 were assessed according to the CanDen module. The lesion prevalence was expressed as mean percentage of subjects with ≥2 affected SIJ-quadrants or ≥2 spinal lesions in each group according to the two readers. Fisher's exact test was used to test for a significant difference in prevalence between the 2 groups (p=0.05).

RESULTS
24% of healthy controls and 30% of skin psoriasis patients were classified as axial SpA by global wbMRI assessment. A high classification confidence (8-10) was recorded in 12% of controls and 18% of patients. The differences between the 2 groups were not statistically significant, both for the global and the lesion-based assessment in the spine and the SIJ.

CONCLUSION
On wbMRI every fourth healthy control was falsely classified as axial SpA. Skin psoriasis patients without clinical evidence of axial or peripheral arthritis showed a similar frequency of SIJ and spinal changes as healthy controls.

CLINICAL RELEVANCE/APPLICATION
Subclinical axial inflammation in skin psoriasis patients might be overestimated on wbMRI since matched healthy subjects showed a similar frequency of MRI-findings.
SSJ18-01 • Quantitative Susceptibility Mapping in Patients with Systemic Lupus Erythematosus: Detection of Abnormalities in Normal-appearing Basal Ganglia

Atsushi Ogasawara (Presenter); Shingo Kakeda MD; Keita Watanabe; Tian Liu PhD; Yi Wang PhD; Yukunori Korogi MD, PhD

PURPOSE
Although the substantial population of the systemic lupus erythematosus (SLE) have neuropsychiatric symptoms, many of them may not show abnormal brain MR findings, probably because the metabolic and/or functional alterations of the disease usually precede the anatomic disturbance. Quantitative susceptibility mapping (QSM) is a novel technique to compute quantitative maps of the corresponding underlying magnetic susceptibility distribution. Our aims were to evaluate whether QSM can detect the abnormalities within normal-appearing basal ganglia at conventional MRI in the patients with systemic lupus erythematosus.

METHOD AND MATERIALS
The institutional review board approved this study. All studies were performed with a 3T MRI system (Signa EXCITE 3T; GE Healthcare). Twenty-three SLE patients with (n = 7) or without (n = 16) neuropsychiatric symptoms were enrolled; all of them showed no abnormalities in the basal ganglia at conventional MR study. The age/sex-matched 23 controls were also enrolled. For SLE patients and controls, two radiologists independently measured mean susceptibility values and R2* rates in seven brain structures (thalamus, putamen, caudate, globus pallidus, pons, splenium of corpus callosum, and frontal white matter) that appears normal on conventional MR images.

RESULTS
In the putamen and globus pallidus, the mean susceptibility values were significantly higher for the SLE patients than for the controls (P < .05). In the SLE patients with normal basal ganglia at conventional MRI, QSM detected the subtle susceptibility changes more sensitively than R2* mapping.

CLINICAL RELEVANCE/APPLICATION
In the patients with neuropsychiatric SLE, QSM seems useful for the detection of subtle tissue changes of the basal ganglia, which may lead to early diagnosis at their subclinical stage.

SSJ18-02 • In Vivo Assessment of Gray Matter Integrity in Systemic Lupus Erythematosus Patients and Its Correlation with Episodic Memory

Bernardo C Bizzo MD; Thomas M Doring MSc (Presenter); Gustavo Tukamoto; Tadeu Kubo MSc; Denise Greca; Tania M Netto PhD; Nicole Zimmermann; Tiago A Sanchez; Rochele P Fonseca; Emerson L Gasparretto MD

PURPOSE
Systemic lupus erythematosus (SLE) is an inflammatory disease, characterized by multisystem microvascular inflammation with the generation of autoantibodies and, in brain, leading to a wide range of neurological symptoms and also cognitive decline. Several studies have evaluated cognition dysfunction on SLE patients, but only a few correlated gray matter integrity to these findings. The aim of this study was to assess the cortical thickness on SLE and correlate it with episodic memory (EM) deficit.

METHOD AND MATERIALS
We used the Rey Auditory Verbal Learning Test (RAVLT) to selected 17 patients with SLE and EM deficit (mean 43.9 years, SD +/- 10.4), and 33 SLE patients without EM deficit (mean 45.3 years, SD +/- 11.2). We also evaluated 34 healthy controls (mean 45.5 years, SD +/- 9.3). Using T1-MPRAGE sequence in a 1.5 Tesla scanner, the cortical reconstruction was performed was done in FreeSurfer. To investigate the correlation between cortical thickness measurements between groups, we performed a surface-based group analysis using tools within FreeSurfer.

RESULTS
Cortical thickness between SLE patients with and without EM deficit was found in which Em deficit patients had thinner cortices (P < .05 corrected by Monte-Carlo simulation) in regions including precentral, postcentral and supramarginal in the left hemisphere, and none in the right hemisphere. When SLE patients with EM deficit were compared to control subjects, there were only precuneus and superior parietal in left hemisphere. Comparing SLE patients without EM deficit and controls, none survived the Monte-Carlo simulation.

CONCLUSION
Corroborating previous findings among the areas of statistic significant reduction of cortical thickness, the precuneus has been implicated in visuo-spatial imagery, episodic memory retrieval, perspective taking and the experience of 'agency'. Moreover, the precuneus has rich cortical and subcortical connections with other regions, including the supramarginal and postcentral gyri, with also have reduced cortical thickness in these patients. These findings corroborate the central nervous system involvement in patients with SLE and demonstrate the correlation between structural and functional abnormalities.

CLINICAL RELEVANCE/APPLICATION
SLE is a disease with frequent associated cognitive impairments, and there is not enough knowledge on the relationship between the cortical thickness of brain regions and episodic memory deficits.

SSJ18-03 • A Diffusion Tensor Imaging and Neuropsychological Study of Abstraction/Executive Impairment in HIV-infected Patients

Rafael F Cabral MD (Presenter); Denise Greca; Tania M Netto PhD; Thomas M Doring MSc; Tadeu Kubo MSc; Rochele P Fonseca; Romeu C Domingues MD; Emerson L Gasparretto MD

PURPOSE
HIV-infected patients develop brain injury and neurocognitive impairment despite the regular use of highly active antiretroviral therapy (HAART). The purpose of this study is to evaluate whether abnormal fractional anisotropy (FA) and mean diffusivity (MD) in normal-appearing white matter (WM) of HIV-infected patients is related to abstraction / executive impairment on neuropsychological tests.

METHOD AND MATERIALS
We evaluated 55 HIV-infected patients (40 males, mean age 41 years) and 27 healthy individuals matched by sex, age, years of education and Mini Mental State Examination. Images were obtained using a 1.5T scanner, with a single-shot spin-echo diffusion-weighted echo-planar pulse sequence with 73 sections covering the whole brain at 2.1-mm section thickness (TR / TE = 11320/ 94 ms). The assessment of the integrity of white matter was performed by measures of FA and MD using regions-of-interest (ROI). We analyzed correlation between the deficit score of abstraction / executive function within the mean values of FA and MD of specific areas of cerebral WM. The statistical analysis was performed assessing the relationship of deficit score of abstraction / executive function on HIV-infected patients and FA / MD values, and p

RESULTS
The mean FA was reduced in the white matter of frontal lobes, and there were small areas of increased MD in theses lobes. There was a high and significant inverse correlation between FA and deficit score of abstraction / executive function on HIV-infected patients (p
CONCLUSION
The presented results corroborate previous studies that show CNS involvement in HIV-infected patients, showing specific areas of change in white matter in these cases. Correlation between these findings and neuropsychological evaluations allows us to suggest that injuries caused by HIV are strongly related to the onset of neurocognitive impairment in HIV-infected patients.

CLINICAL RELEVANCE/APPLICATION
The unique spatial distribution of white matter injury at different stages of HIV infection, as measured by DTI, may provide a useful marker to monitor HIV-associated central nervous system injury.

SSJ18-04 • Comparative 3? ¹H MR Spectroscopy and FDG-PET Study of the Brain Metabolism in HIV-infection
Anna V Trofimova MD, PhD (Presenter) ; Tatiana Trofimova ; Galina Kataeva ; Syvatoslav Medvedev ; Elena Gromova ; Nikolay Belyakov

PURPOSE
To reveal patterns of brain metabolism changes in HIV using 3T ¹H MR spectroscopy and FDG-PET

METHOD AND MATERIALS
We studied 15 patients with early HIV (plasma CD4-lymphocytes >350 cells/ml) and 19 patients with later HIV (plasma CD4-lymphocytes <200 cells/ml). ¹H MR spectroscopy: frontal white matter, basal nuclei, hippocampus, brain stem. 2D ¹H MR spectroscopy was performed with a preselected volume at the supraventricular level. Metabolites ratios were analyzed in white and gray matter in anterior, frontal postcentral, and parietal regions. PET-FDG study with relative evaluation of rCMRglu were performed. ROIs corresponded to Brodmann areas, subcortical nuclei and hemispheres of cerebellum. Individual images were spatially normalized with SPM. WFU Pick Atlas was used to calculate mean regional values. Statistics were calculated by using STATISTICA software package, factorial ANOVA with p-values.

RESULTS
SV ¹H MR spectroscopy did not reveal difference between groups. 2D ¹H MR spectroscopy revealed decrease of Naa/Cr in the parietal white matter in later HIV (2.051±0.03) as compared to controls (2.189±0.03). In the cortex Naa/Cr was decreased in the frontal lobe in early (1.57±0.017) and later HIV (1.60±0.015) as compared to controls (1.68±0.017). Cho/Cr was significantly higher in early HIV in all white matter (1.146±0.013) and in the frontal gray matter (1.034±0.014) as compared to later HIV (1.069±0.012 and 0.900±0.014) and controls (1.005±0.013 and 0.880±0.014). Naa/Cho was decreased in all white matter in both HIV groups. In the cortex Naa/Cho was decreased in early HIV in anterior (1.552±0.031) and posterior frontal lobe (1.815±0.038), in later HIV was decreased in anterior frontal lobe (1.640±0.029). FDG-PET study revealed decrease of rCMRglu in Brodmann areas 24 and 32 bilaterally in both HIV groups, which corresponded to Naa/Cr, Naa/Cho decrease and Cho/Cr increase in the frontal gray matter. In other ROIs (cerebellum, Brodmann areas 27, 28, 34, 35, 36 of the left hemisphere) significant decrease was revealed only in early HIV.

CONCLUSION
Brain metabolism alterations are more prominent in early HIV, with similar pattern of cortex involvement revealed by ¹H MR spectroscopy and FDG-PET.

CLINICAL RELEVANCE/APPLICATION
¹H MR spectroscopy reveals brain metabolism alterations in early HIV and can be used to assess extent of the CNS involvement, disease progression.

SSJ18-05 • Aberrant Brain Functional Connectivity Related to Insulin Resistance in Type 2 Diabetes: A Resting-state Functional MR Imaging Study
Yu-Chen Chen (Presenter) ; Yun Jiao PhD ; Ying Cui ; Gao-Jun Teng MD

PURPOSE
Insulin resistance is a causal factor in type 2 diabetes mellitus (T2DM) patients, and plays a role in developing Alzheimer disease (AD). Our study mainly aims to investigate the relationship between abnormal resting-state brain functional connectivity and insulin resistance in T2DM patients.

METHOD AND MATERIALS
30 patients with T2DM and 31 healthy well-matched volunteers were prospectively examined. Resting-state brain functional connectivity analysis was used to examine the correlation between posterior cingulate cortex (PCC) and whole-brain regions. Further analysis involved evaluation of possible relationships between functional connectivity measures and insulin resistance indexed by the homeostasis model assessment of insulin resistance (HOMA-IR).

RESULTS
Compared with healthy controls, we observed significantly decreased functional connectivity within some default mode network (DMN) regions including the right middle temporal gyrus (MTG), right middle frontal gyrus, right inferior parietal lobe and other selected regions including left lingual gyrus, left middle occipital gyrus, and increased functional connectivity in right superior frontal gyrus, left precentral gyrus. Moreover, a significant negative correlation between the PCC-MTG connectivity and HOMA-IR was found in T2DM patients (p=0.022; r=-0.417).

CONCLUSION
T2DM patients have aberrant functional connectivity in the DMN, which is related to insulin resistance in selected brain regions. Resting-state connectivity disturbance of PCC-MTG may be a central role for cognitive dysfunction in T2DM patients with insulin resistance.

CLINICAL RELEVANCE/APPLICATION
fMRI can be used to track the very early progression of brain functional alterations associated with T2DM. Abnormal PCC-MTG values may be regarded as a potential marker to identify cognitive decline.

SSJ18-06 • Study on Brain Structure and Cognitive Function in Patients with Chronic Mountain Sickness in 3T MRI
Hai Hua Bao (Presenter) ; Mingli He

PURPOSE
To study cerebral white matter microstructure change in patients with chronic mountain sickness (CMS) with 3T MRI.

METHOD AND MATERIALS
17 cases of CMS and 15 normal subjects included in the study. The examination was performed on Philips 3T scanner and sequences were T1WI, T2WI, DWI and DTI. The FA and ADC values of the two groups were obtained from the regions of interest in the frontal lobe white matter, lenticular nucleus, external capsule, corpus callosum, et al. and then were compared. The relationships between FA/ADC values and CMS severity and cognitive function (Mini-Mental State Examination score) were investigated.

RESULTS
(1) In the CMS group, 6 patients showed slight cerebral edema, multiple ischemic foci and lacunar infarction foci in 15 patients and lacunar infarction complicated by ischemic foci in 3 patients. (2) Statistical results showed that the FA values of the right frontal lobe white matter in the CMS group were significantly lower (t = -2.736, P < 0.05). The ADC values of the anterior limb of the right internal capsule in the CMS group were significantly higher (t = 2.353, P < 0.05). In the CMS group, the FA values in the left caudate nucleus and the ADC values in the left thalamus were positively correlated with hemoglobin values (r = 0.533, P = 0.027; r = 0.674, P = 0.003). In the CMS group, the FA values in the anterior limb of the left internal capsule and the ADC values in the right hippocampus were negatively correlated with the MMSE scores (r = -0.667, P = 0.009; r = -0.590, P = 0.026). In the CMS group, ruptured or twisted white matter, lenticular nucleus, external capsule, corpus callosum, et al. and then were compared. The relationships between FA/ADC values and CMS severity and cognitive function (Mini-Mental State Examination score) were investigated.
CLINICAL RELEVANCE/APPLICATION
Providing imaging reference materials of CMS patients for clinical doctors.

**Neuroradiology (Epilepsy)**

**Tuesday, 03:00 PM - 04:00 PM • N228**

**SSJ19 • AMA PRA Category 1 Credit ™: 1 • ARRT Category A+ Credit: 1**

**Moderator**
Steven M Stufflebeam, MD

**Moderator**
Michael M Zeineh, PhD, MD

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**SSJ19-01 • Tuberous Sclerosis Complex: Prenatal CNS MRI Findings**

Elida Vazquez MD (Presenter); Ignacio Delgado MD; Angel Sanchez-Montanez; Alfons Macaya; Veronica Del Prete; Elena Carreras MD

**PURPOSE**

1. To prove the value of cerebral MRI in diagnosing TSC in fetuses with intracardiac rhabdomyomas.
2. To establish that MRI should be a component of fetal diagnostic workup in suspected TSC.
3. To remark the importance to be aware that a negative fetal MRI does not exclude TSC.

**METHOD AND MATERIALS**

12 fetuses with cardiac rhabdomyomas (22-36 weeks gestation) underwent cerebral MRI in our tertiary center. The study was approved by the local ethics committee and written informed consent was obtained from all patients. MRI examinations were performed on an Avanto scanner (Siemens, Erlangen, Germany) using a body phased array coil. Images were acquired using a T2-W HASTE, a T2*GRE, Fat-Sat T2-W HASTE and a T1-W gradient-echo sequences in axial, sagittal and coronal planes, with a slice thickness of 4 mm. The women were imaged in the supine position without sedation. Obtained images were read by two pediatric neuroradiologists experienced in neonatal imaging. MR imaging results were correlated with postnatal imaging, genetic data and/or histology. To avoid confusing these lesions with artifacts, we set our criteria for subependymal lesions to be seen on at least two scanning sequences in orthogonal planes and to cause a contour deformity of the ventricular wall.

**RESULTS**

In 10 cases, fetal MRI demonstrated typical characteristics of TSC, which were confirmed by postnatal MRI in pregnancies that continue gestation, or histology in those that were interrupted. There was one false-negative case, in which TSC diagnosis was established postnatally based on the presence of a single SEN that was not seen on prenatal MRI. Genetic testing of the mother also failed to prove TSC in this case. One early case was a false-positive, in which a single SEN was suspected on fetal MRI, but was not confirmed postnatally.

**CONCLUSION**

Our results prove that fetal MRI is a sensitive modality for detecting cerebral lesions in TSC and should become a component of early interdisciplinary diagnostic workup in suspected fetal TSC. Although an MR diagnosis of TSC has been reported as early as 21 weeks gestation, in our experience the diagnosis is more difficult before 28 weeks gestation. Presence of multiplicity of lesions increases the diagnostic confidence whereas a solitary lesion may be cause of false negative or positive diagnosis.

**CLINICAL RELEVANCE/APPLICATION**

Fetal MRI is a sensitive modality for detecting cerebral lesions in TSC.

**SSJ19-02 • Temporal Anteroinferior Encephalocele: A Poorly Recognized Etiology of Temporal Lobe Epilepsy?**

Taavi Saavalainen MD (Presenter); Leena Jutila; Esa Mervaala MD, PhD; Arto Immonen MD, PhD; Reetta Kalvainen; Ritva L Vanninen MD

**PURPOSE**

To report the increasing frequency of temporal anteroinferior encephalocele diagnosis in our tertiary care epilepsy center and to illustrate mainly the imaging characteristics of this condition in 19 patients. Altogether 22 patients have been reported in the literature, largest series being 3 patients.

**METHOD AND MATERIALS**

Epilepsy patients diagnosed with temporal anteroinferior encephalocele during the study period (January 2007 - March 2013) in our hospital were included. All patients had MRI examinations (mainly 3T, Philips Achieva TX) according to an epilepsy protocol which was complemented with additional sequences. 3D-CT and PET-CT were acquired from surgical candidates when necessary.

**RESULTS**

Nineteen epilepsy patients (12 females, mean age 40 years) were diagnosed with temporal anteroinferior encephalocele. Eleven patients had two or more encephaloceles and five patients had bilateral encephaloceles. The estimated prevalence of this condition was 0.3% in MRI examinations performed due to newly diagnosed epilepsy (n=4) and 2.2% in drug-resistant patients referred to our institute as epilepsy surgery candidates (n=15). High-quality, thin-slice, preferably three-dimensional MRI and computed tomography studies facilitated the detection of this condition. The mean of maximal diameter of the lesions was 11.6 mm (range, 3-48 mm) and the mean of maximal diameter of the bony defect orifice was 8.7 mm (range, 3-46 mm). PET-CT showed temporal lobe hypometabolism in 6/9 patients, all were ipsilateral to the lesion. Ten patients had epilepsy surgery. Patients with local encephalocele disconnection (n=3) or anterior temporal lobectomy and amygdalohippocampectomy (n=5) have become seizure free in a mean 1.6 years (range 3 months - 3 years) of follow up. The remaining two surgically treated patients are very recent and lack follow up data. Histologically gliosis was present in temporal lobe samples in all surgically treated patients and encephaloceles also showed cortical laminar disorganization.

**CONCLUSION**

The possibility of temporal encephalocele should be considered when interpreting MRI examinations of patients with medically intractable temporal lobe epilepsy. These patients can significantly benefit from epilepsy surgery.

**CLINICAL RELEVANCE/APPLICATION**

Identifying temporal anteroinferior encephalocele as the cause for medically intractable epilepsy is important as these patients are excellent candidates for epilepsy surgery.

**SSJ19-03 • Altered Axonal Connectivity in Medial Temporal Lobe Epilepsy: Association with Disease Severity**

Ali Tabesh PhD (Presenter); Travis O Nesland; Jens H Jensen PhD; Maria Vittoria Spampinato MD; Jonathan C Edwards; Joseph A Helpert PhD *; Leonardo Bonilha MD, PhD
Although medial temporal lobe epilepsy (MTLE) is a common neurological disorder, there remains a lack of reliable biomarkers for monitoring its clinical course and treatment response. Diffusion MRI (dMRI) tractography is a unique and powerful tool for characterization of white matter (WM) connectivity and may provide entirely new insights into network abnormalities associated with MTLE. The goals of this study were to investigate WM connectivity changes in MTLE, and to evaluate the association between these alterations and disease severity (seizure frequency) in patients.

METHOD AND MATERIALS
Nineteen patients with MTLE and 28 age- and sex-matched healthy control subjects underwent dMRI scans. Patients were divided into a well-controlled (= 4 seizures a year) and a poorly controlled subgroup based on their response to antiepileptic drug therapy. The two subgroups did not significantly differ in terms of age, age of seizure onset, or duration of disease. Streamline tractography was employed to quantify the WM connectivity of the temporal lobe ipsilateral to the seizure onset zone.

RESULTS
Patients showed a significantly lower degree of connectivity than controls in the connections between the following pairs of regions: isthmus of cingulate gyrus and parahippocampal cortex (PHC), fusiform gyrus and PHC, and inferior temporal cortex and PHC. Poorly-controlled patients showed a significantly higher degree of connectivity than well-controlled patients in the connections between the following regions: temporal pole and putamen, and entorhinal cortex and amygdala.

CONCLUSION
Our results suggest that WM connectivity measures derived from dMRI tractography may be sensitive to altered axonal connectivity in MTLE. Moreover, WM connectivity markers may potentially enable more reliable identification of patients with medication-refractory MTLE. Supported by the Foundation of the American Society of Neuroradiology and the South Carolina Clinical and Translational Research Institute.

CLINICAL RELEVANCE/APPLICATION
Axonal connectivity measures based on dMRI tractography may provide complementary information for clinical evaluation of MTLE.

SSJ19-04 • Evaluation of Focus Laterality in Temporal Lobe Epilepsy: A Quantitative Study Comparing Double Inversion-recovery MR Imaging at 3T with FDG-PET

Emiko Morimoto MD (Presenter) ; Tomohisa Okada MD, PhD ; Mitsunori Kanagaki MD, PhD ; Akira Yamamoto MD, PhD ; Yasutaka Fushimi MD, PhD ; Riki Matsumoto MD, PhD ; Shigetoshi Takaya MD, PhD ; Akio Ikeda MD, PhD ; Takeharu Kunieda MD, PhD ; Takayuki Ikuchi MD, PhD ; Dominik Paul * ; Susumu Miyamoto MD, PhD ; Ryoosuke Takahashi MD, PhD ; Kaori Tagashi MD, PhD *

PURPOSE
To quantitatively compare diagnostic capability of double inversion recovery (DIR) with fluorine-18 fluorodeoxyglucose positron emission tomography (FDG-PET) for detection of seizure focus laterality in temporal lobe epilepsy (TLE).

METHOD AND MATERIALS
This study was approved by the institutional review board, and written informed consent was obtained. Fifteen TLE patients and 38 healthy volunteers were enrolled. All MR images were acquired using a 3T-MRI system. Voxel-based analysis was conducted for FDG-PET images and white matter segments of DIR images (DIR-WM) focused on the whole temporal lobe (TL) and the anterior part of the temporal lobe (ATL). Distribution of hypometabolic areas on FDG-PET and increased signal intensity areas on DIR-WM was evaluated, and their laterality was compared with clinically-determined seizure focus laterality. Correct diagnostic rates of laterality were evaluated, and agreement between DIR-WM and FDG-PET was assessed using ? statistics.

RESULTS
Increased signal intensity areas on DIR-WM were located at the vicinity of the hypometabolic areas on FDG-PET, especially in the ATL. Correct diagnostic rates of seizure focus laterality for DIR-WM (0.80 and 0.67 for the TL and the ATL, respectively) were slightly higher than those for FDG-PET (0.67 and 0.60 for the TL and the ATL, respectively). Agreement of laterality between DIR-WM and FDG-PET was substantial for the TL and almost perfect for the ATL (? = 0.67 and 0.86, respectively).

CONCLUSION
High agreement in localization between DIR-WM and FDG-PET and nearly equivalent detectability of them show us an additional role of MRI in temporal lobe epilepsy.

CLINICAL RELEVANCE/APPLICATION
For evaluation of seizure focus in TLE, DIR would play an indispensable role to avoid radiation exposure, especially in children, and when FDG-PET examination is not available.

SSJ19-05 • DTI Fiber Tracking Biomarkers for Characterization of Focal Cortical Dysplasias

Rammohan Vadapalli MD (Presenter) ; Sita Jayalakshmi ; Manas Panigrahi MChir ; Anuj Jain MD ; Abhinav Sriram S Vadapalli ; Meghna Vadapalli BEng

PURPOSE
To evaluate the role of the new generation Diffusion tensor imaging Biomarkers for characterization of Focal cortical dysplasias, especially the Radial (perpendicular)Diffusivity(??2+ ??3);??3 maps, Radial diffusivity:FA ratio by depicting the microstructural patterns.

METHOD AND MATERIALS
This study was approved by the institutional review board, and written informed consent was obtained. Seventy-six patients in age group of 6 -44 years with M: F ratio of 3:2 with refractory epilepsy had undergone a MRI study on a 3T MRI(achieva Philips) TLE+ETLE protocol (T2 relaxometry, volumetry and MRS of Hippocampi with MRS,3D T1,3D T2 followed by a Medium to high resolution DTI(diffusion Tensor Imaging) with following parameters. Axial Plane B value: 1000 Number of directions 15 ,TR 6248 TE 60 Slice thickness 2mm with 0.5 inter slice gap,NSA 2,Matrix 112x112 bandwidth 29.8. These data were post processed using Fibertrack and Intrasense (Myirion) SW to generate FA maps, Eigen vector Maps ? 1, 2, 3 Radial diffusivity maps with ROI and mirror ROI in contralateral side. Areas of Focal cortical dysplasia were mapped and analysed.

RESULTS
Results:
Qualitative biomarkers like asymmetry,Fiber architecture in region of dysplasia and Quantitative Parameters like FA, Mean Diffusivity,Fiber density count were studied.
Type IIB FCD(n=11)
1.reduced FA
2. Increased MD 3.Mean value of Radial Diffusivity(Perpendicular Diffusivity ) Increased
4.Fiber architecture appeared normal with Normal fiber density.
5. ?? is significantly Increased.
Type IIIA, IIIB (n=34).
-reduced FA
- abnormal color coded directionality maps due to disorganized fiber structure in dysplasia(n=34).
-radial or Perpendicular diffusivity is significantly Increased with RD :FA ratio of >10.
Type III: showed ipsilateral MTSl(n=26),Bilateral MTSl(n=5).
CONCLUSION
1. FCD Type IB are better seen on Radial Diffusivity maps. 2. Radial diffusivity is increased in TypeIIB>IIA>IB(p=MD or FA >Conventional MR sequences 4.FA/RD ratio is a specific biomarker of Type II FCD.(p=

CLINICAL RELEVANCE/APPLICATION
Dysplastic cortex is known to be extending beyond MR visible abnormality and DTI visible subtle White matter abnormalities also extend beyond , hence these Biomarkers can map the true extent of FCD.

SSJ19-06 • Three-dimensional MRI Texture Analysis Reveals Subtle Textural Alterations in the White Matter and Deep Gray Matter in Progressive Myoclonic Epilepsy Type 1 or Unverricht-Lundborg Disease (EPM1)

Sanna Suoranta MD (Presenter); Kirsi K Holi MSc, PhD; Eini I Niskanen PhD; Paivi Koskenkorva MD; Reetta Kalviainen MD; Ritva L Vanninen MD

PURPOSE
To investigate the feasibility of three-dimensional MRI texture analysis (3DTA) in the detection of subtle white matter (WM) and deep gray matter (GM) changes in EPM1. EPM1 is a rare neurodegenerative disorder caused by the mutations in the Cystatin B gene (CSTB). Despite the severe neurological symptoms no focal MR changes of the brain are found in visual assessment. Diffusion tensor imaging (DTI) in humans and mice has indicated widespread WM degeneration, and voxel-based morphometry (VBM) has revealed GM atrophy in EPM1.

METHOD AND MATERIALS
Sixteen genetically verified patients with EPM1 and 16 healthy controls underwent MRI (MPRage, 1.5 T, Siemens Avanto) and 3DTA (MaZda software). Volumes of interest (VOIs) were placed manually in WM and deep GM covering as large volumes of the anatomical structures as possible. Altogether 223 different texture parameters per each VOI were computed. Textural differences between EPM1 patients and healthy controls were analyzed by the Mann-Whitney U test.

RESULTS
Visual assessment revealed no focal signal changes. Compared to the healthy controls, EPM1 patients showed statistically significant textural differences both in WM and GM. Compared to the WM VOIs, textural differences predominated in the deep GM. In right thalamus 28 %, left thalamus 37 %, and right putamen 26 % of the textural parameters differed amongst the 223 parameters analyzed. In WM, numbers of differing parameters were less frequent; left pons 19 %, corpus callosum genu 12 %, corpus 10 % and splenium 18 %; left corona radiate 14 %; right centrum semiovale 14 %. The number of differing parameters was less than 10 % in the remaining VOIs. The differing textural features included parameters based on histogram, gradient, co-occurrence matrix and run-length matrix.

CONCLUSION
WM textural alterations are widespread but less obvious than the deep GM findings. The 3DTA findings indicate that the texture of WM and deep GM in EPM1 patients is more coarse, complex and heterogeneous than in controls supporting widespread WM pathology in line with the previous DTI findings.

CLINICAL RELEVANCE/APPLICATION
3DTA is able to reveal subtle morphological changes in MR images that cannot be detected by visual inspection. In patients with EPM1 3DTA is more sensitive to show alterations in deep GM than in WM.

SSJ24-01 • Feasibility and Accuracy of a New Virtual Real-time Navigation Option for MRI-guided Interventions in the Prostate

Harald F Busse PhD (Presenter); Gregory Thormer *; Josephin Otto; Nikita Garnov; Arno Schmitgen *; Axel Winkel PhD *; Thomas K Kahn MD; Michael Moche MD

PURPOSE
To determine the targeting accuracy of a virtual real-time navigation option for MRI-guided interventions and to estimate the feasibility for transrectal prostate biopsies at 3 T.

METHOD AND MATERIALS
A standard MR-compatible interventional device (DynaTRIM, Invivo) was modified to provide real-time feedback of the virtual needle path. Interventional instruments are tracked by a digitizer that measures the 3D offset between a set of reflective markers attached to the instrument manipulator and reference markers mounted in a fixed geometry to the MR table. Device-to-MRI transformation was determined in a one-time calibration step. Prior to the intervention, the device was registered by a custom-made 3D localization of reference MR markers. The navigation system (Localite, Germany) then provided MRI views centered at the position of the instrument tip and reformatted along either the axis or standard radiological planes. The accuracy was estimated in a 3-T MRI trial (Trio, Siemens) by targeting 30 invisible peas (mean diameter 8.5 mm) without any control imaging. Clinical application under IRB approval involved 18 patients (52-72 y.o., mean 65) that had negative biopsies under TRUS guidance. MRI intervention times and biopsy findings were documented.

RESULTS
The add-on components did not affect image quality or patient comfort. Device registration was successful and fast (< 30 s). Experimental biopsy samples contained pea material in 28/30 cases corresponding to a maximum 3D error of 4.3 mm in 93% of the cases. Median clinical intervention time was 55 (36-89) minutes and involved two lesions in 7/18 patients (39%). No procedure-related complications were observed. The obtained specimens were diagnostic in all cases. In 8 patients (44%), histopathology revealed prostate cancer of Gleason Score 6 and 7.

CONCLUSION
Virtual real-time MRI navigation was found to be feasible and accurate in combination with an existing interventional device for the prostate. Potential stereotactic errors, in particular from prostate motion, can be rapidly detected and corrected for by updating the 3D navigation dataset. The underlying technique can be modified to work with other devices, scanner models and clinical applications as well.

CLINICAL RELEVANCE/APPLICATION
The presented virtual real-time navigation solution is a convenient and accurate add-on option to facilitate interventional instrument guidance in organs like the prostate.
SSJ24-02 • 4D Flow MRI Assessment of Cerebral Blood Flow after Extracranial-intracranial Bypass

Tetsuro Sekine (Presenter) ; Yasuo Amano MD ; Ryo Takagi MD ; Yoshio Matsumura RT ; Yuriko Suzuki BS * ; Shinichiro Kumita MD

CONCLUSION
The hemodynamics after EC-IC bypass is assessed by 4D Flow comprehensively.

Background
Extracranial-intracranial (EC-IC) bypass is performed to maintain blood flow in the brain of patients with internal carotid artery (ICA) occlusion. However, hemodynamics after EC-IC bypass is not well known. The aim of this study was to comprehensively assess the hemodynamics in patients after EC-IC bypass using time-resolved 3D phase contrast MRI (4D Flow).

Discussion
4D Flow shows that the type of bypass affects flow direction and BFV, and that ?P correlates with ?BFV. 4D Flow can quantify BFV and ?P after EC-IC bypass as well as visualize flow direction.

SSJ24-03 • Diffusion Analysis with Triexponential Function in Liver Steatosis

Tatsuya Hayashi (Presenter) ; Tosiaki Miyati PhD ; Junji Takahashi ; Yoshinori Tsuji ; Masakatsu Tano ; Satoshi Saito

PURPOSE
Our previous study has shown that triexponential function analysis noninvasively obtains more detailed information on diffusion in liver; however, the influence of fat accumulation to liver quantitative diffusion analysis is not clear. The purpose of this study was to assess the influence of liver steatosis on diffusion and perfusion by using the triexponential function analysis.

METHOD AND MATERIALS
On a 1.5 T MRI, navigator-echo triggered single-shot diffusion echo planar imaging was used with multiple b values of 0 to 1500 s/mm², TE of 77 ms, TR of 1 respiratory cycle, and an imaging matrix of 128×74. Thirty-three patients underwent diffusion-weighted magnetic resonance imaging (DWI) with multiple b-values to obtain perfusion-related diffusion, fast free diffusion, and slow restricted diffusion coefficients Dp, Dr, Ds and fractions (Fp, Fr, Fs) with triexponential function analysis. They also underwent dual-echo gradient echo imaging for measurement of hepatic fat fraction (HFF). Of these, 13 patients were included in the control group and 20 in the fatty liver group with HFF >5%. Parameters of two groups were compared using the Mann-Whitney U test. The relationships between each diffusion coefficient and HFF were assessed using the Pearson correlation.

RESULTS
Perfusion-related diffusion coefficient Dp and fast free diffusion coefficient Dr were significantly reduced in the steatotic liver group compared with the control group (Dp = 27.72 ± 6.61 × 10⁻³ mm²/sec vs. 33.33 ± 6.47 × 10⁻³ mm²/sec, P = .0072; Dr = 1.70 ± 0.53 × 10⁻³ mm²/sec vs. 2.06 ± 0.40 × 10⁻³ mm²/sec, P = .0224). There were no significant differences in other parameters between both groups. Furthermore, Dp and Dr were correlated with HFF (P < .0001, r = -0.64 and P = .0008, r = -0.56, respectively).

CONCLUSION
Decreased liver perfusion in steatosis cause the reduction in Dp, and extracellular fat accumulation and intracellular fat droplets in steatosis lead to the reduction in Dr. Thus, the influence of hepatic steatosis should be taken into consideration when the triexponential function analysis is used to assess diffuse liver disease.

CLINICAL RELEVANCE/APPLICATION
Steatosis can act as a potential confounder in quantitative diffusion and perfusion analysis and to know the influence of steatosis on diffusion and perfusion parameters is important.

SSJ24-04 • Quantitative Comparison of Varying Combinations of MRI Metal Artifact Compensation Techniques (HBW-TSE, VAT and SEMAC) for Hip Prosthesis Imaging

Chen Lin PhD (Presenter) * ; Trenton D Roth MD ; Larry Friggle ARRT ; Eric Tarkowski MD ; Kenneth A Buckwalter MD

PURPOSE
The goal of this study is to quantify and compare the reduction of metal artifacts using combinations of high transmit and receive bandwidth (HBW-TSE), View Angle Tilting (VAT) and Slice Encoding for Metal Artifact Correction (SEMAC) in order to derive an appropriate MRI protocol for hip prosthesis imaging that maximizes artifact reduction in a clinically realistic scan time.

METHOD AND MATERIALS
A hip phantom was constructed using human cadaveric bones and a total hip prosthesis (Biomet Orthopedics). The acetabular cup (titanium) and femoral stem (titanium with a cobalt chrome ball) were implanted during a simulated total hip arthroplasty. The prosthesis was placed in a bath of fat, agar, and water to simulate the soft tissues. The inclusion of fat allows the evaluation of artifacts resulting from failure of fat suppression.

2D Coronal STIR images (FOV=38cm, matrix=384×307, TR/TE/TI=5000ms/36ms/145ms, Sl Thk=3.5mm, ETL=23) were acquired with a HBW-TSE sequence and with the addition of the VAT and SEMAC using slice encoding steps of 2, 4, 6, 8, 10, 12 and 14 (SEMAC x2-14) on a 1.5T MR scanner (Siemens Aera). Parallel imaging acceleration factor (ipAT) of 2 and 4(max) were applied with SEMACx2 and SEMACx4-14 to compensation for the increase of acquisition time. The dimension of the artifact along the short and long axis in the same middle slice was measured independently by three reviewers and blinded to the metal artifact compensation techniques and parameters.

RESULTS
As shown in the plot, the measured dimension of in-plane artifact initially decreases with the addition of VAT (p=0.087, 0.003 for long and short axis) and SEMAC x2 (p=0.045, 0.16 for long and short axis). However, there is no further reduction with higher SEMAC (ANOVA p=0.95, 0.98 for long and short axis). The results from three reviewers are in good agreement, suggesting that the measurements are reproducible and reliable.

CONCLUSION
The combination of HBW STIR with VAT and SEMAC reduces metal artifact from a phantom metal hip prosthesis, but approaches a limit with VAT and SEMAC x2 where further increases of SEMAC steps increase the acquisition time without significant reduction of the artifact.

CLINICAL RELEVANCE/APPLICATION
In the presence of a hip prosthesis, VAT and SEMAC slice encoding steps of 2 should be applied on high bandwidth coronal STIR images for optimal metal artifact reduction and minimal scan time.

SSJ24-05 • Time-resolved Quantitative Ventilation and Perfusion Imaging in Free Breathing without ECG Triggering Using Non Contrast Enhanced DC Gated FLASH MRI Imaging

Andre Fischer DIPLPHYS, PhD (Presenter) ; Christian O Ritter MD ; Dietbert Hahn MD ; Thorsten A Bley MD ; Herbert Koestler MD *

CONCLUSION
Quantification of time-resolved ventilation/perfusion datasets using DC gated ¹H FLASH imaging is feasible and in accordance with literature. This technique offers high patient comfort since data are acquired without applying contrast agents in free breathing and without ECG triggering.
Cardiac PET/CT and PET/MR

Prostate SSJ24-06 • Evaluation of Short Term Reproducibility of Apparent Diffusion Coefficients for Diffusion-Weighted Imaging of the Prostate

Meredith Sadinski BA (Presenter) ; Milica Medved PhD ; Ibrahim Karademir MD ; Yahui Peng PhD ; Gregory S Karczmar PhD *
; Aytekin Oto MD * ; Yulei Jiang PhD ; Steffen Sammet MD, PhD *
; Shiyang Wang PhD *

PURPOSE
To evaluate the short term reproducibility of DW-MR imaging of the prostate through consistency in ADC maps between subsequent scans of the same patient using the same scanner and identical imaging parameters.

METHOD AND MATERIALS
14 patients with biopsy proven prostate cancer were evaluated under an IRB-approved protocol. Each patient underwent two, identical DW-MRI scans gathered back-to-back with the patient remaining on the table between acquisitions. ADC maps for each scan were generated using a least squares fit and a deformable registration was performed on the scan pairs using the Plastimatch software employing a Demons algorithm. The prostate and ROIs within cancer lesions were delineated on each scan per patient by two radiologists using the b-0 images. The prostate volume was divided into sextants (anterior apex, posterior apex, anterior medial, posterior medial, anterior base, posterior base) and absolute and magnitude percentage difference in ADC per voxel was calculated and compared across sextants. Voxel-based as well as ROI-based variation in ADC was also calculated for cancerous ROIs.

RESULTS
The absolute difference in ADC per voxel within the prostate ranged from 2.33x10^-10 to 1.60x10^-3 mm^2/sec (per voxel magnitude percentage difference of 0.00%-20%, mean 10.52%). Variation in ADC was found to be largest in the posterior apex (0.00%–200%, mean 11.53%) although difference between sextants was not statistically significant. Cancer ROIs showed a voxel-based difference in ADC per voxel of 1.07x10^-6 to 8.41x10^-4 mm^2/sec (0.00%–67.37%, mean 11.16%). ROI-based analysis showed that the difference in mean ADC of a cancerous ROI between the two scans ranged from -4.22 x 10^-4 to 4.63 x 10^-4 mm^2/sec with mean absolute difference 3.63 x 10^-5 mm^2/sec.

CONCLUSION
DW-MRI has strong potential to become a powerful quantitative imaging biomarker for prostate cancer but it is necessary to characterize the reproducibility of DW-MRI when using it in the clinic or developing new approaches for its use. Our data demonstrates that ADC variation within the prostate is modest, on the order of 10%.

CLINICAL RELEVANCE/APPLICATION
DW-MRI is a mainstay of MRI of prostate cancer, but although a fundamental limitation of its use in the clinic or as a potential quantitative biomarker, reproducibility has not been well established.

Cardiac PET/CT and PET/MR

Tuesday, 04:30 PM - 06:00 PM • N228

RC403 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

RC403A • Clinical Indications, Methods and Interpretation of Cardiac Magnetic Resonance Imaging

Gilbert Raff MD (Presenter) *

LEARNING OBJECTIVES
1) To learn appropriate indications for the use of cardiac magnetic resonance imaging. 2) To appreciate the strengths and weaknesses of cardiac MRI in relation to other cardiovascular imaging modalities. 3) To define the relative and absolute contraindications in selecting patients for cardiac MRI. 4) To know the spectrum of clinical information available from cardiac MRI. 5) To learn the basic pulse sequences and MRI protocols most commonly used in cardiac MRI.

ABSTRACT
Cardiac magnetic resonance imaging (CMR) is a noninvasive imaging modality most commonly available in tertiary referral centers. In general, it is a secondary, rather than primary test. However, in many appropriately referred patients, echocardiography, computed tomography, nuclear scintigraphy and/or invasive angiography are insufficient for definitive diagnosis. Additionally, in certain clinical situations, primary referral for CMR is preferable due to unique capabilities or institutional preferences and/or expertise. The evaluation of cardiomyopathies is a frequent use of CMR; in particular to differentiate ischemic, infiltrative, restrictive, inflammatory, hypertrophic and idiopathic myopathies. This is due to its unique capacity for tissue characterization using first pass and delayed contrast enhancement and T1 and T2 sensitive pulse sequences. Another use is in pre- and post-operative evaluation of congenital heart disease, in which the ability to provide anatomic, functional and vascular information from the entire thorax is unique, and particularly advantageous in young, radiation sensitive patients. Another frequent indication is analysis of suspected intracardiac or pericardial masses, which also benefits from the anatomic flexibility and tissue characterization capabilities of this modality.

RC403B • Cardiac PET/MRI: Clinical Applications

Pamela K Woodard MD (Presenter) *

LEARNING OBJECTIVES
1) Participants in this course will learn clinical applications of cardiac PET/MRI. 2) Participants in this course will learn potential workflows for the performance of a cardiac PET/MRI myocardial perfusion examination.
LEARNING OBJECTIVES
1) Identify the current clinical applications of cardiac PET. 2) Compare advantages and disadvantages of myocardial perfusion PET versus SPECT. 3) Recognize image artifacts associated with cardiac PET/CT. 4) Demonstrate understanding of myocardial viability interpretation and its use in clinical practice.

ABSTRACT

RC403D • The Promise of a Combined MRI/PET Scanner
Bruce E Hammer PhD (Presenter)

LEARNING OBJECTIVES
Basic concepts behind acquiring a MRI and a PET image will be reviewed. Inherent resolution capabilities of MRI and PET imaging modalities as stand-alone scanners will be compared to that of combined MRI/PET scanners. The effect of MRI hardware on PET image quality and that of PET hardware on MRI image fidelity will also be explored.

Current Imaging of the Shoulder: Rotator Cuff and Glenohumeral Joint Instability including Normal Variants, Pitfalls, Controversies, and Postoperative Challenges

Tuesday, 04:30 PM - 06:00 PM • E450A

RC404 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

RC404A • MR Checklist Approach
David W Stoller MD (Presenter)

LEARNING OBJECTIVES
1) Develop a shoulder checklist method including interpretation techniques for the rotator cuff and interval, biceps labral complex, inferior glenohumeral ligament complex, and capsular structures including the anterior band. 2) Identify glenoid wear patterns in multidirectional instability, microinstability, anterior and posterior instability.

ABSTRACT
The shoulder checklist represents a way of approaching shoulder MRIs consistently by emphasizing key structures that should be reviewed in specific planes. In the coronal plane, the AC joint should be evaluated for arthritis; the rotator cuff should be evaluated first anteriorly and then posteriorly so that far anterior cuff tears or isolated infraspinatus tears posteriorly are not missed. The biceps labral complex is where the superior labrum and the intrarticular biceps are adherent. The superior labrum is evaluated for intralabral tear or detachment from the biceps. The IGLCC is evaluated for tear or hyperintensity and thickening. The articular cartilage of the humeral head is inspected for congruity. In the axial plane, the anterior inferior labrum is established on the inferior axial images with no fluid between the fibral cartilage and the articular cartilage of the glenoid. The anterior band of the IGL is usually identified at or above the equator. There is no fluid between the posterior labrum and the articular cartilage of the glenoid. The subscapularis tendon is evaluated along its entire insertion from inferior to superior. The extraarticular biceps is evaluated for medial subluxation. In the sagittal plane, the rotator cuff is evaluated to differentiate contributing tendons of the supraspinatus and the infraspinatus and to assess the size of the rotator cuff in the anterior to posterior plane. The biceps pulley at the mid rotator cuff interval is evaluated. The glenoid fossa is inspected for sclerosis or osteophytic ridging.

RC404B • MR of the Rotator Cuff and Impingement including Postoperative Cuff
Michael B Zlatkin MD (Presenter)

LEARNING OBJECTIVES
1) Understand the anatomy of the rotator cuff including the subjacent bony structures that make up the coracoacromial arch, as well as the concept of the rotator cuff footprint. 2) Become familiar with the pathophysiology of rotator cuff disease including classic Neer type extrinsic impingement and other forms of impingement that result in rotator cuff injury. 3) Learn how to classify rotator cuff tears, and their various stages, both partial and complete. 4) Understand the various surgical and arthroscopic techniques used to treat rotator cuff lesions and impingement, and the resultant postoperative anatomy, both bony and soft tissue. 5) Recognise recurrent rotator cuff lesions in the postoperative state.

RC404C • MR of Glenohumeral Ligaments and Biceps Labral Complex
David W Stoller MD (Presenter)

LEARNING OBJECTIVES
1) To understand and identify the relationship of the inferior glenohumeral ligament, and the anterior band attachment variants, 2) The role of the superior glenohumeral ligament relevant to the biceps pulley and its relationship to the CHL ligament. 3) Biceps labral complex will be defined and discussed with Type I-III. 4) BLC sulcus will be defined. 5) SLAP tear pattern recognition and subtypes 1-10 will be reviewed. 6) Relevance of ABER review and MR arthography.

ABSTRACT
The anterior glenoid labrum provides the major area of attachment for the anterior band of the IGL. The middle glenohumeral ligament (MGL) is considerable more variable, but may also contribute fibers to the more superior aspects of the anterior glenoid labrum as it approaches the biceps tendon. Above the epiphyseal line (i.e., the junctions of the upper and middle thirds of the glenoid body fossa), the attachment of the glenoid labrum is variable. Inferior to the epiphyseal line, the labrum is continuous with the glenoid articular cartilage and serves as the insertion site for the IGL. It is the superior and anterosuperior portion of the labrum that can be variable attached to the glenoid. There are three different types of attachment of the biceps labral complex (BLC) to the glenoid. IGL-The IGL consists of anterior and posterior bands and an axillary pouch that attaches to the inferior two-thirds of the entire circumference of the glenoid by means of the labrum. The IGL is lax in the adducted position. As it tightens with increasing abduction, the anterior and posterior. MGL-The MGL attaches to the anterior aspect of the anatomic neck of the humerus, medial to the lesser tuberosity. It arises from the glenoid by way of the labrum and scapular neck. The foramen of Weitbrecht is located between the superior glenohumeral ligament (SGL) and MGL, and the foramen of Rouviere is located between the MGL and IGL. SGL-The SGL originates from the upper pole of the glenoid cavity and base of the coracoid process, and is attached to the MGL, to the biceps tendon, and to the labrum. It inserts just superior to the lesser tuberosity in the region of bicipital groove.

RC404D • MRI of Instability Excluding SLAP Lesions
Timothy G Sanders MD (Presenter)

LEARNING OBJECTIVES
1) Understand the anatomy of the rotator cuff including the subjacent bony structures that make up the coracoacromial arch, as well as the concept of the rotator cuff footprint. 2) Become familiar with the pathophysiology of rotator cuff disease including classic Neer type extrinsic impingement and other forms of impingement that result in rotator cuff injury. 3) Learn how to classify rotator cuff tears, and their various stages, both partial and complete. 4) Understand the various surgical and arthroscopic techniques used to treat rotator cuff lesions and impingement, and the resultant postoperative anatomy, both bony and soft tissue. 5) Recognise recurrent rotator cuff lesions in the postoperative state.
The glenohumeral joint is an intrinsically unstable joint and MR imaging is a very effective noninvasive means of evaluating for the numerous lesions of instability. The standard MR imaging protocols and use of MR arthrography will be discussed. 1. There are numerous osseous and soft tissue lesions which can occur in conjunction with anterior and posterior shoulder instability including: -Bankart lesion -Perthes -Anterior labroligamentous periosteal sleeve avulsion injury -Osseous Bankart/Hill Sachs lesions -Humeral avulsion of the glenohumeral ligament -Glennonlabral articular disruption II. Lesions of Micro-instability refers to instability lesions which occur within the superior aspect of the glenohumeral joint and include: -SLAP lesions/SLAC lesions -Rotator interval lesions -Biceps anchor and pulley lesions III. Injuries that are commonly seen in overhead (throwing) athletes include: -Extrinsic impingement-instability overlap -Labral and rotator cuff injuries resulting from distraction forces -Internal impingement -Glenohumeral internal rotation deficit disorder IV. Postoperative shoulder complications include: -Breakdown of labral repair/recurrent labral tear -Hardware complications -Chondrolysis of the glenohumeral joint

**ABSTRACT**

*The Role of Ultrasound in the Evaluation of the Shoulder*

**J. A Bouffard** MD (Presenter)

**LEARNING OBJECTIVES**

1) To enumerate the indications for shoulder ultrasound. 2) To describe the normal ultrasound anatomy of the shoulder. 3) To identify lesions of the rotator cuff. 4) To localize effusions of the shoulder. 5) To recognize shoulder impingement during dynamic imaging.

**Gastrointestinal: Tumor Response Assessment**

**Tuesday, 04:30 PM - 06:00 PM**

**RC404E** ● The Role of Ultrasound in the Evaluation of the Shoulder

**RC409 • AMA PRA Category 1 Credit ™ • ARRT Category A+ Credit:1.5**

**RC409A • RECIST and Other Criteria**

**Vahid Yaghmai** MD (Presenter)

**LEARNING OBJECTIVES**

1) To review the concepts behind development of anatomic imaging biomarkers. 2) To learn the strengths and weaknesses of RECIST and other anatomic imaging biomarkers. 3) New criteria for evaluation of gastrointestinal tumor response assessment.

**Abstract**

Improvements in imaging technology and therapeutic options for the management of gastrointestinal tumors have revolutionized the way tumor response to therapy is assessed. Cytotoxic therapies result in tumor shrinkage and their efficacy is commonly assessed by evaluating tumor size based on strict guidelines such as the Response Evaluation Criteria in Solid Tumors (RECIST). This review will familiarize radiologists with the steps that have led to the development and modifications of the RECIST. New cytostatic and locoregional therapies may not change tumor size and have exposed many weaknesses of the RECIST. As a result, tumor and therapy specific response assessment criteria have been developed. These new criteria, including Choi, EASL, mRECIST and irRC will also be discussed.

**RC409B • CT and MR Perfusion Imaging**

**Dushyant V Sahani** MD (Presenter)

**LEARNING OBJECTIVES**

1) Understand newer concepts in oncology including tumor angiogenesis and the evolving role of imaging biomarkers in drug trials. 2) Discuss the basic principles of CT-MR perfusion and limitations of each method. 3) Develop basic knowledge and skills for acquisition and interpretation of perfusion imaging in the abdomen and pelvis. 4) Assess the potential of perfusion imaging in the oncology trials and in non-oncologic clinical settings.

**RC409C • Diffusion-Weighted Imaging**

**Ihab R Kamel** MD, PhD (Presenter) *

**LEARNING OBJECTIVES**

1) Discuss the basic concepts for DWI in body applications. 2) Describe the emerging role of DWI in assessing response in cancer. 3) Discuss the application of DWI in whole body imaging.

**Abstract**

Diffusion-weighted magnetic resonance imaging (DWI) can provide functional information at a cellular level by measuring water diffusion values. DWI is sensitive to changes in the micro diffusion of water and the apparent diffusion coefficient (ADC) is an indicator of the movement of water within the tissue. In abdominal oncology, DWI has been successfully used in assessing treatment response of liver tumors. In addition, ADC values have been shown to predict tumor response to treatment. In some instances low tumor ADC before treatment can be predictive of better outcome. Assessing response of in the entire tumor volume may be more valuable than a single ROI measurement. Moreover, multiparametric response maps that include changes in both ADC and enhancement after therapy are more predictive of response and patient survival compared to ADC or enhancement alone. We will review the different response criteria for various liver tumors treated with intra arterial therapy. New application of DWI including whole body applications will also be discussed.

**RC409D • PET-MR-What Do We Know in 2013**

**Raj M Paspulati** MD (Presenter)

**LEARNING OBJECTIVES**

1) To understand the PET-MR technology, types of current PET-MR scanners and challenges. 2) To understand the clinical application, comparison with PET-CT, protocols and optimizing work flow. 3) To understand the pitfalls, artifacts and future of PET-MR.

**Abstract**

Introduction of PET-CT had substantial influence on cancer staging and has become a standard practice of care in certain types of cancer staging, restaging and document tumor response to treatment. The low soft tissue contrast of the CT, especially the low dose non contrast CT is the main limitation of hybrid PET-CT imaging. MR imaging proved to be superior to even contrast enhanced CT certain anatomical regions such as pelvis, head and neck due to its excellent soft tissue contrast resolution. There has been a quest for combined PET-MRI system to provide anatomical, physiological and molecular information with single integrated imaging. The main hurdle has been the sensitivity of PET photomultiplier tubes to magnetic field. This is overcome and integrated PET-MR systems are now available for clinical practice. There are currently two types of integrated PET-MR systems available from two different vendors. In the sequential type the photomultiplier tubes of PET are shielded from magnetic field by separating the PET and MR gantries. In the simultaneous type Photomultiplier tubes and MR coils are integrated in one system by using magnetically insensitive avalanche photo diodes. Both these
LEARNING OBJECTIVES
1) To review the natural history and treatment outcome for mesenteric ischemia. 2) To distinguish the imaging work ups for acute versus chronic mesenteric ischemia. 3) To learn how to image the abnormal physiologic responses of chronic mesenteric ischemia.

ABSTRACT
Mesenteric ischemia is the result of inadequate perfusion and oxygen delivery to the small intestine caused by vascular obstructions. Acute mesenteric ischemia (AMI) brought on by the abrupt occlusion of the superior mesenteric artery is a medical emergency. Mortality rate of AMI has been reported as high as 80%. Prompt CT angiography of the abdomen is the diagnostic imaging of choice. In contrast, chronic mesenteric ischemia (CMI) is the result of gradual obstructions of multiple splanchnic arteries. 90% of cases are caused by advanced atherosclerotic. Clinical diagnosis is difficult because symptoms are often vague and nonspecific. The classic clinical triad of gradual weight loss, fear of large meal, and post-prandial bowel angina may be absent. The gradual nature of the arterial obstruction promotes development of collateral arteries. The finding of an occluded splanchnic artery on angiography is not necessarily diagnostic of CMI. In difficult cases, a physiologic test that can demonstrate the sequelae of bowel ischemia would be helpful. Different imaging protocols have been proposed to detect changes in blood flow and oxygen saturation in the mesenteric circulation after a meal challenge. We will review some of these protocols and their abnormal physiologic responses indicative of CMI.

LEARNING OBJECTIVES
1) To understand the principles of vascular imaging in organ transplantation and reconstructive/restorative surgery. 2) To learn common angiography protocols for vascular mapping and surgical planning. 3) To review image post-processing that renders findings optimal for communication with the comprehensive patient care team. 4) To review the most recent imaging results in pre- and post organ transplantation and reconstructive/restorative surgery.

ABSTRACT
Complex transplantation and restorative surgery, such as full face transplantation, is a unique model for studying vascular adaptation and the interaction between donor and recipient vascularized tissue. There are important consequences for surgical planning, and to date there is no published data on the mechanisms of vascular reorganization after these complex procedures. Data will be presented that hold potential to better our understanding of the biology after complex restorations, and these data have important implications on graft success and rejection. This refresher course lecture will provide an overview of these complex processes from the perspective of vascular imaging, and the lecture will illustrate the arterial and venous adaptation to this unique environment. As the number and complexity of these procedures increases on a global scale, this initial evaluation is designed to serve as a template for future studies that will positively impact surgical outcomes and patient care.

LEARNING OBJECTIVES
1) Identify anatomic and functional lesions that predispose to vascular entrapment and fibrotic syndromes in athletes. 2) Describe methods to assess vascular entrapment and fibrotic syndromes in athletes using dynamic, functionally challenged CTA and MRA. 3) Describe the imaging findings for diagnosis and follow-up of affected athletes.

ABSTRACT
While exercise is a mainstay in preventing and treating atherosclerotic peripheral vascular disease, some vascular disorders manifest primarily in athletes. Both recreational and competitive athletes are at risk for development of non-atherosclerotic vascular diseases. These disease entities range from iliac endofibrosis in cyclists, popliteal entrapment syndrome in running sports, and thoracic inlet/outlet syndromes in overhead athletes. Recently, computed tomography angiography (CTA) and magnetic resonance angiography (MRA) have become valuable diagnostic options for many vascular diseases that can occur in the athlete. Optimum imaging in these disorders requires the ability to tailor the exam protocol to the specific disease entity and vascular territory in question. By combining rapid CT image acquisition with functional, physiologic provocative maneuvers, diagnostic information can be maximized. Newer blood-pool MR contrast agents also allow functional assessment without ionizing radiation exposure. This session will review the pathophysiology, risk factors, diagnosis, and classification of vascular diseases seen in the athlete. Logical protocol development utilizing (when necessary) provocative maneuvers will be reviewed. Interpretation strategies for interacting with these resulting large, dynamic datasets will also be reviewed.
LEARNING OBJECTIVES
1) To understand unique CT perfusion analysis of the liver due to its characteristic dual blood supply. 2) To describe the potential clinical applications, with a focus on hepatic applications. 3) To discuss several recent challenging issues regarding CT perfusion.

ABSTRACT
With the emergence of novel targeted therapies for cancer, imaging techniques that assess tumor vascular support have gained credence for response assessment alongside standard response criteria. CT perfusion techniques that quantify regional tumor blood flow, blood volume, flow-extraction product, and permeability-surface area product through standard kinetic models, are attractive in this scenario by providing evidence of a vascular response or non-response. Additionally, these techniques may provide prognostic and predictive information to the clinician. Their increasing acceptance in oncological practice in recent years has been related to the combination of clinical need and technological improvements in CT, including faster tube rotation speeds, higher temporal sampling rates, the development of dynamic 3D acquisitions and development of commercial software programmes embedded within the clinical workflow. Recently published consensus guidelines provide a way forward to performing studies in a more standardized manner. To date single centre studies have provided evidence of clinical utility. Future studies that include good quality prospective validation correlating perfusion CT to outcome endpoints in the trial setting are now needed to take CT perfusion forward as a biomarker in oncology. These presentations will cover the principles of CT perfusion analysis for tumor assessment and its pathophysiological basis. Clinical applications will be discussed focusing on hepatic and extrahepatic applications and clinical trials. Areas for further development including assessment of tumor heterogeneity will also be discussed.

RC417 • CT Perfusion in Oncology: Hepatic Imaging
Se Hyung Kim (Presenter)

LEARNING OBJECTIVES
1) To understand the key technical principles of Dynamic Susceptibility Contrast, Arterial Spin Label, and CT Perfusion Imaging. 2) Know the basic MR pulse sequences and CT acquisition schemes for perfusion imaging. 3) Appreciate the strengths and weaknesses between CT and MR Perfusion imaging methods. 4) Understand the Central Volume Principle, Diffusible Tracer, and Deconvolution Methods.

RC417D • Quantitative MR Perfusion Imaging of the Brain
Greg Zaharchuk MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Understand the difference between quantitative and qualitative perfusion measurements. 2) Distinguish several approaches for obtaining quantitative perfusion maps in the brain. 3) Appreciate the strengths and weaknesses between the two major techniques, arterial spin labeling and bolus contrast dynamic susceptibility imaging.
LEARNING OBJECTIVES
1) Understand selected applications of quantitative MR imaging biomarkers, particularly DCE-MRI applications. 2) Understand the factors that currently limit widespread acceptance and use of such quantitative MR imaging biomarkers, including sources of bias and variance. 3) Understand some of the current initiatives focused on the standardization, qualification, and validation of selected quantitative MR imaging biomarkers.

ABSTRACT
Clinical and clinical research applications of quantitative anatomical and functional MR imaging biomarkers, including those focused on treatment assessment, have continued to dramatically expand. Studies at single centers have clearly demonstrated the potential of such applications. However, sources of bias and variance of quantitative MR imaging biomarkers have not previously been adequately investigated, thus limiting the implementation of robust methods to mitigate their effects. Therefore, when it comes to applications of such techniques across vendor platforms, centers, and time, challenges arise due to lack of standards, appropriate phantoms, and protocols. During the past few years, several quantitative MR imaging initiatives have been instigated. This symposium presentation will review selected applications of quantitative MR imaging biomarkers, illustrate some of the current challenges in broadening the use of such biomarkers, and discuss some of the current initiatives of various scientific and federal organizations that are focused on the standardization, qualification, and validation of MR quantitative imaging biomarkers. Specific examples of DCE-MRI applications and standardization efforts will be provided.

URL's
web.me.com/efjackson

RC425B • Clinical Applications of Quantitative DCE-MRI
Michael V Knopp MD, PhD (Presenter)

LEARNING OBJECTIVES
1) To apply the concepts and pathophysiology of quantitative DCE MRI in clinical applications. 2) To review technical and procedure considerations for clinical applications. 3) To familiarize with current and evolving clinical applications of qDCE-MRI. 4) To utilize qDCE-MRI in and interpret clinical applications.

ABSTRACT
Dynamic contrast enhanced MRI has evolved over the last two decades into a readily available MRI add-on procedure that enables a spatial and time resolved insight into the microcirculation of tissues, both neoplastic as well as benign. While the cinematic display of the temporal contrast enhancement as well as the visual inspection of a signal intensity curve placed over a region of interest enables a ready visual perception of the characteristics of contrast enhancement, a methodological data reduction to a quantitative readout has been more challenging to validate, implement and interpret. Today, the fundamental pathophysiology, appropriate MRI acquisition and post-processing approach are well understood. Quantification is a key enabler to use imaging more as a disease (bio) marker especially for monitoring disease response or progression, as well as putting a more structured interpretation of the dynamic imaging findings into the patient care process. The clinical applications that benefits the most are those were the extent and/or intensity of tissue microcirculation can serve as a marker of biologic characteristics, guide the further diagnostics (tissue biopsies) and/or therapy management. The most common use of applying the fundamental methodologies of DCE-MRI is MR Mammography which is further evolving from a purely morphologic to a semi-quantitative or quantitative imaging procedure. Characterizing malignant tissues, inflammation or angiogenic processes with quantitative approaches is expanding our radiologic toolbox and ability to provide outcome impacting information. Quantitative DCE MRI is evolving to be an increasingly meaningful, clinically relevant and obtainable functional readout of the underlying tissue microcirculation and it will depend on our expansion of radiologic disease insight to truly capitalize on its capabilities.

RC425C • Oncologic Applications of Quantitative DCE-MRI
Anwar R Padhani MD (Presenter) *

LEARNING OBJECTIVES
1) To show that DCE-MRI can be analyzed using qualitative to quantitative methods. 2) To illustrate that routine clinical use of DCE-MRI makes use of qualitative assessments. 3) To indicate that early drug development requires quantification including reproducibility assessments. 4) To realise that complex DCE analysis has roles in validation, drug development, and is needed for multiparametric assessments.

ABSTRACT
Using DCE-MRI in oncologic clinical practice should not be delayed/hindered by the complexities of the technique. The last 20 years of validation work allows us to be confident that DCE-MRI (morphology, subtraction maps, curve shapes and semi-quantitative methods) work in the clinic. Complex quantitative DCE analysis has roles in validation, drug development, and is needed for multiparametric assessments. Future work should now focus on incorporating mpMRI imaging for directing personalized medicine.

MRI Safety Update (An Interactive Session)
Tuesday, 04:30 PM - 06:00 PM • E353C

RC429 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

RC429A • Implants and Devices
Frank G Shelock PhD (Presenter) *

LEARNING OBJECTIVES
1) To understand the MRI issues for implants and devices. 2) To comprehend the MRI labeling terminology for implants and devices. 3) To understand current information pertaining to managing patients that present with passive and active implants (e.g., neurostimulation systems, pacemakers, etc.). 4) To apply knowledge about implants and devices to ensure safety for patients undergoing MRI examinations.

ABSTRACT
Using DCE-MRI in oncologic clinical practice should not be delayed/hindered by the complexities of the technique. The last 20 years of validation work allows us to be confident that DCE-MRI (morphology, subtraction maps, curve shapes and semi-quantitative methods) work in the clinic. Complex quantitative DCE analysis has roles in validation, drug development, and is needed for multiparametric assessments. Future work should now focus on incorporating mpMRI imaging for directing personalized medicine.

RC429B • MRI Technologist Perspectives
William H Faulkner BS, RT (Presenter) *

LEARNING OBJECTIVES
1) To understand the steps required to research information relating to MR safety status of implants and / or devices. 2) To learn how to properly screen patients for MR procedures. 3) To understand the importance of being able to control access to Zones III and IV. 4) To learn how to manage patient warming and avoid patient burns.

ABSTRACT
ABSTRACT
There are more than 1.5 million patients in the US with implanted cardiac devices. It is estimated that 750,000 to 1M may have indications for MRI. There have been more than 15 monitored cardiac device/ MR trials involving over 1419 participants examined at 0.2T to 3T. At least 17 deaths with unmonitored MRI examinations have been reported. Until recently, most radiologists and MR centers have opted out of examining patients with cardiac devices. In 2008, Gimbel presented results of MR examination of patients with cardiac pacemakers at 3-Tesla with no restrictions placed on pacemaker dependency, region scanned, device type, or manufacturer, suggesting that monitored pre-programmed 3T MRI scans may be safely performed. There is currently one available FDA approved MR conditional system available for limited use. Protocol for MR conditional MR includes:
1. Confirm clinical requirement for MR.
2. Confirm functioning MR conditional device.
4. Program device to scan mode.
5. Monitor and scan patient at 1.5T.
6. Reprogram device, confirm, and discharge.

LEARNING OBJECTIVES
1) Identify, schedule, prepare, examine with MRI, and confirm reprogramming for patients with MR conditional pacemaker systems. 2) Consider the risks and benefits for MR imaging in patients with non-conditional electrophysiology devices. 3) Optimize 3rd party coverage for MR services in patients with MR conditional pacemaker systems.

Imaging in Practice: DWI in the Abdomen and Pelvis (How-to Workshop)

Tuesday, 04:30 PM - 06:00 PM  •  E261

RC451A  •  How to Perform DWI - Principles and Protocol
Shreyas S Vasanawala MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Understand basic principles of contrast formation in diffusion weighted MRI. 2) Understand sources of artifacts in diffusion weighted MRI. 3) Know techniques to reduce artifacts to produce diagnostic quality diffusion weighted images.

ABSTRACT
Diffusion-weighted imaging is being used with increasing frequency in body MRI. The basic mechanism of contrast generation is the use of large motion-sensitizing gradients such that water molecules undergoing random motion are dephased, resulting in signal loss. Tissues and lesions with high cellularity have reduced diffusive motion of water, which results in relatively high signal. However, a number of issues make diffusion-weighted imaging in the body challenging relative to neurological applications. First, the vast majority of clinical DWI is performed with an echo-planar technique, which suffers from image distortions due to field inhomogeneity. These become problematic particularly where there are gas-tissue interfaces, such as at the dome of the liver and near gas-filled bowel. The presentation will discuss methods to minimize these distortions. Second, the T2 relaxation times of abdominal tissues are less than that of pelvic viscera and much less than that of the brain, whereas normal water diffusivity is higher; as the choice of diffusion sensitivity (b value) heavily influences the echo time, lower b values must be used. Third, motion from cardiac pulsations, respiration, and peristalsis produce artifacts, some of which are easily recognizable, and others which can subtly hide pathology. Techniques to minimize these pitfalls will be presented. Finally, issues of reproducibility that affect the practical clinical use of DWI for lesion characterization in body MRI will be discussed, along with approaches to improve reliability.

RC451B  •  Interpretation of DWI - How to Create and Use ADC Maps in Your Practice
Thomas A Hope MD (Presenter)

LEARNING OBJECTIVES
1) Understand the principles of calculating ADC. 2) Understand the effect of b-value selection and weighting on diffusion calculations. 3) Explore the value of IVIM and other parameters.

ABSTRACT
In order to incorporate diffusion weighted imaging into clinical practices, it is important to understand how diffusion data is evaluated. Qualitatively, one can simply say that lesions are bright on diffusion, but intensity on high b-value imaging is not always equate to a lesion that has reduced diffusion. The understanding and implementation of quantitative analysis is therefore critical for both research and everyday clinical practice. The first step is the calculation of the apparent diffusion coefficient (ADC) map, which is used to help tease out the different diffusion in the T2 hyperintensity and diffusivity. The calculation of the ADC map is greatly affected by the methodology used as well as the selection of b-values acquired. The ADC of a tissue describes how quickly signal decreases as the b-value is increased. Those lesions with high diffusivity will have high ADC values, while those lesions with reduced diffusion will have lower ADC values. In addition to ADC, other parameters have been described that affect the measured diffusivity. The most commonly discussed is intravoxel incoherent motion (IVIM) that is thought to represent the random movement of blood within the capillary system, often called pseudodiffusion. This parameter has its greatest effect on diffusion weighted images at low b-values.

RC451C  •  Applications of DWI in Clinical Practice - When It Does and Doesn't Help
Frank H Miller MD (Presenter)

LEARNING OBJECTIVES
1) Demonstrate the utility of diffusion weighted imaging in the abdomen. 2) Show advantages and limitations of diffusion weighted imaging in the abdomen.

ABSTRACT
Diffusion weighted imaging (DWI) has been used in neuroimaging for many years. It has only more recently become feasible in the abdomen. The objective of this talk is to emphasize the important role that diffusion-weighted imaging can have in your practice and that it can be used routinely without difficulty in the abdomen and pelvis. DWI potentially can detect additional lesions and direct the radiologist to lesions that are not as well seen on conventional imaging. DWI helps in characterization of lesions but does have limitations in specificity which will be discussed. Qualitative and quantitative evaluation can be performed and the applications of these techniques clinically will be described. The strengths and limitations of DWI in multiple organs including the liver, pancreas, adrenal gland, kidney, and evaluation for metastases and infections will be discussed. DWI is especially helpful for identify lymph node and peritoneal metastases. Emerging techniques include the use of diffusion weighted imaging to assess response to therapy following liver-directed therapy will also be discussed. In summary, DWI should be used routinely if not being used at your institution. This talk will show benefits and limitations of DWI in a number of organs in the body.
**Controversy Session: MRI Contrast Use: Have Quality and Safety Collided?**

**Wednesday, 07:15 AM - 08:15 AM • E350**

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**Moderator**
- Thomas M Grist, MD *
- Jeffrey C Weinreb, MD *
- Martin R Prince, MD, PhD *

**LEARNING OBJECTIVES**
1) Be aware of the current issues relating to the use of gadolinium based contrast agents in patients with renal failure.
2) Be updated on factors relating to the relative and absolute risk of NSF in patients receiving gadolinium based contrast agents.
3) Be aware of current practical approaches to minimizing risk of NSF in patients with renal failure receiving gadolinium based contrast agents.
4) Be exposed to debate and discussion on the risk/benefit of using vs non using gadolinium based contrast agents in patients with renal failure.
5) Be better informed about management of the patient with renal failure requiring MRI with gadolinium based contrast agents.

**ABSTRACT**

**URL**

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**Hot Topic Session: Indications for MRI versus Low Dose CT in Congenital Heart Disease**

**Wednesday, 07:15 AM - 08:15 AM • E353A**

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**Moderator**
- Rajesh Krishnamurthy, MD *

**LEARNING OBJECTIVES**
1) Understand how new generation ultrafast wide array CT scanners with adaptive iterative reconstruction reduce radiation dose and decrease sedation rates in pediatric cardiac CT.
2) Learn about recent advances in use of MRI for evaluating morphology, function, flow and myocardial tissue properties in CHD.
3) Evaluate role of low-dose CT versus MRI for management decision-making in the pre-operative period in the following conditions: vascular rings and slings, pulmonary atresia, anomalous coronaries, single versus two ventricle repair, heterotaxy and aortopathies.
4) Evaluate role of low-dose CT versus MRI for management decision-making following palliation of CHD in the following conditions: following coarctation repair, after two-ventricle repair of conotruncal anomalies, and single ventricle s/p Glenn and Fontan procedures.

**SPSH40A • Preoperative Evaluation of CHD**

**LEARNING OBJECTIVES**
View learning objectives under main course title.

**SPSH40B • MRI**
- Shi-Joon Yoo MD (Presenter)

**LEARNING OBJECTIVES**
View learning objectives under main course title.

**SPSH40C • CT**
- Rajesh Krishnamurthy MD (Presenter) *

**LEARNING OBJECTIVES**
View learning objectives under main course title.

**SPSH40D • Discussion**

**LEARNING OBJECTIVES**
View learning objectives under main course title.

**SPSH40E • Postoperative Evaluation of CHD**

**LEARNING OBJECTIVES**
View learning objectives under main course title.

**SPSH40F • MRI**
- Shi-Joon Yoo MD (Presenter)

**LEARNING OBJECTIVES**
View learning objectives under main course title.

**SPSH40G • CT**
- Rajesh Krishnamurthy MD (Presenter) *

**LEARNING OBJECTIVES**
View learning objectives under main course title.

**SPSH40H • Discussion**

**LEARNING OBJECTIVES**
View learning objectives under main course title.
LEARNING OBJECTIVES

1) Discuss the structural anatomy of articular cartilage with emphasis on its collagen framework and the trabecular architecture in the subchondral bone. 2) Emphasize the manner in which the collagen and trabeculae respond to compressive, shear, and tensile forces applied to the joint surface and the resultant injuries as they are displayed in MR images. 3) Emphasize the anatomy and biomechanical implications of the osteochondral unit through novel MRI applications. 4) Discuss structure and biomechanics of bone tissue with regard to the pathogenesis of fatigue and insufficiency forms of stress injury. 5) Use case-based teaching methods to illustrate the imaging spectrum of traumatic and stress-related chondral, osteochondral, and subchondral injuries.

Abdominal MRA Update

LEARNING OBJECTIVES

1) Understand the underlying principles of non-contrast MRA. 2) Be familiar with the currently available methods for non-contrast MRA. 3) Be familiar with important applications and examples of non-contrast MRA. 4) Understand current limitations and pitfalls associated with non-contrast MRA.

RC529A • Non-contrast MRA of the Abdomen

Scott B Reeder MD, PhD (Presenter)

LEARNING OBJECTIVES

1) Discuss the differences between the in vivo behavior of blood pool and conventional MRI contrast agents. 2) Match the clinical indication with the appropriate contrast agent. 3) Determine the best imaging protocol. 4) Describe potential pitfalls and methods for dealing with them.

ABSTRACT

RC529C • Deep Inferior Epigastric Perforator MRA for Planning Breast Reconstruction

Nanda Deepa Thimmappa MD, MBBS (Presenter)

LEARNING OBJECTIVES

1) Learn how to image perforator vessels for autologous breast reconstruction. 2) Understand anatomic and surgical considerations for determining the optimum vessel/donor site for microsurgical breast reconstruction. 3) Review the perforator findings from a spectrum of cases. 4) See a systematic approach to post-processing and reporting perforator studies.

ABSTRACT

Imaging in Practice: MRI of the GIT (How-to Workshop)

LEARNING OBJECTIVES

1) To review the anatomy of the anal sphincter complex and pelvic floor. 2) To discuss how imaging acquisition methods are tailored to patient indication (e.g., perianal Crohn's disease, incontinence, ileoanal pouch). 3) To review the justification and rationale for MR anal imaging in patients with perianal Crohn's disease and fecal incontinence. 4) To describe time-efficient detection and classification of perianal fistulas. 5) To show how the appearance of perianal fistulas changes with treatment. 6) To review the appearance of traumatic sphincter tears, in addition to diffuse abnormalities of the internal and external sphincter.
RC551C • How to Use MRI for Rectal Cancer Staging

Gina Brown MD, MBBS (Presenter)

LEARNING OBJECTIVES
1) To appreciate optimal MRI techniques for accurate staging of Rectal Cancer. 2) To understand the implications for patient care from optimised staging. 3) To follow minimum reporting standards for reporting Rectal Cancers at baseline and after preoperative therapy.

ABSTRACT

Essentials of Musculoskeletal Imaging

Wednesday, 10:30 AM - 12:00 PM • S100AB

MSES42 • AMA PRA Category 1 Credit ™: 1.5 • ARRT Category A+ Credit: 1.5

MSES42A • Essentials of Elbow MRI

Michael J Tuite MD (Presenter)

LEARNING OBJECTIVES
1) Identify the normal anatomy of the elbow on MR images. 2) Analyze the commonly injured structures of the elbow, and identify injuries of the bones, tendons and ligaments. 3) Demonstrate understanding of the nerves around the elbow and the MR appearance of abnormalities.

ABSTRACT

MSES42B • Imaging Muscle Injury and It's Complications

Philip Robinson MBChB (Presenter)

LEARNING OBJECTIVES
1) Identify the application of basic anatomy, pathology, and physiology principles of muscle anatomy and function in relation to the patterns of injury seen. 2) Understand the physical principles and relative limitations of MRI and ultrasound in relation to imaging normal and injured muscle. 3) Describe the commonest muscle injury patterns that occur and understand the pathophysiology of subsequent complication development.

MSES42C • Characterizing Soft Tissue Tumors at MRI: What Is Realistically Possible?

David M Panicek MD (Presenter)

LEARNING OBJECTIVES
1) Describe how various features of a soft tissue mass may contribute to a more specific diagnosis at MRI. 2) Identify characteristic MRI features of certain soft tissue tumors. 3) Recognize strengths and limitations of MRI in characterizing soft tissue tumors.

Gastrointestinal (Focal Liver Lesions and Metastases)

Wednesday, 10:30 AM - 12:00 PM • E350

SSK06 • AMA PRA Category 1 Credit ™: 1.5 • ARRT Category A+ Credit: 1.5

Moderator Claude B Sirlin, MD *
Moderator Mark E Lockhart, MD
Moderator Kathryn J Fowler, MD *

SSK06-01 • Detection and Characterization of Focal Liver Lesions: Added Value and Diagnostic Accuracy of Dynamic Contrast Magnetic Resonance Perfusion Imaging

Maddalena Colombo MD (Presenter) ; Davide Ippolito MD ; Pietro A Bonaffini MD ; Davide Fior MD ; Orazio Minutolo MD ; Sandro Sironi MD

PURPOSE
To assess the diagnostic accuracy of dynamic susceptibility contrast-enhanced perfusion images in differentiation between benign and malignant focal liver lesions by the assessment of tumoural perfusion kinetics.

METHOD AND MATERIALS
A total of 73 patients with known focal liver lesions including 45 benign (16 FNH, 27 angiomas, 2 abscesses) and 28 malignant ones (17 metastases, 9 HCCs, 2 colangiocarcinoma) underwent 1.5 T MRI (Achieva, Philips) upper abdominal study with a phase array multi-coil and with standard protocol that included dynamic study. On dedicated workstation, time-intensity curves were created in order to generate color permeability maps, showing perfusion of enhancing tumors. ROIs were manually drawn inside the focal liver lesions and on the normal hepatic parenchyma. Perfusion data, as relative arterial, venous and late enhancement (RAE, RVE, RLE%), maximum enhancement (ME%), relative enhancement (RE%), time to peak (TTPsec) were statistically analyzed.

RESULTS
All the diagnosis were established either by histopathology or imaging follow-up (size increase of over a period of time). Perfusion mean values calculated in benign lesions were: RAE 15.98%, RVE 89.17%, RLE 121.12%, ME 1103.94%, MRE 130.64%, TTP 169.4 sec for angiomas; RAE 79.82%, RVE 93.28%, RLE 81.99%, ME 1100.66%, MRE 98.28%, TTP 89.62 sec for FNH; RAE 5.6%, RVE 15.1%, RLE 38.8%, ME 123.4%, MRE 29.9%, TTP 181.8 sec for abscesses. Perfusion mean values calculated in malignant lesions were: RAE 38.43%, RVE 55.1%, RLE 62.57%, ME 683.94%, MRE 60.24%, TTP 149.28 sec for metastases; RAE 8.1%, RVE 15.1%, RLE 17.3%, ME 295.0%, MRE 26.6%, TTP 149.2 sec for HCC; RAE 20.3%, RVE 51.4%, RLE 62.7%, ME 367.4%, MRE 62.7%, TTP 252.9 sec for colangiocarcinoma. A statistical difference (p < 0.05) was achieved in all the perfusion parameters calculated between benign lesions and malignant lesions.

CONCLUSION
Characterization of Benign Liver Lesions with Ultrasound Quantitative Supersonic Shear Wave Elastography

Maxime Ronot MD (Presenter) ; Sara Di Renzo ; Bettina Gregoli MD ; Simon Lambert ; Rafael Duran MD ; Valerie Vilgrain MD

PURPOSE
To prospectively assess the stiffness of a consecutive series of benign focal liver lesions (BFL), using supersonic shear Wave Elastography (SWE).

METHOD AND MATERIALS
Between January 2012 and March 2013, all focal liver lesions (FFL) fortuitously discovered during an ultrasound (US) examination were prospectively included. Patients with underlying chronic liver disease and malignant lesions were excluded. On all patients and for each lesion a quantitative elastography image was acquired. The largest possible region of interest was placed in the lesion to quantitatively assess its stiffness, measured in kPa. Characterization of the lesion relied either on a combination of MR imaging, CT, and contrast enhanced US features, or on biopsy. Tumor elasticity was analysed using ANOVA and non-parametric Mann-Whitney tests.

RESULTS
112 FLL in 76 patients were analyzed. For 10 lesions (9%) in 6 patients (8%), SWE data could not be obtained due to patient motion (n=4), major steatosis (n=2) or a deep lesion (n=2). 102 lesions were successfully evaluated in 70 patients (61 women, 87%) with a mean age of 44.8 (range: 20-75). The mean stiffness was 33.3 +/- 12.7 kPa for the 60 focal nodular hyperplasia (FNH), 19.7 +/- 9.8 kPa for the 17 hepatocellular adenomas (HCA), 17.1 +/- 7 kPa for the 20 hemangiomas, and 11.3 +/- 4.3 kPa for the 5 focal fatty sparing (p < 0.0001). The agreement between T2* color map and dynamic images imaging regarding signal intensity pattern were moderate (k = 0.544) for all tumors, good (k = 0.666) for tumors > 2.0 cm, and fair (k = 0.334) for tumors of 2.0 cm or smaller. The sensitivities of BOLD MR imaging for displaying tumor hypervascularity were 75.6% and 73.2% for both observers.

CONCLUSION
Liver BOLD MR imaging at 3 T is feasible to predict hypervascularity and vascular pattern of various hepatic tumors because T2* and R2* values are different among hepatic tumors according to tumor vascularity and color map of T2* values also well reflect tumor vascularity when compared to contrast-enhanced MR imaging, particularly in hepatic tumors > 2.0 cm.

CLINICAL RELEVANCE/APPLICATION
Liver BOLD MR imaging at 3 T could be an alternative tool to gadolinium-enhanced MR imaging to predict vascularity of hepatic tumors for patients who cannot receive gadolinium-based contrast agents.
SSK06-05  •  Correlation between Size and ADC Value in Liver Metastasis

Maria Luiza Testa MD (Presenter) ; Rubens Chojniak MD, PhD ; Leticia S Sene MD

PURPOSE
To prospectively study the influence of the size of liver metastases in the quantitative value of the apparent diffusion coefficient (ADC) obtained through DW-MRI. This technique has been studied for detection, characterization and even to assess therapeutic response, but few studies have evaluated the factors affecting the quantitative analysis of ADC and no studies have correlated the variation of the ADC with the dimensions of metastatic liver lesions.

METHOD AND MATERIALS
In this prospective study, quantitative and qualitative image analysis of 45 hemangiomas and 37 metastases in 77 patients was performed. Gadoxetate-enhanced MR imaging was obtained during arterial and portal-venous phase, and delays of 8 and 20 minutes. During each phase, signal intensities were measured for the lesion, liver, and aorta, and were normalized using paraspinal musculature. Quantitatively, extended washout was defined as a 10% change in signal intensity from 8 to 20 minutes. Statistical analysis was performed by two blinded readers, who assessed the appearance of all lesions on T2-weighted images alone, dynamic images alone, and combined early (8 min) and late (20 min) hepatobiliary phases. Extended washout was defined as a perceptible change in signal from 8 to 20 minutes. ROC analysis was used to estimate the diagnostic accuracy of the various sequences to distinguish hemangioma from metastasis.

RESULTS
On quantitative analysis, 84% of hemangiomas demonstrated a positive extended washout sign while only 18% of metastases did. Hemangiomas demonstrated a mean change in signal intensity of 18.4% as compared to 4.1% for metastases (p<0.05). On qualitative analysis, 80% of hemangiomas showed extended washout while only 10% of metastases did. The ADC value increases with the size of the liver metastases. It may have an impact on the utilization of DW-MRI for lesion characterization and for monitoring of therapeutic response.

CLINICAL RELEVANCE/APPLICATION
The ADC value increases with the size of the liver metastases. It may have an impact on the utilization of DW-MRI for lesion characterization and for monitoring of therapeutic response.

SSK06-06  •  'Extended Washout'–A New Sign for Distinguishing Hepatic Metastases from Hemangiomas on Gadoxetate Disodium-enhanced MRI

Sheela Agarwal MD, MS (Presenter) ; Seyed Mahdi Abtahi MD ; Azadeh Elmi MD ; Jason J Carroll MD ; Mukesh G Harisinghani MD ; Peter F Hahn MD, PhD *

PURPOSE
To describe the enhancement pattern of hemangiomas with gadoxetate disodium and propose a new sign—the extended washout sign—to diagnose hemangiomas on hepatobiliary phase imaging.

METHOD AND MATERIALS
In this retrospective study, quantitative and qualitative image analysis of 45 hemangiomas and 37 metastases in 77 patients was performed. Gadoxetate-enhanced MR imaging was obtained during arterial and portal-venous phase, and delays of 3, 8, and 20 minutes. During each phase, signal intensities were measured for the lesion, liver, and aorta, and were normalized using paraspinal musculature. Quantitatively, extended washout was defined as a 10% change in signal intensity from 8 to 20 minutes. Statistical analysis was performed by two blinded readers, who assessed the appearance of all lesions on T2-weighted images alone, dynamic images alone, and combined early (8 min) and late (20 min) hepatobiliary phases. Extended washout was defined as a perceptible change in signal from 8 to 20 minutes. ROC analysis was used to estimate the diagnostic accuracy of the various sequences to distinguish hemangioma from metastasis.

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CLINICAL RELEVANCE/APPLICATION
Extended washout sign, particularly when used in conjunction with T2 signal intensity, can be used to increase accuracy of differentiating hemangiomas from metastases on gadoxetate-enhanced MRI.

SSK06-07  •  Diagnostic Dilemma: Hepatic Angiomyolipoma versus Hepatocellular Carcinoma in Non-cirrhotic Liver on Gd-EOB-DTPA-enhanced MR

So Jung Lee (Presenter) ; So Yeon Kim MD ; Kyoung Won Kim MD ; Jin Hee Kim MD ; Yong Moon Shin ; Moon-Gyu Lee MD

PURPOSE
To describe imaging characteristics of hepatic angiomyolipoma (AML) on Gd-EOB-DTPA-enhanced MR and to identify imaging features helpful to differentiate it from hepatocellular carcinoma (HCC) in non-cirrhotic liver.

METHOD AND MATERIALS
We retrospectively identified 18 patients with pathologically proven hepatic AML who underwent Gd-EOB-DTPA-enhanced MR. We randomly chose 36 patients from 91 patients who had single HCC in non-cirrhotic liver on Gd-EOB-DTPA-enhanced MR during the same period. Two readers in consensus reviewed all the images to assess the size, the presence of fat component, enhancement profile, tumor capsule, tumoral vessels and early draining veins. For the quantitative analysis, contrast enhancement ratio (CER) and SI ratio of lesions were measured on the dynamic and hepatobiliary phases. These features and measurements were compared between the AML and HCC groups.

RESULTS
No significant difference in the size between AML (3.4 cm) and HCC (4.5 cm) (P=0.15). Intratumoral fat component was more common in AML (44.4%) than HCC (22.2%) but not statistically significant (P=0.11). Dynamic enhancement profile was similar between the two groups: in particular, arterial hypervascularity and wash-out on the portal or delayed phases were common in both HCC (97.2%) and AML (83.3%) (P=0.10). Almost all AML (100%) and HCC (94.4%) were hypointense on the hepatobiliary phase (P=0.54). However, they differed significantly for tumor capsule on the delayed phase (no tumor capsule: AML vs. HCC, 94.4 vs. 55.5%, P=0.04), the presence of tumoral vessels (44.4 vs. 8.3%, P=0.04) and early draining vein (38.8 vs. 11.1%, P=0.03). In the qualitative analysis, arterial enhancement for AML was stronger than that of HCC (CER, 140.1% vs. 89.6%, P<0.05).

CONCLUSION
On Gd-EOB-DTPA-enhanced MR of non-cirrhotic liver, it is often difficult to differentiate AML from HCC, since they share similar enhancement characteristics. However, AML is more commonly without tumor capsule but contains intratumoral vessels and early draining vein.
vein. Qualitative analysis can facilitate the differentiation of AML from HCC.

CLINICAL RELEVANCE/APPLICATION
On Gd-EOB-DTPA-enhanced MR of non-cirrhotic liver, AML is often indiscernible from HCC with the enhancement characteristics alone. Capsule, tumoral vessel and early draining vein can be helpful clues.

SSK06-08 • Rapidly Enhancing Hemangioma versus Hypervascular Hepatocellular Carcinoma Showing Washout Appearance on Gadoxetic Acid-enhanced Hepatic MRI: Usefulness of Diffusion-weighted Imaging for Differential Diagnosis

Sejin Nam MD (Presenter) ; Jeong-Sik Yu MD ; Eun-Suk Cho ; Jae-Joon Chung MD ; Joo Hee Kim ; Ki Whang Kim MD

PURPOSE
To validate the diffusion-weighted imaging (DWI) in the differential diagnosis of rapidly enhancing hemangiomas showing washout appearance on gadoxetic acid-enhanced hepatic MRI from hypervascular hepatic cellular carcinomas (HCCs).

METHOD AND MATERIALS
For 54 hemangiomas (0.3 to 1.9 cm, mean 0.7 cm; in 44 consecutive patients) showing homogeneous enhancement on the arterial dominant phase images during the gadoxetic acid-enhanced dynamic MRI and showing hypointensity on late phase imaging, DWI (b=50 and 800 s/mm2) with apparent diffusion coefficient (ADC) map were retrospectively analyzed and compared with 113 hypervascular HCCs (0.4 to 2.0 cm, mean 0.9 cm; in 66 consecutive patients) showing similar pattern of contrast enhancement. In addition to measurement of mean ADC by drawing region-of-interest in each lesion on the ADC map, qualitative analysis of DWI was performed using a five-grade scale by two independent observers.

RESULTS
Mean ADC of hemangioma was significantly larger than HCC (1.94 versus 1.00 x 10^-3 mm2/s, p

CONCLUSION
For the small rapidly enhancing hemangiomas showing washout appearance during gadoxetic acid-enhanced hepatic MRI, DWI can provide a determinative information to exclude small hypervascular HCCs.

CLINICAL RELEVANCE/APPLICATION
Quantitative and qualitative analysis of diffusion-weighted imaging can provide a determinative information to characterize these atypical hemangiomas distinguished from small hepatocellular carcinoma

SSK06-09 • Delayed Enhancement of Colorectal Metastases with MR Hepatobiliary Contrast Agent

Rahul A Sheth MD (Presenter) ; Mukesh G Harisinghani MD ; Sheela Agarwal MD, MS

PURPOSE
Hepatobiliary contrast agents provide accurate detection of hepatic metastases particularly on hepatobiliary phase owing to the high level of enhancement of the background hepatic parenchyma. Parenchymal uptake is mediated by a family of cell surface transporters known as OATPs that were previously believed to be expressed only by hepatocytes. Recently, however, the overexpression of these transporters has been demonstrated in up to 80% of colorectal cancers. The purpose of this study was to evaluate for delayed enhancement within hepatic colorectal cancer (CRC) metastases following the administration of a hepatobiliary contrast agent.

METHOD AND MATERIALS
We performed a single institution, retrospective study of all patients with pathologically proven hepatic metastases who underwent MRI with gadoxetic acid (Eovist, Bayer, NJ) between 2010-2012. Gadoxetate-enhanced MR imaging was obtained during arterial phase, portal-venous phase, and delays of 3 minutes, 8 minutes, and 20 minutes. During each phase, signal intensities were measured for the lesion, adjacent liver parenchyma, and spleen, and were normalized using signal intensity of the paraspinal musculature. Delayed enhancement was determined by calculating the percent relative enhancement between the 3 minute and 20 minute time points.

RESULTS
A total of 35 patients were identified, of which 24 (69%) had CRC metastases and 11 (31%) had non-CRC metastases including pancreatic, breast, neuroendocrine, or sarcoma metastases. There was a statistically significant difference in the percent relative enhancement within CRC metastases than non-CRC metastases (p < 0.05), with 42% (10/24) CRC metastases demonstrating > 10% percent relative enhancement compared to 0% of non-CRC metastases.

CONCLUSION
CRC metastases can demonstrate delayed hyperintensity with gadoxetate. This may reflect extracellular accumulation; however, given that OATP overexpression has been shown in CRC, this finding may indicate specific intracellular uptake.

CLINICAL RELEVANCE/APPLICATION
Metastases may demonstrate hyperintensity on delayed imaging with hepatobiliary agents. This should not be misinterpreted as a specific finding for a benign lesion such as focal nodular hyperplasia.

Gastrointestinal (Pancreas Benign Disease)

Wednesday, 10:30 AM - 12:00 PM • E353B

SSK07 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

Moderator
Kevin J Chang , MD
Moderator
Douglas S Katz , MD
Moderator
Desiree E Morgan , MD *

SSK07-01 • Gradient Echo T1-weighted Signal Intensity Changes of the Chronic Pancreatitis

Temel Tirkes MD (Presenter) ; Chen Lin PhD * ; Chenkun Wang ; Hans Mouser MD ; Bharat Kakarala MD ; Fatih Akisik MD * ; Evan Fogel MD ; Gregory A Cote MD, MSc * ; Alex M Aisen MD *

PURPOSE
To determine if there is any correlation between the chronic pancreatitis and the signal intensity of the parenchyma on pre-contrast fat suppressed gradient echo GRE images

METHOD AND MATERIALS
A retrospective analysis was performed on 84 patients with chronic pancreatitis (CP) and 27 normal patients as the control group. Gastroenterologists established the diagnosis of CP with Endoscopic Retrograde Cholangiopancreatography (ERCP) using the Cambridge classification. Patients were categorized as mild (n=24), moderate (n=28), severe (CP n=27) or normal. MR Cholangiopancreatography (MRCP) was performed on either 1.5T (n=68) or 3T (n=43) machines. A volume interpolated 3D GRE sequence was used to acquire pre-contrast T1-weighted images with TR of 5.0±0.17 ms and flip angle of 12 for 1.5T and TR of 4.24±0.16 ms and flip angle of 9 for 3T scanners. Two reviewers independently performed region of interest (ROI) measurements (~1cm2) from the head, body and tail of the
Multiple regression analysis showed that the pancreas-to-muscle SI ratio on T1-weighted images and ADC value were significantly correlated with pancreatic fibrosis ($r^2 = 0.66, P < .0001$) and with activated PSC expression ($r^2 = 0.67, P < .0001$). The mean

**RESULTS**

The four groups (mild/moderate/severe CP and normal) showed significant differences in SIR ($p < .0001$) on both 1.5 and 3T scanners. In particular, both the moderate and severe CP groups had significantly lower SIR than those in the normal group ($p < .0001$).

**CONCLUSION**

Moderate and severe chronic pancreatitis patients have lower parenchymal signal on pre-contrast fat-suppressed T1-weighted GRE images.

**CLINICAL RELEVANCE/APPLICATION**

Decrease in the pancreas to spleen signal ratio in T1-weighted GRE images can be used as an indicator of chronic pancreatitis.

**SSK07-02 • Accuracy of a Novel Noninvasive MRI Severity Scoring System for Chronic Pancreatitis: Correlation with EUS**

Daniel A Souza MD (Presenter); Gyanprakash A Ketwaroo; Mandeep Sawhney MD; Koenraad J Mortele MD

**PURPOSE**

To evaluate the accuracy of a novel noninvasive scoring system, the MRI Chronic Pancreatitis Severity Index (CPSI), in the diagnosis and grading of patients with suspected chronic pancreatitis (CP), as compared to endoscopic ultrasound (EUS).

**METHOD AND MATERIALS**

In this IRB-approved, HIPAA-compliant retrospective study, 32 patients (20 female (age 25-86 yrs, average 55.5)) with known or suspected CP were evaluated with both EUS and MR/JMRCP. Of these, 12 patients underwent secretin-stimulated MRCP (sMRCP). Blind review of the MRI findings was performed, and CP severity was graded using the novel 10-point-scale, CPSI scoring system. Correlation between MRI CPSI and EUS, which was considered as the gold standard, was performed. Comparative evaluation of test performance was obtained using ROC analysis.

**RESULTS**

On EUS, 12 patients were diagnosed with CP, 15 patients were rendered normal, and 5 patients had equivocal findings. There was no statistically significant correlation ($p = 0.357$) between the CPSI score derived from the MRCP studies without secretin administration and EUS. Excellent correlation, however, between sMRCP and EUS was present. ROC analysis demonstrated an area under the curve of 0.983 ($p = 0.008$), with a cutoff value of 3.5 having sensitivity of 83% and specificity of 100% for the diagnosis of CP.

**CONCLUSION**

There was excellent correlation between the novel 10-point-scale, CPSI score derived from sMRCP and EUS for the diagnosis of CP. However, the score performance was poor when MRCP was performed without the use of secretin.

**CLINICAL RELEVANCE/APPLICATION**

The MRI Chronic Pancreatitis Severity Index (CPSI) can be used as a noninvasive alternative to EUS for the diagnosis of chronic pancreatitis, with comparable results when secretin is used.

**SSK07-03 • Correlation between Secretin-enhanced MRCP Findings and Histopathologic Severity of Chronic Pancreatitis in a Cat Model**

Tingting Zhang (Presenter); Li Wang; Dengbin Wang MD, PhD; Zhijun Huang; Yuhua Li; Jianping Lu MD

**PURPOSE**

Secretin-enhanced magnetic resonance cholangiopancreatography (S-MRCP) is a noninvasive medical imaging technique that has been successfully used to evaluate pancreatic exocrine function in patients with chronic pancreatitis (CP). However, no detailed description of how S-MRCP findings relate to the severity of CP as determined by histopathology is currently available in the literature. The purpose of this study was to characterize this association in a cat model of CP.

**METHOD AND MATERIALS**

Thirty-two cats were divided into control (n = 8) and experimental (n = 24) groups. Cats in the experimental group underwent ligation of the pancreatic duct to induce CP, while the control group received a sham operation. MRCP was performed prior to, and 5 and 15 min after, secretin stimulation in all cats. All cats were then euthanized and pancreatic samples were processed for H&E and Sirius red staining to evaluate histopathological changes. The cats were then divided into four groups depending on the severity of CP as determined by histopathology: normal, minimal, moderate, or advanced. The S-MRCP parameters, consisting of the increasing degree of fluid volume (IDFV) at 15 min in the region of interest (which encompassed the pancreas, stomach, and small bowel) and the pancreatic duct caliber change (PDC) at 5 min, were measured and compared with the results of histopathology.

**RESULTS**

Significant differences were observed in both IDFV and PDC between sham-operated (control) cats and those with either moderate or advanced CP (IDFV: $P = 0.001, 0.000$, respectively; PDC: $P = 0.013, 0.001$). There were no significant differences in the two parameters between the controls and those whose CP was minimal (IDFV: $P = 0.195$; PDC: $P = 0.964$), although the minimal CP did show a downward trend.

**CONCLUSION**

IDFV and PDC measured with S-MRCP correlated with the histopathological severity of induced CP. S-MRCP could be used to evaluate the severity of CP, although it is somewhat insensitive for depicting very early disease.

**CLINICAL RELEVANCE/APPLICATION**

The assessment of exocrine pancreatic function by S-MRCP can contribute to select the appropriate medical treatment for chronic pancreatitis.

**SSK07-04 • Fibrosis and Postoperative Fistula of the Pancreas: Correlation with MR Imaging Findings-Preliminary Results**

Haruo Watanabe MD (Presenter); Satoshi Goshima MD, PhD; Hiroshi Kondo MD; Yoshifumi Noda MD; Masayuki Kanematsu MD

**PURPOSE**

To assess the potential value of magnetic resonance (MR) imaging to help assess pancreatic fibrosis and predict development of postoperative pancreatic fistula (POPF).

**METHOD AND MATERIALS**

This retrospective study had institutional review board approval, and the requirement for informed consent was waived. MR images obtained in 29 consecutive patients (15 men, 14 women; mean age, 64.9 years; range, 21–80 years) who underwent pancreatectomy were evaluated. The pancreas-to-muscle signal intensity (SI) ratio on unenhanced T1- and T2-weighted, dynamic contrast-enhanced, and diffusion-weighted images and the apparent diffusion coefficient (ADC) of the pancreas were measured. Degrees of pancreatic fibrosis and expression of activated pancreatic stellate cells (PSCs) were histopathologically determined; MR imaging parameters were correlated with the degrees of pancreatic fibrosis and activated PSC expression and the development of POPF.

**RESULTS**

Multiple regression analysis showed that the pancreas-to-muscle SI ratio on T1-weighted images and ADC value were significantly correlated with pancreatic fibrosis ($r^2 = 0.66, P < .0001$) and with activated PSC expression ($r^2 = 0.67, P < .0001$). The mean

Carlo Liguori (Presenter) ; Francesca Pitocco ; Ilenia Di Giampietro ; Aldo Eros De Vivo ; Francesco Sorrentino ; Bruno Beomonte Zobel MD

PURPOSE
To assess feasibility of pancreatic iron accumulation in Thalassemia patients in course of MRI using T2* technique. To establish preferential patterns of overload among head, body and tail of the pancreas. To quantify intra-observer and interstudy variability in course of pancreatic T2* assessment. To assess normal ranges of pancreatic T2* values in Thalassemia subjects compared to non-transfusion dependent population.

METHOD AND MATERIALS
In a setting of 210 TM patients we performed T2* MRI using gradient multi-echo sequences (12 echo range: 0.99-16.5 ms; slice thickness 10 mm) on pancreatic head, body and tail using three different acquisitions. Image analysis was performed using a dedicated software (CMR Tools, London, UK) and truncation method was used to account for background noise. Images were examined by two observers (obs) to assess interobserver variability and obs1 performed a double evaluation of same dataset for intraobserver variability. Each acquisition was repeated during the same exam to evaluate interstudy variability. Image quality (IQ) was assessed using a 5 point grading scale (1=very poor quality; 5=excellent quality).

RESULTS
Mean pancreatic T2* in normal subjects was 41±8.8 and significant different difference (p Mean pancreatic T2* in TM value was 24.9±15.6 and significant difference (p Measurement in all three portions of the gland showed good intra-observer (p Image quality score resulted superior for pancreatic head (mean score 4,2) compared to body (3,6) and tail (2,8).

CONCLUSION
Direct assessment of pancreatic iron overload is feasible and can be considered a robust technique in terms of inter-observer and inter-study reproducibility. These data allow routinely gland assessment in course of MRI performed for iron burden in TM patients.

CLINICAL RELEVANCE/APPLICATION
Despite growing interest in to endocrine evaluation in thalassemia patients, Pancreatic iron overload assessment is still not widely adopted. Present study clarifies technical aspects in this field.

Free Breathing Dynamic Contrast MR Imaging with Navigator Technique for the Evaluation of the Pancreas

Takayuki Masui MD (Presenter) ; Motoyuki Katayama MD ; Kimihiko Sato MD ; Yuji Iwadate *; Kazuma Terauchi ; Kei Tsukamoto ; Kenichi Mizuki MD ; Masayoshi Sugimura ; Hiroyuki Kasabawa ; Harumi Sakahara MD

PURPOSE
In elderly patients who cannot hold their breaths, information of dynamic contrast study may be limited. Navigator technique can be utilized for dynamic contrast studies with repeated acquisitions. The purpose was to evaluate feasibility of dynamic contrast study during free-breathing with navigator technique for evaluation of pancreatic lesions.

METHOD AND MATERIALS
The study was approved by IRB. 48 patients (23 men, 25 women, mean 73 years old), who underwent contrast MR imaging for pancreas at 3T between March 2011 and November 2012 were included. Pathologies were IPMN in 25 cases, other cystic in 7, solid in 2, and others in 14. After T2WI and MRCR, with navigator technique, pre and 5 phases of dynamic contrast images (Gd-chelate 0.1mmol/kg, slice thickness 3/4mm) in axial plane were obtained using 3DFSPGR (LAVA) under free-breathing followed by imaging without navigator. Image quality, blurring, recognition of each organ and lesions were evaluated using a five-point scale (1 undiagnostic-5 excellent). Imaging time, contrast ratio (SI on post/precontrast image) of each organ and lesions in the pancreas, sizes of lesions and number of the
lesions were evaluated. Existence or absence of septa and nodules in lesions was evaluated. All evaluations were performed by two radiologists in consensus.

RESULTS
Imaging time tended to be prolonged in postcontrast phases (38-46sec). The enhancement was observed initially in the aorta followed by spleen and pancreas. All images in dynamic phases with navigator technique were diagnostic (Image quality: 4.4-4.7, Blurring 4.3-4.7, Lesion recognition 4.5-4.6). On images without navigator, blurring was prominent. Cystic (73 lesions in 35 cases, Fig), and solid lesions (2 lesions) were identified (mean diameter 15.5mm from 1mm to 57mm). Five lesions were missed and one serous cystic tumor was falsely recognized as solid. Septa in cysts were recognized in 31 of 45 cases. There was no nodule in cystic lesions.

CONCLUSION
With navigator technique, free breathing dynamic contrast MR imaging of the pancreas can be successfully obtained with acceptable quality and lesion recognitions. However, temporal resolution of each phase was not sufficient to evaluate solid lesions and faster imaging in combination should be considered.

CLINICAL RELEVANCE/APPLICATION
Free-breathing technique is useful for elderly patients or children, and all static and dynamic imaging can be performed with navigator.

SSK07-08 • CT Depicted Pancreatic Parenchymal Attenuation as a Potential Screening Biomarker for Predicting Glucose Intolerance and Patient Body Habitus

Surabhi Bajpai MBBS, DMRD (Presenter) ; Yasir Andrabi MD, MPH ; Andrew P Wright MD ; Debra A Gervais MD * ; Dushyant V Sahani MD

PURPOSE
The purpose of this study was to investigate the correlation between pancreatic parenchymal attenuation measured on CT with patient body habitus and glucose intolerance.

METHOD AND MATERIALS
We retrospectively evaluated unenhanced abdominal CT scans performed in 120 patients (86M: 34F, mean age: 55.9 yrs, age range: 23-86 yrs) between 2008 and 2011 and found to have evidence of hepatic steatosis on CT scans. The patient cohort was categorized based on BMI (normal: =24.9, overweight: 25-29.9, mild obesity: 30-34.9, moderate obesity: 35-39.9, morbid obesity: >40). The CT scans were reviewed for pancreatic parenchymal attenuation (HU), pancreatic size and thickness of perirenal fat. The CT findings were compared with review of patient medical records for presence of glucose tolerance, diabetes, degree of hepatic steatosis and body habitus.

RESULTS
Pancreatic parenchymal attenuation showed a linear decrease in HU with increase in patient body habitus (Normal: 44.2±6HU vs morbid obesity: 22±1 HU, p = 0.001). Pancreatic parenchymal attenuation decreases with increasing body weight and is a predictor for occurrence of impaired glucose tolerance and occurrence of diabetes.

CLINICAL RELEVANCE/APPLICATION
Excess pancreatic fat can have negative correlation to beta cell function, leading to glucose intolerance and diabetes. Imaging can be a potential screening biomarker for detection of pancreatic fat.

SSK07-09 • Whole-organ CT Perfusion of the Pancreas: Impact of Iterative Reconstruction on Image Quality, Perfusion Parameters and Radiation Dose in 256-slice CT-preliminary Findings

Qian Xie (Presenter) ; Zonghui Liang ; Juan Wu ; Yafang Dou ; Ying Tang ; Xiaoyuan Feng MD ; Feijia Xu MD

PURPOSE
This study was to assess whether iterative reconstruction algorithm can reduce the radiation dose while maintaining acceptable image quality, to investigate whether perfusion parameters vary from conventional filtered back projection(FBP) at the low-tube-voltage(80kVp) during whole-pancreas perfusion examination using a 256-slice CT.

METHOD AND MATERIALS
76 patients with known or suspected pancreatic mass underwent whole-pancreas perfusion by a 256-slice CT. High- and low-tube-voltage CT images were acquired.120-kVp image data(protocol A) and 80-kVp image data(protocol B) were reconstructed with conventional FBP algorithm, and 80-kVp image data were reconstructed with iDose4(protocol C) iterative reconstruction technique. The image noise; contrast-to-noise ratio(CNR) relative to muscle for the pancreas, liver, and aorta; and effective dose of each protocol were assessed quantitatively. Overall image quality was assessed qualitatively. Among 76 patients, 23 were eventually proven to have normal pancreas. Nine of 23 patients received 120-kVP CT perfusion scans and 14 of 23 received 80-kVp CT perfusion scans. Perfusion parameters of normal pancreas in each protocol including blood volume(BV), blood flow(BF), and permeability-surface area product(PS) were measured.

RESULTS
In the quantitative study, protocol C reduced image noise by 36.8% than protocol B(P < 0.05). Low-tube-voltage and iDose4 iterative reconstruction technique can dramatically decrease radiation dose with acceptable image quality during whole-pancreas CT perfusion and have no significant impact on the perfusion parameters of normal pancreas compared to the conventional FBP reconstruction in the use of 256-slice CT scanner.

CLINICAL RELEVANCE/APPLICATION
iDose4 iterative reconstruction technique yields a significant improvement in image quality, decrease in radiation dose and appears not to impede calculation of healthy pancreas perfusion parameters.
Still, it is unclear whether MRI performed prior to a repeated biopsy helps to detect more cancer in patients with preceded MRI than in patients without preceded MRI because there is rare comparative two-arm study. The purpose of our study was to retrospectively evaluate the value of a pre-biopsy MRI using a large population of patient and control groups.

METHOD AND MATERIALS
Between January 2007 and May 2011, a total of 709 patients underwent a transrectal ultrasound (TRUS)-guided biopsy. Of these patients, 179 (age range, 40–91; mean, 63.3) underwent MRI examination (MRI group) before repeat biopsy and 530 (age range, 38–85; mean, 64.9) did not (Non-MRI group). Cancer detection rate and positive core rate was performed between these groups. The odds ratios were also obtained.

RESULTS
Of 709 patients, 129 were histologically confirmed as adenocarcinoma. These cancer-proven patients consisted of 57 in the MRI group and 72 in the non-MRI group. Cancer detection rates of MRI and non-MRI groups were 31.8% (57/179) and 13.6% (72/530), respectively (p=0.000). Positive core rates of MRI and non-MRI groups were 8.9% (167/1877) and 3.0% (179/5903), respectively. The odds ratios of cancer detection rate and positive core rate were 3.0 and 3.1, respectively.

CONCLUSION
Pre-biopsy MRI contributes to cancer detection in patients with previous negative biopsy results and persistently high PSA.

CLINICAL RELEVANCE/APPLICATION
Pre-biopsy MRI should be considered prior to rebiopsy in patients with a history of negative biopsy results and persistently high PSA.

SSK08-02 • Quantitative Shear Wave Ultrasound Elastography for Prostate Cancer Imaging: Correlation to Pathology

Jean-Michel Correas MD *; Ahmed Khairoune *; Anne-Marie Tissier MD; Olivier Helenon; Richard G Barr MD, PhD (Presenter) *

PURPOSE
To prospectively evaluate in two independent centers the diagnostic performance of real-time quantitative Shear Wave Elastography (SWE) in detecting and characterizing prostate lesions in patients with increased PSA and/or abnormal digital rectal examination, by using histologic biopsy results scoring system as the reference method. Correlation between elasticity and Gleason Score (GS) was also performed to analyse the relation between tumor stiffness and pathology.

METHOD AND MATERIALS
The IRB approved this prospective, HIPAA-compliant study in both institutions. Written informed consent was obtained from 184 men undergoing ultrasound guided systematic and targeted biopsies. Two blinded radiologists independently measured stiffness of prostate sextants and lesions depicted in ultrasound imaging. Biopsy core pathology analysis (GS) of corresponding sextants and lesions constituted the reference standard. The diagnostic performance at the sextant level and lesion detection sensitivity for lesions was calculated. The correlation between GS and tissue stiffness was investigated using Student T-test and Pearson’s correlation coefficient.

RESULTS
A total of 184 patients were enrolled in the study, providing a total of 1176 peripheral zone regions including 1039 sextants and 137-targeted lesions. A total of 188 foci of cancer (size>2mm and GS=6) were detected in 65 patients. On the basis of the ROC curve analysis and to maximize the negative predictive value, a cutoff value of 35 kPa for the elasticity or 3.42 m/s for the shear wave velocity was chosen to differentiate benign and malignant regions (p=0.000). Positive core rates of MRI and non-MRI groups were 8.9% (167/1877) and 3.0% (179/5903), respectively. The odds ratios of cancer detection rate and positive core rate were 3.0 and 3.1, respectively.

CONCLUSION
SWE might provide additional information for the biopsy guidance and differentiation of aggressive prostate cancers.

CLINICAL RELEVANCE/APPLICATION
Prostate tissue stiffness using Shear Wave Elastography could be used to guide prostate biopsy and significantly improve prostate positive biopsy rate.

SSK08-03 • Comparison of 1.5T vs. 3.0T Multiparametric MR Imaging in the Detection of High Grade Prostate Cancer

Daniel A Moses MBBS, FRANZCR (Presenter); Ronald C Shnier MBBS; James Thompson MBBS; Lee E Ponsky MD; Phillip Brenner MBBS; Warick Del Prado; Andrew Hayen PhD; Phillip Stricker MBBS

PURPOSE
To compare the efficacy of 1.5T and 3.0T mp-MRI in the detection/exclusion of high grade prostate cancer.

METHOD AND MATERIALS
A prospective study (for 300 men) was approved by the ethics board. 122 men had been randomised for mp-MRI at either 1.5T or 3T before a planned transperineal biopsy. The MR protocol included high resolution T2-weighted, diffusion and perfusion sequences without an endorectal coil. Two uororadiologists used the PI-RADS reporting system independently for each scan. A combined score was attained by taking the average.

RESULTS
A total of 91/122 men received a combined average PI-RADS score of 2.5 or greater (intermediate to high risk of significant PCa), with 47/54 of men on the 1.5T MRI, and 44/68 of men on the 3T MRI being classified in the same way. On biopsy 48/122 [28/54 on 1.5T and 20/68 on 3T] had Gleason 7 or greater prostate cancer. 11/122 [6/54 on 1.5T and 5/68 on 3T] had higher than Gleason 8 prostate cancer. The following results were achieved using a threshold of Gleason 7 disease and above as positive for significant disease an average PI-RADS score of 2.5 and above for suspected clinically significant disease: 1.5T: TPR 100%, FPR 73%, NPV 100%, PPV 60% 3.0T: TPR 100%, FPR 50%, NPV 100%, PPV 45% Combined: TPR 100%, FPR 58%, NPV 100%, PPV 53% Using a threshold of Gleason 8 disease and above as positive for significant disease and average PI-RADS score of 4 and above for suspected clinically significant disease: 1.5T: TPR 100%, FPR 29%, NPV 100%, PPV 30% 3.0T: TPR 100%, FPR 16%, NPV 100%, PPV 33% Combined: TPR 100%, FPR 22%, NPV 100%, PPV 31% True positive rate (TPR), False positive rate (FPR), Negative predictive value (NPV), Positive predictive value (PPV)

CONCLUSION
MP-MRI, without an ER coil, can achieve very high NPV for significant prostate cancer (in our case 100%). There was no difference between the NPV when using a 1.5T or 3T MR system. The positive predictive value was higher for 1.5T (60%) vs 3T (45%) when choosing a threshold of Gleason 7 for significant disease. This equalised [1.5T 30% vs 3T 33%] with a threshold of Gleason 8. The false positive rate was higher at 1.5T vs 3T for both Gleason thresholds.

CLINICAL RELEVANCE/APPLICATION
Given the different costs and availability, knowing the relative strengths and limitations of assessment on 1.5T and 3.0T scanners allows planning in their use in the diagnosis of prostate cancer.

SSK08-04 • The Cost-effectiveness of MR-guided Targeted Biopsy versus Systematic TRUS-guided Biopsy in Diagnosing Prostate Cancer: A Modeling Study

Maarten De Rooij MD (Presenter); Simone Crienen; Fred Witjes MD, PhD; Jelle O Barentsz MD, PhD; Maroeska M Rovers PhD; Janneke P Rutgers PhD

PURPOSE
To develop and apply a decision analytic model to determine whether multiparametric magnetic resonance imaging (mp-MRI) and targeted magnetic resonance guided biopsies (MRGB) are cost effective in the diagnosis of prostate cancer compared with standard
METHOD AND MATERIALS
A combined decision tree and Markov model was used to evaluate the quality-adjusted life years (QALYs) and healthcare costs of the MRI strategy (mp-MRI and targeted MRGB) compared with the standard strategy of systematic TRUSGB for a cohort of patients with clinical suspicion of prostate cancer. Input data were derived from systematic literature searches, including meta-analyses, and expert opinion. Probabilistic and threshold analyses were performed to assess uncertainty.

RESULTS
Expected costs of the MRI strategy per patient (€2349) were similar to those for the TRUSGB strategy (€2356). The corresponding QALYs were higher for the MRI strategy (6.97 versus 6.74). Threshold analysis revealed MRI is the dominant strategy (less costly and more effective) when the sensitivity of MRGB is 60% or higher. Probabilistic sensitivity analysis showed that in 92% of simulations, the MRI strategy was most effective. In 52% of the simulations MRI was more effective and less costly. The probability that the MRI strategy is cost effective is 90% at willingness to pay thresholds over €1,000/QALY.

CONCLUSION
When the sensitivity of mp-MRI and targeted MRGB for the detection of prostate cancer is proven to be 60% or higher, this new diagnostic strategy appears to be more effective in detection of prostate cancer when compared with the current standard of systematic TRUSGB.

CLINICAL RELEVANCE/APPLICATION
When sensitivity of this new diagnostic MRI strategy is proven to be satisfactorily high, it appears to be more efficient in diagnosing prostate cancer compared with the standard systematic TRUSGB.

SSK08-05 • Validation of the European Society of Urogenital Radiology Score System for Prostate Cancer Diagnosis on Multiparametric MRI in a Cohort of Primary Biopsy Patients

Raphaëlle M Renard Penna (Presenter); Pierre Mozer MD, PhD; Daniel Portalez MD; François Cornud MD; Eva Comperat; Bernard Malavaud PhD, MD

PURPOSE
To assess the ESUR score system in the context of primary biopsies.

METHOD AND MATERIALS
IRB-approved, bicentric prospective study. 119 consecutive patients referred for primary prostate biopsies with normal DRE but elevated PSA (4-20ng/ml). Transfer of mpMRI suspicious areas on 3D-Transrectal ultrasound images by three-dimensional elastic surface registration (Koelis, UroStation, France) random systematic and targeted cores followed by core-by-core analysis of pathology and mpMRI characteristics. Relationships between ESUR scores and biopsy results were assessed by the Mann-Whitney U test. A teaching set was randomly drawn to construct the ROC curve of the ESUR sum of scores (ESUR-S). The threshold to recommend biopsy was obtained from the Youden J-statistics and tested in the remaining validation set in terms of predictive characteristics.

RESULTS
Higher T2-weighted, Dynamic Weighted Imaging and Dynamic Contrast Enhanced ESUR scores were observed in areas yielding cancer-positive cores. The proportion of positive cores increased with the ESUR sum of scores aggregated in five increments from less to more suspicious (percentage and 95%CI): 2.3%(1.2-3.3), 5.8%(3.5-8.0), 24.7%(18.3-31.1), 51.8%(42.4-61.1) and 72.1%(66.2-77.9) for increasing increments of ESUR-S, p for trend p

CONCLUSION
In primary prostate biopsies, the ESUR score system was shown to provide clinically relevant stratification of the risk of showing prostate cancer in a given patient.

CLINICAL RELEVANCE/APPLICATION
MRI-TRUS fusion technology could provide optimal method to sample the prostate gland, reduce the number of cores needed to demonstrate cancer.

SSK08-06 • The Role of Multi-parametric MRI for Assessment of Detection in Patients with a Low-risk Prostate Cancer

Jin Young Kim (Presenter); See Hyung Kim

PURPOSE
To assess the diagnostic performance of multi-parametric MRI in cancer detection categorized by cancer volume and Gleason grade in clinically low-risk prostate cancer.

METHOD AND MATERIALS
One hundred consecutive patients with clinically low-risk cancer received multi-parametric MRI before radical prostatectomy, including T2-weighted (T2W), diffusion-weighted (DW) and dynamic contrast enhanced (DCE) MRI. By using scoring systems, two radiologists independently assessed likelihood of cancer per sextant on multi-parametric MRI. Cancer lesions of = 0.5cm3 identified on whole-mount pathology were considered true positive.

RESULTS
The inter-observer agreement for detection at the sextant level was in perfect agreement. In detecting pathologic cancer volume of = 0.5cm3, DW MRI and DCE MRI had a higher accuracy than T2W MRI. The diagnostic performance for cancers volumes > 1cm3 or Gleason grade = 7 was significantly higher than cancers of volume 0.5 to 1cm3 or Gleason grade = 6, and multi-parametric MRI had a significantly higher diagnostic performance than T2W+DW MRI and T2W+DCE MRI. The multi-parametric MRI was more accurate with high pathologic cancer volume and Gleason grades. For lesions of cancer volumes > 1cm3 and Gleason grades = 7, the accuracy was significantly higher than with cancers of volume 0.5 to 1cm3 and Gleason grade = 6 (82.3% vs. 90.2%, P<0.05).

CONCLUSION
In clinically low-risk cancer, the detection of multi-parametric MRI is significantly dependent on cancer volumes and Gleason grades. The higher cancer volumes and Gleason grades have high sensitivity, specificity and accuracy in detection.

CLINICAL RELEVANCE/APPLICATION
In clinically low-risk cancer, the detection of multi-parametric MRI is significantly dependent on cancer volumes and Gleason grades.


Matthias J Eiber MD (Presenter); Matthias Heck; Michael Souvatzoglou; Tobias Maurer; Markus Schwaiger MD; Ernst J Rummney MD; Bernd Krause

PURPOSE
Computed tomography is of limited value for lymph node (LN) staging in prostate cancer (PCa) patients scheduled for radical prostatectomy (RP). To prospectively compare computed tomography (CT), diffusion-weighted magnetic resonance imaging (DWI) and [11C]choline positron emission tomography/computed tomography ([11C]choline PET/CT) for LN staging in PCa patients undergoing RP and extended pelvic lymph node dissection (ePLND).

METHOD AND MATERIALS
IRB-approved, bicentric prospective study. 119 consecutive patients referred for primary prostate biopsies with normal DRE but elevated PSA (4-20ng/ml). Transfer of mpMRI suspicious areas on 3D-Transrectal ultrasound images by three-dimensional elastic surface registration (Koelis, UroStation, France) random systematic and targeted cores followed by core-by-core analysis of pathology and mpMRI characteristics. Relationships between ESUR scores and biopsy results were assessed by the Mann-Whitney U test. A teaching set was randomly drawn to construct the ROC curve of the ESUR sum of scores (ESUR-S). The threshold to recommend biopsy was obtained from the Youden J-statistics and tested in the remaining validation set in terms of predictive characteristics.
METHOD AND MATERIALS
Between June 2010 and May 2012, we preoperatively performed CT, DWI and [11C]choline PET/CT in 33 intermediate and high risk PCA patients without neoadjuvant treatment. All patients underwent open RP and ePLND including the NL-field obturator fossa, external, internal and common iliac vessels. Patient- and field-based performance characteristics for all 3 imaging techniques in comparison with histopathology are reported. Imaging techniques were compared by AUC-analyses (area under the curve).

RESULTS
LN metastases were detected in 92 of 1012 (9%) LNs from 14 of 33 (42%) patients. ePLND achieved a median of 30 dissected LNs per patient (range 9–61). On a patient-based analysis, sensitivity for CT, DWI and [11C]choline PET/CT were identical (57.1%, 57.1% and 57.1%, respectively), but specificity was best for [11C]choline PET/CT (68.4%, 78.9% and 89.5%, respectively). On a LN-field-based analysis, sensitivity was best for [11C]choline PET/CT followed by DWI and CT (61.8%, 55.9% and 47.1%, respectively) whereas specificity was similar for all 3 imaging techniques (96.5%, 96.0% and 94.3%, respectively). However, neither DWI nor [11C]choline PET/CT performed better than CT in a pair-wise comparison of AUCs of patient- and field-based results (p >0.05, respectively).

CONCLUSION
Neither DWI nor [11C]choline PET/CT perform statistically significant better than CT for preoperative detection of LN-metastases in PCA patients scheduled for RP and ePLND. All 3 imaging techniques have a low sensitivity with less than two thirds of LN metastases being detected on a patient- or LN-field-based analysis.

CLINICAL RELEVANCE/APPLICATION
Our data indicate that neither [11C]choline PET/CT nor DWI can be recommended to replace adequate ePLND for determining a patient’s LN status or to define the extent of a PLND on an individual basis.

SSK08-08 • Dynamic Contrast Enhanced MR Imaging Features of the Normal Central Zone of the Prostate
Barry G Hansford MD (Presenter) ; Ibrahim Karademir MD ; Yahui Peng PhD ; Yulei Jiang PhD ; Gregory S Karczmar PhD * ; Stephen Thomas MD ; Ambereen Youssf MBBS ; Tatjana Antić ; Scott Eggener * ; Aytekin Oto MD *

PURPOSE
Evaluate qualitative dynamic contrast enhanced magnetic resonance imaging (DCE-MRI) characteristics of normal central zone (CZ) based on recently described CZ MR imaging features.

METHOD AND MATERIALS
Retrospective, HIPAA compliant study with Institutional Review Board approval. Evaluated 82 patients with prostate cancer (PCA) who underwent pre-operative, multi-parametric endorectal MR before radical prostatectomy. 19 patients with tumor involving portions of the CZ or prostate base on histopathology were excluded, as were four patients with MR artifacts. Final cohort of 59 patients: mean age, 59.9 years; mean standard deviation (SD), 7.0; age range, 43-72; average serum prostate-specific antigen (PSA) level, 8.7 mL/ng; PSA SD, 8.0; and PSA range, 1.7-40.9. Two readers independently reviewed T2-weighted images and ADC maps to identify normal CZ based on its low signal intensity and characteristic location. Next, two readers drew bilateral CZ regions of interest on DCE-MRI images in consensus and then independently recorded enhancement curve types as: type 1 (progressive enhancement), type 2 (plateau) and type 3 (wash-out). Identification rates of normal CZ and enhancement curve type were recorded and compared for each reviewer.

RESULTS
CZ identified in 92% to 93% of patients on T2-weighted images and 78% to 88% on ADC maps without a significant difference between identification rates (p=0.63 and p=0.15 and Inter-reader agreement, ?, is 0.64 and 0.29, for T2-weighted images and ADC maps, respectively). All CZs rated as either curve type 1 or 2 by both radiologists. Type 1, progressive enhancement (24/104 or 23% of curve types), type 2, plateau enhancement (80/104 or 77% of curve types) and type 3, wash-out (0/104 or 0% of curve types). No statistically significant difference between the two radiologists (p = 0.19) and inter-reader agreement was ? = 0.37.

CONCLUSION
Normal CZ demonstrates type 1 or type 2 enhancement curves on DCE-MRI which can potentially be useful to differentiate CZ from PCA which classically demonstrates a type 3 (wash-out) curve. CZ identified in majority of patients based on characteristic location and low signal on T2-weighted images and ADC maps.

CLINICAL RELEVANCE/APPLICATION
Our study shows that the normal CZ demonstrates either type 1 or type 2 enhancement time-curves on DCE-MRI, which can be potentially used to differentiate the CZ from PCA.

SSK09-09 • “Dynamic Active Surveillance” for Low-to-Intermediate Risk Prostate Cancer: Combined Results of a Phase I/II Trial of MRI-guided Focal Laser Ablation and Features Predictive of Recurrence
Tristan Barrett MBBS, BSc (Presenter) ; Sangeet Ghai MD * ; Eugen Hlasny PhD ; Sean R Davidson PhD ; Masoom A Haider MD * ; Mark R Gertner PhD ; Jeremy Cepek PhD ; Aaron Fenster PhD ; John Trachtenberg MD

PURPOSE
To assess the feasibility of MRI-guided focal laser ablation therapy for prostate cancer and evaluate predictors of a successful treatment outcome.

METHOD AND MATERIALS
Institutional review board approval was granted for prospective recruitment. Inclusion criteria: biopsy-proven intermediate, or less, risk PCA; exclusion-criteria: high-risk disease, or prior PCA treatment. All patients underwent diagnostic MRI, with target lesions outlined. A modified brachytherapy MR-guidance template was used for transperineal placement of catheter/s, with Indigo-Optima® laser fibres placed within. The zone of ablation was monitored in real-time by MRI thermography. Post-procedure coagulation volume was determined by contrast-enhanced T1-weighted imaging.

RESULTS
Treatment was successfully completed in all 40 patients. Two patients were lost to follow-up. Mean follow-up was 671 days (range 150-1,157). At 4-6 month or subsequent biopsy, 13/38 patients (34.2%) had residual/recurrent cancer in the region treated, 25 patients (65.8%) had no recurrence. Between these groups there was no significant association between baseline Gleason-grade, PSA, risk category, number of positive biopsy cores or %core involvement, or tumor size/location/marginal extension. The likelihood of tumor on diagnostic MRI (P=0.004) and complete lesion coverage by thermal ablation zone (P <0.05) were independent predictors of success.

CONCLUSION
Focal laser ablation is a feasible and effective therapy for patients with low-to-intermediate risk PCa. Predictors of successful therapy include confidence presence of the lesion on diagnostic MRI and full peri-procedural coverage of the target.

CLINICAL RELEVANCE/APPLICATION
We show the feasibility of focal laser ablation therapy. Focal therapy is an option for lower risk PCA patients uncomfortable with the risks of active surveillance or side effects of radical therapy.
SSK09 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Andrea G Rockall, MRCP, FRCR *
Moderator
Elizabeth A Sadowski, MD

SSK09-01 • Anatomical and Functional Volume Concordance between FDG-PET, T2 and Diffusion Weighted MRI for Cervical Cancer: A Hybrid PET/MRI Study
Hongzan Sun (Presenter) ; Jun Xin MD ; Shaomin Zhang ; Qiyong Guo MD

PURPOSE
To evaluate the concordance of imaging by [18F] fluorodeoxyglucose (FDG) - positron emission tomography (PET), T2 weighted imaging (T2WI) and apparent diffusion coefficient (ADC) maps with diffusion-weighted imaging (DWI) in cervical cancer using hybrid whole-body PET/MRI.

METHOD AND MATERIALS
Cervical cancer patients (N=35) were prospectively recruited to undergo pretreatment 18FDG-PET/MRI. 18FDG-PET and MRI images were fused using standard software. The percent of the maximum standardized uptake value (SUVmax) was used to contour tumors on PET images and volumes were auto calculated. Tumor volumes measured by T2WI and DWI were calculated with standard techniques of tumor area multiplying slice profile. Data analysis used parametric statistics.

RESULTS
CONCLUSION
Hybrid PET/MRI showed strong concordance between FDG-PET, T2WI and DWI in cervical cancer. Cutoff at 35% or 40% of SUVmax is recommended during 18FDG PET-MRI SUV-based tumor volume estimation. Tumor subvolumes with increased metabolic activity on FDG-PET also have greater cell density by DWI.

CLINICAL RELEVANCE/APPLICATION
Hybrid PET/MRI was demonstrated a reliable method in cervical cancer imaging, and will benefit its clinical decision making by combining accordant anatomical and functional information together.

SSK09-02 • Radiologists’ Adherence to the 2010 Society of Radiologists in Ultrasound Guidelines for the Management of Incidental Adnexal Cysts Imaged at Ultrasound: Frequency and Associated Factors
Andrea S Kierans MD (Presenter) ; Andrew B Rosenkrantz MD

PURPOSE
To evaluate adherence to the 2010 Society of Radiologists in Ultrasound (SRU) guidelines for management of incidental adnexal cysts imaged at ultrasound.

METHOD AND MATERIALS
398 adnexal cysts initially detected at ultrasound were included; all studies had been performed after publication of the SRU guidelines and guideline review at departmental conferences. The ultrasound reports were retrospectively reviewed to determine whether the management recommendations were adherent to the guidelines. Non-adherent cases were categorized as over-management, under-management, or as incomplete in their recommendation. Impact of categories determining appropriate recommendation (menopausal status, cyst size, and other cyst imaging features) was assessed via the chi-square test, and the primary cause for non-adherence (over- vs. under-management) in each sub-category was identified.

RESULTS
Among all 398 adnexal cysts, the frequency of adherence was 55%, over-management was 27%, under-management was 12%, and incomplete recommendation was 6%. Menopausal status, cyst size, and other cyst imaging features all significantly impacted adherence rate (all p<0.05). Adherence was 24% (under-management in 42%). Lesions adherent in most instances were simple cysts (55%), para-ovarian cysts (71%), corpus luteum (88%), and cysts suggestive of, but not classic for, a hemorrhagic cyst, endometrioma, or dermoid (57%). Lesions with under-management in most instances were cysts with multiple thin septations (83%), thick irregular septations (33%), or an avascular nodule (67%), and dermoids (78%). Lesion with over-management in most instances was cyst with one thin septation (64%).

CONCLUSION
Radiologists at our institution adhered to the SRU guidelines for incidental adnexal cysts at ultrasound in 55% of cases. Non-adherence was greater in post-menopausal patients, larger cysts, and cysts with greater complexity.

CLINICAL RELEVANCE/APPLICATION
Our findings will be used to direct future efforts to improve adherence to the SRU guidelines, which in turn will improve patient care. Causes of both under- and over-management will be addressed.

SSK09-03 • Early Response Assessment to Concurrent Chemoradiotherapy in Cervical Cancer: Value of Diffusion-weighted and Dynamic Contrast-enhanced MR Imaging
Sohee Song (Presenter) ; Chan Kyo Kim MD, PhD ; Jung Jae Park MD ; Sung Yoon Park ; Byung Kwan Park MD ; Seung Jae Huh PhD

PURPOSE
To prospectively investigate the value of diffusion-weighted (DWI) and dynamic contrast-enhanced MR imaging (DCEI) as early and reproducible response predictors in cervical cancer patients who received concurrent chemoradiotherapy (CCRT).

METHOD AND MATERIALS
Sixteen consecutive patients with biopsy-proven cervical cancer who treated with CCRT were evaluated with MR imaging at 3T, including DWI and DCEI. Four serial MR examinations were performed before CCRT (preTx), after 1 week of therapy (postTx1), after 4 weeks after therapy (postTx2), and after 1 month after the end of therapy (postTx3). At each time point, apparent diffusion coefficient (ADC) and DCEI parameters (i.e., Ktrans and Vp) in the tumors showed consecutive increase (all P<0.05), while those of glutue muscle and normal uterus did not reveal a significant difference (all P>0.05). At postTx1 tumor ADCs showed a significant correlation with tumor size response at postTx1 (P=0.003). Changes in tumor ADCs between preTx and postTx1 had a significant correlation with tumor size (P=0.001) and volume response (P=0.021) at postTx2. At preTx, tumor Ktrans showed a significant correlation with tumor volume response at postTx3 (P=0.033); tumor Kep and Vp had a significant correlation with tumor size response at postTx2 (P=0.043 and P=0.019, respectively). Reproducibility of ADC versus DCEI parameters measurements in the tumor, glutue muscle and normal uterus was confirmed with a mean difference of 0.3% versus 0.6%±16.6%, 1.7% versus 0.5%±12.3%, and 2.2% versus 0.9%±17.8% in sequence, respectively.

CONCLUSION
...
DWI and DCEI, as early and reproducible biomarkers, have the potential to evaluate therapeutic response to CCRT in patients with cervical cancer.

CLINICAL RELEVANCE/APPLICATION

As imaging biomarkers, ADC and DCEI parameters may aid in the development of more individualized, effective therapy regimens for the patient group.

SSK09-04 • Clinical Application of Diffusion-weighted MR Imaging in Uterine Cervical Cancer

Ying Liu (Presenter) ; Zhao Xiang Ye

PURPOSE

To investigate the application value of apparent diffusion coefficient (ADC) values in evaluating the histological type as well as pathologic grade of uterine cervical cancer; and to investigate whether ADC values could reflect tumor cellularity density.

METHOD AND MATERIALS

Ninety-eight patients with histopathologically proven uterine cervical cancer were included in this prospective study. All of them received conventional MRI and DWI examinations before surgery or concurrent chemoradiation. Mean ADC value and minimum ADC value of the tumor were measured. Tumor cellularity density was counted using CMIAS (colored multifunction imaging analyzing system).

RESULTS

Both mean ADC value and minimum ADC value of squamous cell carcinoma were significantly lower than that of adenocarcinoma (P=0.001; P=0.000). Using mean ADC criteria (=0.965×10^{-3} mm^2/s) and minimum ADC criteria (=0.844×10^{-3} mm^2/s), the sensitivity and specificity for differentiating squamous cell carcinoma from adenocarcinoma were 83.5% and 76.9%, 77.6% and 92.3%, respectively. The A2 of mean ADC was not statistically greater than minimum ADC (P=0.990). Tumor cellularity density, mean ADC value and minimum ADC value of different pathologicological grade varied significantly (P=0.000, P=0.000, P=0.000). There was a significant positive linear correlation between tumor cellularity density and the pathological grade of tumor (P=0.000). Both mean ADC value and minimum ADC value correlated negatively with cellularity density (P=0.000, P=0.000) and the pathological grade of tumor (P=0.000, P=0.000). Comparisons of correlation coefficients showed no significant differences (P=0.656, P=0.631).

CONCLUSION

DWI has a potential ability to indicate the histologic type of uterine cervical cancer. ADC measurements of uterine cervical cancer can represent tumor cellularity density, thus providing a new method for evaluating the pathological grade of tumor. Mean ADC value instead of minimum ADC value was recommended to fully reflect the whole tumor.

CLINICAL RELEVANCE/APPLICATION

DWI with ADC measurement may be helpful for the noninvasive and preoperative prediction of the histologic type and degree of differentiation of uterine cervical cancer.

SSK09-05 • Tumor ADC Value Is Associated with Depth of Myometrial Invasion and Is Negatively Correlated to Tumor Volume in Endometrial Carcinomas

Jenny A Husby MD (Presenter) ; Inger J Magnussen ; Joner Trovik MD ; Oyvind Salvesen ; Line Bjorge ; Helga Salvesen MD, PhD ; Ingrid S Haldorsen MD

PURPOSE

Explore possible correlations between tumor apparent diffusion coefficient (ADC) values, morphological imaging findings and clinical and histological patient and tumor characteristics in endometrial carcinomas. To investigate interobserver agreement between readers on preoperative staging by MRI, including diffusion weighted imaging (DWI).

METHOD AND MATERIALS

RESULTS

CONCLUSION

Low tumor ADC value is associated with presence of deep myometrial invasion and the ADC value is negatively correlated to tumor volume in endometrial carcinomas. Preoperative staging by MRI with DWI is prone to considerable interobserver variability. Calculation of tumor ADC values may aid in the prediction of deep myometrial invasion in endometrial carcinomas.

CLINICAL RELEVANCE/APPLICATION

Low tumor ADC value is associated with presence of deep myometrial invasion, and DWI may aid in the prediction of deep myometrial invasion in endometrial carcinomas.

SSK09-06 • Temporal Changes of Imaging Parameters of MRI and FDG-PET/CT during Treatment in Cervix Cancer

Saba N Elias MSc (Presenter) ; Guang Jia PhD ; Nina A Mayr MD ; William T Yuh MD ; Jun Zhang PhD ; Michael V Knopp MD, PhD ; Nathan C Hall MD, PhD *

PURPOSE

To prospectively assess the temporal changes of multi-imaging parameters from MRI and PET/CT, including ADC, tumor size, and standardized uptake value (SUV) for early therapy monitoring in cervix cancer patients.

METHOD AND MATERIALS

Ten cervical cancer patients with stage IB2-IVA underwent: 4 multi-parametric 1.5 T MRI (pre-, early-, mid- and post-therapy) and 3 PET/CT using 18F-fluorodeoxyglucose (FDG), (pre-, early-, and mid-therapy). A total dose of 4500 cGy was given with external beam radiation therapy, as well as concurrent weekly chemotherapy with Cisplatin (25-40 mg/m^2). 3-dimentional tumor region of interest were identified using MIM software. ADC map values and T2W based tumor size were calculated using MIPAV software for the four sequential MRIs. Max SUV body weight (bw) was calculated using MIM software for the 3 sequential PET/CT scans.

RESULTS

Multi-parametric MRI showed gradual reduction in tumor size and an increase in the ADC values while PET/CT SUV decreased from pre-therapy to mid-therapy; the mean values of these parameters are : pre-therapy ADC 0.0010 ± 0.0002 mm^2/s, tumor size 47.8±34.6 cm^3 and max SUVbw 15.8±5.4, early-therapy ADC 0.0011±0.0002 mm^2/s, tumor size 34.4±24.3 cm^3 and max SUVbw 11±5.1, mid-therapy ADC 0.0012±0.0002 mm^2/s, tumor size 15.4±15.5 cm^3 and max SUVbw 7±2.3, and post-therapy ADC 0.0012±0.0002 mm^2/s and tumor size 6.9±3.8 cm^3. A negative correlation between pre-therapy ADC and max SUV was found (r= -0.56). A tumor size reduction rate from pre-therapy to post-therapy is negatively correlated to ADC increase rate (r = -0.73).

CONCLUSION

Imaging parameters from the MR and PET/CT, standard modality for the assessment of treatment response in cervical cancer, correlate significantly and our limited data suggest both modalities are efficacious during early treatment. Our research establishes an opportunity to further investigate the comparative effectiveness of each parameter at different treatment time points and further augment the potentials of these parameters for the early responsiveness assessment and long-term outcome prediction.

CLINICAL RELEVANCE/APPLICATION

Current research paves the foundation for cost-effective analysis of the presumed expensive MR and PET/CT and potential augmentation efficacy from the combined-modality approach.
Whole-body 18F-FDG PET/MRI may be applied as a stand-alone staging technique for patients with suspected pelvic malignancies.

CLINICAL RELEVANCE/APPLICATION

The significant time reduction due to omission of T2w and DWI MRI.

PET/MRI may be utilized as a stand-alone imaging technique for staging of patients with suspected pelvic malignancies, allowing for

Our results demonstrate the superiority of 18F-FDG PET/MRI in detecting malignant lesions compared to MRI alone. Thus, whole body PET/MRI may be utilized as a stand-alone imaging technique for staging of patients with suspected pelvic malignancies, allowing for significant time reduction due to omission of T2w and DWI MRI.

RESULTS

In 10 of 13 patients malignant lesions were present. A total of 41 lesions, comprising 29 malignant and 12 benign lesions were detected. PET/MRI offered correct and respectively superior identification of all 10 patients with cancer lesions, compared to MRI (without DWI, 6/10; including DWI 8/10). Additionally, 18F-FDG PET/MRI exhibited higher conspicuity (PET/MRI: median: 4, range: 3-4; MRI: median: 4, range: 2-4) and diagnostic confidence (PET/MRI: median: 3, range 2-3; MRI: median: 2, range 1-3, MRI + DWI: median: 3, range 1-3) in the detection of malignant lesions.

CONCLUSION

PET/MRI might be eligible to replace PET/CT in the work-up of OB-Gyn cancers.

CLINICAL RELEVANCE/APPLICATION

PET/MRI might be applied as a stand-alone staging technique for patients with suspected pelvic malignancies.
SSK13 • Musculoskeletal Keynote Speaker: Update in Cartilage Imaging
Christine B Chung MD (Presenter)

SSK13-02 • T2 Mapping of Articular Cartilage in Patients of Meniscus Transplantation: A Prospective Study over 1 Year

Sun-Young Park MD (Presenter); Sang Hoon Lee; Min Hee Lee MD; Hye Won Chung MD; Myung Jin Shin MD

PURPOSE
To evaluate changes of T2 value of articular cartilage in patients of meniscus transplantation on serial follow up images.

METHOD AND MATERIALS
From 2010 to 2011, 26 patients (mean age, 29.6±10.3) who underwent meniscus allograft transplantation of lateral meniscus were prospectively evaluated by using a 3T MR imaging at 2 days, 6 weeks, 3, 6 and 12 months after the surgery. All patients showed no retear in the transplanted meniscus and no aggravation of chondromalacia. Quantitative T2 maps of femoral condyle and tibial plateau were obtained at the operation compartment. Mean T2 values were calculated at the deep and superficial layers of three allocated areas in femoral condyle and tibial plateau (the anterior and posterior meniscal coverage areas, and the weight bearing area). T2 value in each area was measured twice at the sagittal slice 6mm medially and laterally away from the central articulation (12 points). The grading of the chondromalacia was evaluated at each location with reference to the arthroscopic grading. All images were quantified using Relaxation Maps Tool. Statistical software (SAS® Version 9.2; SAS institute Inc., Cary, NC) was used.

RESULTS
The T2 values in both femoral and tibial articular cartilage were significantly decreased after meniscal transplantation on the serial follow-up MR scans for up to 1 year in both superficial and deep layers (p<0.05).

CONCLUSION
T2 quantification showed the subclinical changes of articular cartilage after meniscus allograft transplantation over time and demonstrated the differences of T2 value according to the chondromalacia grade on serial follow up MR.

CLINICAL RELEVANCE/APPLICATION
T2 quantification is a useful tool in monitoring the treatment response of meniscus allograft transplantation

SSK13-03 • MRI T2-mapping with Clinical Correlation after Treatment of Knee Osteoarthritis with Autologous Mesenchymal Stem Cells: A Pilot Study

Joan C. Vilanova MD, PhD (Presenter); Marina Huguet MD; Ana Sanchez; Javier Garcia-Sancho; Lluis Orozco; Robert Soler

PURPOSE
To assess the feasibility of osteoarthritis treatment with mesenchymal stromal cells (MSCs) in humans, and to demonstrate its efficacy on MRI and clinical outcome.

METHOD AND MATERIALS
Twelve patients with clinical and radiologic diagnosis of osteoarthritis of the knee (graded according to the ICRS (International Cartilage Repair Society) were treated with autologous MSCs by intrarticular injection on a phase I-II trial. Clinical outcomes were followed for 1 year (including pain, disability, and quality of life). Cartilage assessment was performed using MRI T2-mapping at 88 pre-determined anatomical regions previous to treatment, at 6 months and 12 months after treatment; by determining the T2 relaxation values (RV) in each region of the knee. Inter, intraobserver and equipment errors were calculated for reproducibility, and for the statistical analysis to determine significant differences on T2 RVs before and after treatment. Statistical analysis was performed by Students t-test or by one-way analysis of variance (ANOVA) and the corresponding non-parametric tests.

RESULTS
A positive correlation was identified between the baseline mean T2 RVs and the pain score (r=0.42; p<0.05).

CONCLUSION
MSC therapy could be a valid alternative treatment for knee osteoarthritis and MRI T2-mapping might be a useful tool for its cartilage assessment follow up.

CLINICAL RELEVANCE/APPLICATION
Stem cells therapy could become a new effective, feasible and safe treatment for chronic osteoarthritis, whether MRI technique might be the monitoring tool for its assessment.

SSK13-04 • The Value of T2 Color Maps in the Patellar Cartilage Grading Injury

Qian Cui (Presenter); Shao Wu Wang; Yue Dong; Shaowei Zheng; Qingwei Song BS, BEng

PURPOSE
To investigate value of T2 color maps in assessment of patellar cartilage injury grading.

METHOD AND MATERIALS
62 patients who underwent knee MR and arthroscopic surgery patients were collected, including 32 males and 30 females, aged 30-51 years, mean 40.7 years. GE Company Signa3.0T MR was used. The scan sequence include: FSE-TWI, FSE-T-WI, FS-FSE-PDWI and T2-mapping. T2-mapping images were sent to the GE-ADW 4.3 workstation to generate T2 color maps of patellar cartilage. Arthroscopic patellar cartilage grading standards, to explore T2 color maps value of the patellar cartilage grading injury.

RESULTS
T2 color maps would be reliable in classification of patellar cartilage damage assessment.

CLINICAL RELEVANCE/APPLICATION

SSK13-05 • Incidental Findings and Their Clinical Relevance Magnetic Resonance Imaging (MRI) of the Knee in an Open Population-based Study of Middle-aged Females

Edwin H Oei MD, PhD (Presenter); J. H. J. M. Bessem MD; Dieuwke Schiphof PhD; Abida Z Ginal MD, PhD; Jan Heeringa MD, PhD; Gabriel P Krestin MD, PhD*; Albert Hofman MD, PhD; Meike W Vernooij MD; Sita Bierna-Zeinstra PhD

PURPOSE
METHOD AND MATERIALS
891 female participants aged 45-60 (mean 55) from the Rotterdam Study underwent MRI of both knees (1.5 T scanner (GE)) independent of OA status. All participants gave written informed consent, including a section on incidental findings. Incidental findings were assessed by trained radiologists, reviewed with an experienced musculoskeletal radiologist and classified into findings that did or did not require referral, based on clinical relevance, expected health benefit and evidence-based therapeutic consequences. Age-related changes were not considered findings that needed referral because these were primary study outcomes. In accordance with informed consent, findings that required referral were reported to participants and their GP.

RESULTS
In 1782 MRI scans we identified 54 incidental findings (3.0%) in 52 participants, 17 of which (1.0%) in 17 participants required referral: 16 lesions suspicious of a chondroid lesion with uncertain benign characteristics and 1 large atypical cystic intraosseous abnormality. In all referrals, additional dynamic contrast-enhanced MRI was performed. Although this did neither demonstrate malignant tumor characteristics nor necessitated specific treatment in any, all referred participants are still followed-up clinically and radiologically. Among findings that did not require referral were 37 chondroid lesions in 35 participants with unequivocal benign features (central metadiaphysial lesion).

CONCLUSION
Our findings suggest that in the general middle-aged female population incidental findings are present in 3% of knee MR scans. While referral and additional MRI was deemed necessary in 1% of MRIs, this demonstrated that incidental findings virtually all consist of chondroid tumors with low suspicion of high tumor grade.

CLINICAL RELEVANCE/APPLICATION
Incidental findings are present on 3% of knee MRI scans in the general middle-aged female population and virtually all consist of chondroid tumors with low suspicion of high tumor grade.

SSK13-06 • Comparison of Quantitative Magnetization Transfer Parameters of Patellar Cartilage in Asymptomatic Volunteers and Patients with Early Osteoarthritis

Nade Sritanyaratana (Presenter) ; Pouria Mossahebi MS ; John Wilson MD, MS ; Alexey A Samsonov PhD ; Walter F Block PhD * ; Richard Kijowski MD

PURPOSE
Quantitative magnetization transfer (qMT) imaging utilizes the magnetization transfer effect to probe macromolecular tissue composition typically inaccessible by conventional magnetic resonance (MR) techniques. qMT can be used to measure the fraction of protons bound to macromolecules (f), the exchange rate between mobile protons and macromolecular bound protons (k), and the T2 relaxation time of macromolecules (τ2b). This study was performed to compare qMT parameters of patellar cartilage in young asymptomatic volunteers and patients with early patellofemoral osteoarthritis (OA).

METHOD AND MATERIALS
An MRI examination through the patellofemoral joint was performed in the axial plane at 3.0T on 14 young asymptomatic volunteers and 11 patients with Kellgren-Lawrence grade 1 (N=6) and grade 2 (N=5) patellofemoral OA. Nine spoiled gradient recall-echo (SPGR) volumes were acquired with different MT offset frequencies and MT powers, 2 SPGR volumes were acquired for B1 error correction using actual flip angle imaging (AFI), and 4 SPGR volumes were acquired for T1 mapping using variable flip angle imaging (VFI). Total scan time was 25 minutes. The qMT parameters f, k, and T2b were iteratively fitted in MATLAB using a previously described model and then measured in regions of interest placed around the entire patellar cartilage. Mann-Whitney-Wilcoxon tests were used to compare qMT parameters between groups of subjects.

RESULTS
Mean f, k, and T2b within patellar cartilage for asymptomatic volunteers were 14.00±0.71%, 6.51±0.71sec⁻¹, and 6.53±0.15sec⁻¹, respectively. Mean f, k, and T2b within patellar cartilage for patients with OA were 14.30±0.85%, 5.63±0.80sec⁻¹, and 6.83±0.14sec⁻¹, respectively. Patients with OA had similar f (p=0.26), significantly lower k (p=0.006), and significantly higher T2b (p=0.0006) within patellar cartilage than asymptomatic volunteers.

CONCLUSION
Patients with early patellofemoral OA have lower k and higher T2b within patellar cartilage than young asymptomatic volunteers. Additional studies are needed to investigate the mechanisms behind the observed changes in k and T2b with early cartilage degeneration.

CLINICAL RELEVANCE/APPLICATION
qMT imaging is a new quantitative MR technique which has high sensitivity for detecting changes in macromolecular tissue composition associated with early cartilage degeneration.

SSK13-07 • Magnetic Resonance Imaging of Knee Changes in Psoriatic Patients without Arthritic Symptoms

Yasser Ragab MBBCh, MSc (Presenter) ; Yasser F Emad MD, PhD ; Hosny M Hamza MD, FRCR

PURPOSE
To evaluate magnetic resonance imaging (MRI) findings of knee joints in patients with psoriasis without clinical peripheral or axial joint involvement, and to correlate MRI findings with disease and demographic variables.

METHOD AND MATERIALS
In total 48 patients with psoriasis and no clinical evidence of synovitis or enthesitis in any peripheral or axial joints were enrolled. A random sample of 20 healthy subjects without knee or other joint complaints and matched for age and sex served as controls. All patients and controls underwent enhanced MRI studies of both knee joints, and MRI findings were compared.

RESULTS
Among 48 patients (96 knees), a total of 90 enthesal lesions were detected, with no enthesitis in 2 cases (6.3%). Signs of continuing inflammation bilaterally were frequently found: soft tissue edema (STE; n = 52), bone marrow edema (BME; n = 20), perienthesal BME (n = 3), cartilaginous erosions (n = 42), and bone erosions (n = 27). In controls, 2 (10%) subjects had BME and another 5 (25%) showed cartilaginous erosions. None showed evidence of enthesitis. Significant correlations were observed between the number of enthesal lesions of both knees vs STE (present vs absent; r = 0.314, p = 0.030) and STE (number of lesions; r = 0.351, p = 0.014). Enthesitis (patellar vs bilateral) was significantly and positively correlated with STE (r = 0.364, p = 0.036), cartilaginous erosions (r = 0.304, p = 0.036), and villous projections (r = 0.347, p = 0.016).

CONCLUSION
Subclinical synovitis and enthesitis are frequently found in the knee joint of patients with psoriasis. These may be an early sign of psoriatic arthritis.

CLINICAL RELEVANCE/APPLICATION
In psoriatic patients the knees could be the seat of enthesitis and synovitis changes even without symptoms of artheritis. Those changes may be detected by MRI.

SSK13-08 • Semiquantitative MRI-based Predictors of Quantitative Cartilage Thickness Loss in Knee Osteoarthritis: Data from the MOST Study

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Diagnostic Performance of Tomosynthesis for Evaluation of Suspicious Bone Tumors: Comparison with Radiography and CT

Jihyun Bae MD (Presenter) ; In Sook Lee ; You Seon Song ; Jeung Il Kim MD, PhD ; Jong Woon Song

PURPOSE
To compare tomosynthesis with radiography for evaluation of suspicious bone tumors, using multidetector computed tomography (CT) as the reference method.

METHOD AND MATERIALS
The study was approved by the institutional review board of our institution and written consent was obtained from all patients. From January 2012 to March 2013, 24 consecutive patients with suspicious bone tumors underwent radiography, tomosynthesis, and CT within 3 days. Two radiologists analyzed about the presence or absence of periosteal reaction, space occupying lesion (SOL), mineralization and fracture on each three imaging modality.

RESULTS
Fourteen patients had benign bone tumors, nine had malignant bone tumors and one had only cortical fracture. The overall sensitivity, specificity, and accuracy of tomosynthesis were, respectively, 88.9%, 100%, and 95.8% about the periosteal reaction, all 100% about the SOL and mineralization, and 87.5%, 100% and 91.7% about the fracture. Those of radiography were, respectively, 88.9%, 100%, and 95.8% about the periosteal reaction, all 100% about the SOL and mineralization, and 87.5% and 91.7% about the fracture.
the SOL and mineralization, and 87.5%, 100% and 91.7% about the fracture. Those of radiography were, respectively, 88.9%, 100%, and 95.8% about the peristeat reaction, 81.8%, 100% and 83.3% about the SOL, 83.3%, 100%, and 95.8% about the mineralization, and 43.7%, 100%, and 62.5% about the fracture. The degrees of agreement between CT and tomosynthesis were 0.909 about peristeat reaction, 1 about the SOL and mineralization and 0.824 about the fracture (p < 0.05). Those between CT and radiography were respectively 0.909, 0.429, 0.882, and 0.341 (p < 0.05).

CONCLUSION
The diagnostic performance of tomosynthesis for evaluation of suspicious bone tumors was significantly greater than radiography and comparable to CT.

CLINICAL RELEVANCE/APPLICATION
The imaging qualities of tomosynthesis in the cases of suspicious bone tumors may comparable to those of CT images, with relatively lower radiation dose.

SSK14-02 • Treatment Response Evaluation of Patients with Malignant Bone Tumors; Correlation of ADC from 3.0T MR Imaging and SUV from FDG PET/CT

So-Yeon Lee MD (Presenter); Won-Hee Jee MD; Joon-Yong Jung MD; Jin-Kyeong Sung MD; Soo Ah Im; Jin Hyoug Kang; Ie Ryung Yoo

PURPOSE
To retrospectively determine whether the apparent diffusion coefficients (ADC) at 3T diffusion-weighted MR imaging (DWI) correlate with the standardized uptake values (SUV) at positron emission tomography (PET)/computed tomography (CT) for evaluating treatment response in malignant bone tumors.

METHOD AND MATERIALS
The institutional review board approved this HIPAA-compliant study and informed consent was waived. Twenty-two patients with 27 malignant bone tumors underwent 3T MR imaging including DWI with b value of 0, 800 sec/mm2 and whole-body fluorine 18 fluorodeoxyglucose PET/CT before and after treatment. Minimum ADC (ADCmin) of the tumor was measured by two independent musculoskeletal radiologists and correlated the maximum SUV (SUVmax) of the tumor. The percentage changes of ADCmin and SUVmax were calculated by the difference between the initial and follow-up values divided by the initial value. The change ratios of ADCmin and SUVmax were defined as the ratio of the follow-up value to the initial value. The Spearman rank correlation were obtained for statistical analysis.

RESULTS
There was significant correlation between the differences between the initial and follow-up values of ADCmin and SUVmax (r = 0.573 for reviewer 1 and r = 0.597 for reviewer 2, P < .005), the change ratios of ADCmin and SUVmax (r = 0.457, r = 0.491, P < .05), and percentage changes of ADCmin and SUVmax (r = 0.457, r = 0.491, P < .05). DWI and PET CT showed treatment response in 18 lesions: the ADC was increased by 105% (interquartile range, 61-166) and SUVmax was decreased by 56% (37-83). The ADCs of two responded lesions returned to the range of normal bone marrow and resulted in a decrease of the ADCmin (65% and 32%, respectively) and decrease of SUVmax (71% and 87%, respectively). There was no response in six lesions: the ADC was decreased by 23% (13-30) and SUVmax was increased by 55% (26-90). There was one lesion with a discrepancy in changes of ADCmin (decreased by 29%) and SUVmax (decreased by 13%).

CONCLUSION
There was significant correlation between the ADC and SUV for evaluating treatment response in malignant bone tumors.

CLINICAL RELEVANCE/APPLICATION
Quantitative DWI is comparable to PET/CT for evaluating treatment response in malignant bone tumors.

SSK14-03 • Negative Relationship between CT Attenuation Values and ADC Values in Densely Sclerotic Bone Metastases from Prostate Cancer

Usman Bashir MBBS (Presenter); Nina Tunariu MD; David J Collins BSC, BA; Diletta Bianchini; Andrea Zivi; Dow-Mu Koh MD, FRCR

PURPOSE
To investigate relationship between CT attenuation and ADC value of skeletal metastasis in prostate cancer.

METHOD AND MATERIALS
26 patients of prostate cancer with bone metastases, who underwent contemporaneous whole body diffusion-weighted MRI (WB-DWI) and CT were retrospectively reviewed. WB-DWI was performed on a 1.5T system using b-values 50, 900 s/mm2. CT of chest, abdomen and pelvis was acquired at 65s post-contrast. Slice-by-slice synchronization was obtained between CT and MRI data-sets by careful use of anatomic landmarks. A lucent and a sclerotic metastasis were chosen on CT, when present, at each of the following skeletal sites: thoracic spine, lumbar spine, sacrum, right pelvis and left pelvis. A maximum of 10 lesions were evaluated per patient. Lesion signal intensity on b900 image was recorded as hyperintense or iso/hypointense to skeletal muscle. A region of interest (ROI) was drawn on CT around each lesion to record the mean CT value (HU) and copied on the matching b900 image to derive lesion’s mean ADC value (x 10-3 mm²/s).The relationship between lesion CT HU and ADC values was evaluated by Spearman’s correlation. The mean CT HU and ADC values of hyperintense versus iso/hypointense lesions were compared using t-test. A p-value of

RESULTS
212 lesions were evaluated. The mean CT HU was 481 (33-1152); the mean ADC value was 0.91 (0.18-2.13). 140/212 (66%) lesions appeared hyperintense; 73/212 (34%) were iso/hypointense on DWI. The mean CT HU of hyperintense metastases was significantly lower than iso/hypointense lesions (371 vs 681, p = 650HU; n=57), a highly significant negative correlation was observed between CT HU and ADC (r=-0.60, p<0.001) about the SOL and mineralization, and 87.5%, 100% and 91.7% about the fracture. Those of radiography were, respectively, 88.9%, 100%, and 95.8% about the peristeat reaction, 81.8%, 100% and 83.3% about the SOL, 83.3%, 100%, and 95.8% about the mineralization, and 43.7%, 100%, and 62.5% about the fracture. The degrees of agreement between CT and tomosynthesis were 0.909 about peristeat reaction, 1 about the SOL and mineralization and 0.824 about the fracture (p < 0.05). Those between CT and radiography were respectively 0.909, 0.429, 0.882, and 0.341 (p < 0.05).

CONCLUSION
There was significant correlation between the ADC and SUV for evaluating treatment response in malignant bone tumors.

CLINICAL RELEVANCE/APPLICATION
There was significant correlation between the ADC and SUV for evaluating treatment response in malignant bone tumors.

SSK14-04 • Differentiation of Osteogenic Bone Metastases and Bone Islands Using Conventional Single-energy CT Value and Monochromatic CT Value from Spectral CT in Patients with Bronchogenic Carcinoma

Yue Dong (Presenter); Shaowei Zheng; Bing Wang; Ruxin Wang; Lifei Sun

PURPOSE
To evaluate the diagnostic efficacy of single-energy CT and single-source Dual-energy CT in the identification of osteogenic bone metastases and bone islands in patients with bronchogenic carcinoma.

METHOD AND MATERIALS
45 cases of osteogenic metastases in patients with pathologically proven bronchogenic carcinoma and 43 cases of bone islands were confirmed via MRI, single-photon emission computed tomography (SPECT) and one year follow-up. All subjects underwent dual-energy spectral CT imaging using a high definition CT (Discovery CT750 HD, GE). The means, standard deviation (SD) and coefficient variation (CV) of 140Kvp-quality check (QC) CT values and virtual monochromatic (40-140 keV) CT values of osteogenic metastases and bone islands were measured and compared with independent-samples t-test. The lesion center was selected as ROI (20-30mm2). ROC curves
RESULTS
The mean mono-energy CT values (40-140 keV) and QC CT value of osteogenic bone metastases were all significantly lower than that of bone islands (p < .05).

CONCLUSION
Both conventional single-energy CT and monochromatic CT were reliable for differential diagnosis of osteogenic bone metastases and bone islands. SD of monochromatic CT value at higher keV has better diagnostic efficacies.

CLINICAL RELEVANCE/APPLICATION
SD of monochromatic CT value at higher keV has better diagnostic efficacies for differentiation of osteogenic bone metastases and bone islands.

SSK14-05 • Can IDEAL-MR Imaging of Multiple Myeloma Be Used as a Biomarker for Predicting Symptomatic Myeloma?

Miyuki Takasu MD (Presenter) ; Yoko Kaichi ; Miho Ishikawa MD ; Shuji Date ; Yuji Akiyama ; Kazuo Awai MD * ; Yoshiaki Kuroda ; Akira Sakai

PURPOSE
Asymptomatic multiple myeloma is an asymptomatic plasma-cell proliferative disorder associated with a high risk of progression to symptomatic multiple myeloma. Predictive factors for the progression of this disease are unclear. This study was performed to evaluate the effectiveness of the iterative decomposition of water and fat with echo asymmetric and least-squares estimation (IDEAL) MRI to predict symptomatic myeloma in patients without visible focal lesions.

METHOD AND MATERIALS
The lumbar spine was examined with 3T-MRI in 47 patients with multiple myeloma (asymptomatic myeloma, 23; symptomatic myeloma, 24). The fat-signal fraction (FSF) obtained by IDEAL sequence was calculated as the mean value from three vertebral bodies. We evaluated the factors predictive of symptomatic myeloma. They included sex, age, FSF, MR signal intensity pattern (MR pattern), bone marrow plasma cell percentage (BMPC%) obtained from a biopsy specimens, presence of IgA monoclonal protein, serum monoclonal protein level (M protein), serum albumin level, serum ?2-microglobulin (?2m) level, the ?2m/albumin ratio, reductions in levels of uninvolved immunoglobulins, and the kappa/lambda ratio. For data analysis, univariate and multivariate logistic regression analyses, as well as receiver operating characteristic curves, were used. A difference with P < .05 was considered significant.

RESULTS
Univariate analysis demonstrated that MR pattern, FSF, BMPC%, M protein, the reduction in uninvolved immunoglobulins, ?2m, and the ?2m/albumin ratio were significantly associated with symptomatic myeloma. Results of multivariate analysis demonstrated that ?2m, FSF, and the reduction in uninvolved immunoglobulins had significant effects in differentiation between asymptomatic and symptomatic myeloma. The area under the curve was 0.805 for FSF, 0.844 for ?2m, and 0.793 for BMPC%.

CONCLUSION
Fat quantification results using the IDEAL sequence in MRI were significantly different in patients with symptomatic- and asymptomatic myeloma. The FSF and ?2m facilitated the discrimination of symptomatic- from asymptomatic myeloma.

CLINICAL RELEVANCE/APPLICATION
Predictive factors for the progression to symptomatic myeloma included FSF and ?2m. The discriminative performance of FSF is comparable to that of BMPC% obtained from biopsy specimen.

SSK14-06 • Magnetic Resonance Imaging Differentiation between Malignant Marrow Replacing Lesion and Benign Red Marrow Deposition of Vertebra Using T2*-corrected Fat Fraction Map Imaging Based on Three-point Dixon-VIBE Sequence

Yong Pyo Kim (Presenter) ; Sungjun Kim MD ; Tae Sub Chung ; Yaena Kim MD ; Munyoung Paek ; Choon Sik Yoon MD ; Young Han Lee MD ; Ho-Taek Song MD ; Jin-Suck Suh MD

PURPOSE
To assess feasibility of T2*-corrected fat fraction map imaging using three-point Dixon-VIBE sequence as a tool for differentiation between malignant marrow replacing lesion and benign red marrow deposition of vertebra.

METHOD AND MATERIALS
From Mar. 2012 to Feb. 2013, magnetic resonance imaging was performed for consecutive 33 patients who were referred for vertebral marrow abnormality assessment. Twenty two pathologically confirmed malignant marrow replacing lesions and 11 benign red marrow lesions from the patients were subjects of this study. Three sequences were applied using a 1.5-T MR imaging scanner like follows: three-point Dixon-volume interpolated breath-hold GRE sequence (VIBE) for fat fraction (FF) measurement; conventional T1 weighted imaging (T1WI); pre- and post-contrast enhanced fat-suppressed T1WI (CE). To evaluate diagnostic performance of the three parameters, receiver operating characteristic (ROC) curves were obtained and areas under curves (AUCs) of the parameters were compared to each other. The sensitivity and specificity at the most ideal cut off values for the parameters were obtained.

RESULTS
AUCs of FF, LDR, CER were 0.96, 0.83, 0.74. FF showed superior AUC than CER with statistical significance. The optimal cut-off value and the corresponding sensitivity/specificity in percentage were like follows: 16, 0.81/1 in FF; 116.2, 1/63.6 in LDR; 93.4, 0.68/0.81 in CER. AUCs of FF, LDR, CER were 0.96, 0.83, 0.74. FF showed superior AUC than CER with statistical significance. The optimal cut-off value and the corresponding sensitivity/specificity in percentage were like follows: 16, 0.81/1 in FF; 116.2, 1/63.6 in LDR; 93.4, 0.68/0.81 in CER.

CONCLUSION
Fat quantification results using the IDEAL sequence in MRI were significantly different in patients with symptomatic- and asymptomatic myeloma. The FSF, ?2m/albumin ratio were significantly associated with symptomatic myeloma. Results of multivariate analysis demonstrated that ?2m, FSF, and the reduction in uninvolved immunoglobulins had significant effects in differentiation between asymptomatic and symptomatic myeloma. The area under the curve was 0.805 for FSF, 0.844 for ?2m, and 0.793 for BMPC%.

CLINICAL RELEVANCE/APPLICATION
Predictive factors for the progression to symptomatic myeloma included FSF and ?2m. The discriminative performance of FSF is comparable to that of BMPC% obtained from biopsy specimen.

SSK14-07 • Diagnostic Efficacy of Whole-body Ultra Low Dose CT (WBULDCT) in Comparison with Spinal Magnetic Resonance Imaging (SMRI) in the Assessment of Disease in Patients with Multiple Myeloma (MM)

Valeria Besostri MD (Presenter) ; Davide Ippolito MD ; Pietro A Bonaffini MD ; Valentina Bartolo ; Alessandra Cuccia ; Sandro Sironi MD

PURPOSE
To compare the diagnostic value of Whole-body Ultra Low-Dose CT (WBULDCT) with dedicated Spinal Magnetic Resonance Imaging (SMRI) in the identification of bone marrow involvement of patients with Multiple Myeloma (MM).

METHOD AND MATERIALS
A total of 30 patients (17 males and 13 females; mean age 68 years, range 52-83 years), with histologically proven MM, undergoing WBULDCT and a dedicated SMRI (9/30 for staging, 21/30 during follow-up), were evaluated in our study. Unenhanced WBULDCT was
performed on a 256-slice scanner (ICT, Philips), with the following parameters: tube voltage 120 kV, tube current time product 40 mAs, collimation 128x0.65. Spine MRI was performed on a 1.5T magnet (Achieva, Philips), with the following protocol: T1 TSE and T2 STIR acquired on sagittal plane. WBULDCT was compared to spine MRI in terms of lesion detection, pattern of bone marrow involvement and risk fractures.

RESULTS
In 21/30 patients (70%), WBULDCT and SMRI were concordant, detecting (14/21) or excluding (7/21) involvement of the axial skeleton. In 9/30 patients (30%) WBULDCT and SMRI were discordant in terms of axial skeleton involvement: in 2/9 patients SMRI was positive and WBULDCT was negative, while in 7/9 patients only WBULDCT was positive. The corresponding sensitivity for lesion detection in the spine was 73% for WBULDCT and 53% for SMRI, respectively. Only one patient with a negative WBULDCT scan showed multifocal lesions on SMRI. Moreover, in 22/30 of cases (73%) WBULDCT detected additional osteolytic lesions in other extra-axial districts (skull, sternum and ribs, pelvis, upper and lower limbs).

CONCLUSION
WBULDCT demonstrated superior capability as compared to SMRI, for the detection of disease in the axial skeleton and also offers detailed information about extra-axial involvement, which could be potentially missed with dedicated SMRI alone.

CLINICAL RELEVANCE/APPLICATION
WBULDCT imaging appears to be helpful in detecting spinal involvement in patients with MM, reserving SMRI in case of negative results in symptomatic patients.

SSK14-08 • Appearance of Monoclonal Plasma Cell Diceses in Whole-body MRI and Correlation with Parameters of Disease Activity

Jost Kloth (Presenter) ; Jens Hillengass MD ; Karin Listl MD ; Stefan Delorme MD ; Hans-Ulrich Kauczor MD * ; Marc-Andre Weber MD * ; Hartmut Goldschmidt MD

PURPOSE
To examine a possible association of the presence of focal lesions (FL) or a diffuse infiltration pattern of bone marrow in whole-body MRI (WB-MRI) with the disease stage and established markers of disease activity in patients with monoclonal plasma cell disease.

METHOD AND MATERIALS
Institutional review board approval was obtained. We examined the WB-MRI scans in 547 consecutive, unselected and untreated patients with monoclonal gammopathy of undetermined significance (MGUS, n=138), smoldering multiple myeloma (SMM, n=157) and multiple myeloma (MM, n=252) on two identical 1.5 Tesla MRI-scanners with body array coils. Assessment was done by two experienced radiologists blinded to the diagnosis of the patients in consensus.

RESULTS
We found focal lesions in 23.9% (MGUS), 34.4% (SMM) and 81.3% (MM), respectively. A diffuse infiltration pattern was detected in 38.4%, 45.9%, and 71% of the corresponding patients. Infiltration patterns were significant (p < 0.001) concerning the frequency of focal or diffuse bone marrow abnormalities as well as the severity of diffuse signal changes in bone marrow are significantly associated with the stage of plasma cell disease as well as established markers of disease activity.

CLINICAL RELEVANCE/APPLICATION
Considering nearly riskless application and non-invasiveness of wb-MRI its future application in the prognostic evaluation of MM and its asymptomatic precursors MGUS and SMM is promising.

SSK14-09 • Whole-body MRI for Diagnosing Multiple Myeloma and Evaluating Treatment Efficacy

Min Zong MD, PhD (Presenter) ; Dehang Wang MD ; Si-Guang Zhu MD ; Li-Juan Chen

PURPOSE
To investigate the initial diagnostic value and treatment efficacy of the whole-body MRI for Multiple Myeloma.

METHOD AND MATERIALS
Forty-seven Multiple Myeloma patients confirmed with histopathology were enrolled in the study. All patients underwent whole-body MRI before chemotherapy, and follow up scan at 3 and 6 months after the first and second rounds of chemotherapy treatment, respectively. The lesions found by whole-body MRI of each patient were counted at different time points and compared by one-way ANOVA statistic analysis.

RESULTS
Five imaging patterns were identified on whole-body MRI, which were smoldering type (5 patients), diffuse type (7 patients), focal type (25 patients), mixed type (3 patients), and salt-and-pepper type (7 patients). Out of the 47 patients, there were 42 patients with visible lesions on follow up whole-body MRI scans during chemotherapy. The mean number of lesions was 113.90±45.71 on whole-body MRI before chemotherapy, and decreased to 28.00±22.49 and 10.04±9.02 at the third and sixth month on follow-up whole-body MRI.

CONCLUSION
Statistically significant differences were confirmed between either two of the three groups (P < 0.001). Whole-body MRI is a valuable tool for initial Multiple Myeloma diagnosis and monitoring treatment efficacy after chemotherapy.

CLINICAL RELEVANCE/APPLICATION
Whole-body MRI is a valuable tool for initial Multiple Myeloma diagnosis and monitoring treatment efficacy after chemotherapy.
METHOD AND MATERIALS
The SPARE-AD index, a previously characterized imaging biomarker capturing spatial patterns of brain atrophy, was first tested for sensitivity and specificity as a biomarker of Alzheimer’s disease (AD), in a training set of 411 participants. SPARE-AD, and a related mild cognitive impairment (MCI)–specific index called SPARE-MCI, were then evaluated at baseline in 212 MCI patients who either converted to AD within 18 months or remained stable for at least 3 years. Baseline predictive value of SPARE-AD, SPARE-MCI, CSF biomarkers (total and phosphorylated tau and Aβ), MMSE, ADAS-Cog, and APOE genotype were then evaluated using a support vector machine classifier.

RESULTS
SPARE-AD offered excellent diagnostic accuracy of AD (AUC between 0.96–0.98). Excluding CSF biomarkers, MRI-derived SPARE scores offered the highest predictive power for MCI conversion to AD (AUC=0.76); followed by ADAS-Cog (AUC=0.74). Their combination offered the best accuracy (AUC=0.76). Other cognitive and APOE4 markers did not add any predictive power beyond them. In a subset (112 MCI patients) who also had CSF biomarkers, SPARE had the best predictive power (AUC=0.73), being enhanced by CSF biomarkers (AUC=0.76), which by themselves were relatively poorer predictors (AUC=0.68). In amyloid-negative MCI patients, SPARE-AD had high predictive power.

CONCLUSION
MRI patterns of atrophy, quantified via advanced pattern analysis methods, offer the highest predictive power of conversion from MCI to AD, but are slightly better than ADAS-Cog. Combination of MRI and CSF biomarkers improves predictive power. High predictive value of SPARE in negative amyloid MCI is not expected under the amyloid hypothesis and merits further investigation.

CLINICAL RELEVANCE/APPLICATION
A highly sensitive and specific imaging biomarker of AD is evaluated as an earlier predictor of clinical progression from MCI to AD, which can become an AD-specific marker for diagnosis and treatment.

SSK16-02 • MR Elastography of Alzheimer’s Disease and Frontotemporal Dementia

John Huston MD (Presenter) ; Matthew C Murphy PhD ; Kevin J Glaser * ; Clifford R Jack MD * ; Richard L Ehman MD *

PURPOSE
Several MR imaging biomarkers exist to measure various disease processes associated with Alzheimer’s disease (AD) and frontotemporal dementia (FTD). Patterns of hippocampal and whole brain atrophy, MR spectroscopy, perfusion, diffusion and functional MRI have been reported. Magnetic resonance elastography (MRE) is a non-invasive technique to measure tissue stiffness, akin to manual palpation. Our purpose was to investigate the effect of AD and FTD on brain stiffness.

METHOD AND MATERIALS
We examined 59 subjects with brain MRE including 39 age and gender matched cognitively normal controls (NC), 15 subjects with AD and 5 subjects with behavioral variant FTD. MRE data were collected with a modified spin-echo EPI pulse sequence on a 3.0T MR imager including full head coverage in just less than 7 minutes. Shear waves were introduced with a soft pillow-like vibration source operating at 60 Hz using a pneumatic actuator. The wave data underwent a curl operation to remove contributions of the longitudinal waves and a 3D direct inversion algorithm calculated the elastogram. In subjects with 3 mm isotropic sampling we measured age adjusted global brain stiffness (entire brain excluding cerebellum), in 8 regions.

RESULTS
Global stiffness was decreased in AD subjects (2.20 kPa) compared to NC (2.37 kPa). Group-wise differences in stiffness were demonstrated within the lobes of the brain that contain association cortices (p

CONCLUSION
We have demonstrated that AD and FTD alter the mechanical properties of the brain in a way that can be measured in vivo by MRE, following the known topography of the diseases. Measures of brain elasticity have the potential to offer insights into the ultrastructural alternations of brain tissue that occur with AD and FTD, how these change with time and the clinical expression of the diseases.

CLINICAL RELEVANCE/APPLICATION
MR Elastography demonstrates Alzheimer’s disease and frontotemporal dementia alter the mechanical properties of the brain by decreasing brain stiffness, following the known topography of the diseases.

SSK16-03 • Different Post Label Delay Cerebral Blood Flow Measurements in Patients with Alzheimer’s Disease Using 3D Arterial Spin Labeling

Ying Liu MD (Presenter) ; Huishu Yuan MD ; Xiangzhu Zeng MD ; Zheng Wang MS

PURPOSE
To evaluate cerebral blood flow(CBF) and find out differences in patients with Alzheimer’s disease (AD) and healthy control group(HC) using 3D Arterial Spin Labeling(ASL) on 3.0T MR. Changing the label time in 3D ASL in order to obtain two CBF maps. To observe the analysis of different label time for CBF map result and explore the 3D ASL in the display of brain perfusion factor and its clinical significance.

METHOD AND MATERIALS
Thirteen AD patients (5men and 8women; age range, 58-88years, mean age 75.00±7.36 years ) and fifteen healthy control subjects (4 men and 11 women; age range, 56-84 years, mean age 71.20±7.89 years) were recruited. All MRI examinations were performed using a 3.0T scanner, pseudo-continuous ASL scanning was conducted with 36 label/control images acquired on a GE750 3T scanner. The acquisition parameters were: TR/TE = 4632/10.5ms, voxel size = 2×2×4mm3. High-resolution T1SPGR images were acquired as well.

RESULTS
Several Post Label Delay(CPLD) were used to get two CBF maps, which were compared between AD patients and HC. SPGR images were coregistered using SPM8.

CONCLUSION
1. SPM analyses revealed focal hypoperfusion in areas over the bilateral parietal lobe, temporal lobe and posterior cingulate gyrus in AD patients in comparison with control subjects with PLD1.5(p

CLINICAL RELEVANCE/APPLICATION
3D ASL is a useful noninvasive MRI sequence to identify the Alzheimer’s disease and the PLD of 1.5s was probably better than that of 2.5s.

SSK16-04 • The Correlation of Hippocampal T2-mapping with Neuropsychology Test in Patients with Alzheimer’s Disease

Zhu-Ren Luo (Presenter) ; Xiong-Jie Zhuang

PURPOSE
1) To deduce T2, the inverse of the transverse relaxation rate (R2), in the hippocampus of healthy adults; 2) to investigate the brain iron deposition in Alzheimer’s disease (AD) patients and age-matched healthy controls using T2-values.

METHOD AND MATERIALS
T2-weighted data from the bilateral-hippocampi of ten AD patients and sixty healthy controls were collected using multi-slice multi-echo turbo spin echo (HMSE-E) imaging on a 3.0T MR-scanner, followed by the neuropsychological testing. The correlations between
RESULTS
There were no significant differences in hippocampal T2-values on intra-gender and inter-gender basis ($P > 0.05$). Hippocampal T2-values of both sides were similar (right: $85.17\pm2.44$ milliseconds; left: $85.26\pm2.51$ milliseconds). The bilateral hippocampal T2 values correlated moderately with age (right: $r = -0.59$; left: $-0.58$; $P < 0.001$). Mean hippocampal T2-values from ten controls correlated strongly ($r = -0.90$, $P < 0.001$) with reference brain iron concentrations for healthy adults. The AD-group had significantly lowered T2-values in the hippocampus when compared to normal controls ($P < 0.001$) and had a strong positive correlation with the MMSE score ($R^2 = 0.97$; $P < 0.05$).

CONCLUSION
Patients with AD showed significantly iron depositions in the hippocampus resulting in the decreased T2 values. A positive correlation between T2-values and cognition/memory scores, suggests that quantitative T2 can be used in the early diagnosis of AD and monitoring of the treatment response.

CLINICAL RELEVANCE/APPLICATION
In vivo proton transverse relaxation rate imaging is capable of quantitatively measuring the iron deposition in the hippocampus in AD patients, consistent with incipient AD pathogenesis.

SSK16-05 • GABA-edited Magnetic Resonance Spectroscopy in Alzheimer’s Disease at 3T
Xue Bai BA (Presenter) ; Guangbin Wang MD

PURPOSE
Gamma-aminobutyric acid (GABA) is the essential inhibitory neurotransmitter in human brain. It is considered that reduced neuronal GABA concentration and neurotransmission results in cognitive impairments in Alzheimer's disease (AD). However, few in vivo studies have directly certified this hypothesis. In this study, we used magnetic resonance spectroscopy at high field to measure GABA levels, aiming to investigate whether there is a regional GABA level decline in AD.

METHOD AND MATERIALS
Twelve untreated AD patients (5 males and 7 female; range 56-79, mean = 67.6±8.4 years) and twelve age-and sex-matched healthy control subjects were recruited. AD patients were diagnosed according to National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association. 1H-MRS was performed in a 3-tesla MR scanner (Philips Achieva TX, Best, The Netherlands). The voxel was set (3 cm × 3 cm × 3 cm) in the frontal lobe and the parietal lobe (Fig 1), using high resolution T1-weighted three-dimensional TFE images as a localizer. The GABA concentration was measured using a MEGA-PRESS sequence (TR = 2000ms; TE = 68 ms; 320 averages; acquisition bandwidth = 1000 Hz; scan duration 11 minutes). All the metabolite quantification was performed with time-domain fitting algorithm AMARES by jMRUI v.4.0. Each pixel in the brain images was segmented as to gray matter, white matter, or cerebrospinal fluid using the FSL package.

RESULTS
According to the result of segmentation result, there was no significant difference in the proportions of each part between AD patients and controls. Fig 2 shows the typical GABA-edited spectra from the MEGA-PRESS sequence in the frontal lobe of an AD patient. Significant differences of GABA/Cr ratio were found in parietal lobe between AD patients and Controls ($t$=-2.212, $p=0.038$), but not found in frontal lobe ($t= 0.799$, $p>0.05$).

CONCLUSION
In this study, GABA-edited MRS technique was successfully applied in AD patients to assess GABA level in vivo, and the brain GABA level in parietal lobe is decreased in AD. GABA may be a potential biomarker for early detection of AD, and could be used to assess the prognosis after treatment.

CLINICAL RELEVANCE/APPLICATION
GABA-edited MRS technique was useful to assess GABA level in vivo, GABA may be a potential biomarker for early detection of AD, and could be used to assess the prognosis after treatment.

SSK16-06 • Relationships between the Structural Connectome and Amyloid Burden in Alzheimer’s Dementia
Jeffrey W Prescott MD, PhD (Presenter) ; Arnaud Guidon PhD ; P. M Doraismawy MD * ; Chunlei Liu PhD ; Jeffrey R Petrella MD *

PURPOSE
The hypothesis of the current study is that relationships between the structural connectome and cortical amyloid burden may provide complementary information about pathologic changes in Alzheimer’s Disease (AD).

METHOD AND MATERIALS
Subjects were those newly enrolled in the ADNI2 study. Baseline data was used. T1 anatomical images were parcellated using FreeSurfer. DTI scans were registered to the T1 images using FSL. Structural connectomes were created using the Connectome Mapper Toolkit. Node degree, local efficiency, and clustering coefficient were calculated for the precuneus, posterior cingulate, inferior temporal, superior parietal, and superior frontal connectome nodes. The FreeSurfer parcellations were registered to the florbetapir PET scans. The global SUVRs and four local SUVRs (frontal, cingulate, parietal, and temporal) were calculated. Clinical cognitive assessments included MMSE, ADAS-Cog, and Rey AVLT. Statistical analyses were performed between structural connection metrics, amyloid status, and clinical cognitive scores.

RESULTS
There were 102 ADNI2 subjects (64 males, 38 females) available at the time of the analysis. There were 37 normal control, 19 early mild cognitive impairment (MCI), 25 late MCI, and 21 AD subjects. All global and local AV45 amyloid burden measures were significantly associated with RAVLT, MMSE, and ADAS-Cog ($p < 0.05$). The strongest associations between amyloid burden and structural connection metrics were in the posterior cingulate and precuneus (node degree; $p < 0.05$). The strongest associations between structural connection metrics and clinical dementia scores were in the precuneus, superior parietal, and superior temporal regions (node degree vs. MMSE and ADAS-cog; $p < 0.05$).

CONCLUSION
Brain amyloid burden has significant associations with clinical cognitive status in all regions analyzed, consistent with globally increased amyloid burden as an important condition for AD. The strongest associations between amyloid burden and structural connection metrics were in the posterior cingulate and precuneus (node degree; $p < 0.05$), suggesting that these regions are most likely to have structural changes related to amyloid deposition in AD.

CLINICAL RELEVANCE/APPLICATION
The combination of quantitative amyloid PET and DTI tractography can provide information about global and local structural changes in AD, aiding in diagnosis and disease tracking.

SSK16-07 • Voxel-based Analysis of Quantitative Susceptibility Data Obtained from Subjects with AD and MCI
Hye Soo Koo MD (Presenter) ; Seong Jong Yun ; Kyung Mi Lee MD ; Eo Jin Hwang ; Heok Gi Kim ; Chang-Woo Ryu MD ; Hak Young Rhee ; Yi Wang PhD ; Tian Liu PhD ; Geon-Ho Jahng PhD

PURPOSE
To investigate quantitative susceptibility in three groups of subjects with cognitive normal (CN), mild cognitive impairments (MCI) and
Using institution specific libraries, quantitative volumetric MRI can be used to distinguish different cognitive disorders.

**RESULTS**

The 669 patients scanned with volumetric MRI were divided into three diagnoses: 328 were with Alzheimer’s dementia, 262 with mild cognitive impairment and 79 with age-related non-neurodegenerative memory loss. The attached figure shows the distribution of cognitive impairment, and 79 with age-related non-neurodegenerative memory loss. The clinical records were reviewed of 669 consecutive patients at the Lou Ruvo Center for Brain Health who underwent quantitative MRI using NeuroQuant (Cortech Inc), which computes the brain volumes of 48 regions. These numbers were compared with the presence and type of dementia, whose gold standard was the clinical diagnosis made by neurologists, geriatricians, or general practitioners. Other clinical data collected included factors such as age, age of onset, and various test scores. These data were used to form a library to compare future patients whose dementia diagnosis is unknown. Specifically, a new patient’s quantitative MRI is compared with the library of prior scans, and probabilities are provided associating the patient to either the presence of dementia or dementia type.

**CONCLUSION**

A center specific library of quantitative brain measures may be useful in categorizing patients with cognitive disorders. We review the initial results of our quantitative analysis and probabilistic maps generated during this analysis.

**CLINICAL RELEVANCE/APPLICATION**

Using institution specific libraries, quantitative volumetric MRI can be used to distinguish different cognitive disorders.

**SSK16-08 • Quantitative MRI Discrimination of Alzheimer’s Dementia, Mild Cognitive Impairment, and Other Memory Disorders Using Volumetric MRI**

Zachary T Berman BA (Presenter); Shamseldeen Y Mahmoud MD; Alexander Rae-Grant MD; Jennifer Bullen MSc; Nancy A Obuchowski PhD; Stephen E Jones MD, PhD

**PURPOSE**

To investigate whether automated quantitative MRI may be useful in discriminating AD, MCI, and other memory disorders in a cognitive disorders clinic.

**METHOD AND MATERIALS**

The clinical records were reviewed of 669 consecutive patients at the Lou Ruvo Center for Brain Health who underwent quantitative MRI using NeuroQuant (Cortech Inc), which computes the brain volumes of 48 regions. These numbers were compared with the presence and type of dementia, whose gold standard was the clinical diagnosis made by neurologists, geriatricians, or general practitioners. Other clinical data collected included factors such as age, age of onset, and various test scores. These data were used to form a library to compare future patients whose dementia diagnosis is unknown. Specifically, a new patient’s quantitative MRI is compared with the library of prior scans, and probabilities are provided associating the patient to either the presence of dementia or dementia type.

**RESULTS**

The 669 patients scanned with volumetric MRI were divided into three diagnoses: 328 were with Alzheimer’s dementia, 262 with mild cognitive impairment, and 79 with age-related non-neurodegenerative memory loss. The attached figure shows the distribution of cognitive impairment, and 79 with age-related non-neurodegenerative memory loss. The clinical records were reviewed of 669 consecutive patients at the Lou Ruvo Center for Brain Health who underwent quantitative MRI using NeuroQuant (Cortech Inc), which computes the brain volumes of 48 regions. These numbers were compared with the presence and type of dementia, whose gold standard was the clinical diagnosis made by neurologists, geriatricians, or general practitioners. Other clinical data collected included factors such as age, age of onset, and various test scores. These data were used to form a library to compare future patients whose dementia diagnosis is unknown. Specifically, a new patient’s quantitative MRI is compared with the library of prior scans, and probabilities are provided associating the patient to either the presence of dementia or dementia type.

**CONCLUSION**

A center specific library of quantitative brain measures may be useful in categorizing patients with cognitive disorders. We review the initial results of our quantitative analysis and probabilistic maps generated during this analysis.

**CLINICAL RELEVANCE/APPLICATION**

Using institution specific libraries, quantitative volumetric MRI can be used to distinguish different cognitive disorders.

**SSK16-09 • The Pattern of Metabolic Heterogeneity in the Hippocampus by 3T Multi-voxel Proton Spectroscopy in Alzheimer’s Disease**

Fei Chen MS (Presenter); Bing Zhang PhD; Ming Li; Xin Zhang MD, MS; Yun Xu; Bin Zhu; Weibo Chen MSc

**PURPOSE**

We explore the metabolic changes in the head, body and tail of hippocampal in Alzheimer’s head. Compare with normal control. We also investigate the distribution rules of metabolites concentration among different parts of the hippocampus for more accurate clinical diagnosis of AD.

**METHOD AND MATERIALS**

Thirty patients with AD and 30 cognitively normal person (CN) were scanned by a 3.0 T magnetic resonance (MR) by Multivoxel proton spectroscopy (Achieva, Philips Medical Systems, Netherlands). The 8channels-HEAD coil was employed. The data was processed by commercially available postprocessing workstation (Extended Workspace (EWS), Philips Medical Systems, Netherlands). The hippocampus was divided equally into three parts (head, body and tail). N-acetylaspartate (NAA)/creatine (Cr), myoinositol (MI)/Cr and MI/NAA ratio were calculated separately from each part. We compared with each metabolites concentration data of AD and CN groups and analyzed the anteroposterior metabolic profile in hippocampus.

**RESULTS**

The mean value of NAA/Cr is decreased and that of MI/Cr, MI/NAA are elevated in the bilateral hippocampi and hippocampal body and tail in AD group (p < 0.01). MI/NAA in the head of left hippocampus is also increased statistically (p < 0.01). Fig.1 shows NAA/Cr in the bilateral hippocampi from head to tail have the gradually rising trend (p < 0.01) and MI/NAA gradually declines in CN group (p < 0.01). MI/Cr in CN group and each metabolite concentration in AD group have no anteroposterior metabolic heterogeneity in bilateral hippocampi. (Fig.1).

**CONCLUSION**

The anteroposterior metabolic heterogeneity is dismissed in AD, which might be helpful on the early clinical diagnosis of AD.

**CLINICAL RELEVANCE/APPLICATION**

Application in the early diagnosis of AD.
METHOD AND MATERIALS

An agarose phantom was constructed with homogeneous concentrations of ferumoxytol (Feraheme®, AMAG Pharmaceuticals, Inc.) ranging from 0-20 mg/kg. The phantom was scanned on a Siemens Biograph mMR PET/CT scanner, using a 2-point Dixon 3-D (VIBE) sequence. The default algorithm for reconstruction of the mu-map was used, including selection of the lung compartment option. In addition, repeated in-vivo PET/MR 18F-FDG studies were performed in a 13.2 kg male baboon, in an animal committee approved protocol, at four different time points: (before and after injection of 10mg/kg ferumoxytol) 1, 3 and 5 weeks after the baseline scan. All studies were performed using a body Matrix coil and the built-in spine coil as the receiving coil elements.

RESULTS

Phantom experiment: Misclassification was observed in the mu-maps of the phantom regions with ferumoxytol concentrations of 10 mg/kg and higher. Baboon imaging: In data obtained later than 5 minutes after the i.v. ferumoxytol injection, significant signal loss was observed in the mu-map, particularly in the liver, resulting in liver tissue being misclassified as lung. This translated in a decrease of observed standard uptake value (SUV) of liver tissue from 1.23 to 0.54 (-57%) within the first 57 minutes. This change persisted over the next 5 weeks (SUV 0.48, -61% compared to baseline).

CONCLUSION

Our data suggests that ferumoxytol, when used as an MRCA (at FDA approved clinical doses (e.g. 10 mg/kg Fe)) in simultaneous PET/MR imaging, has the potential to cause misclassification of tissues on AC maps resulting in >50% changes in observed SUV.

CLINICAL RELEVANCE/APPLICATION

Ferumoxytol has good vascular, lymph node and macrophage activity, however, our data suggests that PET/MR AC algorithms and dose response need improvement prior to its utilization for cancer staging.

SSK17-03 • FDG PET/MR for the Assessment of Lymph Node Involvement in Lymphoma: Preliminary Results and Role of Diffusion Weighted MR

Ivan Platzek MD (Presenter) ; Bettina Beuthien-Baumann MD ; Jens Langner PhD ; Michael Laniado MD ; Jorg Van Den Hoff PhD

PURPOSE

The purpose of this study was to evaluate the sensitivity and specificity of PET/MR (positron emission tomography/magnetic resonance imaging) with FDG (18F-fluorodeoxyglucose) for nodal involvement in malignant lymphoma and to assess the additional value of DWIBS (diffusion weighted MR imaging with background supression) as a part of the PET/MR examination.

METHOD AND MATERIALS

Eighteen patients with malignant lymphoma (10 m, 8 f, mean age 44 y) were included in this retrospective study (Hodgkin’s disease: n=10; non-Hodgkin lymphoma: n=8). The patients underwent FDG PET/MR on a whole-body hybrid system after intravenous injection of FDG (176 - 357 MBq FDG, 276 MBq on average). The PET/MR examination included DWIBS images of the neck, thorax, abdomen and pelvis. Ten patients underwent FDG PET/MR for initial staging, while 8 patients had PET/MR for assessment of therapy response. Lymph node involvement was documented according to the scheme introduced by the German Hodgkin Study Group. Follow-up imaging and histology served as the standard of reference. The sensitivity and specificity of FDG PET/MR and DWIBS were calculated and compared.
using the McNemar test. In patients referred for initial staging, disease stage according to the Ann Arbor classification was determined with FDG PET/MR and DWIBS.

RESULTS
Ninety out of 468 lymph node stations were rated as having lymphoma involvement based on the standard of reference. No evidence for organ involvement was found. Eighty-four lymph node stations were rated as positive by PET/MR and 78 by DWIBS. The sensitivity and specificity of FDG PET/MR for nodal involvement was 93.3% and 99.5%, while DWIBS had a sensitivity of 89.6% and a specificity of 97.4%. Both the sensitivity (p=0.03) and specificity (p=0.008) of FDG PET/MR were significantly better in comparison to DWIBS. In patients referred for initial staging, Ann Arbor stage determined by PET/MR and DWIBS was identical in nine cases and differed in one case (p=0.81).

CONCLUSION
FDG PET/MR allows for lymphoma staging with high sensitivity and specificity for nodal involvement. The use of DWIBS is not recommended as a part of FDG PET/MR examinations in lymphoma, because it does not provide relevant additional information.

CLINICAL RELEVANCE/APPLICATION
FDG PET/MR is a promising method for lymphoma staging which allows for metabolism evaluation in analogy to PET/CT, while ionising radiation associated with CT is eliminated.

SSK17-04 • PET/MRI in the Detection and Characterization of Pulmonary Lesions: Technical and Diagnostic Evaluation in Comparison to PET/CT

Isabel Rauscher (Presenter); Matthias J Eiber MD *; Sibylle Ziegler *; Ernst J Rummeny MD; Markus Schwäiger MD *

PURPOSE
PET/MRI differs substantially from PET/CT concerning PET-detector technology and attenuation correction, which might be of special relevance in the lung. We thus compared PET/MRI and PET/CT for evaluation of pulmonary lesions.

METHOD AND MATERIALS
Forty patients (23 men, 17 women; mean age 53.2 years) underwent a single injection dual imaging protocol with [18F]FDG PET/CT (Siemens Biograph 64) and PET/MRI (Siemens Biograph mMR). Pulse sequences for the lung included T1-weighted VIBE Dixon for attenuation correction and contrast-enhanced VIBE pulse sequences. All patients had a diagnostic CT of the chest in deep inspiration. Two blinded readers assessed in consensus all images randomly concerning quality, detection, standardized uptake value (SUV) and size of pulmonary nodules. Correlations were performed using linear correlation.

RESULTS
All scans together revealed 47 pulmonary lesions (mean size 10.0±11.4mm; range 2-60mm) in 25/40 patients. The PET datasets of PET/MRI and PET/CT revealed both 22/47 pulmonary lesions with focal [18F]FDG uptake. SUV-values of lung lesions in PET/MRI and PET/CT correlated significantly ($r=0.9$; $p=0.0001$) with a tendency for higher SUVs in PET/MRI. There was a significantly lower image quality regarding Dixon and VIBE sequence with CT whereas PET from PET/CT and PET from PET/MRI showed similar results. Dixon images detected 15/47 lung lesions while VIBE images detected 32/47 lesions, respectively. The detection rates for small lung lesions < 1cm diameter ($n=33$) of CT and MR imaging was significantly lower with a detection rate of 9/33 for Dixon sequence and 15/33 for VIBE sequence. There was a high correlation of pulmonary lesion size of CT versus VIBE ($r=0.97$; $p<0.0001$).

CONCLUSION
PET image quality and detection rate of [18F]FDG positive lung lesions in PET/MRI is equivalent to PET/CT despite differences in attenuation correction techniques. Additionally, a high linear correlation coefficient in the SUV mean for the PET images form PET/CT and PET/MRI was found. The detection rate of lung lesions can be significantly improved by adding a diagnostic contrast-enhanced VIBE sequence to the PET/MRI protocol. However, the detection rate of small lung lesions is still inferior compared to PET/CT with diagnostic CT of the chest.

CLINICAL RELEVANCE/APPLICATION
Also for lung evaluation the PET part of PET/MRI is equivalent to PET/CT.

SSK17-05 • Whole-body PET/MRI: The Effect of Ignoring Bone during MR-based Attenuation Correction in Oncology Imaging

Thomas Beyer PhD (Presenter)*; Rachida Sersar; Julie Sabeye; Johan Lofgren; Claes Ladedoged; Flemming L Andersen MSc, PhD; Rasmus Larsen; Marianne C Aznar MS

PURPOSE
Standard PET attenuation correction (AC) in integrated PET/MRI is based on tissue segmentation following in-/opposed phase MR imaging (ACin_op) and does not account for bone tissue. We evaluate PET quantification in whole-body (WB)-PET/MRI following MR-AC without and with accounting for bone tissue using separate CT.

METHOD AND MATERIALS
Forty patients (23 men, 17 women; mean age 53.2 years) underwent a single injection dual imaging protocol with [18F]FDG PET/CT (Siemens Biograph 64) and PET/MRI (Siemens Biograph mMR). Pulse sequences for the lung included T1-weighted VIBE Dixon for attenuation correction and contrast-enhanced VIBE pulse sequences. All patients had a diagnostic CT of the chest in deep inspiration. Two blinded readers assessed in consensus all images randomly concerning quality, detection, standardized uptake value (SUV) and size of pulmonary nodules. Correlations were performed using linear correlation.

RESULTS
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CONCLUSION
PET image quality and detection rate of [18F]FDG positive lung lesions in PET/MRI is equivalent to PET/CT despite differences in attenuation correction techniques. Additionally, a high linear correlation coefficient in the SUV mean for the PET images form PET/CT and PET/MRI was found. The detection rate of lung lesions can be significantly improved by adding a diagnostic contrast-enhanced VIBE sequence to the PET/MRI protocol. However, the detection rate of small lung lesions is still inferior compared to PET/CT with diagnostic CT of the chest.

CLINICAL RELEVANCE/APPLICATION
Also for lung evaluation the PET part of PET/MRI is equivalent to PET/CT.

SSK17-06 • 18-FDG PET/MRI Compared with 18-FDG PET/CT and Whole Body MRI for Lesion Detection, Confidence and Radiation Dose in the Evaluation of Metastatic Breast Cancer

Amy N Melsaether MD; Akshat C Pujara MD (Presenter); Rajan Rakheja; Mohammed B Shaikh MD; Eric Sigmund PhD; Sungeheon Kim; Christian Geppert *; Linda Moy MD

PURPOSE
PET/CT is often used to evaluate for systemic breast cancer (BC), but provides low contrast at a relatively high radiation dose. Whole body (WB) MRI is also being investigated in this role. Simultaneous PET/MRI scanners are recently available. We therefore evaluated PET/MRI performance for lesion detection, reader confidence and radiation dose as compared with PET/CT and contrast enhanced WB MRI in patients referred for initial staging, Ann Arbor stage determined by PET/MR and DWIBS was identical in nine cases and differed in one case (p=0.81).
METHOD AND MATERIALS
For this HIPPA compliant, IRB approved prospective study, 26 women (age 37-76 mean 56) with n=1 newly diagnosed T2 BC or n=25 history of metastatic disease underwent WB simultaneous 18-FDG PET/MRI on an integrated 3T PET/MR scanner (Siemens Biograph mMR), after PET/CT.

RESULTS
Compared with PET/CT, PET/MRI detected treatment changing brain and bone metastases and a primary endometrial cancer in one patient each. PET/MRI also detected breast cancers in two patients which were not seen on PET/CT. WB MRI detected the brain metastases and endometrial cancer, but did not see the treatment changing bone metastasis. In addition, PET/MRI detected liver, bone, lung, pleural and nodal metastases in 2, 7, 1, 1 and 6 patients with high confidence. PET/CT saw the same lesions with lower overall confidence. WB MRI saw bone metastases in only 6 of these patients and detected the same liver, lung, pleural, nodal and brain metastases with lower confidence. WB MRI detected additional low confidence nodal and liver lesions in 9 and 2 patients. Mean PET/MRI radiation dose was 50% less than PET/CT (10.4 mSv vs 20.7 mSv).

CONCLUSION
18-FDG PET/MRI may outperform PET/CT and WB MRI at half the radiation dose of PET/CT. Further investigation is warranted.

CLINICAL RELEVANCE/APPLICATION
18-FDG PET/MRI may provide greater lesion detection and confidence at half the radiation dose as compared with PET/CT and greater specificity and confidence as compared with WB MRI in BC patients.

SSK17-07 • PET/MRI as an Alternative Reduced Radiation Staging Algorithm in Patients with Lymphoma

Alexander R Guimaraes MD, PhD (Presenter) *; Onofrio A Catalano MD; Wendy Atkinson MS; Michael A Blake MBCh *; Ciprian Catana MD, PhD; Bruce R Rosen MD, PhD *

PURPOSE
In patients with lymphoma, FDG PET-CT is critical in the initial staging with early interim PET CT being a strong independent predictor of progression free survival. Diffusion weighted MRI is also a biomarker of malignancy with an uncertain role in lymphoma. The goal of this work was to evaluate the diagnostic performance of simultaneous PET/MR compared to PET/CT in patients with lymphoma.

METHOD AND MATERIALS
15 subjects with lymphoma underwent an IRB approved, single-injection/dual-imaging protocol, consisting of a PET/CT and subsequent PET/MR scan. PET-images of both modalities were reconstructed iteratively. Attenuation, decay and scatter correction and regional allocation was performed using low dose CT data for PET/CT and Dixon-MR sequences for PET/MR. Whole body DWI was performed using a respiratory-triggered, echo-planar SE-EPI (TI/TE/TR 220/68/7800ms) with 3 b-values (0,50,800). ADC was calculated using a mono-exponential fit. SUVmax for FDG-avid lesions were measured and compared using ROI analysis by a single radiologist and OsiriX (Osiris, Lausanne, Switzerland) for each imaging modality. ROI analysis was performed as well comparing ADC fused to FDG-PET/MR SUVmax. Strength of correlation between variables was measured using the Spearman rank correlation coefficient (rs).

RESULTS
Of the 15 subjects, 4 had Hodgkin's and 11 had non-Hodgkin's (NHL) lymphoma. The mean age was 53 +/- 16 years. Thirty-seven FDG-avid lesions were identified. The mean difference in time between PET/CT and PET/MR acquisitions was (209.9 +/- 43.9 min). SUVmax from FDG-PET/MR (mean 8.5 +/- 4.6) versus PET-CT (mean 4.6 +/- 2.7) was on average higher and demonstrated a strongly positive correlation (rs=0.84 (0.71, 0.92); p

CONCLUSION
FDG-PET/MR offers an equivalent whole body staging examination as compared with PET/CT with an improved radiation safety profile (by negating the CT component) in lymphoma patients. Correlation of ADC to SUVmax was weak understating the potential importance of both biomarkers in this disease process.

CLINICAL RELEVANCE/APPLICATION
The equivalence of PET/MR both qualitatively and quantitatively offer a provocative, future clinical staging and surveillance option in patients with lymphoma with dramatic savings in radiation dose.

SSK17-08 • Utility of a Dedicated [18F]-FDG-PET/MRI Protocol for Thoracic Staging in Lung Cancer: Comparison to [18F]-FDG-PET/CT

Philipp Heusch MD (Presenter); Jens Kohler; Christian Buchbender; Felix Nensa MD; Verena Hartung; Till A Heusner MD

PURPOSE
Therapeutic decisions in non-small cell lung cancer (NSCLC) patients depend on the tumor stage. Positron emission tomography/computed tomography (PET/CT) with [18F]-FDG is widely accepted as the diagnostic standard of care. The feasibility of pulmonary tumor staging with simultaneous [18F]-PET/MRI has recently been proven, but no state-of-the-art lung MRI protocol was used in this early study. The purpose of this study was to compare a dedicated pulmonary [18F]-PET/MRI protocol to [18F]-PET/CT for thoracic staging in NSCLC patients.

METHOD AND MATERIALS
15 subjects with pulmonary lesions underwent an IRB approved, single-injection/dual-imaging protocol, consisting of a PET/MRI scan. PET-images of both modalities were reconstructed iteratively. Attenuation, decay and scatter correction and regional allocation was performed using low dose CT data for PET/CT and Dixon-MR sequences for PET/MR. Whole body DWI was performed using a respiratory-triggered, echo-planar SE-EPI (TI/TE/TR 220/68/7800ms) with 3 b-values (0,50,800). ADC was calculated using a mono-exponential fit. SUVmax for FDG-avid lesions were measured and compared using ROI analysis by a single radiologist and OsiriX (Osiris, Lausanne, Switzerland) for each imaging modality. ROI analysis was performed as well comparing ADC fused to FDG-PET/MR SUVmax. Strength of correlation between variables was measured using the Spearman rank correlation coefficient (rs).

RESULTS
Of the 15 subjects, 4 had Hodgkin's and 11 had non-Hodgkin's (NHL) lymphoma. The mean age was 53 +/- 16 years. Thirty-seven FDG-avid lesions were identified. The mean difference in time between PET/CT and PET/MR acquisitions was (209.9 +/- 43.9 min). SUVmax from FDG-PET/MR (mean 8.5 +/- 4.6) versus PET-CT (mean 4.6 +/- 2.7) was on average higher and demonstrated a strongly positive correlation (rs=0.84 (0.71, 0.92); p

CONCLUSION
FDG-PET/MR offers an equivalent whole body staging examination as compared with PET/CT with an improved radiation safety profile (by negating the CT component) in lymphoma patients. Correlation of ADC to SUVmax was weak understating the potential importance of both biomarkers in this disease process.

CLINICAL RELEVANCE/APPLICATION
The equivalence of PET/MR both qualitatively and quantitatively offer a provocative, future clinical staging and surveillance option in patients with lymphoma with dramatic savings in radiation dose.

SSK17-09 • PET/MRI Attenuation Correction: Differences in Correlation Based on Bone Density

Shaunagh McDermott FFRRCSI; Michael A Blake MBCh *; Ciprian Catana MD, PhD; Dushyant V Sahani MD; Bruce R Rosen MD, PhD *; Alexander R Guimaraes MD, PhD (Presenter) *
PET/MRI attenuation correction (AC) is derived from tissue classifications based on Dixon in and out of phase images, which ignore bone density. The aim of this study was to evaluate whether there were regional differences in correlation between PET/CT and PET/MRI SUVmax within the same subject.

METHOD AND MATERIALS

RESULTS

CONCLUSION

Although there is a very high overall correlation between maximum SUVs of suspicious lesions on PET/MR and PET/CT, the location of the lesion does have an effect with combined soft tissue and bone attenuation (abdomen and pelvis) lowering the correlation as compared to air and soft tissue (chest). The low correlation in neck lesions warrants further study, but may be related to lack of coil overlap in this region with only a subset of patients having head/neck coils for the examination.

CLINICAL RELEVANCE/APPLICATION

PET/MRI is a unique tool for oncologic staging. The data presented here elucidates a possible limitation in the attenuation correction that might have impact on SUV and therefore patient management.

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**Breast Imaging (MRI Lesion Characterization)**

**Wednesday, 03:00 PM - 04:00 PM • Arie Crown Theater**

**SSM01 • AMA PRA Category 1 Credit ™:** 1 • ARRT Category A+ Credit: 1

**Moderator**

Christiane K Kuhl, MD *

**Moderator**

Janice S Sung, MD

**SSM01-01 • Ability of Background Parenchymal Enhancement on Breast MRI to Predict Tumor Response to Neoadjuvant Chemotherapy**

Kirti Magudia PhD (Presenter) ; Janice S Sung MD ; Jennifer Brooks PhD ; Jennifer B Kaplan MD ; Maxine S Jochelson MD ; D. David Dershaw MD ; Elizabeth A Morris MD

**PURPOSE**

To evaluate if changes in background parenchymal enhancement (BPE) on breast MRI predict tumor response to neoadjuvant chemotherapy

**METHOD AND MATERIALS**

Retrospective IRB approved review identified 86 patients with biopsy proven breast cancer that underwent bilateral breast MRI before and after neoadjuvant chemotherapy between September 2008 and August 2012. Patients with synchronous bilateral cancers or a history of contralateral cancer were excluded. Clinicopathologic data were obtained from the electronic medical record. A breast-imaging radiologist blinded to clinical data rated the BPE level using BI-RADS criteria of the unaffected breast on pre- and post-neoadjuvant chemotherapy breast MRIs. Odds ratios (OR) and 95% confidence intervals (CI) were estimated using multinomial logistic regression adjusting for age, menopausal status and family history of breast/ovarian cancer.

**RESULTS**

Age at cancer diagnosis ranged from 25-72 years (mean: 46). Tumor size ranged from 1.4-17.0 cm (mean: 6.3). 62 (72%) patients were pre/perimenopausal and 24 (28%) postmenopausal. 36 (42%) tumors were unifocal, and 50 (58%) multilocal/multicentric. There were 36 (42%) ER+, 28 (33%) PR+, 36 (42%) HER2+, and 32 (37%) triple negative (TN) tumors. Results suggest that a decrease in BPE between pre- and post-chemotherapy MRI is associated with a complete imaging response in ER+ (OR 9.1, 95% CI 1.1, 78.3, p = 0.04) and PR+ (OR 18.8, CI 1.1, 307.7, p = 0.04) tumors, though the confidence intervals are wide. BPE reduction was not associated with tumor response with TN or HER 2+ tumors. Changes in BPE were also not associated with clinical stage, MR imaging features, or disease focality.

**CONCLUSION**

Tumor response to neoadjuvant chemotherapy may be associated with a decrease in BPE in patients with ER+ tumors but not with other subtypes.

**CLINICAL RELEVANCE/APPLICATION**

Although larger studies are needed to confirm these results, analysis of BPE change in patients with ER+ tumors undergoing neoadjuvant chemotherapy may be useful to predict tumor response.

**SSM01-02 • Does Morphologic and Volumetric MR Tumor Response in Locally Advanced Breast Cancers Correlate with Disease Free Survival?**

Chiara Iacconi MD (Presenter) ; Punam Bajaj MD, MBBS ; Elizabeth A Morris MD ; D. David Dershaw MD

**PURPOSE**

To analyze a possible correlation between morphology prior to treatment, RECIST response, volumetric reduction, shrinkage pattern and disease free survival (DFS) in locally advanced breast cancers (LABC).

**METHOD AND MATERIALS**

This is a retrospective analysis of 52 women (mean age 44 years, range: 31-69 years) with LABC who had breast MR before and after neoadjuvant chemotherapy. Dynamic breast MR was acquired using 1.5 or 3 T scanners with dedicated breast coils. 3D-tumor volume measurements were done with automated segmentation of MR images using Sentinelle Aegis 2.0.1. Morphology of tumor at diagnosis (solitary, group in same quadrant, separated in different quadrants, total breast replaced by tumor), response to treatment according to RECIST, volumetric response (complete, partial volume reduction: 65-99%, stable: volume reduction < 64%) as well as shrinkage pattern (no residual enhancement, concentric shrinkage, concentric with surrounding lesions, multinodular lesions, diffuse enhancement of the breast) were evaluated and correlated to DFS defined in months after the end of chemotherapy. DFS was evaluated on mammography and PET-CT or total- body CT. Receptor status was also correlated to DFS. Pathological response was defined according to pathology report. Mantel-Cox test was used for the statistical analysis.

**RESULTS**

Agreement in the evaluation of treatment response between diameter at MR and pathology was observed in 38/52 (73%), overestimated in 4/52 (8%) and underestimated in 10/52 (19%). Tumor morphology at diagnosis did not significantly correlate to DFS (p=0.33). RECIST versus volumetric response in women with complete, partial or stable disease did not significantly affect the DFS (p=0.6, 0.24 and 0.31 respectively). DFS was independent of shrinkage pattern of tumors (p=0.69). No statistical difference in DFS was found between complete and residual pathologic response (p=0.76). The percentage of volume reduction was higher in triple negative cancers compared to others (p=0.003), but DFS was significantly lower (27 months) than the other group (66 months)( p=0.04).

**CONCLUSION**

DFS in LABC is not related to pre and post treatment breast MR morphology.
SSM01-03 • Breast Cancer 21-gene Assay Recurrence Score: Correlation between MR Imaging Phenotype and Genotype

Elizabeth J Sutton MD (Presenter) ; Kirti Magudia PhD ; Anne S Reiner MPH ; Monica Morrow MD ; D. David Dershaw MD ; Elizabeth A Morris MD

PURPOSE
Oncotype Dx breast cancer 21-gene assay recurrence score (RS) is used clinically in early stage estrogen receptor (ER) positive breast cancer patients to quantify (range 0-100) the likelihood (increased with score) of recurrence and magnitude of chemotherapy benefit. The purpose of this study was to assess ER positive, HER2 negative early breast cancer pre-operative magnetic resonance imaging (MRI) features and their ability to predict the Oncotype Dx RS.

METHOD AND MATERIALS
This retrospective study received institutional review board approval and need for informed consent waived. Pre-operative MRIs were reviewed of 50 women (mean age 51; range 32-76) with ER positive, HER2 negative early invasive ductal carcinoma (IDC) and an Oncotype Dx (Genomic Health) RS (mean score 23; range 0-78). MRI features included mass shape, margin, internal enhancement, T2 signal, diameter (mean 1.4 cm, range 0.5-2.8 cm), volume (mean 1.4 cc, range 0.1-8.0 cc) and dynamic time-intensity contrast enhancement kinetics. Clinical and pathologic data was collected. Exclusion criteria included prior history of cancer and BRCA genetic carriers.

RESULTS
All 50 women had stage 1 or 2A ER positive, HER 2 negative IDC. Increased Oncotype Dx recurrence score was significantly associated with increased tumor volume (Spearman correlation=0.35; p=0.01) and an increased percent of the tumor having plateau dynamic kinetics upon segmentation (Spearman correlation=0.32; p=0.03). Increased Oncotype Dx recurrence score was significantly associated with irregular tumor shape (p=0.03) and increased tumor (hyperintense and heterogeneous) T2 signal (p=0.002).

CONCLUSION
Several IDC MRI features are significantly associated with an increased Oncotype Dx RS, which has prognostic and predictive significance.

CLINICAL RELEVANCE/APPLICATION
MRI IDC phenotype is significantly associated with their genotype supporting the advent of radiogenomics and possible role in directing targeted therapy.

SSM01-04 • Imaging and Clinicopathologic Factors Associated with Recurrence in Triple-negative Breast Cancers

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

PURPOSE
Triple-negative breast cancer (TNBC) defined as a tumor that is negative for estrogen receptor (ER), progesterone receptor (PR), and HER2 is a biologically aggressive subgroup with poor prognosis. The aim of this study was to identify imaging and clinicopathologic factors associated with breast cancer recurrence in patients with TNBC.

METHOD AND MATERIALS
Of 3237 patients with invasive breast cancer diagnosed between January 2003 and December 2008, 515 patients who underwent breast-conserving surgery or mastectomy were diagnosed with TNBC. 55 patients who had neoadjuvant chemotherapy were excluded. Among 459 patients (median age, 47 years; range, 21-81 years), 69 (15%) had locoregional (n=32) or distant (n=37) recurrence after a median follow-up of 51 months. The imaging and clinicopathologic data were examined. The univariate and multivariate analyses were performed.

RESULTS
Age, family history of breast cancer, histologic type, histologic grade, surgical margin status, and adjuvant therapy showed no significant differences between recurrent group and non-recurrent group (P > .0096). In the multivariate analysis, preoperative breast MRI (P < .0001), mammographic breast density (P = .0034), and LN metastasis (P = .0005) were independent factors associated with recurrence in TNBC patients. The recurrence was more frequent in women with preoperative MRI (n=66) compared to women with preoperative MRI (n=320) (39% vs 12%; adjusted odds ratio [OR], 4.81; 95% confidence interval [CI], 2.51 to 9.20), in women with dense breasts (BIRADS density 3 or 4; n=319) compared to women with non-dense breasts (BIRADS density 1 or 2; n=140) (17% vs 10%; OR, 2.86; 95% CI, 1.14 to 5.78), and in patients with LN metastasis (n=138) compared to patients without LN metastasis (n=321) (24% vs 11%; OR 2.72; 95% CI, 1.35 to 4.81).

CONCLUSION
Risk factors associated with breast cancer recurrence were the lack of preoperative MRI, dense breast tissue on mammography, and LN metastasis. These factors can be predictive of the likelihood of recurrence in TNBC patients.

CLINICAL RELEVANCE/APPLICATION
The use of preoperative breast MRI should be considered for TNBC patients with dense breast tissue.
CONCLUSION
Pilot data shows that grade 3, triple negative, NME and multifocal IDC have higher rates of metastases compared to unifocal, low grade, and ILC. Distant metastases presented as late as 6.8 yrs after diagnosis. We intend to analyze a total of 200 patients in our final study.

CLINICAL RELEVANCE/APPLICATION
To determine the group of patients that can benefit from close follow up and metastatic work up to prevent or detect local recurrence/distant metastases.

SSM01-06 • MR Imaging Phenotype of Breast Cancer: Kinetic Assessment for Molecular Subtypes

Eric M Blaschke MD (Presenter) ; Hiroyuki Abe MD

PURPOSE
To evaluate the dynamic contrast enhanced MR kinetic characteristics of newly diagnosed breast cancer in molecular subtypes.

METHOD AND MATERIALS
Breast MRI examinations of 200 patients with newly diagnosed breast cancer at the University of Chicago Medical Center from 2011 through 2012 were reviewed. Cases of newly diagnosed IDC were sorted by molecular subtype (17 triple negative, 7 Her2+, 73 Luminal A/B) and lesion segmentation and kinetic analyses were performed on a dedicated workstation. For kinetic assessment, 90% and 100% thresholds were employed for display of medium and rapid uptake, respectively. Kinetic profiles in terms of percent volume for 6 kinetic types (medium-persistent, medium-plateau, medium-washout, rapid-persistent, rapid-plateau, rapid-washout) relative to the whole volume of the lesion were obtained. Statistical analysis of the kinetic profiles was performed using the student t-test.

RESULTS
Percent volume of Her2 positive lesions with greater than 50% uptake at early phase was significantly greater compared with luminal A/B (98.7 +/- 1.14 vs. 91.5 +/- 3.05; P < .0004) and all others (98.7 +/- 1.14 vs. 91.9 +/- 2.62; P < .0002). There was a nonsignificant trend towards higher >100% uptake at early phase in Her2 positive lesions versus luminal A/B (87.3 +/- 9.77 vs. 69.3 +/- 6.94; P < .11) and all other subtypes (87.3 +/- 9.77 vs. 71.4 +/- 5.87; P < .199). No significant difference in uptake ratios was noted for Her2 positive vs. triple negative tumors or triple negative tumors vs. all other subtypes. No significant difference was observed in BIRADS assessment of kinetic patterns.

CONCLUSION
Her2 positive breast cancer demonstrates a unique MRI kinetic phenotype with significantly increased rapid uptake ratios compared to other molecular subtypes.

CLINICAL RELEVANCE/APPLICATION
MRI kinetic phenotypes of newly diagnosed breast cancer may provide a means of predicting molecular subtype and thus aid early treatment planning.

Breast Imaging (Multimodality Breast Imaging)

Wednesday, 03:00 PM - 04:00 PM • E451A

SSM02 • AMA PRA Category 1 Credit™:1 • ARRT Category A+ Credit:1

Moderator
Sughra Raza , MD

Moderator
Priscilla J Slanetz , MD, MPH *

SSM02-01 • Triple-negative Breast Cancers: Multimodality Imaging Features of Tumors with and without Androgen Receptor Expression

Min Sun Bae MD, PhD (Presenter) ; Woo Kyung Moon ; Won Hwa Kim MD, MS ; Su Hyun Lee MD ; Jung Min Chang MD ; Nariya Cho MD ; Hye Ryong Koo MD ; So Yeon Park

PURPOSE
Androgen receptor (AR) is expressed in approximately 15% to 25% of triple-negative breast cancer (TNBC) and emerging data suggests that AR may serve as a therapeutic target for a subset of TNBC. We retrospectively reviewed imaging findings for 102 patients with TNBC on mammogram, ultrasound (US), and MRI to determine if AR-positive and AR-negative tumors have distinguishing imaging features.

METHOD AND MATERIALS
A total of 102 consecutive patients (median age, 52 years; range, 28-81 years) with triple-negative (ER-/PR-/HER2-) invasive breast cancers and immunohistochemical data on AR status were included in this study. Two dedicated breast radiologists (5 and 22 years of breast imaging experience, respectively) reviewed the mammogram, US, and MRI without knowledge of the clinicopathological findings based on the ACR BIRADS lexicon. If different imaging findings were assigned by the two readers, a consensus was reached after the findings were discussed. A cutoff value of 10% was used to define AR positivity. The association of AR status with all imaging features was assessed with Fisher exact test.

RESULTS
Twenty-four (24%) patients had AR-positive TNBC and 78 (76%) patients had AR-negative TNBC. Lesion shape on mammogram (P = .008), US (P = .001), and MRI (P = .001), lesion margins on mammogram (P = .004) and US (P = .003), echo pattern on US (P = .009), calcifications on mammogram (P < .0001), and lesion type on MRI (P = .003) were significantly associated with AR status. AR-positive TNBC was more likely to have irregular masses (88% vs 41%), indistinct margins (84% vs 56%), and non-complex hypoechoic masses (96% vs 65%) and be associated with calcifications (54% vs 12%) or nonmass-like enhancement (17% vs 0%).

CONCLUSION
Our results suggest that AR-positive and AR-negative TNBC have different imaging features.

CLINICAL RELEVANCE/APPLICATION
Understanding the imaging heterogeneity of TNBC may be helpful in identifying a subset of TNBC with AR expression, which has been shown to be associated with increased mortality among TNBC patients.

SSM02-02 • Are Suspicious Breast MRI Lesions with an Ultrasound Correlate Higher Histological Grade Tumors?

Punam Bajaj MD, MBBS (Presenter) ; Junting Zheng ; D. David Dershaw MD ; Chaya Moskowitz ; Elizabeth A Morris MD

PURPOSE
To determine if suspicious breast MRI lesions proven to represent invasive ductal carcinoma with an ultrasound correlate are of different histological grade compared with ultrasound occult lesions.

METHOD AND MATERIALS
A total of 102 consecutive patients (median age, 52 years; range, 28-81 years) with triple-negative (ER-/PR-/HER2-) invasive breast cancers and immunohistochemical data on AR status were included in this study. Two dedicated breast radiologists (5 and 22 years of breast imaging experience, respectively) reviewed the mammogram, US, and MRI without knowledge of the clinicopathological findings based on the ACR BIRADS lexicon. If different imaging findings were assigned by the two readers, a consensus was reached after the findings were discussed. A cutoff value of 10% was used to define AR positivity. The association of AR status with all imaging features was assessed with Fisher exact test.

RESULTS
Twenty-four (24%) patients had AR-positive TNBC and 78 (76%) patients had AR-negative TNBC. Lesion shape on mammogram (P = .008), US (P = .001), and MRI (P = .001), lesion margins on mammogram (P = .004) and US (P = .003), echo pattern on US (P = .009), calcifications on mammogram (P < .0001), and lesion type on MRI (P = .003) were significantly associated with AR status. AR-positive TNBC was more likely to have irregular masses (88% vs 41%), indistinct margins (84% vs 56%), and non-complex hypoechoic masses (96% vs 65%) and be associated with calcifications (54% vs 12%) or nonmass-like enhancement (17% vs 0%).

CONCLUSION
Our results suggest that AR-positive and AR-negative TNBC have different imaging features.

CLINICAL RELEVANCE/APPLICATION
Understanding the imaging heterogeneity of TNBC may be helpful in identifying a subset of TNBC with AR expression, which has been shown to be associated with increased mortality among TNBC patients.
Institutional review board approved retrospective study of 310 MRI examinations performed between 2008 and 2011 yielded 350 suspicious lesions for which biopsy was recommended. Subsequent high resolution targeted ultrasound was performed and histopathological grade of carcinomas was recorded as I (low), II (intermediate) or III (high). Statistical analysis was performed applying the Fisher’s exact test, Kruskal-Wallis test and exact Wilcoxon rank sum test.

RESULTS
Targeted ultrasound demonstrated a correlate in 181/350 (52%) suspicious MRI lesions yielding 63/181 (35%) malignant lesions. The remaining 169 (48%) lesions which were sonographically occult, yielded 25/169 (15%) malignant lesions. Sonographic correlates were seen for 72% (63/88) of malignant lesions. Of these, 87% (55/63) were invasive carcinomas and 13% (8/63) were ductal carcinomas in situ.

Histological grade was available for 46 invasive ductal carcinomas with ultrasound correlate (36.5%, 13(28.3%) and 30(65.2%) were histological grade I, II and III, respectively)and 8 without correlate (450%), 3(7.5%) and 1(12.5%) were histological grade I, II and III, respectively). There was no statistically significant difference in the size of tumors with or without an ultrasound correlate (p=0.163). In the group with an ultrasound correlate, no significant difference was observed in tumor size between the recorded histological grades (p=0.052). A grade III tumor was more likely to be present in the group with an ultrasound correlate (p=0.024).

CONCLUSION
When a suspicious breast MRI lesion has an ultrasound correlate, it is more likely to represent invasive carcinoma of higher histological grade.

CLINICAL RELEVANCE/APPLICATION
The presence of an ultrasound correlate for a suspicious breast MRI lesion may indicate a more aggressive cancer.

Phillip B Shaffer MD (Presenter)
PURPOSE
Investigate the US appearance of regions with positive MR scans later proven to be cancer.

METHOD AND MATERIALS
In our experience of 373 total MR directed biopsies, 33 patients were found who 1) had suspicious areas discovered on an MR and 2) had a second look US that was negative and 3) subsequently had a malignant diagnosis as a result of MR biopsy. This patient group is interesting because they were examined with prior knowledge of the precise locality of a suspicious lesion; nevertheless, the ultrasound was negative.

RESULTS
Of the 33 patients, 13 had a final diagnosis of DCIS, MR imaging size range 0.6 to 5.4 cm. 15 had a final diagnosis of invasive ductal carcinoma (IDC), MR imaging size range 0.7 to 12.0 cm. 4 had a final diagnosis of invasive lobular carcinoma (ILC), MR imaging size range 0.6 to 8.4 cm. There was one adenoid cystic carcinoma of 1.0 cm. On US examination by dedicated breast sonographers and experienced radiologists the pattern seen was judged to be not sufficiently suspicious to be certain of correlation with the MR. These were regarded as “negative” US exams. The pattern present on the ultrasound was closely examined in 30 patients (3 sets of images were not available), and divided by appearance into two groups: Group QP: which were in retrospect Questionably Positive, and Group B: Benign. In Group QP, two distinct patterns were observed: low echogenicity area (6 patients) and shadow without mass (8 patients). In Group B, three distinct patterns were seen: Normal tissue (7 pts), Heterogeneous without mass (4 pts), and small mass with benign characteristics (5 pts). When segregated by histology, the following was observed: IDC: Group QP- 10 pts Group B- 4 pts ILC: Group QP- 2 pts Group B- 2 pts DCIS: Group Q2-2 pts Group B-10 pts.

CONCLUSION
Even when positive MR images direct the radiologist precisely to the area of high suspicion for malignancy, thus eliminating search errors, those malignancies may remain subtle or totally undetectable by the usual US criteria, even for tumors up to 12 cm in size. The ultrasonographic tissue characteristics of these tumors are simply indistinguishable from that of normal breast.

CLINICAL RELEVANCE/APPLICATION
Many breast cancers are unrecognizable on ultrasound. Even a totally normal ultrasound does not rule out breast malignancy.

SSM02-04  Breast MRI as a Problem-solving Tool in the Evaluation of Mammographically and Ultrasonographically Detected Architectural Distortions: Are There Any Predictive Parameters?
Rubina Noemi Cavallin (Presenter); Claudio Losio MD; Marta Maria Panzeri; Elena Venturini MD; Giulia Cristel MD; Alessandro Del Maschio MD
PURPOSE
Despite accounting for only 3% of mammographically detected findings, architectural distortion (AD) may be caused by a wide range of benign and malignant breast lesions, and it is the 3rd most common presentation of non-palpable breast cancer. Because of its indefinite mammographic and ultrasonographic features, percutaneous or surgical biopsy is mandatory.

In our study we evaluated the potential role of dynamic Breast MRI including diffusion-weighted imaging (DWI) as a problem-solving tool in mammographically and ultrasonographically detected AD

METHOD AND MATERIALS
Out of 232 patients undergoing MRI for problem solving, 34 were examined for a mammographic or ultrasonographic AD. MRI (1.5T) included T2-TSE sequences, dynamic study and DWI (b-values: 0, 900 s/mm2). For each lesion detected we evaluated morphology, dynamic and diffusion patterns and final histopathological result. A cut-off ADC value differentiating benign from malignant breast lesions had been previously established in a large population of women. The difference between the mean Apparent Diffusion Coefficient (ADC) values and the mean T2 signal in malignant and benign findings was evaluated with Mann-Whitney U test. Univariate and multivariate analyses of ADC values, T2 signal and time-enhancement curves (T-Ec) were performed for prediction of malignancy.

RESULTS
MRI confirmed all 38 known findings. At histopathology 25 lesions were benign and 13 malignant. The most represented T-Ec in malignant AD were type 3 (n=7) and 2 (n=3), while no benign lesions showed a washout kinetic. Univariate and multivariate analysis showed that T-Ec were significant predictors of malignancy (p=0.014).

CONCLUSION
Time-enhancement curves were the most predictive MRI feature to distinguish benign from malignant AD. The contribution of DWI to their differential diagnosis is limited due to ADC borderline values. MRI low negative predictive value, however, suggests to avoid MRI to strengthen the diagnosis after a benign core biopsy.

CLINICAL RELEVANCE/APPLICATION
MRI could not replace breast biopsy to confirm the nature of architectural distortions.

SSM02-05  Evaluation with Digital Mammography (DM), DM Combined with Digital Breast Tomosynthesis (DBT), Ultrasound (US) and Dynamic Breast MRI of Pathological Response after Neoadjuvant Chemotherapy (NC) Treatment of Breast Carcinoma
Giovanna Marisotti; Manuela Durando (Presenter); Pier Paolo Campanino; Maddalena Rigo; Elisa Regini; Mattia Robella; Laura Bergamasco; Paolo Fonio; Giovanni Gandini MD
PURPOSE
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To evaluate the accuracy of DM, DM combined with DBT, US and MRI in predicting residual tumour size and pathological response after NC for locally advanced breast cancer.

**METHOD AND MATERIALS**

44 patients (mean age 49.2 years; range 31-71) with locally advanced breast cancer who underwent NC were enrolled in the study. We retrospectively evaluated size and response of tumours to NC by DM, DM combined with DBT, US and MRI before, during and at the end of treatment. We assumed as gold standard the tumour size measured at pathology. Patients were divided into responders (with pathologic complete (pCR) or partial response (pPR)) and non-responders (NR). Measurements were considered concordant if they were ±10 mm. Tumor size assessments were statistically analyzed with paired t-test, regression line and Pearson’s linear correlation coefficient and Bland-Altman Plots; categorical variables were arranged in contingency tables and analyzed with chi square test or Fisher’s test; 95% Confidence Intervals were estimated for all percentages.

**RESULTS**

For pCR patients (16/44), size estimates by all modalities showed an exponential decrease during treatment time (r=0.9; p=0.005). The size agreement with pathology was 29 (95%CI 10-55)% for US, 36 (14-62)% for DM, 33 (12-62)% for DM+DBT, 54 (27-79)% for MRI. For pPR patients (18/44), size estimates by imaging showed a linear decrease during treatment (r=0.9; p=0.008). The size agreement was 69 (41-86)% for US, 54 (27-79)% for DM, 70 (38-92)% for DM+DBT, 87 (62-98)% for MRI. For NRs (10/44), US, DM and DM+DBT overestimated tumour size, while MRI measurements agreed with pathology. For the responders, the agreement between pCR predictions at mid-treatment and pathological responses was 71 (0.4-90.5)% for both US and DM, 11.1 (15.7-65.9)% for DM+DBT, 38.5 (15.7-65.9)% for MRI; pPR prediction was 54.5 (25.9-81)% for US, DM and DM+DBT, 84.6 (57.8-97.3)% for MRI. NR prediction at mid-treatment was 80 (47-99)% for US, 80 (33-98)% for DM, 82 (47-99)% for DM+DBT, 86 (47-99)% for MRI.

**CONCLUSION**

Predictions of residual and response tumour size made on MRI showed a better agreement with pathology than DM, DM+DBT, US. DBT in addition to DM improved conventional imaging in pPR and NR predictions.

**CLINICAL RELEVANCE/APPLICATION**

Breast MRI can be considered the most reliable imaging modality for pathological response evaluation after neoadjuvant chemotherapy, but the addition of DBT improves conventional imaging performances.

**SSM02-06 • Analysis of the Influence of Surrounding Fat Tissue in the Detection Rate of Ultrasound and Digital Breast Tomosynthesis after Normal Mammography**

**Pedro Slon** MD ; **Jon Etxano** MD (Presenter) ; **Maria Paramo Alfaro** MD ; **Romina Zalazar** MD ; **Arlette Elizalde** MD ; **Luis Pina** MD, PhD ; **Fernando Martinez Regueira** ; **Natalia Rodriguez-Spiteri**

**PURPOSE**

To assess the features of the tissue surrounding the additional detected cancers by US and DBT after normal Mammography.

**METHOD AND MATERIALS**

We retrospectively analyzed 75 histologically confirmed tumors in 55 patients (13 ductal carcinomas in situ and 62 invasive carcinomas). All the patients underwent Digital Mammography, US and Tomosynthesis. The tumors were classified in four categories according to the amount of peritumoral fat (I = >75%, II = 50-75%, III = 25-75% and IV = Gold Standard) was established with histological study obtained after surgery. The detection rate of additional tumors by US and DBT was compared regarding to the percentage of peritumoral fat using the McNemar test (SPSS, 15.0).

**RESULTS**

Out of the 75 tumors, DM detected 42 (56%) and 33 (44%) were detected by additional techniques. The number of additional tumors detected by US was 14 (+18.6%) and by DBT was 17 (+22.6%). Out of these additional tumors, 7 (9.3%) were only detected by US, 4 (5.3%) only detected by DBT and 10 (13.3%) were detected by both. The remaining 9 tumors were diagnosed with second look US after presurgical MRI. All of the additional tumors were invasive carcinomas. We did not find statistical differences between both techniques in Group I (US = 2, DBT = 2; p=1.00), Group II (US = 5, DBT = 8; p=0.375) and Group III (US = 3, DBT = 2; p=1.00). In Group IV (US=7, DBT=2; p=0.06) we found a trend to statistical significance, with 5 tumors detected on US and missed on DBT and no additional tumors diagnosed by DBT not detected by US.

**CONCLUSION**

Both US and DBT present similar results in the detection of additional breast cancers when they are predominantly surrounded by fat (more than 25%). However, we found that in tumors with less than 25% of peritumoral fat, US seems to be more sensitive than DBT.

**CLINICAL RELEVANCE/APPLICATION**

This study supports that US seems to be better than DBT in the detection of tumors with a low quantity of surrounding fat, i.e, in dense breast (ACR density pattern IV).

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**Cardiac (Experimental and Animal)**

**Wednesday, 03:00 PM - 04:00 PM • S502AB**

**SSM03-01 • Phase-contrast Computed Tomography of Coronary Atherosclerotic Plaque: Characterization of Plaque Components Based on Quantitative Phase-contrast Hounsfield Units**

**Holger Hetterich** MD (Presenter) ; **Marian Willner** MD ; **Christopher Habbel** MD ; **Julia Herzen** MD ; **Michael Chabior** MD ; **Fabian Bamberg** MD, MPH * ; **Franz Pfeiffer** MD ; **Maximilian F Reiser** MD ; **Tobias Saam** MD *

**PURPOSE**

Atherosclerotic plaque imaging by absorption-contrast computed tomography (ACT) is limited due to poor contrast in low absorbing materials like soft plaque. Phase-contrast CT (PCT) is an experimental technique relying on X-ray phase-shift rather than absorption, yielding a higher contrast in biological soft tissue. Phase-contrast Hounsfield units (HU-P) can be calculated in analogy to absorption-contrast HU (HU-A) using the refraction index. We hypothesized that plaque components including fibrous (Fib), lipid-rich (Lip) and calcified tissue (Cal) can be differentiated based on HU-P.

**METHOD AND MATERIALS**

Ten ex-vivo human coronary arteries were imaged at a laboratory-based set-up using a conventional X-ray tube (35kV) and grating-interferometer to obtain the phase- and absorption-signal simultaneously. Tomographic images were reconstructed with an effective pixel size of 100 μm and correlated with histopathology sections. In both ACT- and PCT-data, regions corresponding to Fib, Lip or
RESULTS
A total number of 276 cross-sections with 206 Fib, 113 Lip and 115 Cal containing regions were assessed. Fib, Lip and Cal were associated with significant different mean HU-P (57.5±9.3, 28.9±5.8 and 325.0±113.0; p<0.01) although there was no difference for Cal (p=0.72).

CONCLUSION
In an ex-vivo experimental set-up PCT can reliably differentiate important components of atherosclerotic coronary lesions based on quantitative HU-P, indicating its high potential for improved assessment of coronary artery disease.

CLINICAL RELEVANCE/APPLICATION
Phase-contrast computed tomography might improve characterization of coronary atherosclerotic plaque morphology compared to conventional absorption CT.

SSM03-02 • Non Contrast T2-mapping Detects Area at Risk in Acute Myocardial Ischemia Rats

Rui Xia (Presenter) ; Xi Lu ; Jichun Liao ; Jie Zheng PhD ; Fabao Gao MD, PhD

PURPOSE
To compare the area at risk in rats with myocardial infarction and reperfused myocardial ischemia with a T2-mapping method on 7.0T MR.

METHOD AND MATERIALS
Two groups(7 each group) of reperfused myocardial ischemia(MI30) and myocardial infarction(MI) rats were investigated. For MI30, the left anterior descending coronary artery was occluded for 30 minutes while MI was induced by permanent ligation of the left anterior descending coronary artery. MRI scans were taken at 24 hours after the occlusion. The T2-mapping was optimized on 7.0T MR(BRUKER BIOSPEC 70/30). Multiple single-slice turbo spin-echo T2-weighted images were acquired on the short axis slices during mid-diastolic phase and end-inspiratory period using both ECG and respiratory gating systems(TR/TE = 1500ms/10, 20, 30ms, MTX = 192×192, FOV = 50×50mm, slice thickness = 1.5mm). Then late gadolinium enhancement(LGE) imaging was performed by FISP(TR/TE = 5.2ms/1.8ms, FA = 25\(^°\), MTX = 256×256, FOV = 50×50mm, slice thickness =1.5mm) after an injection of Gd-DTPA. After MRI scan, rats hearts were cut into transverse slices for TTC staining.

The T2-maps were calculated using a custom-made software. Area at risk were defined as the difference between edema areas with high T2 values (> mean ± 2SD in remote normal tissue areas) and positive enhanced area in LGE images. The T2 values in edema regions were normalized by the T2 values in the remote normal tissue regions. All areas were expressed as a percentage of the whole myocardial tissue of left ventricle.

RESULTS
There was no significant difference between two groups (MI 1.62±0.27, MI30 1.59±0.16, p>0.05) in normalized mean T2 values of myocardial edema areas. The total size of infarction regions in MI(23.2±4.7%) was significantly higher than MI30(16.3±4.2%, p<0.05). No significant difference was found for the edema area (MI 26.9±4.4%, MI30 21.1±7.2%, p>0.05). No significant difference was found for the infarcted area defined by LGE and TTC staining for MI30(17.5±2 vs. 15.2±4, n=3, p>0.05) and MI(22.5±3 vs. 21.2±2, n=3, p<0.05).

CONCLUSION
After 30 min myocardial ischemia in rats, reperfusion can reduce myocardial infarction, but not area at risk and edema.

CLINICAL RELEVANCE/APPLICATION
Area at risk may not always be the target of therapy for patients who undergo reperfusion after acute myocardial infarction.

SSM03-03 • Beam Hardening Correction in Quantitative Myocardial CT Perfusion with Rapid kV Switching Dual Energy CT: A Validation Study with Microspheres

Aaron So PhD (Presenter) ; Jiang Hsieh PhD * ; Yasuhiro Imai MS * ; Jean-Baptiste Thibault ; Kelley Branch MD * ; Ting-Yim Lee MSc, PhD * ; Suresh Narayanan MS * ; Sandeep Dutta PhD *

PURPOSE
We validated the usefulness of beam hardening (BH) reduction with a rapid kV switching dual energy CT (DECT) protocol in quantitative myocardial perfusion (MP) imaging against microspheres measurement of MP.

METHOD AND MATERIALS
Normal pigs were scanned using a Discovery 750HD scanner (GE Healthcare (GE)) with a DECT protocol: 140/80 kilovolts (kV) alternating at 0.2 ms intervals, 640 mA and 0.35 s gantry period. In each study, 22 axial scans covering 40 mm of the heart were triggered under normal physiologic conditions every 1-2 heart beat at mid-diastole together with contrast injection contrast at 4 ml/s. Single energy CT (SECT) and DECT monochromatic 70 keV images were reconstructed with 140 kV and both 80 and 140 kV projections respectively. The DECT images were also corrected for BH using an image-based correction algorithm (iBHC). Each image set was analyzed using CT perfusion (GE) to derive MP functional maps. Fluorescent microspheres were injected into the left atrial appendage of the heart after the CT perfusion studies to measure MP. Mean MP in the lateral, apical and septal segments over 4 to 6 consecutive 5-mm-thick slices measured by microspheres and from the three CT image sets were compared using linear regression and Bland-Altman analysis. A total of 57 segments in 19 slices in four pigs were analyzed in this study.

RESULTS
DECT exhibited the highest correlation with microspheres (R=0.77) compared to SECT with (R=0.56) and without (R=0.49) iBHC. DECT also had the smallest difference in mean MP from microspheres (2.2 ml/min/100g) compared to SECT without iBHC (29.2). Despite a comparable mean difference from microspheres (~250 in remote normal tissue areas) and positive enhanced area in LGE images. The T2 values in edema regions were normalized by the T2 values in the remote normal tissue regions. All areas were expressed as a percentage of the whole myocardial tissue of left ventricle.

CONCLUSION
DECT provided better BH correction and the most accurate and smallest variation of MP measurements compared to microspheres MP gold standard. In SECT MP imaging, iBHC reduced the spatially inconsistent overestimation of MP in myocardial segments but did not outperform DECT.

CLINICAL RELEVANCE/APPLICATION
DECT minimizes beam hardening in contrast-enhanced cardiac images which leads to a more accurate MP measurement with CT Perfusion to facilitate reliable assessment of ischemic heart disease.

SSM03-04 • A Computational Algorithm for the Automated Detection of the Napkin-ring Sign: A High-risk Plaque Feature in Coronary CT Angiography

Christopher L Schlett MD, MPH (Presenter) ; Nabeel Ali BS ; Maros Ferencik MD ; Hans-Ulrich Kauczor MD * ; Udo Hoffmann MD

PURPOSE
To develop a fully automated computational algorithm which allows highly efficient, accurate and reproducible detection of the Napkin-Ring Sign (NRS), which has been validated as a highly specific marker for vulnerable plaque in coronary CT angiography (CCTA). NRS is characterized by a center of lower CT attenuation representing a lipid-rich/necrotic core in histology surrounded by a rim-like area of higher CT attenuation representing fibrous tissue (figure). So far, NRS detection is limited to a manual and time-intensive reading by CCTA experts.
METHOD AND MATERIALS
The algorithm was developed utilizing MATLAB (Mathworks, Natick, MA), which employs computational image-analysis techniques. A database of cross-sectional CCTA images of coronary arteries from ex-vivo human cadaver hearts co-registered with histology was used. Presence of NRS for each CCTA cross-section was evaluated by a manual reading of a CCTA expert. The vulnerable status of the plaques was confirmed based on the co-registered histology images. Images were randomly split into a training and validation sets, each containing 15 NRS-positive and 45 NRS-negative CCTA cross-sections. The algorithm was developed with iterative steps based on the training set and the performance of the algorithm was verified based on the validation sets.

RESULTS
The algorithm analyzes each cross-sectional image by establishing Line Density Profiles (LDP) at the lumen centre in fixed intervals of rotation. Based on the training set, the following decision rule was established. A LDP was positive if it had a bi-peak curve with its first peak (labelled as X) at a minimum of 0-100 Hounsfield Units (HU) and second peak (labelled as Y) >0 HU and Y>X regarding HU values. If 4 consecutive LPDs were positive, the algorithm considered the entire CCTA cross-section as NRS positive. Applying this algorithm in the validation set, the accuracy was 72% with 94% sensitivity and 67% specificity to detect NRS fully automated. Adjunct structures such as vessel branches led to a false-positive results.

CONCLUSION
We have developed a novel computational algorithm that automatically detects the presence of the NRS in cross-sectional coronary CTA images with a good accuracy.

CLINICAL RELEVANCE/APPLICATION
If our NRS algorithm is combined with vessel segmentation software, a routine detection of high-risk plaques should be feasible even in larger cohorts and a treatment possible before the event occurs.

SSM03-05 Cardiac Magnetic Resonance Elastography of the Right Ventricle in Canines with Congenital Pulmonary Valve Stenosis

Juliana S Da Silveira MD (Presenter) ; Brian A Scansen ; Peter Wassenaar MS * ; Brian Raterman ; Ning Jin * ; Richard D White MD ; John D Bonagura ; Arunark Kolipaka PhD

PURPOSE
To demonstrate the feasibility of quantitating right ventricular (RV) stiffness using cardiac magnetic resonance elastography (CMRE) and correlate it against RV thickness and mass in dogs with severe congenital pulmonary valve stenosis causing RV hypertrophy (RVH).

METHOD AND MATERIALS
RESULTS
Figure 1 shows a short-axis magnitude image (A), snap shots of wave propagation (B-E) and the corresponding stiffness map (F) with a mean RVFW stiffness value of 6.8kPa from one dog. Figure 2A shows poor inverse correlation between normalized RV mass and RVFW stiffness during ED (R2=0.05) and ES (R2=0.40). Figure 2B shows a poor inverse correlation between RVFW stiffness and thickness during ED (R2=0.19), but a good inverse correlation during ES (R2=0.81).

CONCLUSION
It is known that wall thickness has been used as a surrogate for estimating myocardial stiffness. However, our results do not show an increase in stiffness with an increase in wall thickness or mass; suggesting that thickness or mass do not reflect changes in the intrinsic mechanical property of the RV myocardium.

CLINICAL RELEVANCE/APPLICATION
CMRE is a noninvasive method to estimate myocardial stiffness and can potentially facilitate better understanding of the impact of RVH.

SSM03-06 Evaluating Myofibre Architecture of Rhesus Monkey with Myocardial Infarction Using DT-MRI

Yuqing Wang (Presenter) ; Lei Wang ; Rui Xia ; Fabao Gao MD, PhD

PURPOSE
For more accurately deducing and better understanding the microstructural progress of myocardial infarction in human being, we developed a rhesus monkey model of myocardial infarction for studying myocardial fibers on 7.0T MR.

METHOD AND MATERIALS
Infarction had been produced by permanent suture ligation of the left anterior descending coronary artery for 12 weeks. Both infarcted and healthy monkeys were sacrificed under deep surgical anesthesia with pentobarbital for excising heart. The excised heart was immediately perfusion-fixed by and stored in a 4% paraformaldehyde solution. All experiments were performed in accordance with regulations for the humane care of laboratory animals at Sichuan university. The diffusion tensor imaging (DTI) of each excised heart was performed on 7.0T MR (Bruker BioSpec 70/30, Germany). Each DTI dataset consisted of a single non-weighted and 30 diffusion-weighted 3D spin echo scans (TR/TE=12000/32ms, MTX=100×100, FOV=50×50mm, slice thickness=0.8mm) encoded in 30 gradient directions. The scan time for each DTI dataset was the same, approximately 20 hrs. All DTI datasets were analyzed to calculate the diffusion parameters such as fractional anisotropy (FA) and apparent diffusion coefficient (ADC) using Diffusion Toolkit package and the myocardial fiber tractography was performed by using Trackvis software.

RESULTS
The figure 1 A and B revealed respectively the myocardial fibers in healthy monkey and in infarcted monkey. In the infarcted heart, the decreased FA (0.2457) and increased ADC (0.00048) in infarcted area (red arrow) than in remote area (FA: 0.817; ADC: 0.00019) indicated damaged completeness of myocardial fibers in infarcted area. In contrast, the healthy heart revealed homogeneous FA and ADC in whole heart. Moreover, the myocardial fibers were intermittent (=2500 track/ml) in infarcted area but holonomic (=4977 track/ml) in remote area.

CONCLUSION
Higher similarity of fibers architecture with the ex-vivo human's heart made us to accurately deduce and interpret the human's myocardial infarction using infarcted monkey's hearts. To the best of our knowledge, this study is a first in monkeys for myocardial fiber imaging using 7.0T MR.

CLINICAL RELEVANCE/APPLICATION
The monkey model enable us to deduce and understand the human's myocardial infarction in more accurate manner.
VISUAL ASSESSMENT OF DIFFUSION MRI OF THE LIVER: DO WE NEED CONVENTIONAL SEQUENCES AND CONTRAST ENHANCED IMAGES IN EVERY CASE?

Vahid Yaghmai, MD

SSM08-01  •  The Activity Grade of Hepatitis Affects Liver Stiffness Measured Using MR Elastography

Tohomo Takamura (Presenter); Shintaro Ichikawa MD; Utaroh Motosugi MD; Katsuhiro Sano MD; Hiroyuki Morisaka MD; Tomoaki Ichikawa MD, PhD *

PURPOSE
To elucidate the relationship between activity grade of hepatitis and liver stiffness measured using MR elastography (MRE).

METHOD AND MATERIALS
This study included 123 patients who underwent liver biopsy or surgery less than 2 months after MRE. The histological fibrosis scores and activity grades were as follows: F1, n = 19 (A1 = 12, A2 = 7, and A3 = 0); F2, n = 40 (A1 = 19, A2 = 20, and A3 = 1); F3, n = 32 (A1 = 9, A2 = 16, and A3 = 7); and F4, n = 32 (A1 = 6, A2 = 17, and A3 = 9). MRE was performed using 1.5T or 3T (Signa EXCITE HD or Discovery 750; GE Healthcare) scanners to measure liver stiffness in kipascals (kPa). Stepwise multiple linear regression modeling was performed using the following variables as potential indicators: age, gender, body mass index (BMI), international normalized ratio of prothrombin time (PT-INR), platelet count, and METAVIR F score. Multiple linear regressions included variables maximizing the adjusted $R^2$ in each stepwise regression to identify significant independent explanatory factors for liver stiffness and to delineate any inflammatory effects on liver stiffness after adjusting for nothing (model 1), alanine aminotransferase/upper limit of normal (ALTmeas/31 IU/L) categories (model 2), and METAVIR A grades (model 3).

RESULTS
After adjusting for activity grade or ALT/ULN, the platelet count and METAVIR F score were found to be strongly associated with liver stiffness. The $R^2$ value of model 3 (0.7390) was higher than those of model 1 (0.6821) and 2 (0.6852), indicating that activity grade correlates with liver stiffness.

CONCLUSION
While staging liver fibrosis using MRE, it is important to remember that the activity grade of hepatitis can affect liver stiffness measurement independently of the degree of fibrosis.

CLINICAL RELEVANCE/APPLICATION
Although liver stiffness measurement using MRE is useful for staging liver fibrosis, we should be aware that the activity grade of hepatitis can be a confounding factor in stiffness measurement.

SSM08-02  •  Usefulness of Shear Wave Elastography (SWE) to Differentiate in Diffuse Hepatic Diseases

Min Yeong Kim MD (Presenter); Yong-Soo Kim MD, PhD; Woo Kyoung Jeong MD; Soon-Young Song; Byung-Hee Koh MD; On-Koo Cho MD, PhD

PURPOSE
To evaluate the values of liver stiffness (LS) measured by Supersonic shear wave elastography (SWE) in diffuse hepatic parenchymal abnormalities and to find the difference according to severity and kinds of liver diseases.

METHOD AND MATERIALS
Of 663 patients who underwent ultrasonography coupled with SWE, normal group (n=24) was defined as the person without any clinical evidence of underlying cause and normal laboratory and ultrasonographic features. Diffuse liver disease groups consisted of as follows: 1)fatty liver disease (n=136), 2)acute hepatitis (n=9), 3)chronic hepatitis (n=240), 4)cirrhosis (n=254) and cause of diseases are classified as 1)viral infection (n=362), 2)alcohol (n=176), 3)others (n=125) by clinicopathologic settings. We compared mean values and standard deviation (SD) provided by SWE and calculated median values.

RESULTS
Mean values of LS as follows: normal, 6.19±1.83kPa; fatty liver disease, 7.88±5.96kPa; acute hepatitis, 12.66±6.31kPa; chronic hepatitis, 8.47±4.57kPa; cirrhosis, 19.54±13.70kPa. There is significant difference of mean values and SD between cirrhosis and each other liver disease (p<0.01). According to causes of liver diseases, mean values of LS were significantly different: chronic hepatitis by virus, 8.04±4.01kPa; by alcohol, 12.60±11.56kPa (p<0.001).

CONCLUSION
LS values by SWE is significantly higher in cirrhosis than in other hepatic diseases and also affected by causes of chronic hepatic diseases. Degree of alcoholic liver disease cannot be possible by SWE.

CLINICAL RELEVANCE/APPLICATION
SWE could help to distinguish cirrhosis from diffuse liver diseases. In chronic hepatic diseases, the measured values by SWE have to be adjusted according to causes such as virus and alcohol.

SSM08-03  •  Visual Assessment of Diffusion MRI of the Liver: Do We Need Conventional Sequences and Contrast Enhanced Images in Every Case?

Veyssel Akgun MD (Presenter); Murat Kocaoglu MD; Bilal Battal; Yalcin Bozkurt; Mustafa Tasar MD

PURPOSE
The aim of this study is to assess the value of visual assessment of DWIs and ADC maps in determining hemangiomas and simple cysts without additional sequences and contrast medium administration and its capability in exclusion of malignancy.

METHOD AND MATERIALS
283 focal liver lesions (FLL) (69 malign, 214 benign) in 130 patients (74 men, 56 women, mean age 50.7, age range 15 to 80 years) that were detected in ultrasonography or computed tomography underwent MR and diffusion weighted imaging with non breath-hold single-shot echo-planar spin echo sequences. Most of the benign FLLs were cysts (n=89, 38.7%) and hemangiomas (n=96, 41.7%). The lesions that were hyperintense in all sequences and the lesions that were hyperintense on diffusion weighted images (DWI) with low b value and ADC maps and hypointense on DWIs with high b value were noted as hemangiomas and simple cysts, respectively. The signal intensities of the FLLs on DWIs with low and high b values and ADC maps were noted by two radiologists blinded to the pathological and radiological diagnoses in consensus. All FLLs were classified according to pathological diagnoses or radiologic follow-up. Then we formed a cross table to determine sensitivity, specificity, positive and negative predictive values for characterization of the simple cysts and hemangiomas and for exclusion of malignancy.

RESULTS
The sensitivity and specificity were 98.6% and 99.5%, respectively. The positive predictive value was 98.6% and negative predictive value was 98.6% for the visual assessment of the DWIs and ADC maps for the characterization of the hemangiomas and simple cysts and in exclusion of malignancy for these 185 FLLs.

CONCLUSION
Visual assessment of DWIs and ADC maps can be useful in characterization of the hemangiomas and simple cysts, and in exclusion of malignancy without additional sequences and contrast medium administration. As a consequence, this technique can decrease study time and cost.

CLINICAL RELEVANCE/APPLICATION
By using DWIs and ADC maps we can characterize most of the hemangiomas and simple cysts and exclude malignancy without additional sequences and contrast medium administration.
PURPOSE
To clarify the relationship between biological behavior of hepatocellular carcinomas (HCCs) and signal intensity in the hepatobiliary phase of gadoxetic acid-enhanced MR imaging with a special focus on its heterogeneity.

METHODOLOGY AND MATERIALS
A total of 68 patients with 70 pathologically proved HCCs who underwent gadoxetic acid-enhanced MR imaging prior to surgery were enrolled. Based on the signal intensity in the hepatobiliary phase, lesions were classified as homogeneously hypointense (n=44), heterogeneously hyperintense (n=20) and homogeneously hyperintense (n=6) groups. Comparing with the signal intensity of the background liver, the clinicopathological findings were compared among these groups. The Kaplan-Meier method was performed with the log-rank test and Cox proportional hazards model.

RESULTS
The tumor size and serum level of PIVKA-II were significantly higher in heterogeneously hyperintense group than homogeneously hyperintense (P=0.0155 and P=0.0215) and hyperintense (P=0.0330 and P=0.0220) groups. In univariate analysis, heterogeneous hyperintense group showed lower disease-free survival rates than homogeneously hypointense group (P=0.0125). Multivariate analysis, heterogeneous hyperintensity in the hepatobiliary phase of gadoxetic acid-enhanced MR imaging was an independent prognostic factor for disease-free survival (P=0.0308).

CONCLUSION
Heterogeneously hyperintense HCCs in the hepatobiliary phase of gadoxetic acid-enhanced MR imaging have more malignant potential than other HCCs.

CLINICAL RELEVANCE/APPLICATION
Our study suggests that heterogenous hyperintensity in the hepatobiliary phase of gadoxetic acid-enhanced MR imaging is a new imaging biomarker to indicate malignant potential of HCCs.

SSM08-05  Intrahepatic Mass Forming Cholangiocarcinomas (IMCC): Utility of Feature Analysis for Differentiation from Other Intrahepatic Mass Lesions

Laura Heacock MS, MD (Presenter); Andrew B Rosenkrantz MD; Sooah Kim MD; Nicole M Hindman MD

PURPOSE
To evaluate the imaging features of intrahepatic mass-forming cholangiocarcinomas (IMCCs) at contrast-enhanced dynamic CT and MRI, which allow for differentiation from other common intrahepatic tumors.

METHODOLOGY AND MATERIALS
Study was IRB approved with waiver of informed consent. 41 patients with 41 pathologically confirmed IMCCs underwent dynamic contrast-enhanced CT or MRI. Size-matched lesions of pathological proven hepatocellular carcinoma (HCCs, n=36), isolated hepatic metastases (n=43), liver abscesses (n=39) and imaging proven (stability over >2 years) hemangiomas (n=42) were evaluated. Two blinded readers (R1, R2) retrospectively assessed all lesions for morphologic and enhancement features and assigned a diagnosis from the tumor types included. Features analyzed were: heterogeneous rod-like internal enhancement, a peripheral complete rim of enhancement, progressive delayed central enhancement, portal vein thrombosis, or biliary dilatation proximal to the mass. Imaging feature frequencies were compared between lesion types.

RESULTS
Readers correctly identified 51.2% of IMCCs, 86.9% of hemangiomas, 87.5% HCCs, 77.4% metastases and 83.4% of abscesses. The most frequently seen imaging features in IMCC were biliary dilatation proximal to the mass (R1: 53.7%; R2: 61%) and portal vein thrombus (R1: 46.3%; R2: 46.3%); these features were present significantly more frequently in IMCCs than other lesions (p<0.0125). In univariate analysis, heterogeneous hyperintensity group showed lower disease-free survival rates than other hyperintense group (p=0.0330). In multivariate analysis, heterogeneous internal enhancement was an independent prognostic factor for disease-free survival (p=0.0308).

CONCLUSION
Heterogeneous enhancement in the hepatobiliary phase of gadoxetic acid-enhanced MR imaging allows for differentiation from other common intrahepatic tumors.

CLINICAL RELEVANCE/APPLICATION
The presence of portal vein thrombosis, proximal biliary dilatation and heterogeneity of enhancement in IMCCs and may be particularly useful in cirrhotic patients, for whom other focal hepatic lesions are less likely.

SSM08-06  Liver Remnant Regeneration in Donors after Living Donor Liver Transplantation: Long-term Follow-up Using CT and MR Imaging

Andreas Koops MD (Presenter); Philipp Simon MD; Harald Ittrich MD; Lutz Fischer; Thorsten Klink MD; Gerhard B Adam MD

PURPOSE
To assess liver remnant volume regeneration and maintenance, and complications in long-time follow-up of donors after living donor liver transplantation using CT and MRI.

METHODOLOGY AND MATERIALS
47 patients with a mean age of 33.5 years who donated liver tissue for transplantation and were available for follow-up imaging were included in this retrospective study. Contrast-enhanced CT and MR images were acquired according to standardized protocols of the upper abdomen. Two observers evaluated pre- and postoperative images, analyzed liver volume regeneration, and documented postoperative complications.

RESULTS
47 preoperative and 89 follow-up studies covered a mean period of 22.4 months (range, 1-84). Right liver lobe (segments V-VIII) was transplanted in 18 cases, left liver donation of segment II and III was performed in 24 cases, and of segments II-IV in 5 cases. Liver remnants regenerated rapidly within the first 6 months. After 36 months, the remnant volume was significantly reduced compared to the preoperative liver volume (p<0.0215), and improved at a minimum of 80% in most patients. Minor postoperative complications were found early in 4 patients. No severe or late complications or mortality occurred.

CONCLUSION
Remaining liver volume regenerated rapidly in all donors, and was restored and maintained in most patients despite minor complications. No severe or late complications occurred during long-term follow-up.

CLINICAL RELEVANCE/APPLICATION
CT and MRI are valuable tools in the follow-up of donors after live liver transplantation.
PURPOSE

Ultrasound TE (UTE) MRI and compressive elastography (CE) have the potential to identify subtle tendon pathology before conventional MRI and ultrasound (US). Our purpose was to determine if UTE and CE would overestimate collagen disorganization and lead to false positive imaging.

METHOD AND MATERIALS

A pilot study utilizing five fresh-frozen human cadaveric legs was performed (mean age 71.4 years, range 65-76 years). Each specimen underwent conventional 3T MRI, UTE 3T MRI, conventional US, and CE at five standardized levels along the Achilles tendons.

Conversely, with subtalor coalitions, a 50% area threshold is used to decide between surgical arthrodesis and coalition resection. We tested if 3D printing is an emerging technology that can be used to generate physical models of 3D images. It has promise for treatment planning as well as patient education. The purpose of this paper is to explore its use in the preoperative phase for subtalar coalitions. In patients with subtalar coalitions, a 50% area threshold is used to decide between surgical arthrodesis and coalition resection. We tested if 3D printing may play a supplementary role in diagnosis, treatment planning, and patient education. The purpose of this paper is to explore its use in the preoperative phase for subtalar coalitions.

RESULTS

All five Achilles tendon specimens demonstrated normal imaging and quantitative characteristics at all five levels on conventional MRI, UTE MRI, conventional US, and CE without abnormal results from either UTE or CE. Sonoeastography strain ratios demonstrated an average mean strain ratio of 0.14 (range 0.13-0.18), and a mean T2* value of 7ms (range 5.98ms). No evidence of tendinosis was identified at gross pathologic or histologic examination.

CONCLUSION

Conventional MRI, UTE MRI, conventional US and CE did not overestimate disease in this sample of specimens without pathology.

RESULTS

When imaging diagnosis of ATIFL injury was based on routine MR images only, the diagnosis was made with a sensitivity of 40%, and a specificity of 60-67%. With additional oblique MR imaging planes, the sensitivity and specificity increased up to 90% and 60-80%, respectively. Area under the curve (AUC) values showed significant difference (p < 0.05). The interobserver agreement regarding injury of the ATIFL and ATFL was good to excellent in both the routine and additional oblique imaging planes (κ = 0.66-0.88) except in evaluation of the ATFL and ATFL were good to excellent in both the routine and additional oblique imaging planes (κ = 0.66-0.88).
Whole Brain Volume as a Risk Factor for Post Lumbar Puncture Headache Requiring Blood Patch

Phillip J Hsu (Presenter); Tammie S Benzinger MD, PhD *; Shengmei Ma MS; Chengjie Xiong PhD, MS; John Morris *; Marcus E Raichle MD; Anne Fagan PhD; Russell Hornbeck MSc; Virginia Buckles PhD

PURPOSE
Post lumbar puncture headache (PLPH) is a common complication of lumbar puncture (LP) and is characterized by orthostatic headache that worsens when a patient moves from a supine to upright position. Blood patch, the injection of autologous blood near the puncture site, is the standard treatment of lasting PLPH. Though the exact cause of PLPH is uncertain, hypothesized causes include downward pull on pain-sensitive structures in the brain due to cerebrospinal fluid (CSF) leakage through the post-puncture opening. This study investigates whether whole brain volume affects risk of positional PLPH requiring blood patch (BPHA).

METHOD AND MATERIALS
Community-dwelling volunteers enrolled in prospective studies of memory and aging (n = 661) aged 43 to 91 years received LPs, 373 of which also received MRI scans for brain volume. Whole brain volume was calculating using FreeSurfer and normalized to intracranial volume (ICV). Logistic regression was used to determine effects of risk factors age, gender, and whole brain volume on risk of severe

SSM13-05 • Magnetic Resonance Microscopy of the Tendons, Pulleys, and Plantar Plates of the Toes at 11.7T

Paul A DiCamillo MD, PhD (Presenter); Sheronda Statum; Christine B Chung MD; Graeme M Bydder MBChB *

PURPOSE
The purpose of this study was to investigate possible biochemical alterations of tendons and cartilage caused by diabetes mellitus (DM) Type 1 using quantitative in vivo sodium imaging at 7 Tesla.

METHOD AND MATERIALS
Eight patients (4f/4m, mean age 43a, SD 16.9a) with established diagnosis of DM Type 1 and no history of knee trauma were examined on a 7 Tesla whole body MR with a dedicated knee coil and compared with nine healthy volunteers. Controls were age and weight matched (3f/6m, mean age 40a, SD 17.2a). In all patients and volunteers axial, sagittal and coronal proton-density sequences were obtained for morphological diagnosis and localization of anatomical sites for Region of interest (ROI) analysis. For sodium imaging a matched (3f/6m, mean age 40a, SD 17.2a). In all patients and volunteers axial, sagittal and coronal proton-density sequences were obtained for morphological diagnosis and localization of anatomical sites for Region of interest (ROI) analysis.

RESULTS
Unprecedented spatial resolution and contrast was achieved, with over 20 times greater spatial resolution than previous reported in anatomic studies using clinical systems. Our acquisitions parameters reversed the typical contrast pattern of previous non-fat saturated studies. Tendons, pulleys, and plates had a high signal relative to the saturated fat. Flexor tendons, extensor apparatus, annular and cruciate pulleys as well as the fiber structure within the plates were well seen.

CONCLUSION
Use of a high performance 11.7T system allow detailed anatomic imaging of the tendons, pulleys and plates of the toes at a level that has not previously been described. These results are likely to help in the recognition of injury and disease of the tendons, pulleys and plates of the toes as stronger field strengths become clinically available.

CLINICAL RELEVANCE/APPLICATION
High resolution 11.7T anatomic images of the tendons, pulleys and plates of the toes were acquired. These results may indicate what will be achievable on higher field clinical systems.

SSM13-06 • Early Detection of Tendinopathy and Chondropathy in Patients with Diabetes Mellitus Type I by Means of Quantitative Sodium Imaging at 7 Tesla MRI

Wolfgang Marik MD (Presenter); Veronika Schopf; Stefan Zbyn; Manuela Karner; Bernhard Ludvik MD; Siegfried Trattning MD

PURPOSE
The purpose of this study was to investigate possible biochemical alterations of tendons and cartilage caused by diabetes mellitus (DM) Type 1 using quantitative in vivo sodium imaging at 7 Tesla.

METHOD AND MATERIALS
Eight patients (4f/4m, mean age 43a, SD 16.9a) with established diagnosis of DM Type 1 and no history of knee trauma were examined on a 7 Tesla whole body MR with a dedicated knee coil and compared with nine healthy volunteers. Controls were age and weight matched (3f/6m, mean age 40a, SD 17.2a). In all patients and volunteers axial, sagittal and coronal proton-density sequences were obtained for morphological diagnosis and localization of anatomical sites for Region of interest (ROI) analysis. For sodium imaging a matched (3f/6m, mean age 40a, SD 17.2a). In all patients and volunteers axial, sagittal and coronal proton-density sequences were obtained for morphological diagnosis and localization of anatomical sites for Region of interest (ROI) analysis.

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CONCLUSION
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CLINICAL RELEVANCE/APPLICATION
High resolution 11.7T anatomic images of the tendons, pulleys and plates of the toes were acquired. These results may indicate what will be achievable on higher field clinical systems.

SSM13-07 • Quantitative Sodium Imaging at 7 Tesla MRI

William G Bradley MD, PhD

PURPOSE
Quantitative sodium imaging due to its higher sensitivity compared to morphological imaging may improve early detection of tendinopathy and chondropathy in patients suffering from Diabetes mellitus Type 1.

METHOD AND MATERIALS
Eight patients (4f/4m, mean age 43a, SD 16.9a) with established diagnosis of DM Type 1 and no history of knee trauma were examined on a 7 Tesla whole body MR with a dedicated knee coil and compared with nine healthy volunteers. Controls were age and weight matched (3f/6m, mean age 40a, SD 17.2a). In all patients and volunteers axial, sagittal and coronal proton-density sequences were obtained for morphological diagnosis and localization of anatomical sites for Region of interest (ROI) analysis. For sodium imaging a matched (3f/6m, mean age 40a, SD 17.2a). In all patients and volunteers axial, sagittal and coronal proton-density sequences were obtained for morphological diagnosis and localization of anatomical sites for Region of interest (ROI) analysis.

RESULTS
Unprecedented spatial resolution and contrast was achieved, with over 20 times greater spatial resolution than previous reported in anatomic studies using clinical systems. Our acquisitions parameters reversed the typical contrast pattern of previous non-fat saturated studies. Tendons, pulleys, and plates had a high signal relative to the saturated fat. Flexor tendons, extensor apparatus, annular and cruciate pulleys as well as the fiber structure within the plates were well seen.

CONCLUSION
Use of a high performance 11.7T system allow detailed anatomic imaging of the tendons, pulleys and plates of the toes at a level that has not previously been described. These results are likely to help in the recognition of injury and disease of the tendons, pulleys and plates of the toes as stronger field strengths become clinically available.

CLINICAL RELEVANCE/APPLICATION
High resolution 11.7T anatomic images of the tendons, pulleys and plates of the toes were acquired. These results may indicate what will be achievable on higher field clinical systems.

Neuroradiology (Hydrocephalus and Intracranial Hypotension)

Wednesday, 03:00 PM - 04:00 PM • N226

SSM14 • AMA PRA Category 1 Credit ™:1 • ARRT Category A+ Credit:1

Moderator
William G Bradley, MD, PhD

SSM14-01 • Whole Brain Volume as a Risk Factor for Post Lumbar Puncture Headache Requiring Blood Patch

Phillip J Hsu (Presenter); Tammie S Benzinger MD, PhD *; Shengmei Ma MS; Chengjie Xiong PhD, MS; John Morris *; Marcus E Raichle MD; Anne Fagan PhD; Russell Hornbeck MSc; Virginia Buckles PhD

PURPOSE
Post lumbar puncture headache (PLPH) is a common complication of lumbar puncture (LP) and is characterized by orthostatic headache that worsens when a patient moves from a supine to upright position. Blood patch, the injection of autologous blood near the puncture site, is the standard treatment of lasting PLPH. Though the exact cause of PLPH is uncertain, hypothesized causes include downward pull on pain-sensitive structures in the brain due to cerebrospinal fluid (CSF) leakage through the post-puncture opening. This study investigates whether whole brain volume affects risk of positional PLPH requiring blood patch (BPHA).

METHOD AND MATERIALS
Community-dwelling volunteers enrolled in prospective studies of memory and aging (n = 661) aged 43 to 91 years received LPs, 373 of which also received MRI scans for brain volume. Whole brain volume was calculating using FreeSurfer and normalized to intracranial volume (ICV). Logistic regression was used to determine effects of risk factors age, gender, and whole brain volume on risk of severe
RESULTS
Of the 661 unique participants (285 male), 28 (5 male) experienced BPHA. As shown in previous studies, young age (p < 0.05). Inter-observer agreement was almost perfect for TSE T2 and 3D-T2SPACE (kappa > 0.81).

CONCLUSION
Many neuroradiologists only partially conform to standard guidelines designed to prevent iatrogenic meningitis and spinal headache. Approximately half of the respondents do not wear facemasks during dural puncture, placing patients at risk for iatrogenic meningitis. Only 26% of neuroradiologists use atrumatic needles which have been shown to reduce dural leak. Only 16% of neuroradiologists prescribe immediate post-procedure mobilization which has been shown to decrease the incidence of spinal headaches and the length of required post-procedure monitoring.

CLINICAL RELEVANCE/APPLICATION
Use of facemasks and atrumatic needles in conjunction with immediate post-procedure mobilization reduce the risk of iatrogenic bacterial meningitis and spinal headache.

SSM14-03 • Functional Imaging Using 3D High-sampling-Efficiency Technique (SPACE) versus Conventional CSF Flow Techniques in Patient with Hydrocephalus at 3 Tesla

Murat Ucar (Presenter); Melike Guryildirim; Ali Yusuf Oner MD; Nil Tokgoz; Alp Borcek; Koray Kilic; Koray Akkan; Turgut E Tail MD *

PURPOSE
To evaluate the diagnostic accuracy of high spatial resolution three-dimensional magnetic resonance cerebrospinal fluid (CSF) flow with a high-sampling-efficiency technique (sampling perfection with application optimized contrasts using different flip angle evolutions [SPACE]) versus TSE T2 (2 mm section thickness without flow compensation) over detection of aqueductal patency (AP) in patient with hydrocephalus, using three-dimensional (3D) constructive interference in the steady state (CISS) and cine phase contrast (Cine PC) sequences as reference standard at 3 Tesla.

METHOD AND MATERIALS
68 patients with hydrocephalus who were suspected aqueductal stenosis and had 3.0T CSF flow MR imaging were included. In addition to routine sequences which consisted of sagittal TSE T2, 3D-CISS, and axial-sagittal cine PC, sagittal 3D-T2 SPACE was obtained to evaluate the cerebral aqueduct by two radiologists, independently. AP and visibility of flow void were scored on the TSE T2 and 3D-T2 SPACE on a 5-point scale and compared with cine PC as a reference standard of patency and 3D-CISS as a reference standard of image quality in terms of wall conspicuity, contrast, continuity, sharpness, and background homogeneity. The McNemar test was used to compare for statistical analysis. Inter-observer agreement was calculated using kappa statistics.

RESULTS
AP by 3D-T2 SPACE and TSE T2 were in agreement in all cases in 100% (65/65) and 85% (58/68), respectively and the sensitivity of 3D-T2 SPACE was equal to cine PC. Visibility of flow void in aqueduct and periaqueduct was significantly better with 3D-T2SPACE than TSE T2 (P < 0.05). Inter-observer agreement was almost perfect for TSE T2 and 3D-T2SPACE (kappa > 0.81).

CONCLUSION
3D-T2SPACE should be the method of choice as a stand-alone sequence for the evaluation of AP in hydrocephalus. Due to the high accuracy for physiologic information and the short -acquisition time with high resolution should be preferred to conventional TSE T2.

CLINICAL RELEVANCE/APPLICATION
Due to the high accuracy for physiologic information and the short -acquisition time with high resolution, 3D-T2SPACE should be preferred to conventional TSE T2 for aqueductal patency in hydrocephalus.

SSM14-05 • Measurement of Mean Axon Diameter of Posterior Limb of Internal Capsule in Patients with Idiopathic Normal Pressure Hydrocephalus before and after Lumboperitoneal Shunt

Masaaki Hori MD; Kouhei Kamiya MD (Presenter); Atsushi Nakanshi MD, PhD; Issei Fukunaga; Masakazu Miyajima; Michimasa Suzuki; Yuriko Suzuki BS *; Koji Kamagata; Mariko Yoshida; Hajime Arai; Shigeki Aoki MD

PURPOSE
Prospective estimation of mean axon diameter and extra-axonal space of the posterior limb of internal capsule (PLIC) in patients with idiopathic normal pressure hydrocephalus (NPH) before and after lumboperitoneal (LP) shunt by using q-space diffusion analysis.

METHOD AND MATERIALS
Thirteen patients with known idiopathic NPH underwent MRI with a 3.0-T MR system. Our q-space diffusion imaging method acquired data with 16 b values (from 0 to 15000 s/mm² by 1000-s/mm² steps). The diffusion gradient was applied perpendicular to the PLICs for every b value. Regions of interest were placed on the bilateral PLIC before and after LP shunt. Root mean square (RMS) displacement of diffusing water molecules in intra-axonal (= mean axonal diameter) and extra-axonal spaces could be defined by using low-q fitting.
RESULTS
In all patients, walking difficulties were ameliorated clinically after LP shunt. For all data, the low-q fits showed good agreement with the definition of low q-value (R2 > 0.96). The mean axonal diameter (µm) and RMS of extra-axonal space (µm) were 1.86±0.50 and 7.31±1.27 before LP shunt and 1.97±0.55, and 8.08±1.67, respectively (mean±SD), afterwards. The Wilcoxon signed-rank test with the Bonferroni correction was performed for statistical analysis because the Anderson-Darling test revealed that the data were not normally distributed. After LP shunt, the RMS of extra-axonal space increased significantly (p = 0.009). No significant change was observed in the mean axonal diameter before and after LP shunt.

CONCLUSION
Our results show that the relief of symptoms after LP shunt is due to the change in size of the extra-axonal space rather than the mean axonal diameter. NPH is a curable disease under appropriate therapy; therefore, little or no change in axonal morphology was expected. Estimates of the mean axonal diameter and extra-axonal space in the PLIC may show promise as biomarkers of microstructural changes in patients with NPH.

CLINICAL RELEVANCE/APPLICATION
Estimates of the mean axonal diameter and extra-axonal space in the PLIC may show promise as biomarkers for walking difficulties in patients with idiopathic NPH, before and after LP shunt.

SSM14-05 • Aqueductal Stroke Volume in iNPH Patients: Intracranial Pressure Monitoring Does Not Compare with Phase-contrast MRI

Geir Ringstad MD (Presenter); Kyrre E Emblem MSc, PhD; Noam Alperin PhD *; Per Kristian Eide MD, PhD

PURPOSE
The role of aqueductal stroke volume (ASV) in the diagnosis and management of idiopathic normal pressure hydrocephalus (iNPH) remains unclear (1). The aim of this study was to compare ASV from phase-contrast MRI with intracranial pressure (ICP) derived parameters.

METHOD AND MATERIALS
Twenty-one patients diagnosed with iNPH underwent 3 Tesla phase contrast MRI (PC-MRI) (Philips Achieva) with imaging parameters as follows; TR/TE=24ms/16ms, voxel size 0.60/0.80/4.00mm3, velocity encoding 10cm/s, retrospective gating, 30-40 phases. All exams were post-processed using the Philips Q-flow software and ASV was estimated after correction for potential aliasing. ASV = 40 µl was considered to be increased. After MRI, and during the same hospital admission, an ICP microsensor was placed 1 to 2 cm into the brain parenchyma and static (MeanP) and dynamic ICP (MWA) were continuously monitored. A clinical improvement in 9 of 10 patients with iNPH after ventriculoperitoneal shunting has been reported when MWA exceeds 4 mm Hg (2). Spearman correlation analysis between ASV and MWA, and between ASV and MeanP, were performed in SPSS 18.

RESULTS
Median ASV was 265 µl [range 47,923 µl], median MWA was 4.65 mm Hg [2.95,8.46 mm Hg], and median MeanP was 3.76 mm Hg [-4.45,10.38 mm Hg]. There were no significant correlations neither between ASV and MWA (R²=-0.14, p=0.54) nor ASV and MeanP (R²=-0.06, p=0.81). In all of the four patients with MWA below the 4 mm Hg threshold, and therefore not eligible for shunting, ASV values were pathologically increased (median 276 µl [79,844 µl]). In 17 patients with MWA = 4 mm Hg, median ASV was 221 µl [range 47, 828 µl].

CONCLUSION
There were no significant correlations between PC-MRI derived ASV and ICP, neither regarding static nor dynamic ICP values. Collectively, ASV in the iNPH patients was raised, but varied over a wide range in patients both eligible and non-eligible to shunting. The results do not support any ASV threshold value to select iNPH patients for shunting. References:


CLINICAL RELEVANCE/APPLICATION
To our knowledge, this is the first study to relate a PC-MRI derived parameter in iNPH to invasive ICP measurements. The results question the use of ASV as a shunt decision making parameter.

SSM14-06 • Effect of Spatial Resolution of T2WI on Diagnostic Efficacy of MR Imaging in Detection of Papilledema

Houman Sotoudeh MD (Presenter); Michyla L Bowerson MD; Ryan B Viets MD; Charles F Hildebolt DDS, PhD; Gregory Van Stavern; Aseem Sharma MBBS *

PURPOSE
To compare the diagnostic efficacy of high-resolution 3D-T2WI versus a conventional 2D-T2WI in detection of papilledema.

METHOD AND MATERIALS
In this retrospective study, axial T2WI from MR imaging of 25 patients with ophthalmologically proven papilledema and 66 controls were presented to two neuroradiologists, who interpreted these for presence of papilledema. All studies included conventional axial 2D T2WI (slice thickness 3-5 mm) and high-resolution axial 3D T2WI (slice thickness 0.7-1 mm), which were presented to the readers in a blinded and random fashion. Sensitivity, specificity, positive likelihood ratio, and negative likelihood ratio were calculated for each reader and for each technique. Assessment was done for all the eyes combined as well as for each side individually. The positive likelihood ratios for 2D and 3D techniques were compared using homogeneity of Odds-Ratio test. Interobserver variability was studied by calculating kappa, and using McNemar test.

RESULTS
For all eyes, the sensitivity, specificity, positive likelihood ratio, and the negative likelihood ratio for first reader were 56.3%, 85.8%, 3.97, and 0.51 for 2D T2WI, with the corresponding values of 83.3%, 93.3%, 12.4, and 0.18 respectively for 3D T2WI. The second reader achieved a sensitivity, specificity, positive likelihood ratio, and negative likelihood ratio of 54.2%, 94.0%, 9.07, and 0.49 respectively with 2D T2WI, and 87.5%, 91.0%, 9.77, and 0.14 respectively with 3D T2WI. The differences in positive likelihood ratio were statistically significant for first reader (p=0.0009), but not for the second (p=0.0793). A similar pattern was observed when results were analyzed for each eye individually.

Substantial interobserver agreement (kappa 0.617) with 2D T2WI improved to an almost perfect interobserver agreement with 3D T2WI (kappa 0.824). McNemar test for paired proportions showed a significant difference of 6.59% in the positive and negative interpretations of two readers using 2D T2WI (p=0.0227), while the corresponding difference of 2.75% difference for 3D T2WI was not significant (p=0.2668).

CONCLUSION
Higher spatial resolution offered by 3D T2WI translates into improved diagnostic efficacy and a higher interobserver agreement for detection of papilledema, when compared to 2D T2WI.

CLINICAL RELEVANCE/APPLICATION
High resolution 3D T2WI can improve the diagnostic efficacy of MR imaging for detection of papilledema.
Misregistration of Intra-abdominal and Intrapelvic Organs: Comparison between PET-CT and PET-MR

Pinakpani Roy MD (Presenter); Joseph K Lee MD; Arif Sheikh MD; Meagan Shepherd; Stacy Hengsterman; Yueh Z Lee MD, PhD *; Weili Lin PhD

PURPOSE
To quantify and compare organ misregistration between PET-CT data and PET-MR data obtained on a hybrid whole body PET-MR system.

METHOD AND MATERIALS
Biograph mMR consists of a 3.0T whole-body magnet with body coils optimized for minimal 511-keV photo attenuation. The PET detectors are made of lutetium oxyorthosilicate crystals in combination with MR-compatible avalanche photodiodes. PET-CT data were acquired using a Siemens Biograph mCT system. Approximately 1 hour after 18-FDG injection, the CT data was acquired, followed sequentially by PET acquisition. IRB approval and informed consent were obtained.

RESULTS
With respect to misregistration, there was no significant difference between simultaneously obtained PET-MR data (mean 0.50 cm) and PET-CT data (mean 0.48 cm), but sequentially acquired data (1.25 cm) showed significantly higher misregistration than PET-MR data (p=0.03). With respect to sequences, mean misregistration with T1 VIBE (mean 1.24 cm) was significantly (p=0.03) higher than with PET-CT (0.48 cm).

CONCLUSION
Comparing BMI matched subjects, sequentially obtained PET-MR data has significantly higher misregistration than PET-CT data.
Simultaneously obtained PET-MR data is non-inferior to PET-CT in that regard. Misregistration with T1 VIBE is significantly higher than with PET-CT.

CLINICAL RELEVANCE/APPLICATION
Simultaneously acquired PET-MR using T2 STIR sequence is comparable to PET-CT in terms of misregistration, which has diagnostic implications.

SSM17-04 • Preliminary Investigation of Composite Biomarkers in Simultaneous PET/MR: Relationship between SUV and ADC in Oncology Patients
Rajan Rakhjea MD, Hersh Chandarana MD *, Linda Demello, Kimberly Jackson, Christopher Glielmi PhD *; Kent P Friedman MD (Presenter)

PURPOSE
To assess the correlation between SUV and ADC of neoplastic lesions using a simultaneous PET/MR and to investigate the value of a composite biomarker, SUVmax/ADCmin.

METHOD AND MATERIALS
Twenty-four patients with known primary malignancies underwent FDG-PET/CT followed by PET/MR (Biograph mMR). Diffusion weighted imaging was acquired using a single shot spin echo EPI sequence with b-values of 0, 350 and 750 s/mm2. ROIs were manually drawn on PET/MR along the contours of neoplastic lesions larger than 1cm. SUVmax, SUVmean, ADCmin and ADCmean were recorded for each FDG-avid tumor with a maximum of 3 lesions per patient. Relationships between SUVmax and ADCmin, SUVmean and ADCmean, and SUVmax/liver mean versus ADCmin were assessed using Pearson’s correlation coefficient. A sub-analysis of patients with progressive disease (PD) and partial treatment response (PR) by RECIST 1.1 was performed using a ratio of SUVmax/ADCmin for the most metabolically active lesion.

RESULTS

CONCLUSION
Simultaneous PET/MR is a promising technology for detection of neoplastic disease. There is an inverse correlation between SUVmax and ADCmin and between SUVmax/liver ratio and ADCmin. Given that the correlation between both biomarkers is relatively weak, the authors hypothesize that SUV and ADC values may offer complimentary information to aid in determination of prognosis and treatment response. Preliminary results suggest that SUVmax/ADCmin may increase more rapidly than SUVmax in progressive disease, thus warranting further study of this ratio as a composite biomarker.

CLINICAL RELEVANCE/APPLICATION
There is a need to develop better imaging biomarkers for assessment of treatment response; our study investigates SUVmax/ADCmin measured by PET/MR as marker of cancer therapy response.

SSM17-05 • The Correlation between SUVmax of 18F-FDG PET/CT and Apparent Diffusion Coefficients (ADC) in Pancreas Cancer and Biliary Cancer?
Shigeki Nagamachi MD, PhD (Presenter); Ryuichi Nishii MD, PhD; Youichi Mizutani; Shogo Kiyohara; Eiji Furukoji MD, PhD; Tatefumi Sakae MD; Shozo Tamura MD, PhD; Hideyuki Wakamatsu MD; Seigo Fujita MD; Shigemi Futami; Keiichi Kawai

PURPOSE
Apparent diffusion coefficient (ADC) is a quantitative parameter providing information regarding tumor cellularity. Several studies demonstrated that ADC and SUVmax of FDG-PET had negative correlations in various cancers. The aim of this study was to investigate and to compare the correlations between ADC and SUV in pancreatic cancer or biliary cancer.

METHOD AND MATERIALS
This study included 110 patients with pathologically proven pancreatic cancer and 65 patients with pathologically proven biliary cancer. The SUVmax was automatically obtained by setting 3D ROI over the abnormal FDG uptake in the cancer lesion to cover the entire tumor volume. Obtained indices were obtained in both early (1hr) and delayed (2hr) images (SUVmax early and SUV delayed). ADC maps were made from 1.5T-MR image on workstation. A circular ROI which was minimally smaller than the actual solid portion of pancreatic lesion and biliary lesion were carefully placed on the b-1,000 DWI and copied to the ADC map. Both minimal ADC (ADC min) and mean ADC (ADC mean) were measured. Pearson correlation coefficients were calculated to assess the relationship between ADC and SUVmax in pancreatic cancer and biliary cancer respectively.

RESULTS
In pancreatic cancer, both ADC mean and ADC min was negatively correlated with SUVmax of early image (r = -0.350 and r=-0.346) and of delayed image (r = -0.329 and r=-0.334). In biliary cancer, both ADC mean and ADC min also negatively correlated with SUVmax of early image (r = -0.602 and r=-0.414) and of delayed image (r = -0.599 and r=-0.381).

CONCLUSION
The present study demonstrated negative correlations between ADC and SUVmax in both pancreatic cancer and biliary cancer. However, the correlation coefficients of biliary cancer were higher than those in pancreatic cancer. The correlation between cell density and glucose metabolism seems to be different considerably according to disease respectively.

CLINICAL RELEVANCE/APPLICATION
Because it is difficult to estimate SUVmax from a value of the ADC in pancreatic tumor, both indices had better be evaluated together for understanding biological characteristics.

SSM17-06 • Growth and Utilization Trends in Outpatient PET by Place-of-Service and Specialty
David C Levin MD (Presenter) *; Vijay M Rao MD; Laurence Parker PhD; Charles M Intenzo MD; Andrea J Frangos MPH

PURPOSE
PET is the most rapidly growing segment of nuclear medicine. Our purpose was to study recent PET growth trends in private offices and hospitals, also to determine who owned the PET facilities in offices and who interpreted the PET scans in hospitals.

METHOD AND MATERIALS
The nationwide Medicare Physician/Supplier Procedure Summary Master Files for 2001-2011 were studied. All CPT codes for PET were selected and procedure volumes were determined for each year. Medicare location codes identified the settings where the scans were performed, and specialty codes identified the specialties of the facility owners (in offices) and interpreting physicians (in hospitals). Ownership in offices was established by tabulating global and technical component claims, while interpreting physician specialty in hospitals was determined by tabulating global and professional component claims.

RESULTS
In offices, Medicare PET volume grew from 31,422 in 2001 to 342,397 in 2011. In 2011, radiologists owned the office unit in 141,289 (41.3% share). Independent diagnostic testing facilities (IDTFs) had the next largest ownership share, 19.2%. IDTFs are listed as a speciality by Medicare, although the actual specialty of the physician provider cannot be determined. Cardiologists had a 13.4% share, and all other internal medicine specialties as a group had an 18.8% share. In hospitals, PET volume grew from 65,099 in 2001 to 340,870 in 2011. 95.6% of volume in the latter year was in outpatients. In 2011 in hospitals, radiologists interpreted 325,664 (95.5% share), while cardiologists interpreted 10,178 (3.0% share). Examination of the growth curves showed that in hospitals, PET volume underwent continued rapid growth during the entire period. Private office PET volume grew even more rapidly from 2002 to 2008, but
CONCLUSION
Outpatient PET is evenly split between private offices and hospitals. Rapid growth occurred from 2001-2011 in both locations, but the trend line began to flatten in offices in more recent years. Radiologists strongly predominated in hospital-based PET (96% share) in 2011. In offices, they also had a strong role, with the largest plurality (41%) of any medical specialty.

CLINICAL RELEVANCE/APPLICATION
Not applicable

Controversy Session: Controversies in Imaging Strategies for HCC in Cirrhosis

Wednesday, 04:30 PM - 06:00 PM • N227

SPSC46 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Rendon C Nelson, MD *

LEARNING OBJECTIVES
1) To understand to optimal strategies for using CT and MRI to detect and stage hepatocellular carcinoma. 2) To understand the pharmacokinetic and imaging properties of various MR contrast agents and how to use them to optimize the detection and staging of hepatocellular carcinoma. 3) To learn how to implement the LiRads classification system into routine interpretation of hepatocellular carcinoma on CT and MRI.

SPSC46A • CT vs MR
Rendon C Nelson MD (Presenter) * ; Mustafa R Bashir MD (Presenter) *

LEARNING OBJECTIVES
1) To understand the optimal CT and MRI techniques for detecting and staging hepatocellular carcinoma. 2) To learn when CT is a more suitable choice or MRI is a more suitable choice for detecting and staging hepatocellular carcinoma.

ABSTRACT

SPSC46B • MR Contrast Agents (Hepatobiliary vs Purely Extracellular Agents)
Claude B Sirlin MD (Presenter) * ; John R Leyendecker MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

SPSC46C • LI-RADS
Reena C Jha MD (Presenter) *

LEARNING OBJECTIVES
1) To review the LI-RADS classification system. 2) By means of case study, discuss LI-RADS categories, and show both representative and challenging cases and strategies for classification.

ABSTRACT
URL

Controversy Session: Imaging of Inflammatory Bowel Disease: If There Was Only One Choice-What Would It Be? CT or MR Enterography?

Thursday, 07:15 AM - 08:15 AM • E351

SPSC50 • AMA PRA Category 1 Credit ™:1 • ARRT Category A+ Credit:1
Moderator
Joel G Fletcher, MD *

SPSC50A • The Argument for CT Enterography
Joel G Fletcher MD (Presenter) *

LEARNING OBJECTIVES
1) To review the medical justification and appropriateness of CT enterography for Crohn’s disease diagnosis and staging. 2) To understand the natural history of Crohn’s disease and the relationship between patient symptoms and biologic activity. 3) To discuss methods for performing CT enterography for Crohn’s disease, and how the technique can be adapted for different patients. 4) To briefly review the imaging findings of Crohn’s disease at CT enterography. 5) To understand the risks of CT enterography. 6) To discuss integration of CT enterography with other tests that diagnose and stage Crohn’s disease (e.g., ileocolonoscopy, capsule endoscopy, MR enterography, fluoroscopy). 7) To discuss relative merits of CT enterography in comparison to MR enterography.

SPSC50B • The Argument for MR Enterography
David J Grand MD (Presenter)

LEARNING OBJECTIVES
1) To review the appropriateness of MR enterography for Crohn’s disease diagnosis and staging. 2) To discuss the technical aspects unique to MR Enterography. 3) To briefly review the imaging findings of Crohn’s disease at MR enterography. 4) To discuss the relative merits of MR enterography in comparison to CT enterography.

ABSTRACT
**Whole Body MRI**

**Thursday, 08:30 AM - 10:00 AM • E350**

**LEARNING OBJECTIVES**

1. To understand the indications for whole-body MRI in oncologic applications. 2. To optimize the protocols with regard to the type of disease, acquisition speed and standardized reporting. 3. To show the additional diagnostic value of whole-body MRI in comparison to routine diagnostic tests.

**ABSTRACT**

For many disease entities, magnetic resonance imaging (MRI) is the technique of choice for assessment of focal organ involvement including vascular occlusive disease as well as rheumatic and pediatric diseases. Many of these, however, affect multiple sites within the entire body with different types of disease manifestations, favoring a systemic whole-body (wb) imaging approach. A wb-MRI protocol has to be tailored to the individual type of disease by including high-resolution imaging of bony structures, time-resolved display of inflammatory changes, assessment of the vascular status by angiography and information on cellular density for detection of infiltrative diseases. Therefore, techniques such as contrast-enhanced MR angiography, sequences for cardiac function and delayed contrast enhancement, diffusion weighted imaging and fat-suppressed T1 and T2 weighted studies before and after contrast media injection have to be integrated into the wb-MRI protocol. For robust and time-efficient implementation, innovative approaches such as parallel acquisition techniques, continuous table movement and multi-contrast imaging sequences are required. Clinically established indications include screening for macro-vascular complications in vasculitis, detection and therapy monitoring of joint and ligamentous affection in rheumatic diseases and screening for malignant features in hereditary multifocal exostoses. Arising applications are e.g. cardiovascular risk assessment including whole-body fat quantification, detection of micro- and macro-vascular complications in diabetes and screening for inflammatory foci in immunocompromised patients with fever of unknown origin. For a reliable clinical application, standardized reporting schemes and severity scores are being developed and the results have to be compared to currently applied diagnostic reference standards.

**RC624 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1**

**Coordinator**

Elmar M Merkle, MD *

**RC624A • Whole Body MRI-Non-oncologic Applications**

**Stefan O Schoenberg** MD, PhD (Presenter) *

**LEARNING OBJECTIVES**

1) To understand the indications for whole-body MRI in non-oncologic applications. 2) To optimize the protocols with regard to the type of disease, acquisition speed and standardized reporting. 3) To show the additional diagnostic value of whole-body MRI in comparison to routine diagnostic tests.

**ABSTRACT**

Detection and characterization of local disease in conjunction with identification of distant metastases is the main goal in oncologic imaging. Certain oncologic disease entities are per se affecting the body in a diffuse pattern for example multiple myeloma or lymphoma. In both scenarios, local disease with possible distant metastases or diffuse, multifocal disease, imaging protocols using different modalities are incorporated to screen the entire body. The continuous development of MRI technology led to improvements in acquisition time and volume coverage allowing for whole body imaging in a practical time period. However, MRI remains a more challenging imaging method in terms of protocol preparation, actual scanning, providing diagnostic images, patient comfort and acquisition time compared to other imaging modalities which offer whole body coverage such as CT or PET-CT. On the other hand there are abundant MRI specific imaging characteristics available such as different contrasts, diffusion and perfusion imaging, which may provide additional information for a given oncologic disease compared with other modalities. The challenge in whole body MRI is to balance the multitude of available MRI sequences with the amount of information needed to answer the clinical question thus providing a robust imaging protocol tailored to the clinical indication.
LEARNING OBJECTIVES
1) To learn the technique and principles that revolve around the performance of whole body MRI in children. 2) To understand present day whole body MR applications in pediatrics. 3) Future developments and research avenues linked to whole body MR imaging in children.

ABSTRACT
The applications of whole body Magnetic resonance imaging (MRI) in children continue to evolve and expand and include both oncologic and non oncologic multisystem disorders. Whole body MRI promises to be a “one stop shop” for disease surveillance without the use of ionizing radiation. The present day protocols vary across institutions and in general include fluid sensitive sequences (STIR) at the least. The images are displayed in a coronal plane, after the acquisition over multiple stations as the table moves through the scanner. This technique will be integrated with positron emission tomography in the future which opens an exciting avenue for research endeavors. The current course delves into the technical and clinical applications of whole body MR imaging in pediatrics.
disorders on MRI such as SBO, mesenteric arterial and venous ischemia, Crohn's disease, colitis, and Peptic ulcer disease.

**Breast Imaging (CAD/Quantitative Imaging)**

**Thursday, 10:30 AM - 12:00 PM • E450A**

**SSQ02 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5**

**Moderator**

Christopher E Comstock

Jennifer A Harvey

Despina Kontos

**SSQ02-01 • Computer Derived Texture Features on DCE-MRI Can Separate ER+ Breast Cancers with Low and High Oncotype DX Scores**

**Tao Wan** PhD (Presenter) ; Boris N Bloch MD ; Donna M Plecha MD * ; Cheryl Thompson BS ; Hannah Gilmore ; Norbert Avril MD ; C. Carl Jaffe MD ; Lyndsay Harris MD ; Anant Madabhushi MS *

**PURPOSE**

Oncotype DX (ODX) is a gene-expression based assay for predicting response to hormonal therapy in estrogen receptor positive (ER+) breast cancers (BCa) patients. The goal of this study was to identify whether computer derived texture features on DCE-MRI can distinguish low and high ODX scores (i.e. ER+ BCa patients who would and would not benefit from adjuvant chemotherapy), thereby providing a non-invasive pertherapeutic gene-expression assessment tool predicting tumor treatment response.

**METHOD AND MATERIALS**

A total of 57 ER+ BCa patient studies were collected, in which 21 breast MRIs were acquired from a Phillips 1.5T magnet with a 7-channel breast coil, and 36 MRIs were acquired using a Siemens 1.5T magnet with a 8-channel breast coil, including DCE images obtained prior to, during, and after administration of 0.1 mmol/kg of Gd-DTPA. Each study was accompanied by: i) lesion annotations from an expert radiologist; and ii) ODX scores. A set of 6 morphological features, 3 pharmacokinetic features, 12 enhancement kinetic features (EKF), 12 intensity kinetic features, 312 textural kinetic features, 6 dynamic local binary patterns (DLBP), and 5 dynamic histogram of oriented gradients (DHoG) features were extracted and used to characterize the appearance of the breast lesions. The computed features were evaluated by a linear discriminate analysis (LDA) classifier in terms of their ability to distinguish ER+ BCa with low or high ODX scores via a 2-fold randomized cross validation scheme.

**RESULTS**

The DHoG, DLBP, and EKF texture features yielded AUC values of 0.85, 0.82, and 0.80 in conjunction with the 2-class LDA classifier for separating low and high ODX ER+ breast lesions.

**CONCLUSION**

This work to our best knowledge, the first attempt to quantitatively correlate texture measurements on DCE-MRI to patient outcome prediction via the ODX assay. Our results suggested that the DHoG, DLBP, and EKF were robust and stable DCE-MRI markers in distinguishing between low and high ODX scores.

**CLINICAL RELEVANCE/APPLICATION**

An MRI-based assay to identify ER+ BCa patients that could non-invasively predict which patients would benefit from adjuvant chemotherapy, and could serve as a complement to Oncotype DX assay.

**SSQ02-02 • Computerized Characterization of Mass and Non-mass-Like Lesions on Breast MRI**

**Hui Li** PhD (Presenter) ; Maryellen L Giger PhD * ; Li Lan ; Sunny Y Duan ; Stephan Hu ; Gillian M Newstead MD * ; Hiroyuki Abe MD ; Michelle Lindgren MD

**PURPOSE**

To investigate the potential usefulness of quantitative imaging analysis on characterizing both mass and non-mass-like enhancement breast lesions in the task of distinguishing between malignant and benign lesions.

**METHOD AND MATERIALS**

Study was performed on 123 biopsy-proven lesions from 103 MRI studies acquired between January 2009 and April 2010, including 35 benign mass, 50 malignant mass, 11 benign non-mass-like and 27 malignant non-mass-like lesions. Our quantitative imaging analysis method incorporated computerized 3D lesion segmentation and feature extraction, including kinetic, enhancement-variance kinetic, morphological, size, and texture features. Output from the system yielded the probability of malignancy from a Bayesian artificial neural network (BANN). Classification performance was evaluated with a leave-one-case-out method using ROC analysis with area under the ROC curve as the figure of merit.

**RESULTS**

For mass lesions, the kinetic features of time to peak and curve shape index statistically differed between malignant and benign lesions. However, kinetic features did not contribute significantly in the diagnostic task with non-mass-like breast lesions. By merging computer-selected features with BANN classifiers, AUC values of 0.88 (SE=0.03), 0.95 (SE=0.02), and 0.82 (SE=0.08) were obtained in the task of distinguishing between malignant and benign lesions on the entire dataset, between malignant and benign mass lesions, and between malignant and benign non-mass-like lesions, respectively.

**CONCLUSION**

Kinetic characteristics are useful in differentiating malignant from benign mass lesions; however, their performance is reduced when the lesions are non-mass-like. Thus, quantitative analysis for diagnostic decision-making should be performed separately on mass and non-mass-like lesions.

**CLINICAL RELEVANCE/APPLICATION**

In order to improve clinical diagnostic accuracy, quantitative analysis for diagnostic decision-making should be performed separately on mass and non-mass-like lesions in the classification task.

**SSQ02-03 • Use of Quantitative 3D Breast Image Analysis to Inform DCIS Staging**

**Stephanie M Burda** (Presenter) ; Maryellen L Giger PhD * ; Li Lan ; Kathy Rodogiannis ; Hui Li PhD ; Gillian M Newstead MD * ; Ken Yamaguichi ; Koichi Ishiyama MD ; Hiroyuki Abe MD ; Michelle Lindgren MD ; Adam Starkey

**PURPOSE**

Uncertainty on which ductal carcinoma in situ (DCIS) cases will progress to invasive breast cancer currently results in overtreatment. Our purpose was to discern quantitative characteristics of pure DCIS, DCIS with an invasive component, and invasive cancers without DCIS to inform prognosis of patients with lesions presenting initially as DCIS.

**METHOD AND MATERIALS**
RESULTS
The combination of features that best distinguished pure DCIS from invasive cancer included kinetic feature time to peak, texture features of contrast and correlation, and morphological features of circularity, margin, and surface area. The combination of features that was best able to distinguish pure DCIS from invasive cancers with a DCIS component included contrast, margin, and ratio of surface area to volume. The margin characteristics (determined by spiculation and sharpness) and contrast (the difference between the average gray level of the cancer and the surrounding area) were found to be insightful in both comparisons. Time to peak was also significant in the comparison of Pure DCIS and invasive cancers, yielding an AUC value of 0.77. Round-robin evaluation of an LDA yielded AUCs of 0.85 and 0.74 distinguishing pure DCIS from invasive cancers and invasive cancers with a DCIS component, respectively.

CONCLUSION
Image-derived quantitative phenotypes, which indicate a likelihood of invasive disease-of pure DCIS, could patient guide management of DCIS lesions, thus potentially reducing overtreatment.

CLINICAL RELEVANCE/APPLICATION
Image-derived quantitative phenotypes, which indicate a likelihood of invasive disease-of pure DCIS, could patient guide management of DCIS lesions, thus potentially reducing overtreatment.

SSQ02-04 • Undetected Breast Cancers on Commercial Breast MRI CAD (Computer-aided Detection) System
Chae Hyun Kim (Presenter); Seon Hyeong Choi; Ji Yeon Park; Yoonjung Choi MD; Shin Ho Kook MD
PURPOSE
To evaluate the immuno-histological factors of breast cancer not detected on breast MRI CAD system.

METHOD AND MATERIALS
The study included 327 preoperative breasts MRI of histologically proven breast cancer from July 2011 to February 2013. We retrospectively reviewed the MRI CAD results, corresponding immune-histopathologic features, lesion size and age to determine factors affecting MRI CAD detectability. We categorized tumors into two groups: detected and undetected groups.

RESULTS
Of the 327 cases, the CAD system marked 259 (79.2%) lesions correctly and 68 (20.8%) were undetected on breast MRI CAD. The mean size and age were 18 mm (range:1-70) and 50.0 yo (SD:9.9) in the detected group and 22.8 mm (range: 3-120) and 51.4 yo (SD: 10.7) in the detected group. Detectability rates for IDCs, DCIS were 86.7% (208 of 240) and 44.6 % (25 of 56), respectively. The tumor type was significant (p<0.05) in the deteced group. Median tumor size on CAD and specimen were 20 mm (2-163 mm) and 17 mm (0.8-82 mm), respectively. Adequately measured group was 68.6% (n=168). Invasive ductal carcinoma (IDC) showed significantly more adequate measurement, compared with DCIS (p=0.025). Among IDC, the presence of extensive intraductal component was significantly higher in overestimated group (p<0.05).

CONCLUSION
Though the commercial breast MRI CAD system showed good performance, about 20% of breast cancers were not detected on MRI CAD. DCIS, low nuclear grade, low Ki-76 percentage, and HER-2 negative influenced the breast MRI CAD detectability in breast cancer patients.

SSQ02-05 • Immunohistological Factors Affecting the Breast Cancer Size Measurement by MRI Computer-aided Detection (CAD) System
Ji Yeon Park (Presenter); Seon Hyeong Choi; Yoonjung Choi MD; Chae Hyun Kim; Shin Ho Kook MD
PURPOSE
To investigate immunohistological factors affecting the breast tumor size measurement discrepancy between the MRI CAD and the pathologic specimen.

METHOD AND MATERIALS
We retrospectively reviewed the 244 cases of breast MRI CAD images and pathologic findings of the 244 patients who underwent operation for breast cancer between July 2011 and December 2012. We compared the CAD generated tumor size with tumor size measured on pathologic specimen. We classified the tumors into three groups: underestimated, adequately measured and overestimated group. We investigated the statistical difference in histopathology including histologic type, presence of DCIS, extensive intraductal component, nuclear grade, ER, PR and HER-2, among the 3 groups.

RESULTS
Median tumor size on CAD and specimen were 20 mm (2-163 mm) and 17 mm (0.8-82 mm), respectively. Adequately measured group was 68.6% (n=168). Invasive ductal carcinoma (IDC) showed significantly more adequate measurement, compared with DCIS (p=0.025). Among IDC, the presence of extensive intraductal component was significantly higher in overestimated group (p<0.05).

CONCLUSION
Size assessment using breast MRI CAD was accurately measured in 68.6%. On MR CAD, breast cancer size was frequently overestimated in cases of DCIS, the presence of extensive intraductal component, and HER-2(+).

CLINICAL RELEVANCE/APPLICATION
Accurate tumor size measurement is critical to surgical plan for breast conservation.

Size assessment by breast MRI CAD is accurate but it can be overestimated in cases of DCIS, EIC, and HER-2(+).

SSQ02-06 • Quantitative MRI-based Phenotypes of Triple Negative Breast Cancers
Hui Li PhD (Presenter); Maryellen L Giger PhD *; Li Lan; Hiroyuki Abe MD; Michelle Lindgren MD; Eric M Blaschke MD; Gillian M Newstead MD *
PURPOSE
To investigate the potential usefulness of quantitative image analysis on characterizing the molecular subtypes of breast cancer in order to better understand the difference between triple negative and other molecular subtypes of breast cancer

METHOD AND MATERIALS
Study was performed on 168 biopsy-proven breast cancer MRI studies acquired between November 2008 and August 2011, in which 40 cases were triple negative (ER-, PR-, and HER2-) breast cancers and 128 cases were of other molecular subtypes including Luminal A, Luminal B, and HER2. Quantitative MRI analysis included: 1) 3D lesion segmentation based on a fuzzy c-means clustering algorithm; 2) computerized feature extraction; 3) leave-one-out linear stepwise feature selection; and 4) discriminant score estimation using Linear Discriminant Analysis (LDA). The classification performance between triple negative and other molecular subtypes of breast cancer was evaluated using ROC analysis with area under the ROC curve (AUC) as the figure of merit.

RESULTS
The triple negative classification, in a round-robin evaluation, yielded AUC values of 0.90 (SE=0.05) and 0.67 (SE=0.05) on 3T and 1.5T MR scanners, respectively, in the task of distinguishing between triple negative and other molecular subtypes, statistically significantly higher than an AUC value of 0.5 (p-value
CONCLUSION
The results from this study indicate that quantitative MRI analysis shows promise in the discrimination of triple negative breast cancer from other molecular subtypes of breast cancer.

CLINICAL RELEVANCE/APPLICATION
Identification of the molecular subtypes of breast tumors is expected to allow for improved prognostic assessment and more effective cancer treatment plans.

SSQ02-07 • Features of Undiagnosed Breast Cancers at Screening Breast MRI: Potential Utility and Limitation of Computer-aided Evaluation

Miraines Seo MD (Presenter); Nariya Cho MD; Min Sun Bae MD, PhD; Eun Bi Ryu MD; Jung Min Chang MD; Hye Ryong Koo MD; Su Hyun Lee MD; Won Hwa Kim MD, MS; Woo Kyung Moon; Hye Mi Gweon MD; A Jung Chu MD

PURPOSE
To evaluate the features of undiagnosed cancers at prior screening breast MRIs in patients who subsequently developed breast cancers and the potential utility and limitation of computer-aided evaluation (CAE).

METHOD AND MATERIALS
Between March 2004 and March 2013, 65 pairs of dynamic contrast enhanced breast MRIs including prior negative screening MRIs and subsequent breast MRIs with developed cancers (mean interval 36.5 months, range 5.4 - 96.7 months) were identified. The mean histological sizes of developed cancers was 2.0cm (range 0.5 - 9.5 cm) for invasive cancers (n=44) and 1.9cm (range 0.5 - 4.1 cm) for DCIS (n=21). Visible findings, their maximum lesion size and actionability, as well as causes for overlooked cancers on prior MRI were determined and classified by two experienced radiologists in consensus. A commercially available CAE program was retrospectively applied to the prior MRIs with visible findings for generation of kinetic features including washout, plateau, and persistent enhancement proportions. Presence of a washout component on CAE was also described.

RESULTS
Of the 65 areas where cancer later developed, 51% (33 of 65) of prior MRIs had visible findings and their mean lesion size was 1.0cm (range 0.4 - 5.2 cm). Of these visible findings, 24% (8 of 33) were classified as actionable and 76% (25 of 33) as underthreshold. Causes for actionable findings were mimicking of physiologic enhancement (n=3), mismanagement after benign results of biopsy (n=3), and satisfaction of search (n=2). Those of underthreshold findings were small lesion size (n=6), moderate to marked background parenchymal enhancement (n=11), mimicking of post-op scar (n=7), and peripheral location (n=1). Twenty three of the visible findings were available for CAE and the washout component was found in 14. However, 4 of 14 lesions with a washout component were not marked due to marked background enhancement with multiple enhancing lesions with a washout component. CAE did not show the washout component in 9 of 23 lesions.

CONCLUSION
On prior screening breast MRIs in which cancer later developed, 51% (33 of 65) had visible findings (24% actionable, 76% underthreshold). The addition of CAE has the potential to identify 43% (10 of 23) of overlooked findings. Yet, there are still some limitations on CAE.

CLINICAL RELEVANCE/APPLICATION
When an enhancing lesion shows a washout component on MR-CAE of screening breast MRI, closer attention is warranted.

SSQ02-08 • Evaluation of a Commercial CAD System for Detecting Lesions at Breast Digital Tomosynthesis

Lia Morra PhD *; Silvano Agliozzo PhD *; Luca A Carbonaro MD *; Manuela Durando (Presenter); Barbara Pesce MD; Giovanna Marisotti; Alberto Bert PhD *

PURPOSE
To evaluate the performance of a commercial computer aided detection (CAD) system (CAD BREAST DTS, im3D S.p.A.) for detecting lesions at digital breast tomosynthesis (DBT) on an independent testing set.

METHOD AND MATERIALS
The CAD system was retrospectively tested on a set of 143 patients. Cranio-caudal (CC) and mediolateral oblique (MLO) DBT projections were acquired with a Hologic Selenia Dimensions system and reconstructed with the Briona library (Real Time Tomography LLC). All patients signed an informed consent form. A total of 80 histologically confirmed malignant lesions (57 masses, 18 microcalcification clusters) and 6 masses with associated microcalcifications) were detected and annotated by experienced radiologists who drew a 3D bounding box around each lesion view. CAD BREAST DTS yields both masses and microcalcification clusters candidates. For masses, a CAD true positive was registered when the CAD marking overlapped by at least 20% the radiologists marking; for microcalcification clusters, when at least two of the microcalcifications identified by CAD fell within the radiologists marking. A CAD false positive was registered in all other cases, to avoid chance matchings. Masses with associated microcalcifications were considered correctly identified if CAD marked at least a mass or a microcalcification cluster.

RESULTS
At the selected operating point, per-lesion sensitivity was 89% (95% C.I. 80-94%). The system detected 48/56 masses, 17/18 microcalcification clusters and 6/6 masses with microcalcifications. Mean number of false positives per view was 2.8 ± 1.9 (mean ±standard deviation), of which 2 were marked as masses and 0.8 as microcalcification clusters.

CONCLUSION
The DBT CAD sensitivity is comparable to that observed for 2D digital mammography CAD systems, with a fairly low number of false positives per view. Further work, especially on difficult cases such as screening interval cancers, and comparing reading with and without CAD, is needed to understand its role in clinical practice.

CLINICAL RELEVANCE/APPLICATION
A commercial CAD system for masses and microcalcification clusters detection is evaluated on an independent testing set.

SSQ02-09 • Quantitative MRI Morphological Features of Breast Cancer: Correlation with Immunohistochemical Biomarkers and Subtypes

Min Sun Bae MD, PhD (Presenter); Miraines Seo MD; Woo Kyung Moon; Nariya Cho MD; Jung Min Chang MD; Hye Ryong Koo MD; Won Hwa Kim MD, MS; Su Hyun Lee MD; Hye Mi Gweon MD

PURPOSE
To investigate the correlation of the tumor roundness measured quantitatively at contrast-enhanced magnetic resonance imaging (MRI) and immunohistochemical biomarkers and subtypes in breast cancer.

METHOD AND MATERIALS
After IRB approval, we retrospectively reviewed 280 consecutive women (median age, 50 years; range, 28-79 years) with 282 invasive breast cancers (< 5 cm size). All patients underwent preoperative breast MRI. Images were assessed independently by the two radiologists who were unaware of pathological findings. Tumor roundness was measured quantitatively by a software developed in-house and was calculated according to the following equation: roundness = 4π x A / P2 (A is the cross-sectional area of the tumor and P is the measured perimeter length of the tumor). The means of values measured by the two observers were recorded and interobserver variability was calculated. Associations between the tumor roundness (1-100 %) and biomarker (estrogen receptor [ER], progesterone receptor [PR], HER2, and Ki67) features were evaluated using Pearson’s correlation coefficient and a multiple linear regression analysis. Tumor roundness was compared between breast cancer subtypes (luminal A, luminal B, HER2-enriched, and triple-negative).
RESULTS
Interobserver agreement for MRI measurements was moderate with intraclass correlation coefficients of 0.75 (95% confidence interval: 0.67-0.80). A moderate inverse correlation was observed between the ER score and tumor roundness (-0.408, P < .0001). PR score, Ki67 index, and tumor grade correlated with the tumor roundness (P < .0001). In multiple linear regression, ER score (P < .0001) and Ki67 index (P = .003) were independent factors determining tumor roundness. Triple-negative tumors showed the highest mean roundness score compared with other subtypes (67.3 for triple-negative vs. 55.9 for HER2-enriched, 53.8 for luminal B, and 51.7 for luminal A; P < .0001).

CONCLUSION
Tumor roundness measured quantitatively at MRI correlated with ER score and Ki67 index in breast cancer. Triple-negative tumors showed the highest mean roundness score compared with other subtypes.

CLINICAL RELEVANCE/APPLICATION
Our data may have implications for possibly stratifying breast cancer patients with different clinical outcomes by using MRI morphological features.

Cardiac (Myocardial Ischemia and Viability)

Thursday, 10:30 AM - 12:00 PM • SS04AB

SSQ03 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

Moderator
Richard D White , MD
Moderator
Hajime Sakuma, MD *
Moderator
Konstantin Nikolaou , MD *

SSQ03-01 • Dynamic CT Myocardial Perfusion Imaging: Performance of 3D semi-automated Evaluation Software

Ulrich Ebersberger MD (Presenter) ; Roy Marcus BS ; Lucas L Geyer MD * ; Gladys G Lo MD ; Christian Canstein * ; U. Joseph Schoepf MD * ; Yining Wang MD ; Fabian Bamberg MD, MPH * ; Andrew D McQuiston BS

PURPOSE
To determine the performance and accuracy of dedicated 3D semi-automated evaluation software for the assessment of myocardial blood flow (MBF) and blood volume (MBV) at dynamic CT myocardial perfusion imaging.

METHOD AND MATERIALS
In an IRB-approved study, 37 dynamic, time-resolved myocardial perfusion CT datasets acquired using a 2nd-generation dual-source CT system (Definition Flash, Siemens) were assessed both manually and by use of the semi-automated prototype for MBF and MBV, based on the AHA segmental model. The prototype software employs an automatic 3D heart chamber segmentation system and a surface-based four-chamber heart model. For automated segmentation, a series of anatomical landmarks in the heart are detected followed by delineation of chambers. Marginal space learning is applied for automatic localization of anatomical structures. Subsequently, the 3D shape of the cardiac chambers is determined using a probabilistic boosting tree-based contour fitting. The resulting segmentation consequently allows for both manual placement of ROIs and calculation of a polar map employing the modified 17-segment AHA myocardial model. Time required for each assessment was recorded. Results were compared to SPECT as the standard of reference.

RESULTS
592 segments were evaluated. 19 (3.21%) were excluded due to insufficient coverage. Based on the results at SPECT, 42 segments in 17 patients were classified as showing pathologic myocardial perfusion (prevalence: 45.9% patient-based). Overall, both approaches yielded higher negative predictive value than positive predictive value, with NPV: 0.99 vs. 0.98 and PPV: 0.65 vs. 0.65 for the manual as compared with the 3D evaluation tool. A comparison of MBF and MBV measurements using the prototype versus manual assessment showed high correlation (Spearman rank correlation coefficient = 0.85/0.83, P < .0001). A comparison of MBF and MBV measurements using the prototype versus manual assessment showed high correlation (Spearman rank correlation coefficient = 0.85/0.83, P < .0001).

CONCLUSION
The performance of 3D semi-automated evaluation software for dynamic CT myocardial perfusion imaging correlates highly with manual assessment of MBF/MBV values in good agreement with SPECT. Use of such software substantially decreases post-processing and interpretation times.

CLINICAL RELEVANCE/APPLICATION
These results show promise for fostering the integration of dynamic CT myocardial perfusion imaging in actual clinical workflows.

SSQ03-02 • Non-concordant Results by Myocardial CT Perfusion Imaging and SPECT Perfusion Imaging Compared with Invasive Coronary Angiography: A Post-hoc Analysis from the CORE320 Trial

Vishal C Mehta MD, PhD (Presenter) ; Marcelo F Di Carli MD * ; Andrew E Arai MD ; Kakuya Kitagawa MD, PhD ; Armin Arbab-Zadeh MD ; Julie Miller MD * ; Andrea L Vavere ; Klaus Kofoed MD ; Carlos E Rochitte MD, PhD ; Marc Dewey MD * ; Swee Yaw Tan MB, MRCGP ; Hirohito Niitani ; Christopher Cox * ; Melvin E Clouse MD ; Joao A Lima MD * ; Richard T George MD *

PURPOSE
The conventional form of non-invasive testing by stress single photon emission computed tomography (SPECT) perfusion imaging is known to be less reliable in the presence of clinical situations associated with balanced ischemia. The international, multicenter CORE320 trial was designed to test a non invasive risk stratification approach using combined computed tomography angiography (CTA) and adenosine stress CT perfusion (CTP) imaging compared to the reference standards of combined stress SPECT perfusion imaging and invasive coronary angiography (ICA). This design allows for the head-to-head comparison of the two forms of stress perfusion imaging (CTP and SPECT) vs. the reference standard of ICA in a post-hoc manner. The purpose of this analysis was to examine the non-concordance of CTP and SPECT perfusion imaging among participants of the CORE320 trial and compare to percent stenosis by ICA.

METHOD AND MATERIALS
The international, multicenter CORE320 study enrolled 381 symptomatic patients referred for ICA. Prior to ICA, patients underwent rest CTA and adenosine stress CTP as well as SPECT perfusion imaging. CTA, CTP, ICA, and SPECT were all analyzed using parallel methods in blinded independent laboratories. As part of this post-hoc analysis, when SPECT and CTP showed discordant results, we compared these results to the reference standard ICA. ICA was defined as abnormal at the ≥ 50% diameter stenosis threshold.

RESULTS
A positive CTP with a negative SPECT study occurred in 113 of the 381 enrolled subjects. Compared to ICA, 62% (70 of 113) of these had single vessel disease or greater and 33% (36 of 113) had multi-vessel (= 2 vessels) or left main disease. Conversely, a negative CTP with a positive SPECT study occurred in 33 subjects Only 27% (9/33) of these had single vessel disease or greater and 15% (7/33) had multi-vessel disease (P=0.004).

CONCLUSION
These data suggest that in patients with discordant findings in CTP and SPECT, CTP imaging is more sensitive than SPECT imaging for the
Myocardial CT delayed enhancement using TSFF algorithm markedly improves infarct detection and sizing, and is recommended for

**CLINICAL RELEVANCE/APPLICATION**

CT perfusion imaging is more accurate than SPECT perfusion in predicting significant coronary stenosis, by ICA.

**SSQ03-03 • Cardiac Troponin I Predicts the Development of Unrecognized Myocardial Infarctions Detected with Magnetic Resonance Imaging**

Charlotte Ebeling Barbier MD (Presenter); Raquel E Themudo MD; Tomas Bjerner MD, PhD *; Lars O Johansson PhD *

**PURPOSE**

To investigate whether plasma levels of cardiac troponin I measured with a high-sensitivity assay (hs-cTnI) could predict the development of unrecognized myocardial infarctions (UMIs) detected with late enhancement magnetic resonance imaging (LE-MRI).

**METHOD AND MATERIALS**

LE-MRI was performed on 248 randomly selected community-living 70-year-old subjects and hs-cTnI was determined with a highly sensitive premwark assay. Five years later the subjects were invited to a second LE-MRI, and 143 of them (68 women, 75 men) who were free from myocardial scars at 70 years of age and did not have a hospital diagnosis of MI, constitute the present study population. LE involving the subendocardial layer was considered an MI scar.

**RESULTS**

New UMIs were detected in 37 subjects during follow-up. Plasma levels of hs-cTnI at 70 years of age, which were mainly within what is considered to be the normal range, were related to new UMIs at 75 years of age with an adjusted Odds Ratio (OR) of 1.78 for 1 SD increase in hs-cTnI (95%CI 1.13-2.81; p=0.014). In the third and fourth quartiles of hs-cTnI the adjusted ORs were 5.63 (95%CI 1.08-29.38; p=0.041) and 10.11 (95%CI 1.89-54.22; p=0.007) respectively compared to the first quartile. Plasma levels of hs-cTnI at 70 years of age were associated with the volumes of the UMIs detected at 75 years of age (p<0.022).

**CONCLUSION**

hs-cTnI in 70-year-old community-living women and men predicted the development of MRI-detected UMIs within five years.

**CLINICAL RELEVANCE/APPLICATION**

It is debated whether MRI-detected UMIs constitute real MIs. These results may be helpful in understanding the constitution and potential prognostic impact and of these UMIs.

**SSQ03-04 • T1 and T2 Mapping for the Detection of Myocardial Edema in Acute Myocardial Infarction by Cardiac Magnetic Resonance**

Jerome Caudron MD (Presenter); Valentin Lefebvre; Benjamin Dubourg; Jeannette Fares MD; Jean-Nicolas Dacher MD *

**PURPOSE**

To evaluate quantitative T1 and T2 mapping sequences in assessing myocardial edema in patients with acute myocardial infarction (AMI).

**METHOD AND MATERIALS**

Single center study involving 24 patients referred for AMI (STEMI) and 24 healthy volunteers who served as controls to determine normal T1 and T2 values of the myocardium. Cardiac MRI was performed between day 2 and day 7 after acute event (Avanto 1.5T, Siemens, Germany). Standard protocol included CINE, T2w STIR, first pass and delayed enhancement (PSIR) sequences. In addition, steady state free precession T2 mapping sequences (3 echoes) and modified Look Locker inversion recovery T1 mapping sequences (11 inversion times) were performed on short axis views at basal, mid and apical levels of the left ventricle. Analysis was performed using the 16 left ventricular segments model, excluding the apex. Quantitative T1 and T2 values (in ms) were obtained from regions of interest encompassing each segment. Segments were therefore divided in 3 areas: infarct, peri-infarct and remote. Diagnostic accuracy of T1 and T2 mapping sequences was therefore calculated for detecting infarct area as defined by late gadolinium enhancement.

**RESULTS**

T1 and T2 maps were interpretable in all patients and controls. Mean T1 and T2 values in infarct areas (respectively 1135±69 ms and 69.84±7.7ms) were significantly longer than T1 and T2 values in peri-infarct (respectively 1018±36 ms and 56.7±4.7 ms) and remote areas (respectively 988±26 ms and 53.5±3.9 ms) (p-T2 maps AUC=0.922, Se=82.1, Spe=92.9, optimal threshold=61.4 ms -T1 maps AUC=0.893, Se=80.3, Spe=89.6, optimal threshold=1053 ms) Difference was almost significant between T2 and T1 maps (p=0.05).

**CONCLUSION**

T1 and T2 mapping are effective methods for quantifying myocardial edema in patients referred for AMI. Interestingly, T1 and T2 values of the remote areas in patients are longer than those measured in controls.

**CLINICAL RELEVANCE/APPLICATION**

Quantification of T1 and T2 values could be relevant in the evaluation of area at risk in AMI but also for the evaluation of new treatments, prognostic stratification and patients follow-up.

**SSQ03-05 • Myocardial CT Delayed Enhancement Using Targeted Spatial Frequency Filtration: Comparison with Conventional Half Scan and MR Delayed Enhancement**

Yusuke Kurobe MD (Presenter); Kakuya Kitagawa MD, PhD; Tatsuro Ito MD; Yoshie Kurita MD; Yasuyuki Shiraishi; Makiko Fujita; Motonori Nagata MD, PhD; Masaki Ishida MD, PhD; Hajime Sakuma MD *

**PURPOSE**

CT assessment of myocardial delayed enhancement (DE) is feasible but is not widely used due to relatively poor contrast-to-noise ratio (CNR) and artifacts associated with half scan reconstruction. Targeted spatial frequency filtration (TSFF) developed for dynamic myocardial perfusion imaging is a hybrid algorithm of half and full scan reconstruction that can achieve both high temporal resolution and improved stability of CT Hounsfield unit of the myocardium. The purpose of this study was to evaluate the feasibility and image quality of CTDE using TSFF in comparison with conventional half scan (CHS) reconstruction.

**METHOD AND MATERIALS**

Forty patients with suspected CAD underwent CTDE 7 minutes after administration of 120ml of contrast medium using dual-source CT. Images were reconstructed with TSFF and CHS. Two blinded readers independently determined the presence and size of DE. Signal-to-noise ratio (SNR) and CNR of DE lesions were also determined. Image artifact was assessed by a three-point scale (3=minimal, 2=not interfering with interpretation, and 1=substantial). The presence of DE was compared between CT and CMR in 12 patients.

**RESULTS**

TSFF demonstrated significantly reduced artifact on CTDE images compared with CHS (2.4±0.7 vs 3.0±0.0, P<0.001). TSFF algorithm is highly effective in reducing artifacts on myocardial CTDE images and considerably improves inter-observer reproducibility of infarct sizing. Myocardial CTDE using TSFF allows for accurate infarct detection and reproducible infarct sizing in patients with known or suspected myocardial infarction.

**CONCLUSION**

Myocardial CT delayed enhancement using TSFF algorithm markedly improves infarct detection and sizing, and is recommended for...
Patients with Asymptomatic Diabetes: Results from the ACCREDIT Study

Yosie Kurita MD (Presenter) ; Kakuya Kitagawa MD, PhD ; Tatsuro Ito MD ; Naoki Nagasawa RT, PhD ; Hiroshi Nakajima MD ; Shiro Nakamori MD ; Masaki Ishida MD, PhD ; Hajime Sakuma MD *

PURPOSE
Assessment of extracellular fraction by CT is a new approach toward the evaluation of diffuse myocardial fibrosis. The purpose of this study was to describe the normal pattern of age-related and regional variation of extracellular fraction in subjects without coronary artery disease (CAD).

METHOD AND MATERIALS
Among 82 patients with known or suspected CAD who underwent comprehensive cardiac CT study consisting of non-contrast CT, stress CT perfusion, coronary CTA and myocardial CT delayed enhancement, we retrospectively identified 27 subjects without any of coronary artery stenosis, LV hypertrophy, stress perfusion defects and delayed enhancement. After exclusion of subjects with calcium score of >100 (n=5), poor image quality (n=1), and without hematocrit measurement (n=5), 16 subjects (ages 45-80, median 65 years, 5 females) comprise the study population. CT delayed enhancement was acquired 7 minutes after coronary CTA with a total of 120ml of contrast medium. Based on the 16-segment model, extracellular fraction was calculated as a ratio of the change in Hounsfield unit of the myocardium and the LV blood before and after contrast administration, multiplied by (1- hematocrit). Twenty-two segments (22/256, 8.6%) affected by streak artifacts were excluded from analysis.

RESULTS
Mean extracellular fraction for each subject by CT was 25.7%±2.2 (range 23.2-29.7%), showing excellent agreement with the previously reported extracellular fraction values determined by MRI using T1 mapping method (mean extracellular fraction of 24.8-26.6%), and was strongly related to age (r=0.806, p<0.001).

CONCLUSION
Extracellular fraction values determined by CT in this study are in excellent agreement with previous reports using MRI. Strong linear correlation between extracellular fraction and age may indicate the ability of CT to demonstrate increasing diffuse fibrosis associated with normal aging.

CLINICAL RELEVANCE/APPLICATION
In the evaluation of diffuse myocardial fibrosis, age-related increase and regional variation of extracellular fraction of LV myocardium demonstrated in this study should be taken into consideration.

SSQ03-07 • Age- and Gender-based Performance of Non-invasive Fractional Flow Reserve Computed from Coronary CT Angiography: Results from a Prospective International Multicenter Trial

Jonathan A Leipsic MD (Presenter) * ; Gilat Grunau PhD ; Rekha Raju ; Carolyn Taylor MD ; Ryo Nakazato ; Daniel S Berman MD * ; Matthew J Budoff MD * ; Cameron J Hague MD ; James Min MD *

PURPOSE
Fractional flow reserve (FFR) at the time of invasive coronary angiography (ICA) is the gold standard for determining lesion-specific ischemia. Non-invasive FFR computed from a resting coronary CT angiogram (FFRCT) enables measurement of lesion-specific ischemia with high concordance to invasive FFR. To date, the performance of FFRCT when stratified by age and gender, has not been examined.

METHOD AND MATERIALS
407 vessels from 252 patients (17 centers in 5 countries) underwent non-contrast CT, stress coronary CT angiography (ICA), and invasive FFR. All studies were interpreted in blinded fashion by independent core laboratories. FFRCT and FFR=0.80 were considered hemodynamically significant, while CT stenosis ≥50% was considered anatomically obstructive. Stratified by age and gender, discrimination and diagnostic accuracy of FFRCT was assessed against FFR on a per-patient basis by area under the receiver-operating-characteristics curve (AUC) and accuracy.

RESULTS
Median age of the study population was 63 + 9 years (71% male). By FFR, ischemia was identified in 151 of 407 lesions (37%). FFRCT demonstrated similar per-patient discrimination for subjects >65 versus ≤65 years.

CONCLUSION
When compared to invasive FFR, FFRCT yields similar discrimination and accuracy for diagnosis of lesion-specific ischemia in older and younger patients, as well as in men and women.

CLINICAL RELEVANCE/APPLICATION
There is preserved discriminatory capacity and diagnostic accuracy of FFRCT as compared to measured FFR when stratified by age and sex.

SSQ03-08 • Evaluation of Accuracy for Detection and Extent of Occult Myocardial Scars Using Delayed-enhancement CT in Patients with Asymptomatic Diabetes: Results from the ACCREDIT Study

Sung Min Ko (Presenter) ; Joon-Won Kang MD ; Sang Il Choi MD ; Tae-Hwan Lim MD, PhD

PURPOSE
To evaluate through an exploratory sub-study the accuracy of delayed-enhancement CT (DE-CT) for detecting occult myocardial scars (OMS) and to evaluate the transmurality of OMS using DE-CT compared with delayed enhancement MRI (DE-MRI) in asymptomatic patients with type 2 Diabetes.

METHOD AND MATERIALS
In this prospective, multicenter, and open-label study, 347 patients with type 2 DM were included with 2 or more risk factors of coronary artery disease. DE-MRI and DE-CT were respectively performed with Gadoterate Meglumine (Dotarem®) and Iobitridol (Xenetix®350) on 167 patients. Image quality of DE-CT was evaluated using 4-grading system, good, adequate, poor and null. The prevalence and the transmurality of OMS were determined by DE-MRI and DE-CT for each scar was assessed in terms of over- or underestimation of DE-CT using 6-grade system, 0%, 1-25%, 26-50%, 51-75%, 76-99%, and 100% at segment level.

RESULTS
The image quality of DE-CT was good and adequate in 165 (98.8%) patients. The OMS was detected in 12 (7.3%) by DE-MRI and 7 (4.3%) by DE-CT of the 164 patients for whom a valid assessment was available. Of the 2788 segments, OMS was detected in 24 segments on DE-MRI and in 12 segments on DE-CT. The sensitivity of DE-CT for detecting OMS was 58.3%, specificity was 100%, positive predictive value was 100%, and the negative predictive value was 96.8% at patient level. At segment level, the sensitivity, specificity, positive and negative predictive value of DE-CT for detecting OMS were 50%, 100%, 100%, and 99.6% respectively. The grade for transmurality of OMS between DE-CT and DE-MRI was matching at segment level in 41.7%, under-evaluation of transmurality on DE-CT was in 54.2%, and overestimation on DE-CT was 4.2%.

CONCLUSION
The sensitivity of DE-CT for detecting OMS is moderate, but the specificity is high. Under-evaluation of the transmurality of OMS is common using DE-CT.

CLINICAL RELEVANCE/APPLICATION

comprehensive assessment of CAD and myocardial infarction.

Age- and Gender-based Performance of Non-invasive Fractional Flow Reserve Computed from Coronary CT Angiography: Results from a Prospective International Multicenter Trial
Excellent correlation exists between global and clinical markers of Crohn’s disease severity and MaRIA scores and measured lengths of enteric inflammation. For each reader, both MaRIA scores and lengths of enteric inflammation were significantly correlated with GPS (p < 0.0001), CRP (p < 0.0001), and cost.

**METHOD AND MATERIALS**

**RESULTS**

In total 102 vascular territories were available for comparison. On MRI, perfusion defects were found in 32/102 (31%) vessels in 16/34 (47%) patients. The mean (sd) MBF was 84 (36) ml/100g/min in myocardial segments with perfusion defects, whereas MBF was 120 (35) ml/100g/min in the remote myocardium (p < 0.005).

Regional hyperaemic MBF estimated in absolute terms by dynamic dual-source computed tomography decreased significantly as PRI decreased.

**CLINICAL RELEVANCE/APPLICATION**

MBF is a quantitative parameter obviating the need of rest perfusion imaging, which may have clinical implications on availability, scan time and cost.

**ISP: Gastrointestinal (Crohn’s Disease)**

**SSQ06-01 • Gastrointestinal Keynote Speaker: Imaging of Crohns-Current Status and Future**

Jeff L Fidler MD (Presenter) *

**SSQ06-03 • Evaluation of Dynamic Contrast Enhanced and Diffusion Weighted Imaging for Quantitative Crohn’s Disease Assessment Based on Histopathologic Characterization**

Jeroen Tielbeek MD (Presenter) ; Manon L Ziech MD ; Zhang Li ; Cristina Lavini DPhil ; Shandra Bipat MS ; Frans M Vos PhD ; Jaap Stoker MD, PhD *

**SSQ06-04 • Global Patient Assessment of Crohn’s Disease Severity: Is MaRIA Sufficient, or Does Length of Enteric Inflammation Matter?**

Benjamin D Spilseth MD (Presenter) ; Jeff L Fidler MD * ; David Bruining MD * ; Stephanie Hansel MD * ; William S Harmsen ; Jordi Rimola MD * ; David R Holmes PhD ; Alan Larson ; Shiv Pruthi ; Joel G Fletcher MD *

The MaRIA score (MR Index of Activity) is a validated method for measuring the severity of Crohn’s disease enteric inflammation that is gaining widespread acceptance in the GI community, but does not take into account the length of enteric inflammation, which greatly impact patient function and disability. The purpose of our study was to determine if length of enteric inflammation improves the prediction of global and clinical Crohn’s disease severity scores compared to MaRIA alone.

**METHOD AND MATERIALS**

30 patients with known Crohn’s disease entered MR enterography within 30 days of ileocolonoscopy. Using a dedicated computer workstation, five colonic segments and 3 small bowel segments were systematically evaluated by two radiologists, who measured the MaRIA score and length of enteric inflammation using semi-automated tools for all inflamed bowel segments. A global physician score (GPS) of Crohn’s disease severity (ranging from 0-3) was created by a panel of gastroenterologists using ileocolonoscopy records, biopsy results, imaging reports, Harvey-Bradshaw index (HBI) scores, and C-reactive protein (CRP) was used as a reference standard.

**RESULTS**

For each reader, both MaRIA scores and lengths of enteric inflammation were significantly correlated with GPS (p < 0.0001), CRP (p < 0.0001), and cost.

**SSQ06-09 • Relationship between Hyperaemic Myocardial Blood Flow on Dynamic Dual-source Computed Tomography and Myocardial Perfusion Reserve Index on Magnetic Resonance Imaging**

Federica Pirro (Presenter) ; Ermanno Capuano MD ; Alexia Rossi MD ; Steffen E Petersen ; Lorenzo Bonomo MD ; Francesca Pugliese MD, PhD

To evaluate the relationship between regional hyperaemic myocardial blood flow (MBF) estimated in absolute terms by computed tomography, and perfusion reserve index (PRI) on adenosine stress first-pass magnetic resonance imaging (MRI; reference standard) in a population of patients with stable chest pain.

**METHOD AND MATERIALS**

**RESULTS**

Regional hyperaemic MBF estimated in absolute terms by dynamic dual-source computed tomography decreased significantly as PRI decreased.

**CONCLUSION**

DCE-MRI and DWI give comparable results but do not outperform conventional MRI parameters.

Quantitative parameters from conventional, DCE-MRI and DWI sequences correlate significantly to histopathologic scores of surgical specimens. DCE-MRI and DWI give comparable results but do not outperform conventional MRI parameters.
Excellent correlation exists between global and clinical markers of Crohn’s disease severity and MaRIA scores and measured lengths of enteric inflammation. Because MaRIA scores are highly correlated with length of enteric inflammation, neither was independently predictive of global physician score for both readers in this small cohort. In larger patient cohorts, incorporation of length measurement will likely be useful in a future quantitative model.

CLINICAL RELEVANCE/APPLICATION
Both the MaRIA score and measured lengths of enteric inflammation are highly related quantitative measures that correlate well with global assessment of Crohn’s disease severity.

SSQ06-05 • Diffusion-weighted MR Enterography for Evaluating Crohn’s Disease Activity: A Blinded Prospective Study of Diagnostic Performance Using Stratified Endoscopic Severity as the Reference Standard
Yedaun Lee MD (Presenter) ; Seong Ho Park MD * ; Kyung Jo Kim ; Bo-Kyeong Kang MD ; So Yeon Kim ; Seung Soo Lee MD

PURPOSE
To prospectively determine the performance of diffusion-weighted (DW) MR enterography (MRE) for evaluating bowel inflammation of Crohn’s disease

METHOD AND MATERIALS
17 men and 5 women with Crohn’s disease (mean age, 29.5 years) underwent conventional contrast-enhanced (CE) MRE and DW-MRE at b=0/500 s/mm² on a 1T system and ileocolonoscopy as the reference standard within 1-week interval. For precise location-by-location match between MRE and endoscopy, the terminal ileum, cecum and ascending colon, and rectum were only analyzed. CE-MRE and DW-MRE were reviewed independently blinded to each other except that the bowel segments to evaluate were pre-marked on DW-MRE by a third person given the lack of anatomical details on DW images. Hyperintensity of the bowel wall on DW-MRE comparable to the signal of mesenteric lymph nodes or the spleen (in the absence of lymph nodes); and presence of mural hyperenhancement, stratification, or T2 hyperintensity, perienteric infiltration, or comb sign on CE-MRE were considered positive findings. Endoscopic findings were stratified into 4 groups: normal or healed lesion (i.e. inactive) and three degrees of bowel inflammation including erythema/edema only, aphthoid lesions only, and overt ulcers. The sensitivity and specificity of DW-MRE and CE-MRE were compared.

RESULTS
A total of 64 bowel segments (22 with ulcers, 14 with aphthoid lesions, 2 with erythema/edema, and 26 inactive) were included. DW-MRE sensitivity was 86.4 (19/22), 57.1 (8/14), and 0% (0/2) for ulcers, aphthoid lesions, and erythema/edema, respectively, while the sensitivity of CE-MRE was 90.9 (20/22), 14.3 (2/14), and 0% (0/2), respectively, demonstrating no significant difference for ulcers albeit higher sensitivity in DW-MRE for all active lesions (71.1 vs. 57.9%). DW-MRE specificity (46.2% [12/26]) was significantly lower compared with CE-MRE (100% [26/26]). False-positive DW-MRE results occurred mostly in the colon (13/14) and was largely associated with undistended bowel (11/14).

CONCLUSION
DW-MRE was more sensitive than CE-MRE for non-ulcerative active bowel lesions but was less specific for excluding active inflammation, generating a high rate of false positives presumably related to undistended bowel.

CLINICAL RELEVANCE/APPLICATION
DW-MRE sensitively shows the bowel inflammation of Crohn’s disease; however, its propensity for false positivity and the high accuracy of CE-MRE obscures the real clinical benefit of DW-MRE.

SSQ06-06 • Does Abdominal Ultrasound Show Equivalence to Computed Tomography and Magnetic Resonance Enterography in Predicting Active Crohn Disease and Complications?
Saima Batool MBBS ; Aman Wadhwani BSC (Presenter) ; Kerri Novak MD * ; Stephanie R Wilson MD *

PURPOSE
To show the equivalence of abdominal ultrasound (US) with computed tomography (CT) or magnetic resonance enterography (MRE) /CTE, as gold standard imaging (GSI), in predicting active disease and intestinal complications in patients with crohn disease (CD).

METHOD AND MATERIALS
This retrospective review of 210 patients with CD compares US with temporally performed CT (n=70) or CTE (n=75)/MRE (n=65). Two independent reviewers, blinded to the final pathology, reviewed image files of all modalities for active disease predicted on the basis of wall thickness, hyperemia, and presence of mesenteric inflammatory fat. Complications were predicted based on their familiar morphologic appearances. Sensitivity (SN), specificity (SP), positive predictive value (PPV), negative predictive value (NPV), and accuracy (ACC) for active disease and complications visualized with US were calculated. In each instance, the advantages and disadvantages afforded by US relative to other modalities were documented.

RESULTS
In this select population, a majority presented to Emergency with acute complications. A total of 138 patients had thick bowel, inflammatory fat, and hyperemia on GSI, with agreement on US in 134 (SN 97%, SP 95.8%, PPV 98.5%, NPV 92% and ACC 96.7%). Complications were present on GSI in 118/210 patients. Cumulative US interpretation correctly diagnosed these complications in 105/118 (SN 95.8%, SP 96.3%, NPV 91.0% and ACC 92%). Although fistulae and strictured segments were shown with equivalence between modalities (n=84), US has an advantage to suggest incomplete mechanical bowel obstruction on the basis of dysphasic peristalsis and fixed bowel angulations. Localized perforations with phlegmons were more confidently identified with US although deep positioned abscess with large quantities of gas may be shown with superiority on CT scan. MR was superior for prediction of bowel wall edema and mucosal ulceration although the difference in determination of active disease between US and MR was inconsequential.

CONCLUSION
In our study US showed equivalent ability to predict active disease and a wide range of clinical complications, equal to and at times superior to that of either CT or CTE/MRE.

CLINICAL RELEVANCE/APPLICATION
US is a real-time method for diagnosis of CD and associated complications. Scanning patients for followup or at the time of acute clinical exacerbation is effective with this radiation free modality.

SSQ06-07 • Visualization of Bowel Motility Disorders in Patients with Inflammatory Bowel Disease by Development of an Automated Color-coding Algorithm in Cine MRI
Maria L Hahennman MD (Presenter) ; Felix Nensa MD ; Sonja Kinner MD ; Guido Gerken ; Thomas C Lauenstein MD

PURPOSE
The aim of this study was to establish an automated algorithm for visualizing and quantifying bowel motion disorders in cine MRI.

METHOD AND MATERIALS
Thirty patients with suspected or diagnosed inflammatory bowel disease underwent MR examination on a 1.5T scanner (Avanto, Siemens). In addition to the standard MRI bowel protocol, coronal T2-weighted cine MR images were acquired with a temporal resolution of 4.5s continously over a time span of 150s. After affine 2D respiratory motion correction, bowel motility was estimated from cine MRI using an optical flow algorithm and the resulting motion vector magnitudes were color-coded into bowel motility maps.

RESULTS
...
The acquisition of color-coded maps of bowel motility was feasible in all 30 patients. Increased or decreased bowel movement visualized by motility-mapping allowed for the detection of segments of abnormal bowel motility. Particularly, inflamed bowel segments exhibited a decreased motility.

CONCLUSION
Color-coded motility mapping in T2w cine MRI is a feasible and promising new approach for the assessment of bowel motility disorders. In future, this method may improve the detection of pathological conditions or abnormalities in bowel segments without or with only subtle signs of inflammation on morphologic images.

CLINICAL RELEVANCE/APPLICATION
This new technology may help to increase diagnostic accuracy for the depiction of inflamed bowel segments.

SSQ06-08 ● Pre-obstructive Changes in Small Bowel Motility in Stricturing Crohn’s Disease Appear Reversible on Investigation with MRE

Alex Menss (Presenter); Emma Helbren MBCh, FRCP; Jessica Makanyanga; David Atkinson*; Alistair Forbes; Al Windsor; Steve Halligan MD; Stuart A Taylor MBBS

PURPOSE
To examine whether abnormal motility in pre-obstructive, dilated bowel is reversible.

METHOD AND MATERIALS
21 patients with stricturing Crohn’s disease (9 Male, mean age 31) undergoing two 1.5T MR enterography (MRE) examinations (mean 14 months apart), were retrospectively identified. Multiple True FISP coronal motility sequences were acquired during 20 second breath holds (1 slice/0.8sec, TR 4ms, TE 1.7ms, slice thickness 10mm) to encompass the small bowel volume. On each of the two scans, a radiologist (5 years experience) placed an ROI in the dilated small bowel immediately upstream of the stricture, and in normal bowel remote from the diseased area. Using validated motility analysis software, measurements of small bowel motility (s.d of the pixel Jacobean determinant) and maximum bowel diameter were made. The percent change in bowel diameter and motility between the two scans was calculated for each ROI position and analysed using Spearman’s Rho.

RESULTS
The mean percentage change in pre-stricture bowel diameter and motility was -7% (range -70% to +65%) and -58% (range -625% to +89%) respectively. There was a negative correlation between the percentage change in diameter and motility (Spearman’s Rho coefficient -0.6, P = 0.007) ie as the diameter decreased, motility increased. There was no such correlation between diameter (mean change 3%, range -35% to 36%) and motility (mean change 11%, range -85% and 28%) in normal bowel (Spearman’s Rho 0.08, P = 0.94).

CONCLUSION
Motility changes in pre-stricture dilated bowel are fluid over time and different from normal bowel. As the bowel diameter decreases, motility increases and vice versa.

CLINICAL RELEVANCE/APPLICATION
Medical management could be favourable over surgery in some instances. Loss of function in the small bowel is potentially reversible.

SSQ06-09 ● Comparison of Bismuth, Tungsten, and Tantalum Enteric Contrast Agents to Complement Iodine for Double Contrast Dual-energy CT Enterography

Samira Rathnayake (Presenter); John Mongan MD, PhD*; Yanjun Fu PhD; Andrew S Torres PhD*; Dongwei Gao MD; Margaret J Wong MENG, BS; Wilbur Wang BA; Benjamin M Yeh MD*

PURPOSE
To investigate the effectiveness of double contrast DECT obtained with iodinated intravenous and non-iodinated enteric contrast for small bowel wall and vasculature visualization, compared with conventional CT.

METHOD AND MATERIALS
13 patients with Crohn’s disease (9 Male, mean age 31) undergoing two 1.5T MR enterography (MRE) examinations (mean 14 months apart), were retrospectively identified. Multiple True FISP coronal motility sequences were acquired during 20 second breath holds (1 slice/0.8sec, TR 4ms, TE 1.7ms, slice thickness 10mm) to encompass the small bowel volume. On each of the two scans, a radiologist (5 years experience) placed an ROI in the dilated small bowel immediately upstream of the stricture, and in normal bowel remote from the diseased area. Using validated motility analysis software, measurements of small bowel motility (s.d of the pixel Jacobean determinant) and maximum bowel diameter were made. The percent change in bowel diameter and motility between the two scans was calculated for each ROI position and analysed using Spearman’s Rho.

RESULTS
The mean percentage change in pre-stricture bowel diameter and motility was -7% (range -70% to +65%) and -58% (range -625% to +89%) respectively. There was a negative correlation between the percentage change in diameter and motility (Spearman’s Rho coefficient -0.6, P = 0.007) ie as the diameter decreased, motility increased. There was no such correlation between diameter (mean change 3%, range -35% to 36%) and motility (mean change 11%, range -85% and 28%) in normal bowel (Spearman’s Rho 0.08, P = 0.94).

CONCLUSION
Motility changes in pre-stricture dilated bowel are fluid over time and different from normal bowel. As the bowel diameter decreases, motility increases and vice versa.

CLINICAL RELEVANCE/APPLICATION
Development of tantalum or tungsten enteric agents should enable clearer bowel wall and abdominopelvic vasculature visualization for double contrast DECT than conventional CT.

Gastrointestinal (Gallbladder and Biliary Imaging)

Thursday, 10:30 AM - 12:00 PM ● E353C

SSQ08 ● AMA PRA Category 1 Credit ™:1.5 ● ARRT Category A+ Credit:1.5

Moderator
Michael A Blake, MBChB *
Moderator
David J Lomas, MD

SSQ08-01 ● Early Gallbladder Cancer: CT and MR Findings with Pathologic Correlation

Charles H Mitchell (Presenter); Pamela T Johnson MD*; Elliot K Fishman MD*; Ralph H Hruban*; Siva P Raman MD

PURPOSE
The purpose of this study was to evaluate the efficacy of CT and MR imaging in the detection and staging of early gallbladder cancers. The study included a retrospective review of CT and MR images of patients with early gallbladder cancers. The images were compared with pathologic findings.

RESULTS
The study found that CT and MR imaging were effective in the detection and staging of early gallbladder cancers. CT imaging was more effective in identifying lesions, while MR imaging provided better characterization of lesions.

CONCLUSION
CT and MR imaging are effective in the detection and staging of early gallbladder cancers. Further research is needed to determine the optimal imaging modality for early detection.

CLINICAL RELEVANCE/APPLICATION
The use of CT and MR imaging in the detection and staging of early gallbladder cancers can improve patient outcomes and guide treatment decisions.
METHOD AND MATERIALS
Following IRB approval, 18 patients (10 female, 8 male) were identified in the pathology database with T1, T2, and T3 gallbladder cancers. Patient demographics were recorded, and the medical record was searched to determine if the tumor was correctly diagnosed on CT, MRI, or US. Each of the patients’ preoperative CT or MRI studies were retrospectively reviewed by a board-certified radiologist with regard to tumor morphology (focal thickening, diffuse thickening, polypoid mass), tumor size, presence of gallstones, lymphadenopathy, carcinomatosis, and liver invasion/metasases.

RESULTS
There were 2 T1 tumors, 6 T2 tumors, and 10 T3 tumors. 10 patients were found to have lymph node metastases at surgery, with 4 of these identified during retrospective CT/MR review. 6 lesions presented as a discrete polypoid mass, 9 as focal wall thickening, and 3 as diffuse wall thickening. Of the 6 polypoid masses, the mean maximum diameter was 37 mm (range 15 - 61 mm). Of the 9 tumors with focal wall thickening, the average thickness was 9 mm (range 8 - 24 mm) over a length of 32 mm. CT correctly identified the malignancy prospectively in 12/18 cases, while ultrasound did not make the correct diagnosis prospectively in 2/3 cases. 5 cases demonstrated hepatic invasion and 4 cases demonstrated gallstones.

CONCLUSION
The cross-sectional imaging findings of early gallbladder cancer can be subtle: The most common appearance in this series was limited focal wall thickening, and even the polypoid masses were quite small. Not surprisingly, 1/3 of cases in this series were not correctly diagnosed prospectively on CT/MRI. Identification requires an understanding of the appearance of early gallbladder cancer and dedicated evaluation of the gallbladder in every case. Future investigations should evaluate the utility of MPRs for improving diagnostic accuracy.

CLINICAL RELEVANCE/APPLICATION
The findings of gallbladder cancer in its earliest stages can be extremely subtle, requiring a careful evaluation of the gallbladder in both the axial plane and using multiplanar reformat.
at initial attack of all 59 patients and at the time of relapse of 23 patients were reviewed by two radiologists in consensus regarding the extent and degree of bile duct changes and extrabiliary organ involvement. The clinical data including patients\' age and gender, serology and pathology findings, if available, and steroid therapy regimen at initial attack were recorded. For 23 patients with relapsed IgG4-SC, image findings were compared between initial attack and relapse. To determine risk factors of relapse, image findings and clinical data at initial attack were compared between 23 patients with relapse and 36 patients without relapse using univariate and multivariate analysis.

RESULTS
The relapsed IgG4-SC was characterized by more frequent extrapancreatic and multiple bile duct strictures, a greater number of involved bile duct segment, thicker bile duct wall, and a less frequent combination with autoimmune pancreatitis compared with initial attack (P = .016). On univariate analysis, relapse group was significantly associated with a less frequent performance of maintenance steroid therapy, more frequent extrapancreatic and multiple bile duct strictures, a greater number of involved bile duct segment, and thicker bile duct wall at initial attack than in non-relapse group (P = .023). On multivariate analysis, no performance of maintenance steroid therapy and more severe bile duct wall thickening were independently associated with relapse, with odds ratio of 6.6 and 4.1, respectively (P = .041).

CONCLUSION
The image findings of IgG4-SC at relapse were more aggressive than those at initial attack. The severity of bile duct changes and the performance of maintenance steroid therapy were associated with relapse of IgG4-SC after steroid therapy.

CLINICAL RELEVANCE/APPLICATION
When there are severe bile duct changes in patients with IgG4-SC, more aggressive steroid therapy than standard regimen and maintenance therapy may be necessary due to a high risk of relapse.

SSQ08-05 • Mucus Thread Sign of the Biliary Intraductal Papillary Mucinous Neoplasm on Magnetic Resonance Imaging Including Magnetic Resonance Cholangiography and Diffusion-weighted Imaging
Gil-Sun Hong MD (Presenter); Jae Ho Byun MD; Seung Soo Lee MD; Namkug Kim PhD; Jin Hee Kim MD; Hyoung Jung Kim MD; Yedaun Lee MD; Moon-Gyu Lee MD

PURPOSE
To evaluate a mucus thread sign of biliary intraductal papillary mucinous neoplasm (IPMN) on magnetic resonance imaging (MRI) including MR cholangiography (MRC) and diffusion-weighted imaging (DWI).

METHOD AND MATERIALS
This retrospective study was approved by our institutional review board, and informed consent was waived. Forty-one patients with pathologically confirmed biliary IPMNs, were included in this study. The definite mucus thread sign was defined as linear or curvilinear dark striations in the bile duct. The mucus thread sign were retrospectively analyzed on MRI including MRC (thin-section MRC, thick slab MRC, and 3D MRC) and DWI. For quantitative analysis in 18 patients with the definite mucus thread sign on DWI, apparent diffusion coefficient with b-factors of 150 (ADC$_{150}$) and 1000 (ADC$_{1000}$) of mucus thread sign were compared with those of normal bile. The prevalence of definite mucus thread sign was compared among the MRI and MRC sequences. The relationship between prevalence of definite mucus thread sign and the pathologic grade, the diameter of the dilated bile ducts or the maximum diameter of visible mass of biliary IPMN were statistically evaluated.

RESULTS
DWI with a b-value of 150 demonstrated the definite mucus thread sign better than HASTE or TSE T2-weighted images (70% [19/27], 50% [17/34] and 9.1% [3/33], respectively; P < 0.001). At MRC, the definite mucus thread sign was present in 78.0% (32/41) patients with biliary IPMNs. There was no statistically significant difference in the prevalence of the definite mucus thread sign among the three MRC sequences (thin-slice MRC, thick slab MRC, and 3D MRC; 67.6% [25/37], 46.2% [18/39] and 45.2% [14/31]; P = 0.093). ADC$_{150}$ and ADC$_{1000}$ of the definite mucus thread sign (6.35 ± 2.43 and 3.02 ± 0.42, respectively) were significantly higher than those of normal bile (3.03 ± 0.32 and 2.72 ± 0.23; P < 0.001 and P = 0.01). The prevalence of definite mucus thread sign correlated well with only the diameter of the extrahepatic bile duct (P = 0.001).

CONCLUSION
The definite mucus thread sign, a characteristic finding of biliary IPMN, is well demonstrated on MRI including MRC and DWI.

CLINICAL RELEVANCE/APPLICATION
The definite mucus thread sign on MRI including MRC and DWI is very helpful to diagnose biliary intraductal papillary mucinous neoplasm.

SSQ08-06 • Comparison between Fundamental Images and Harmonic Images with High Back Ground Noise for Detection of Microcrystals in Gall Bladder
You Jin Ku (Presenter); Chul Soon Choi MD; Dae Young Yoon MD; Eun Joo Yun; Young Lan Seo; Kyoung Ja Lim; Sora Baek; Sang H Bae MD, PhD

PURPOSE
To compare conspicuity of fundamental ultrasonographic (FUS) images and harmonic US imaging with high back ground noise (HUSN) for detection of microcrystals in the gall Bladder.

METHOD AND MATERIALS
From November 30, 2012 to March 18, 2013, patients who showed microcrystals in the Gall bladder detected on US were included in this study. Exclusion criteria were gall stones, gall bladder sludge and acute calculous cholecystitis.

During training images, we performed fundamental US images (FUS) and Harmonic US images with high back ground noise (HUSN). All ultrasound examinations were performed by one radiologist, who had more than 20 years of experience in abdominal ultrasound, with an IU 22 ultrasound unit (Philips Medical Systems, Bothell, WA, USA) using a 2- to 5-MHz convex array transducer.

After obtaining images, two radiologists who are a 3th year resident and a specialist having 20 years of US imaging, graded the conspicuity of each images with FUS and HUSN in consensus. The grades were G(1): absent microcrystal, G(2): equivocal, G(3): vague and G(4): clear and present. Grades of both images are statistically compared with Wilcoxon rank sum test. A p-value less than 0.05 was considered to be statistically significant.

RESULTS
There were 18 patients. Their average age was 55.3 years with standard deviation of 12.8 years. The male to female ratio was 11 versus 7. Six patients revealed symptom and 12 patients were asymptomatic. FUS images were G1 in 7 patients, G2 in 5 patients, G3 in 4 patients, G4 in 2 patients. In contrast to FUS images, HUSN images were G1 in none, G2 in 1 patient, G3 in 2 patients, G4 in 15 patients. Wilcoxon rank sum test showed p-value of 0.0002 between two image grading.

CONCLUSION
HUSN images were superior to FUS images for detection of microcrystals in the gall bladder probably due to Rayleigh scattering.

CLINICAL RELEVANCE/APPLICATION
Harmonic image with high back ground noise could demonstrate microcrystals within gall bladder, which are not usually seen on routine fundamental ultrasonography.

SSQ08-07 • Clinical Utility of MR Cholangiopancreatography in the Assessment of Acute Cholecystitis in the Emergency Setting
Jennifer W Uyeda MD (Presenter); Vijay Ramalingam MD; Amrita P Devalapalli BS; Stephen W Anderson MD; Jorge A Soto MD *
PURPOSE
To assess the utility of MRCP in the assessment of acute cholecystitis in the emergency setting with emphasis on patients in whom US and MRCP results are discordant.

METHOD AND MATERIALS
The institutional review board approved this HIPAA-compliant retrospective study. Informed consent was waived. 371 consecutive adults (120 males, 251 females) who presented to the emergency department with abdominal pain between 4/1/2010 and 2/28/2013 who underwent US and MRCP within a 48-hour period were included. MRCP was performed for further assessment of bile duct dilatation. US and MRCP reports were reviewed and were classified as positive, negative or equivocal for the diagnosis of acute cholecystitis. Medical electronic records were reviewed to determine subsequent management and pathology findings.

RESULTS
In 275 (74.1%) of 371 patients, the results of US and MRCP were concordant. 73 (19.7%) patients had negative or equivocal results for acute cholecystitis but MRCP was positive. Of these 73 patients, 52 (71%) underwent cholecystectomy and 3 underwent percutaneous drainage. Of the 52 patients who underwent cholecystectomy with negative or equivocal US findings but positive MRCP findings for acute cholecystitis, 22 (42%) were pathologically proven acute cholecystitis while the remaining 30 were pathologically proven chronic cholecystitis. Of the 371 US examinations, 23 (6.2%) were positive or suspicious for acute cholecystitis on US but negative on MRCP. 14 (61%) of these 23 patients underwent cholecystectomy and 2 (9%) were pathologically proven acute cholecystitis; 12 were pathologically proven chronic cholecystitis.

CONCLUSION
US is the study of choice in patients with acute right upper quadrant suspected to have acute cholecystitis. MRCP provides additional information in select cases. However, MRCP has limitations in discriminating between acute and chronic cholecystitis.

CLINICAL RELEVANCE/APPLICATION
MRCP should be considered in the evaluation of patients suspected to have acute cholecystitis in the emergency setting, particularly when US has negative or equivocal findings.

SSQ08-08 • The Technologist-performed Sonographic Murphy’s Sign: Is It Really an Accurate Test?
Ronald O Bude MD (Presenter) ; Richard K. J. Brown MD * ; Ehab H Youssf MD, FRCR

PURPOSE
In our dept. the sonographic Murphy’s sign, performed by technologists who have not been physician-trained to elicit it, is generally considered the best ultrasound test for detecting acute cholecystitis. Technologist criteria for a positive test vary widely, from pain at probe contact of the RUQ skin to pain at probe palpation of the gallbladder in deep inspiration. We questioned the validity of this evaluation and performed a study to evaluate the test done this way.

METHOD AND MATERIALS
HIDA scan was the gold standard for detection of acute cholecystitis, due to the variability of our pathologists’ criteria (which varied from a few lymphocytes in the gallbladder wall to the need for transmural perforation) and the subjectivity and potential bias of the surgeons’ impressions at operation. All adults in a consecutive 3 year period fulfilling the following criteria were studied: unequivocal HIDA scan; US within one day of HIDA; recorded unequivocal sonographer’s Murphy sign evaluation. Timing of narcotic analgesia was noted. Sensitivities and specificities were calculated.

RESULTS
Study population: 383 patients. The Murphy's sign is used in our dept. without taking narcotic analgesia or presence of gallstones into account. Used this way the sensitivity and specificity for detecting acute cholecystitis, respectively, were 45% (46/103) and 57% (159/280). Interestingly, 43% of patients (163/383) had narcotic analgesia within two hours before US, which probably influenced the results. However, even when considering patients with gallstones who did not have narcotic analgesia for at least 24 hours before US, the sensitivity and specificity were still only 63% (20/32) and 60% (36/60), respectively. Sensitivities and specificities for other combinations of yes/no stones and narcotic timings were similarly unimpressive, but space limits giving them here.

CONCLUSION
The sonographic Murphy’s sign, when performed by technologists not trained in its performance, is neither sensitive nor specific for the detection of acute cholecystitis. It remains to be proven whether this test is useful when performed by physicians, or by ancillary personnel specifically trained in its performance, given the prevalence of narcotic analgesia.

CLINICAL RELEVANCE/APPLICATION
The sonographic Murphy’s sign, when performed by technologists not specifically trained for it, is neither sensitive nor specific for the detection of acute cholecystitis.

SSQ08-09 • MR Signal Change of Hepatobiliary Imaging after Oral Ingestion of Manganese Chloride Tetrahydrate: Preliminary Examination
Nagaaki Marugami (Presenter) ; Megumi Takewa MD ; Junko Takahama MD ; Aki Takahashi MD ; Tomoyuki Okuaki ; Kimihiko Kichikawa MD

PURPOSE
Manganese Chloride Tetrahydrate (MCT) is widely used as a negative oral contrast agent to improve the image quality of MRCP. The purpose of this study is to clarify the MR signal change of the hepatobiliary imaging due to the absorption and excretion of MCT even during routine clinical MRCP examination by assessing it qualitatively and quantitatively.

METHOD AND MATERIALS
The study period were MCT phantom, 10 healthy volunteers and 155 consecutive patients. In phantom study, the relationship between MCT concentration and MR signal intensity (2D MRCP, T1WI and R2* mapping) was evaluated. In volunteer study, we analyzed the time course of hepatobiliary imaging control, 30 60, 120 and 180 minutes after oral ingestion of MCT qualitatively and quantitatively. In clinical study, we analyzed the incidence and factor affecting signal change on additional MRCP with MCT as a final scan during routine clinical MRCP examination.

RESULTS
In phantom study, a significant excellent linear positive correlation was found between MCT concentration and R2* value (r2=0.996, p<0.01). In volunteer study, we analyzed the time course of MR signal intensity of MCT, 30 60, 120 and 180 minutes after oral ingestion of MCT. In clinical study, we analyzed the incidence and factor affecting signal change on additional MRCP with MCT as a final scan during routine clinical MRCP examination.

CONCLUSION
We recommend that MRCP be performed early after oral ingestion of MCT because signal drop happens even during routine MRCP.

CLINICAL RELEVANCE/APPLICATION
The delineation of the bile duct and increase of hepatic R2* value after oral ingestion of MCT may be obtained as additional benefits of contrast enhanced MRC and quantification of manganese uptake.
SSQ10 • AMA PRA Category 1 Credit ™: 1.5 • ARRT Category A+ Credit: 1.5

Moderator
Mindy M Horrow, MD *

Moderator
Dean A Nakamoto, MD *

SSQ10-01 • IgG4-Related Renal Disease: MR Findings with Emphasis on the Usefulness of Diffusion-weighted Imaging

Bohyun Kim MD (Presenter) ; Jin Hee Kim MD ; Seong Ho Park MD * ; So Yeon Kim MD ; Jae Ho Byun MD ; Jeong Kon Kim MD

PURPOSE
To describe imaging characteristics of IgG4-related renal disease (IgG4-RD) on MR including diffusion-weighted imaging (DWI) and to evaluate the usefulness of DWI for lesion detection.

METHOD AND MATERIALS
We retrospectively identified 28 patients with pathologically or clinically diagnosed IgG4-RD who underwent MR covering the kidneys. Of 28 patients, 18 underwent DWI (b values of 0, 150, 500, and 1000 sec/mm²) and 19 underwent contrast-enhanced MR (CE-MR) with dynamic triple-phase including arterial, portal, and equilibrium phase (n=15) or single portal-phase (n=4) scanning. Two radiologists reviewed consensus all MR images to assess the lesion location and number, and signal intensity (SI) of the lesions compared to the normal renal parenchyma on T1-weighted images (T1WI), T2WI, DWI, and CE-MR. The sensitivity of each sequence for lesion detection was obtained and the results were compared between T2WI, DWI, and dynamic CE-MR. The sensitivity of MR with DWI and MR without DWI was also compared. The ADC value of IgG4-RD (for the largest lesion, if multiple) and normal renal parenchyma was compared.

RESULTS
The most common findings of IgG4-RD on MR were bilateral (85.7%), multiple (92.9%), renal parenchymal (85.7%) lesions appearing iso-SI (96.4%) on T1WI, low SI (78.6%) on T2WI, high SI (100%) on DWI (b value of 1000 sec/mm²), and low SI (86.7%) in the arterial phase with progressive enhancement pattern on dynamic CE-MR. The sensitivity of DWI (100%) was higher than those of T2WI (78.6%) and dynamic CE-MR (86.7%) although there was no statistically significant difference between the sequences (P=.068). The sensitivity of MR with DWI was significantly higher than that of MR without DWI (100% vs .70%, P=.037). The mean ADC value of IgG4-RD was significantly lower than that of the normal renal parenchyma (1.28x10⁻³ mm²/sec vs. 1.97x10⁻³ mm²/sec, P<.001).

CONCLUSION
The characteristic MR findings of IgG4-RD were bilateral, multiple, renal parenchymal lesions with T2 hypointensity, diffusion restriction, and progressive enhancement pattern. DWI was very useful to detect IgG4-RD and its sensitivity was higher than those of conventional MR sequences.

CLINICAL RELEVANCE/APPLICATION
It may be helpful to be aware of typical MR findings of IgG4-RD for the diagnosis of IgG4-related sclerosing disease in equivocal cases. The use of DWI may enhance the detection of IgG4-RD.

SSQ10-02 • 10% Tumor Diameter Shrinkage on the First Follow-up CT Predicts Clinical Outcome in Patients with Advanced Renal Cell Carcinoma Treated with Angiogenesis Inhibitors: A Follow-up Validation Study

Katherine M Krajewski MD (Presenter) * ; Yoko Franchetti PhD ; Mizuki Nishino MD ; Nikhil H Ramaiya MD ; Annick D Van Den Abbeele MD ; Toni Choueiri MD

PURPOSE
Vascular Endothelial Growth Factor (VEGF)-targeted agents are standard therapies for metastatic renal cell carcinoma (mRCC), associated with variable tumor shrinkage. Response Evaluation Criteria In Solid Tumors (RECIST) is of limited utility in this setting, and other imaging changes are sought to reliably predict outcome early. We aim to validate 10% tumor shrinkage as the best early indicator of outcome.

METHOD AND MATERIALS
In this institutional review board-approved, HIPAA-compliant study, 66 mRCC patients with 165 lesions on clinical trials of VEGF-targeted agents underwent thoracic and abdominal CT at baseline and at first follow-up after therapy. Measurements were performed according to RECIST and Tumor Shrinkage of >10% decrease in sum of the longest diameter (-10%SLD). Correlation with time-to-treatment failure (TTF) and overall survival (OS) were compared and stratified by response to the radiologic criteria. Receiver Operating Characteristics (ROC) analysis yielded the optimal threshold change in SLD defining patients with prolonged survival.

RESULTS
More than -10%SLD significantly differentiated responders from non-responders (median TTF 8.4 vs. 4.1 months, p = 0.001) while partial response by RECIST did not (median TTF 6.9 versus 5.5 months in responders vs. non-responders, p = 0.34). -10%SLD was also significantly predictive of OS (median OS 35.1 vs. 15.0 months in responders vs. non-responders, p = 0.003). ROC curve analysis yielded -9.3% in SLD as the optimal threshold for response/no-response.

CONCLUSION
Ten percent tumor shrinkage is validated as a reliable early predictor of outcome in mRCC patients receiving VEGF-targeted therapies and may provide a practical measure to guide therapeutic decisions.

CLINICAL RELEVANCE/APPLICATION
10% tumor shrinkage is validated as a reliable and reproducible early predictor of outcome applicable to mRCC patients receiving various VEGF-targeted therapies.

SSQ10-03 • 3D Contrast Enhanced Ultrasound vs. Renal DTPA in the Detection of Perfusion Defects in Early Renal Transplants-Preliminary Findings

Ben Stenberg MSc (Presenter) ; Simon T Elliott MBChB, FRCR * ; Emma Tran BSC

PURPOSE
In the UK, technetium 99m renogam (DTPA) is the primary investigation for perfusion defects post-transplantation. It has high reported accuracy (up to 99% sensitivity), but time consuming, expensive and has the innate risks of an examination using ionising radiation. Contrast enhanced ultrasound (CEUS) is an emerging technology which may solve these issues, giving greater spatial and temporal resolution while having the potential to robustly quantify the degree of defect using 3D acquisition and stacked contour measurement system. However, little research has been done to investigate whether CEUS has the ability to maintain the high sensitivity rates to replace DTPA as the primary investigation, is achievable in this patient group and can be quantified using 3D data sets.

METHOD AND MATERIALS
This project used a blinded, cross over trial using 105 renal transplant patients examined with CEUS and compared to the DTPA within the immediate post-surgical phase. The examinations were reported independently of each other. Each CEUS was performed using a side by side, low MI technique, with a bolus injection of 2.4mL Sonovue (Bracco, Italy). 1 minute of 2D capture was acquired to manually assess the kidney perfusion and to allow for the medullary filling phase. A 3D volume of the whole kidney was then acquired in contrast specific mode.

RESULTS
All 105 patients underwent CEUS and imaging of the kidney was achieved in 100% of the cases (74/31 male/female) (34/71...
CONCLUSION
CEUS is more sensitive in the detection of perfusion defects in early renal transplants and the high resolution and 3D data acquisition techniques allow for robust quantification of the global renal perfusion. This technique is considered 'off-label' by the FDA.

CLINICAL RELEVANCE/APPLICATION
CEUS is achievable and more sensitive in the detection of perfusion defects in early kidney transplants than DTPA and has the ability to quantify defects accurately using 3D stacked contours.

SSQ10-04 • Assessment of Delayed Renal Allograft Function by Diffusion Tensor Imaging and Arterial Spin Labeled Magnetic Resonance Imaging
Katja Hueper (Presenter); Marcel Gutterlet; Frank Lehner MD; Nicolas Richter MD; Nils Hanke MD; Jan Becker MD; Matti Peperhove MD; Hermann Hailer MD; Frank K Wacker MD *; Wilfried Gwinner MD; Dagmar Hartung MD; Antonia Zapf

PURPOSE
Delayed renal allograft function (DGF) is clinically defined as failure of serum creatinine to adequately decrease or need for dialysis during the first week after transplantation. DGF is associated with an increased risk for graft loss, acute rejection, and impaired long-term allograft function. In this study, we investigate whether diffusion tensor imaging (DTI) and arterial spin labeled (ASL) MRI allow assessment of DGF.

METHOD AND MATERIALS
The study was approved by the local ethics committee; written informed consent was obtained. Between July 2012 and February 2013 forty patients were examined between d4-d10 after kidney transplantation using a 1.5 T magnet. Echoplanar DTI (b=0,600 s/mm², 20 diffusion directions) and flow alternating inversion recovery (FAIR) trueFISP ASL sequences were acquired. Parameter maps of fractional anisotropy (FA) and renal perfusion were calculated. Serum creatinine was examined, and DGF was diagnosed by a nephrologist. Renal biopsy was available in 16/40 patients. Statistical analysis comprised unpaired t-tests for comparison of mean renal FA and perfusion values between patients with normal initial graft function and with DGF and correlation analysis between MRI parameters and serum creatinine.

RESULTS
DGF was diagnosed in 19/40 patients and 9 patients had an acute rejection at histology. Mean medullary FA was significantly lower in patients with DGF (0.230±0.067) when compared to patients with normal initial graft function (0.302±0.067; p=0.0009 for Group C against p=0.004 for Groups A and B). Both readers agreed that the degree of fat saturation was greater with Dixon without any displacement artifacts. On qualitative analysis, a statistically significant difference was found in overall image quality and fat suppression characteristics, with the DIXON (p=0.0009 for Group C against p=0.004 for Groups A and B). Both readers agreed that the degree of fat saturation was greater with Dixon without any displacement artifacts. Performances of the sole DIXON were excellent for the identification of tumoral process, fatty component as well as hemorrhagic part (sensitivity = 100%). For quantitative analysis, the SNR of kidney parenchyma was significantly superior with Dixon compared to corresponding information of Groups A and B. Calculated tissue contrast was significantly increased in Dixon for each corresponding image (0.85 vs 0.61 for Group A, 0.71 vs 0.55 and 0.48 vs 0.35 for Group B IP/OP, respectively).

CONCLUSION
DTI and ASL by assessment of renal microstructure and perfusion enable detection of DGF and MRI parameters significantly correlate with renal allograft function. Thus, these techniques may be useful for risk stratification during the early post-transplantation period and may provide additional information to kidney biopsy.

CLINICAL RELEVANCE/APPLICATION
DTI and ASL can be used to non-invasively assess renal microstructure and perfusion and may help to early detect and characterize renal pathology associated with delayed renal allograft function.

SSQ10-05 • MR Renal Imaging Using a 3D T1-weighted Two-point Dixon Sequence at 3T: Is It an Efficient Alternative to Standard Fat Suppression Techniques?
Catherine Roy MD (Presenter); Philippe Host MD; Guillaume Aleman MD; Mickael Ohanna; Herve Lang

PURPOSE
Standard fat suppression techniques such as 2D chemical shift (IP/OP) and spectral saturation sequences are a workhorse of renal MRI. However, they are vulnerable to field and RF inhomogenieties. A 3D two-point DIXON method delivers up to four contrasts in one measurement: IP/OP/water and fat images. The purpose was to assess whether DIXON can be an efficient alternative to standard techniques in terms of quality and examination time.

METHOD AND MATERIALS
158 patients referred for kidney MR examination (68 normal, 75 carcinomas, 15 angiomyolipomas) underwent on a 3T MR unit in addition to our routine protocol three axial T1w fat suppression techniques: Group A (spectral saturation FFE, 5 mm, 28 slices, 25 sec), Group B (2D chemical shift FFE, 5mm, 32 slices, two breathholds of 28 sec, IP/OP images) and Group C (3D two-point Dixon, 1.8mm, 100 slices, 15s) with IP/OP/W/F images. Qualitative and quantitative analysis were performed by two readers independently. Criteria used for qualitative analysis were: fat suppression homogeneity and intensity, overall image quality and diagnosis confidence. For quantitative evaluation they used measurement of SNR between SI of kidney parenchyma and background noise by mean of an identical ROI. Tissue contrast was calculated between normal kidney and fat by using the equation [C=(A-B)/(A+B)].

RESULTS
On qualitative analysis, a statistically significant difference was found in overall image quality and fat suppression characteristics, with the DIXON (p=0.0009 for Group C against p=0.004 for Groups A and B). Both readers agreed that the degree of fat saturation was greater with Dixon without any displacement artifacts. Performances of the sole DIXON were excellent for the identification of tumoral process, fatty component as well as hemorrhagic part (sensitivity = 100%). For quantitative analysis, the SNR of kidney parenchyma was significantly superior with Dixon compared to corresponding information of Groups A and B. Calculated tissue contrast was significantly increased in Dixon for each corresponding image (0.85 vs 0.61 for Group A, 0.71 vs 0.55 and 0.48 vs 0.35 for Group B IP/OP, respectively).

CONCLUSION
The 3D Dixon achieved superior image quality and fat saturation in a shorter time with four informations. It can replace in daily routine standard fat suppression techniques.

CLINICAL RELEVANCE/APPLICATION
The 3D T1w Dixon technique can replace standard fat suppression techniques.

SSQ10-06 • ECG-triggered, Time-resolved Diffusion Weighted Imaging (DWI) of the Kidney: Assessment of Diffusion Parameters over the Entire Cardiac Cycle
Rotem S Lzman MD (Presenter); Philipp Heusch MD; Julia Weller; Anja Lutz; Gerald Antoch MD *; Hans-Joerg Wittsack PhD

PURPOSE
The purpose of this study was to assess changes in renal diffusion properties over the entire cardiac cycle using ECG-gated, time-resolved diffusion-weighted imaging (DWI).

METHOD AND MATERIALS
20 healthy volunteers (10 males, 10 females, 26.2 ± 7.2 years) were investigated on a 1.5T MR scanner (Magnetom Avanto, Siemens AG, Erlangen, Germany) using a 6 channel body matrix coil combined with spine array coil integrated into the scanner table. Blood flow within the renal arteries was determined by ECG-gated phase contrast (PC) flow measurements. For time-resolved renal diffusion weighted imaging (DWI), an ECG-gated and respiratory-triggered coronal single-slice EPI-sequence was acquired at 14 defined time points over the cardiac cycle (20, 70, 120, 170, 220, 570, 620, 720 ms after R-wave) using the following imaging parameters: 4 b-values (0, 50, 100, 300 s/mm²). 3 orthogonal diffusion directions, TR/TE = 3000ms/66ms, FOV=400mm2, MxP = 192x192, slice thickness 6 mm.

ROI measurements were performed in the renal cortex on apparent diffusion coefficient (ADC) parameter maps acquired at different time points. An ADC pulsatility index (PIADC) was defined as normalized maximal change in ADC values within the cardiac cycle (ADXmax/ADXmin).

RESULTS
Image acquisition was completed successfully in all subjects. Mean blood flow in the renal arteries showed a minimal velocity of 16.9 ± 5.6 cm/s at the time-point of the R-wave raising to a maximum of 40.4 ± 10.6 cm/s about 142ms after the R-wave.

CONCLUSION
Renal ADC values as determined by time-resolved DWI exhibit pulsatile characteristics over the cardiac cycle. As there is a significant difference in systolic and diastolic ADC values, an ADC pulsatility index can be calculated. Further studies are required to determine the diagnostic value of the ADC pulsatility index in patients with renal pathologies.

CLINICAL RELEVANCE/APPLICATION
Time-resolved DWI detects significant changes in renal ADC values throughout the entire cardiac cycle and has the potential to become a diagnostic tool for the evaluation of renal pathologies.

SSQ10-07 • Enhancement Characteristics of Kidney on Multi-phase Pancreatic MRI as Predictor of Acute Renal Injury in Patients with Acute Pancreatitis

Xing-Hui Li (Presenter) ; Xiao M Zhang MD, PhD ; Yifan Ji

PURPOSE
To investigate the relationship between presences of delayed nephrographic progression on MRI obtained within 72 hours of onset of AP and development of acute kidney injury (AKI)

METHOD AND MATERIALS
RESULTS
CONCLUSION
Mean RER of renal medulla was significantly higher in patients with acute pancreatitis who later developed ARI than those who did not. RER may be useful in predicting AKI and determining the severity of AP on MRI.

CLINICAL RELEVANCE/APPLICATION
(dealing with enhancement MRI and AKI in AP patients) RER may be useful in predicting AKI and determining the severity of AP on MRI.

SSQ10-08 • Contrast Enhanced Ultrasound Nephrostogram vs. Fluoroscopic Nephrostogram: Initial Results

Mohammad Daneshi MBBS (Presenter) ; Gibran Yusuf MBBS ; Ketul Patel ; Maria E Sellars MD, FRCR ; Dean Y Huang MBBS, FRCR ; Paul S Sidhu MRCP, FRCR *

PURPOSE
The use of contrast-enhanced ultrasound (CEUS) has extended beyond its traditional uses, and the possibility to delineate percutaneous tubes and drains is now achievable. Percutaneous fluoroscopic nephrostomy insertion is the standard management for an obstructed kidney, with fluoroscopic nephrostomy being the conventional method to image the urinary tracts following nephrostomy insertion. We have compared the traditional fluoroscopic nephrostogram using iodinated contrast agents with CEUS nephrostogram to ascertain the accuracy, utility and convenience of the CEUS nephrostogram.

METHOD AND MATERIALS
The standard conventional nephrostogram was performed immediately prior to the CEUS nephrostogram. The CEUS nephrostogram technique involved diluting 0.2ml of SonoVue with 40 ml of normal saline and introduced into the renal collecting system via the nephrostomy tube. Digital cine-clips and still images of the CEUS nephrostogram examination were recorded to allow accurate retrospective comparison by two independent reviewers to the reference standard.

RESULTS
Twelve nephrostomies in 10 patients (median age 64 yrs, range 29-91 yrs, 6 female and 4 male) were performed and reviewed. The causes of obstruction were ureteric calculus (n=3), ureteric stricture (n=2), malignancy (n=3), ureteric clot (n=1) and reflux (n=1). The renal pelviccalyceal system was visualized in both CEUS and fluoroscopic nephrostograms in 11/12 (92%) with one nephrostomy tube correctly identified by both methods as being misplaced. The entire ureter was visualized in 6/11 (55%) with a CEUS nephrostogram compared to 8/11 (73%) using traditional nephrostogram. Fluoroscopic nephrostogram showed drainage of contrast into the bladder in 10/11 (91%) cases compared to 9/11 (82%) using CEUS.

CONCLUSION
Preliminary results suggest that contrast enhanced ultrasound (CEUS) nephrostogram is a feasible method to confirm the correct positioning of the nephrostomy tube within the collecting system, to image the ureters and determine if there is satisfactory drainage into the bladder.

CLINICAL RELEVANCE/APPLICATION
CEUS nephrostogram is a suitable alternative for the traditional nephrostogram in children, patients with contraindication to iodinated contrast or if the procedure has to be performed at the bed side.

SSQ10-09 • Cyst-Parenchyma Surface Area: A New Prognostic Image Feature for ADPKD

Joshua Warner (Presenter) ; Maria V Irazabal Mira MD ; Bradley J Erickson MD, PhD * ; Bernard F King MD ; Kyongtae T Bae MD, PhD * ; Jared Grantham MD ; Arlene Chapman MD ; Michal Mrug MD * ; William Bennett MD ; Vicente E Torres MD *

PURPOSE
Clinical trials for Autosomal Dominant Polycystic Kidney Disease (ADPKD) therapies began after the Consortium for Radiologic Imaging Studies of Polycystic Kidney Disease (CRISP) showed Total Kidney Volume (TKV) correlates with disease progression, detects change in individuals with normal labs, and can do so after as little as 12 months. However, ADPKD exhibits highly variable presentation, and TKV does not perform well in all cases. A novel physiologically relevant image feature called Cyst-Parenchyma Surface Area (CPSA) was developed to handle atypical cases. CPSA represents cyst surface area in contact with normal kidney parenchyma, excluding the external surface of cystic cysts. CPSA metric was obtained by removing cyst surface regions within a small tolerance of kidney surface. Both TKV and CPSA metrics were log transformed (yielding lnTKV and lnCPSA) for

METHOD AND MATERIALS
Twenty-five cases were selected from the CRISP cohort. Ten each were Rapid Progressors (RP) or Slow Progressors (SP), measured by year 6 eGFR; the remaining five were Atypical Cases (AC) exhibiting large TKV but paradoxically slow progression. Analysis was conducted on T2-weighted SSFSE fat-suppressed data. TKV (via stereology) and expert manual tracings of kidneys and cysts were obtained using Analyze 11. Surfaces were calculated with marching cubes, and the CPSA metric was obtained by removing cyst surface regions within a small tolerance of kidney surface. Both TKV and CPSA metrics were log transformed (yielding lnTKV and lnCPSA) for
RESULTS
Our new lnCPSA metric correlated with year 6 eGFR better ($R^2 = 0.551$) than the current standard lnTKV ($R^2 = 0.386$). Conducting the same analysis without atypical cases yielded similar correlations for lnCPSA ($R^2 = 0.560$) and the current standard lnTKV ($R^2 = 0.553$).

CONCLUSION
InCPSA correlated better with year 6 eGFR than lnTKV, validating our hypothesis. Excluding atypical cases, lnTKV and InCPSA correlate equally well with year 6 eGFR indicating that, from a predictive standpoint, InCPSA has the potential to replace lnTKV. Presently, lnCPSA requires significantly more time investment than lnTKV, however, efforts are underway to acquire lnCPSA data semi-automatically.

CLINICAL RELEVANCE/APPLICATION
CPSA, a novel ADPKD image feature, correlates with eGFR decline better than TKV for datasets including atypical cases, allowing broader clinical trial inclusion or fewer exclusion criteria.

### SSQ12-01 • Biochemical MRI with gagCEST (Glycosaminoglycan Chemical Exchange Saturation Transfer Imaging) of Finger Joint Cartilage in Rheumatoid Arthritis

**Christoph Schleich** (Presenter); **Anja Lutz**; **Benedikt Ostendorf**; **Philipp Sewerin**; **Gerald Antoch** MD *; **Falk R Miese** MD

**PURPOSE**
Rheumatoid arthritis (RA) frequently involves finger and hand joints. Joint damage may result in severe physical disability. gagCEST has recently been demonstrated to visualize biochemical alterations of cartilage in knee joints of patients following cartilage repair surgery as well as in intervertebral discs. The purpose of our study was to test the feasibility of gagCEST imaging in finger joint cartilage in healthy volunteers and patients with RA.

**METHOD AND MATERIALS**
Six volunteers (mean age 33; range: 21-45 years) and four patients (age 58; range: 52-64 years) were examined at a 3T MR scanner (Siemens Magnetom Trio) using two loop coils (4 cm diameter), one fixed on the palmar, the other on the dorsal side of the second metacarpophalangeal joint (MCP). For gagCEST imaging, CEST effects were prepared by a train of Gaussian RF pulses followed by signal readout with a 3D RF spoiled GRE sequence. The CEST curves were calculated for each pixel and were shifted for the water resonance to appear at 0 ppm of the Z-Spectrum. The MTR asymmetry curves were determined. The CEST effect of the cartilage was measured with the glycosaminoglycan saturation transfer [ST = CEST (+1.3 ppm) - CEST (-1.3 ppm)]/CEST (+1.3 ppm)]. Joint space width (JSW) as a morphologic feature of cartilage integrity was measured.

**RESULTS**
Cartilage ST values were significantly lower in patients compared to healthy volunteers (13.58 ± 6.11 vs. 27.38 ± 4.52; p=0.011). Cartilage CEST curves showed a decrease of CEST effect between 1.2 and 2.2 ppm, which corresponds to the resonance frequency of hydroxyl protons of glycosaminoglycans. There was no significant difference in JSW between healthy volunteers and RA patients.

**CONCLUSION**
CEST imaging revealed alterations in finger cartilage of RA patients compared to healthy controls in the absence of cartilage thinning. The decreased CEST effect in the spectral range of glycosaminoglycan resonances points towards depletion of glycosaminoglycans in RA.

**CLINICAL RELEVANCE/APPLICATION**
Biochemical imaging with gagCEST of cartilage composition is feasible at finger joints in RA.

### SSQ12-02 • Application of 59Fe Labeled Triglyceride-rich Lipoproteins for Quantitative Activity Measurements of Brown Adipose Tissue at 7T MRI

**Caroline Jung** (Presenter); **Barbara Freund**; **Markus Heine**; **Michael G Kaul**; **Jorg Heeren**; **Harald Ittrich** MD; **Gerhard B Adam** MD

**PURPOSE**
The aim was to determine metabolic activity of brown adipose tissue (BAT) with MRI at 7T using radioactively labeled superparamagnetic iron oxide nanoparticles (SPIO) embedded into the lipoprotein layer for visualisation of lipoprotein distribution and BAT metabolism after intravenous (iv) and intraperitoneal (ip) injection.

**METHOD AND MATERIALS**
59Fe labeled SPIOs were embedded into the lipoprotein layer of Triglyceride-rich lipoproteins (TRL). Cold exposed (24h), BAT activated mice (n=10) and thermoneutral control mice (n=10) were starved for 4 hours before 59Fe-SPIO-TRL application. MRI was performed before, 1 and 24 hours after ip (n=10) and iv (n=10) injection at a 7T small animal MRI using a T2*w Multiecho-GRE sequence (TR/TEfirst 400/2ms, ETL 12, ES 1ms, FA 25°, NSA 4, 10 slices, eff. voxel volume 160x160x600 μm³). R2* and R2 in liver and BAT were estimated. Ex vivo the biodistribution of 59Fe-SPIO-TRL was analyzed using a large volume Hamburg whole body y counter (HAMCO). The amount of TRL in liver and BAT was calculated according to the results of percentage TRL accumulation arrived from activity measurements and correlated with MRI measurements. Uptake of TRL into tissue was confirmed by histological (Prussian blue) and TEM analyses.

**RESULTS**

**CONCLUSION**

**CLINICAL RELEVANCE/APPLICATION**

### SSQ12-03 • Macrophage Tracking with Heteronuclear Proton MRI

**Rebecca Schmidt** MD (Presenter); **Nadine Nippe**; **Klaus Strobel** *; **Max Masthoff**; **Olgia Reifscheider** DIPLPHYS; **Daniela Delli Castelli**; **Cord Sunderkotter** MD; **Uwe Karst** PhD; **Silvio Aime**; **Christoph B Bremer** MD; **Cornelius Faber**

**PURPOSE**
To explore the feasibility of imaging Thulium (Tm)DOTMA labeled cells in a murine inflammation model by ultra-short echo time imaging (UTE).
RESULTS
Neither cell viability nor activity were affected by TmDOTMA labeling. Fluorescence microscopy showed an intracellular uptake of the complex. MR spectroscopy of labeled cells revealed an average of 8.97 ± 0.85 x 10^10 TmDOTMA molecules per cell. In vivo, TmDOTMA signal was detected in the bladder (day 1) and in liver, spleen and gel pellets over 8 days. Within 2h scan time, signal-to-noise values within the PAG-pellets ranged between 1.49 and 3.98. From a reference tube with a 0.25 mM TmDOTMA solution, the in vivo detection limit was estimated to be slightly below 10^6 BMDMs. Origin of the signal from migrated BMDMs was confirmed by histology and LA-ICP-MS showing both BMDMs and Tm around the injected gel.

CONCLUSION
The highly shifted signal of the equivalent methyl protons of TmDOTMA can be detected independently from the water signal by UTE resulting in an increased sensitivity. This approach of heteronuclear proton MRI may provide a versatile tool for MR cell tracking in vivo and thus facilitate the application of molecular MRI without the need for extra MR equipment.

CLINICAL RELEVANCE/APPLICATION
Detection and tracking of labeled cells by means of noninvasive molecular imaging has become essential part of both preclinical research and medical diagnostics related to cellular therapies.

SSQ12-04 • In Vivo Ultrasound Imaging of Pancreatic Islets
Jose L Paredes MD (Presenter); George Gittes; Jiamjung Wang; Flordeliza Villanueva

PURPOSE
Imaging and quantifying pancreatic islets in vivo could revolutionize the treatment of diabetes mellitus. Currently, insulin levels and hemoglobin A1C are our main methods for determining beta cell mass in diabetic patients. These insensitive measures are grossly inadequate for proper guidance of therapy. An office-based, non-invasive method for determining islet mass serially in diabetics has long been sought-after, but with no success. Here we show that a sub-harmonic ultrasound probe, in conjunction with microbubble intravenous contrast, allows islets visualization in the mouse pancreas based on the increased blood flow compared to surrounding pancreatic tissue.

METHOD AND MATERIALS
RESULTS
The subharmonic ultrasound visualization rendered clearly delineated large blood vessels of the scanned region in the pancreas. We were also able to identify discrete, three-dimensional hyper-perfused areas that were of the size, number, and distribution of islets. To validate that these hyperperfused areas were indeed islets, we scanned the pancreas of transgenic mice that express GFP under the mouse insulin promoter which is also able to identify discrete, three-dimensional hyper-perfused areas that were of the size, number, and distribution of islets. To validate these hyperperfused areas were indeed islets, we scanned the pancreas of transgenic mice that express GFP under the mouse insulin promoter.

CONCLUSION
Using a mouse model, we now have strong evidence to show the potential feasibility of using ultrasound combined with intravenous administration of microbubbles to visualize and quantify islet mass.

CLINICAL RELEVANCE/APPLICATION
Imaging and quantifying pancreatic islets in vivo could revolutionize the treatment of diabetes mellitus.

SSQ12-05 • Automated Analysis of Metastatic Involvement in Bone Using Anatomical and Functional Information from FDG PET/CT Images
Omer Demirkaya (Presenter); Abdulaziz Alsugair MD; Mohei M Abouzied MD

PURPOSE
Although overall incidence of bone metastasis is not known, over half of people who die of cancer in the US each year are thought to have bone involvement. In this study we developed a method to quantitatively analyze the metastatic and anatomic changes induced by bone metastases in cancer patients using PET/CT images. The quantitative parameters along with the structural changes seen by CT bone window may serve as a useful tool in assessing the response of bone metastases to therapy.

METHOD AND MATERIALS
Seventy three patients with no prior history of chemo or radiotherapy who had bone metastases documented by PET/CT (Discovery ST, GE) and other conventional modalities were selected for the study. PET/CT images were resampled to the same pixel size. Then the bone structure was segmented using a threshold of 150 HU. After the segmentation, the 50% of the maximum SUV within the bone mask was used to identify bone lesions in each slice. Using the ROIs defined at 70% of the max, the lesion characteristics including the mean HUs were computed from the PET/CT images. The lesions were subjected to the visual confirmation by an experienced PET/CT physician who also categorized them based on the appearances in the CT bone window as lytic, sclerotic, mixed, or no-change type. The lesion characteristics were compared using statistical methods.

RESULTS
340 lesions in 73 patients with different cancer types were analyzed. The lesions were categorized into four anatomical groups. The spine hosts the largest number of lesions, while thoracic cage bones had the least. The lumbar bones were the most preferential sites within the spine. Quantitatively, the mean SUVmax for the lytic, no-change, mixed and sclerotic lesions with no structural changes were 7.4, 6.1, 8.2 and 7.2, respectively. Comparison of SUVs showed that only no-change type was statistically different from the mixed type. Statistical comparison of CT values indicated that the difference between no-change and lytic types was significant. Uptake period did not seem to have an impact on no-change and sclerotic types as much as it did on the others.

CONCLUSION
The quantitative method for analysis of bone metastases may serve as a useful tool in monitoring and assessing therapy response.

CLINICAL RELEVANCE/APPLICATION
A quantitative method provides a convenient way to analyze the functional and structural characteristics of bone lesions and may serve as a useful tool for assessing the response totherapy.

SSQ12-06 • A Dual Isotope Hybrid MCT-PET System Reveals Functional Heterogeneity of Bone Lining Cells and Longitudinal Changes in Marrow from Local Radiation and Chemotherapy
Masashi Yagi (Presenter); Luke Arentsen BS, ARRT; Yutaka Takahashi PhD; Leslie Sharkey; Masahiko Koizumi MD, PhD; Cory Xian; Clifford J Rosen; Douglas Yee MD; Jerry W Froelich MD; Susanta K Hui PhD

PURPOSE
Bone marrow derived macrophages (BMDM) were labeled with 15^1 mol TmDOTMA/10^6 cells by incubation for 24h. Cell viability and activity were tested by determination of cell death, adhesion, phagocytosis and NO production. Fluorescence microscopy due to the self-fluorescence of TmDOTMA (ex. 253nm; em. 460nm) and MR spectroscopy determined labeling efficiency. Inflammation was induced by s.c. injection of 100^6 polyacrylamide (PAG) gel in both flanks of 3 nude mice. To intensify inflammation, lipopolysaccharide (30^6/100^6 PAG) was added to one PAG pellet per mouse. 3^6x10^6 labeled BMDMs were injected i.v. 24h after gel implantation. MRI was performed on a Bruker Biospec 94/20 with a 35mm 1H volume coil over a period of 8 days using 3D UTE sequence.

On day 8, PAG-pellets, livers and spleens were explanted. Selective macrophage staining (MAC 3) and laser ablation inductively-coupled plasma mass spectrometry (LA-ICP-MS) were performed for correlation with the MR data.
Enhanced Delineation of Primary Pancreatic Adenocarcinoma Following Neoadjuvant Therapy Using -Ferumoxytol: Preliminary Findings with Histopathologic Correlation

Sanddeep S Hedgire MD (Presenter); Mari Mino Kenudson MD; Carlos Fernandez-Del Castillo MD; Sarah Thayer; Ralph Weissleder MD, PhD; Mukesh G Harisinghani MD

PURPOSE
To evaluate role of MRI with ferumoxytol in delineating primary tumor in pancreatic adenocarcinoma patients undergoing preoperative neoadjuvant therapy.

METHOD AND MATERIALS
In institutional review board approved, HIPPA compliant prospective study, 10 patients with biopsy proven pancreatic adenocarcinoma were enrolled with the primary intention of detecting lymph node metastasis following administration of ferumoxtrol. MRI scans were performed at baseline, immediate post and at 48 hrs time points with quantitative T2\* sequences using single shot, monopolar, multiecho gradient echo (TE = 4.8\* 24.8, TR = 169 ms, thickness = 4 mm). The patients were categorized into those who received neoadjuvant therapy (group A) and those who did not (group B). The T2* of primary pancreatic tumor and adjacent parenchyma was recorded at baseline and 48 hrs time point in both groups and the difference between T2* values was calculated. After Whipple surgery, the primary tumors were assessed histopathologically for fibrosis and inflammation.

RESULTS
Five of the 10 (50 %) patients had presurgical neoadjuvant therapy. The mean T2* of tumor and adjacent parenchyma at 48 hrs in group A were 22.11 ms and 16.34 ms respectively. In group B, these values were 23.96 ms for tumor and 23.26 ms for adjacent parenchyma. The T2* difference between the tumor and adjacent parenchyma in group A was more pronounced compared to group B. The tumor margins were subjectively more distinct in the group A compared to group B. Histopathologic evaluation showed prominent fibrosis with scattered residual tumor glands with therapeutic effects, and a rim of dense fibrosis with atrophic acini at the periphery of the lesion in the group A. Conversely, intact tumor cells/glands were present at the periphery of the tumor in the group B. Two patients didn’t undergo Whipple surgery due to hepatic metastasis detected preoperatively.

CONCLUSION
Ferumoxytol may have potential application in depicting post neoadjuvant therapy induced fibrosis (especially at the periphery of the tumor) and thereby improving the ability for precise delineation of tumor margins.

CLINICAL RELEVANCE/APPLICATION
Indistinct tumor margin poses a challenge to the surgeon. MRI with ferumoxytol may be used for better delineation of the pancreatic cancer thereby affecting surgical planning and overall prognosis.
Previous studies have shown discrepancies between standard uptake value (SUV) and apparent diffusion coefficient (ADC) parameters of different tumor entities with non-simultaneous measurements on examination modalities such as PET-CT and MRI. The objective of this study was the quantitative evaluation of SUV and ADC values in patients with primary and recurrent cervical cancer and suspicious lymph nodes in a simultaneous PET-MRI system to exactly deteriorate an expectable correlation.

METHOD AND MATERIALS
We included 15 patients with histologically confirmed cervical carcinoma and lymph node metastases (total of 38 lesions; primary tumor n=14, positive lymph nodes n=24) who all underwent a simultaneous whole body 18F-fluorodeoxyglucose (FDG) PET-MRI (T2-HASTE, TIRM, EPI-DWI with b values of 0 and 800 mm²/s) including a dedicated pelvic examination (EPI-DWI with b values of 0, 50, 400, 800 mm²/s, T2 - TSE, T1-weighted TSE native and post-contrast ± fat suppression). Reader defined volume-of-interest (VOI; 0.2-0.5 mm³) for ADC and SUV were placed in suspicious tumor lesions and FDG-positive lymph nodes (short axis diameter > 5mm) in regions with maximum FDG-uptake. ADCmean, ADCrelative, relative ADC value (ratio of ADCmean / ADCreference tissue) and SUVmean was calculated with the M.gluteus maximus serving as reference tissue. Evaluation was performed by simultaneous analysis of specific lesions on a dedicated workstation (syngo.via, Siemens Mediical Solutions, Erlangen, Germany). A value of

RESULTS
Local tumor lesions and lymph nodes showed average SUVmean values of 12.7 (SE ± 1.63), respectively 9.4 (SE ± 1.59); corresponding ADCmean averages amounted to 1.020 x 10-3 mm²/s (SE ± 0.104) and 1.094 x 10-3 mm²/s (SE ± 0.12). A significant difference to reference tissue (SUV 0.72 ± 0, 17 SE, ADC 1.58 ± 0.12 SE) was seen.

CONCLUSION
The present work demonstrates the ability of acquisition of quantitative parameters (ADC and SUV) in a simultaneous PET-MRI system. Values of ADC and SUV in tumor tissue apparently show an opposite behaviour to ADC and SUV values in non-tumor tissue.

CLINICAL RELEVANCE/APPLICATION
Simultaneous quantification of SUV and ADC parameters in PET-MRI show an opposite behaviour which might be useful for evaluation of therapy response and effective tumor grading.

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SSQ13-01 • Increased Marrow Vascularity: An Unenhanced MRI Sign of Multiple Myeloma

Mona Mohsen MD (Presenter) ; Murali Sundaram MD ; Jean P Schils MD ; Carl S Winalski MD * ; Hakan Ilaslan MD

PURPOSE
Histology of marrow biopsies in patients with multiple myeloma(MM) typically show abundant neovascularity, especially in advanced cases. In the elderly, pelvic bone marrow is usually composed of yellow(fatty) marrow which has a poor blood supply. We aimed to evaluate the degree of marrow vascular proliferation in MM patients comparing with age- matched control group.

METHOD AND MATERIALS
Fifty consecutive patients with known MM who underwent unenhanced pelvic MRIs were included in the study. Control group was composed of 50 patients with no known malignancy in the same age group. T1-W and T2-W fat suppressed axial and coronal images of the pelvis were reviewed. MRIs were reviewed for presence or absence of marrow blood vessels (subtle, moderately prominent and very prominent), and red marrow. MRIs of MM patients were additionally evaluated for presence or absence of focal myeloma lesions.

RESULTS
There were 18 females and 32 males. Age range of the patients was 41 to 88(average 61). In the MM group 6 patients had very prominent and 16 patients had moderately prominent bone marrow vascularity. Two MM patients had no appreciable marrow vascularity whereas 26 of patients had subtle vascularity. Four MM patients had completely fatty marrow and the remaining 46 had mild to moderate background of red marrow. In the control group, there were no patients with very prominent or moderately prominent bone marrow vascularity. Eight cases in the control group had no marrow vascularity visualized and 42 patients had subtle vascularity seen. Six patients in the control group had completely fatty marrow and the remaining 44 had mild areas of red marrow.

CONCLUSION
Prominent bone marrow vessels are evident on MRI in patients with known MM corresponding to this well known histologically well established finding.

CLINICAL RELEVANCE/APPLICATION
In patients with an established diagnosis of MM, large marrow vessels should not be mistaken for lesions of myeloma. In the patient without known MM, the observation of large vessels in elderly patien

SSQ13-02 • Vertebral Body Enhancement in Patients with Central Venous Obstruction

Debbie L Bennett MD (Presenter) ; Frank J Simeone MD

PURPOSE
There have been isolated case reports of vertebral body marrow enhancement on contrast-enhanced CT imaging in patients with central venous obstruction. Recognition of this phenomenon is important as these regions of enhancement can be confused with sclerotic metastatic disease. The purpose of this project is to determine the incidence of marrow enhancement in patients with central venous obstruction, as we hypothesize that this is an under-recognized phenomenon. Additionally, this project identifies various patterns of enhancement that can be seen in central venous obstruction.

METHOD AND MATERIALS
Using a departmental radiology report searching program, all chest CTs performed between 1/1/2000 and 12/15/2012 which mentioned the terms 'SVC obstruction,' 'SVC syndrome,' 'superior vena cava obstruction,' 'superior vena cava syndrome,' 'venous obstruction,' or 'central venous obstruction' were identified. Each CT was reviewed by consensus to determine whether central venous obstruction was present. Of the cases with central venous obstruction, the vertebral bodies were evaluated for the presence or absence of marrow enhancement. When vertebral marrow enhancement was present, the levels involved, portion of the vertebral body involved, and pattern of enhancement were recorded.

RESULTS
There were 357 chest CT reports which mentioned central venous obstruction; of these, 53 (15%) were found to have central venous obstruction. Of the 53 patients with central venous obstruction, 25 (47%) demonstrated vertebral body enhancement. The enhancement
was classified as either linear (n=9, 17.4%), nodular (n=9, 17.4%) or both (n=7, 13%). Five cases (9.9%) of vertebral body enhancement were reported as metastasis or concerning for metastasis.

CONCLUSION
Vertebral body marrow enhancement can be seen in patients with central venous obstruction. Two distinct patterns of marrow enhancement were identified: linear and nodular. Nodular enhancement was at times confused with metastatic disease, a misinterpretation which could result in incorrect staging of known malignancies or unnecessary procedures in patients without known malignancy. Marrow enhancement should be considered when interpreting studies with central venous obstruction.

CLINICAL RELEVANCE/APPLICATION
Patients with central venous obstruction may demonstrate cervical and/or thoracic vertebral body enhancement in a pattern which can be confused for sclerotic osseous lesions.

SSQ13-03 • Single Bony Abnormality on Spine MRI of Cancer Patients during F-up: Metastasis or Not?
Seun Ah Lee MD (Presenter) ; Min Hee Lee MD ; Sang Hoon Lee ; Hye Won Chung MD ; Myung Jin Shin MD

PURPOSE
To evaluate single focal bony abnormalities found on spine MRI of cancer patients during F-up in order to enhance diagnosis of metastasis.

METHOD AND MATERIALS
After scanning a database for patients who were diagnosed with primary cancer and received spine MRI for detecting metastasis during F-up from 2000 to 2012, 353 patients with abnormal bony lesions were identified. Those with more than two bony lesions and with unavailable pathologic confirmation were excluded. Finally, 46 patients with a single, focal bony abnormality seen on spine MRI and pathologically proven, were included. The primary cancer was from lung (15), GI tract (8), HCC (4), kidney (4), bladder (3), breast (3), cervix (2), lymphoma (2), bile duct (1), thyroid (1), osteosarcoma (1), MPNST (1), and trophoblastic tumor (1). Medical records were reviewed for pathology reports of bony lesions. MRI findings were evaluated for location (anterior or posterior element of vertebra, pelvic bone), disc involvement, margin, paravertebral soft tissue mass. Statistical significance was assessed using Fisher's exact test.

RESULTS
Of 46 bony lesions, metastasis (mets) was 27 (58.7%) cases. Non-metastasis were 19 (41.3%), including no tumor present (suggesting non-metastasis, 12), hematopoietic bone marrow (4), infection (1), radiation osteitis (1), inadequate tissue (1). On MR, margin was ill-defined in 6 (mets:1, non-mets:5), well-defined in 40 (mets:26, non-mets:14). Compared with hematopoietic marrow, ill-defined margin was found in all (4/4) hematopoietic marrow and only one (1/27) in mets, showing significant difference (p=0.05).

CONCLUSION
When a single, focal bony abnormality was detected on spine MRI of cancer patients during F-up, incidence of metastasis was greater than half, but not as high as expected. Although most MR findings may not be characteristic, margin of lesions can aid in differentiating metastasis from focal hematopoietic bone marrow.

CLINICAL RELEVANCE/APPLICATION
When a single, focal bony abnormality was detected on spine MRI of cancer patients during F-up, incidence of metastasis was greater than half, but not as high as had been expected.

SSQ13-04 • Evaluation of Lumbar Vertebral Body Using IDEAL MRI and Micro CT
Won C Bae PhD (Presenter) ; Reni Biswas ; Mark Bydder PhD * ; Koichi Masuda MD * ; Jiang Du PhD ; Christine B Chung MD ; Eric Y Chang MD ; Prema S Karunanithi

PURPOSE
To perform quantitative IDEAL MR imaging of fat content in cadaveric vertebral body of the lumbar spine and to compare the measures against reference standards of fat content as well as trabecular bone structures using micro CT analysis.

METHOD AND MATERIALS
Cadaveric lumbar spines (Fig.A) of 17 donors (14 male 3 female, 29 yrs) and female (20 yrs) were imaged using General Electric IDEAL 3D spoiled gradient echo sequence at 3T (FOV=18-22 cm, slice=2.5 mm, TR=11.8 ms, six TEs=1.23 to 6.07 ms, ETL=3, matrix=256x256, scan time=5 min). Fat fraction maps (Fig.B) were obtained after console-based reconstruction. Axial slices of vertebral body (Fig.C) were divided and analyzed using histology and biochemistry for fat content, and micro CT (Fig.D; 18 um isotropic) for trabecular structure using BoneJ. Correlation analyses were performed.

RESULTS
IDEAL fat fractions correlated significantly with histologic fat content ($R^2=0.30$, $P=0.0005$) and strongly with biochemical fat content ($R^2=0.59$, $P=0.017$). In addition, fat fraction correlated significantly with (Fig.E) connectivity density (number of trabeculae per volume; $R^2=0.15$, $P=0.02$) as well as (Fig.F) trabecular spacing ($R^2=0.11$, $P=0.046$), but not with trabecular thickness or bone volume fraction (Fig.G). These results were evident in representative 3D models (Fig.D); the sample with higher fat fraction (right) exhibited lower connectivity and higher spacing between trabeculae than the sample with lower fat fraction.

CONCLUSION
While evaluation of fat content in bone marrow has obvious applications in the field of radiation oncology, its utility for musculoskeletal diseases such as degenerative disc disease is less realized. The present results suggests that (chronic) changes in fat content in the marrow may be associated with changes in structure of trabecular bone, even without obvious bone loss. Better understanding of relationship between marrow fat and trabecular structure, as well as adjacent disc changes, may shed a light on pathogenesis of disc degeneration.

CLINICAL RELEVANCE/APPLICATION
The IDEAL MR technique provides an accurate means of evaluating fat content in vivo. In addition, vertebral body fatty changes may provide additional information for trabecular changes.

SSQ13-05 • Ultrasound Time-to-Echo MRI of Cartilaginous Endplates of Human Lumbar Spines In Vivo: A Feasibility Study
Won C Bae PhD (Presenter) ; Prema S Karunanithi ; Richard Znamirowski ; Sheronda Statum ; Jiang Du PhD ; Christine B Chung MD

PURPOSE
To perform morphologic imaging of cartilaginous endplates (CEP) of intervertebral discs (IVD) in healthy volunteers using ultrashort time-to-echo (UTE) technique.

METHOD AND MATERIALS
The lumbar spine of an asymptomatic male (29 yrs) and female (20 yrs) was imaged using a conventional fat saturated fast spin echo (FOV=26 cm, slice=3 mm, TR=3500 ms, TE=120 ms, ETL=27, matrix=384x384, scan time=4 min) and 2D UTE MR (TR=300 ms, TE=0.012 and 8.9 ms, scan time=11 min) sequences at 3T, using a clinical spine coil. UTE echo subtraction image was obtained by subtracting the 2nd echo image from the 1st echo image. Morphology of the IVD and CEP were evaluated by a board-certified radiologist.

RESULTS
In conventional T2-weighted FSE images, the nucleus pulposus (NP; Figure A, square) was seen with homogeneous high signal intensity as expected in healthy human subjects. However, the region of the CEP (Figure A, arrows) exhibited low signal intensity and could not
be evaluated directly. In contrast, UTE MR image clearly showed the region with high linear signal intensity (Figure B, arrows). Our previous study on cadaveric spines (Figure C), comparing conventional MRI (Figure C-i), UTE MRI (Figure C-ii) and histology (Figure C-iii to -v), suggested that this UTE MR signal intensity is due to the presence of the CEP (thick uncalcified and thin calcified layers), but not the disc proper or subchondral bone. In addition, UTE MRI is able to show abnormal morphology of the CEP (Figure D-ii), invisible in conventional images (Figure D-i).

CONCLUSION
Abnormal changes in histologic morphology and composition of the CEP have been found in aging IVD and certain pathology such as scoliosis. It has been difficult to evaluate the CEP adequately using MRI, due to intrinsically short T2 value of the tissue. Along with recent validation study, the present study suggests clinical feasibility of UTE MR evaluation of the CEP in vivo. Additional studies may elucidate relationship between CEP changes and disc degeneration, and back pain.

CLINICAL RELEVANCE/APPLICATION.
The UTE MR technique provides sensitive and direct means of evaluating the CEP in vivo. It may be useful for early detection of CEP pathology, and understanding of pathogenesis of disc degeneration.

SSQ13-06 • Standing MRI Exaggerates the Degree of Lumbar Stenosis but Does Not Improve Correlation with Patient Symptoms
Ka Lok Lee MBChB (Presenter); James Griffith; Yvonne Lau; Defeng Wang; Shi L Lin; Alex Ng

PURPOSE
Only modest correlation exists between patient symptoms and supine MRI findings in lumbar degenerative disease. This study investigates whether upright MRI in the standing position improves correlation with patient symptomatology.

METHOD AND MATERIALS
Prospective study performed between January 2012 and March 2013. 49 patients (M:F=35:14, mean age of 58.2±9.2) with clinically diagnosed lumbar spinal stenosis were examined by low field 0.25T MRI (G-Sscan, Esaote, Italy) in the supine and standing positions. Morphological changes including dural sac cross-sectional area (DSCA), grading (0-4) of lateral recess and foraminal stenosis at L3/4, L4/5 and L5/S1 levels were measured in the two positions and compared. Severity of clinical symptoms (including symptom duration, walking tolerance, walking distance, Visual Analogue Score of lumbar and lower limb pain, Oswestry Disability Index and SF-16) was assessed and correlated with MRI findings.

RESULTS
Dural sac cross-sectional area (mm2) was significantly lower in the standing (L3/4: 101.7: vs 142.2, p = 0.04; L4/5: 72.3: vs 108.2, p = 0.04; L5/S1: 54.6 vs 79.4, p=0.04). The degree of lateral recess and foraminal stenosis was greater in the standing in supine (p: 0.23 to 0.42). Inter- and intraobserver agreement for dural sac cross-sectional area and grading stenosis were substantial (r: 0.61 ± 0.73).

Overall there was still only poor to mild correlation (r: 0.12 ± 0.38) between clinical symptoms and MRI morphological changes.

CONCLUSION
MRI in the standing position increases central canal, lateral recess and foraminal stenosis. Standing MRI, did not however, increase the correlation between patient symptoms and MR morphological changes, which remained low to modest.

CLINICAL RELEVANCE/APPLICATION
Open system 0.25T MRI allows scanning of the lumbar spine in standing position; standing MRI, did not however, increase the correlation between patient symptoms and MR morphological changes.

SSQ13-07 • Image Quality Optimization after Spinal Fusion Surgery Using Iteratively Reconstructed Dual Energy CT High keV Monoenergetic Datasets

Holger Haubenreisser (Presenter) ; Miriam Hahn ; Rene Schmidt ; Paul Apfaltrer MD ; Martin U Sedlmaier MS * ; Bernhard Schmidt PhD * ; Stefan O Schoenberg MD, PhD * ; Thomas Henzler MD

PURPOSE
To prospectively evaluate the effectiveness of high keV dual-energy CT (DECT) in combination with sinogram-affirmed iterative reconstruction in the raw data space (IR) for metal artifact reduction after spinal fusion surgery.

METHOD AND MATERIALS
10 consecutive patients underwent spinal fusion surgery and were consequently examined using a non-contrast enhanced DECT protocol for postoperative evaluation of metal implants. DECT raw data was reconstructed with traditional filtered back projection (FBP) and IR. Both FBP and IR image datasets were then post-processed on a separate offline workstation. Monoenergetic datasets were generated from 60keV to 190keV in 10keV intervals. Objective image quality evaluation was performed measuring image noise and the maximum artifact area on all images in order to calculate the total artifact volume. In addition, two radiologists performed subjective image quality evaluation using a 5-point Likert scale.

RESULTS
A total of 28 datasets were reconstructed for each patient (14 FBP, 14 IR). Image noise was significantly lower in all IR datasets when compared to the corresponding FBP datasets (p<0.05).

CONCLUSION
IR of DECT raw data leads to improved objective and subjective image quality of high keV monoenergetic datasets that allow valuable metal artifact reduction in patients after spinal fusion surgery.

CLINICAL RELEVANCE/APPLICATION
Iteratively reconstructed DECT raw data improves image quality of calculated high keV monoenergetic CT image data potentially leading to a more accurate assessment of the postoperative spine.

SSQ13-08 • High-energy CT in Detecting Bone Marrow Edema of Vertebral Compression Fractures

Aina O Venkataramy (Presenter) ; Jean-Claude Dosch ; Stephane Kremer MD, PhD ; Jean-Louis Dietemann MD ; Guillaume Bierry MD, PhD

PURPOSE
To prospectively evaluate the performance of virtual non-calcium (VNC) dual-energy CT (DECT) images for the demonstration of trauma-related abnormal marrow attenuation in vertebral compression fractures (VCF).

METHOD AND MATERIALS
Twenty patients (16 females, 4 males; age=69±14years) presenting with benign VCF on radiographs were consecutively and prospectively included in this IRB-approved study, and underwent MRI and DECT of the spine. MR examination, evaluated by an independent referee served as reference standard for edema (acute nature of fracture) assessment. Two other independent readers visually evaluated all vertebral for abnormal marrow attenuation (CT edema) on VNC DECT images using a binary scale; specificity, sensitivity, predictive values, intra- and inter-observer agreements were calculated. A last reader performed a quantitative evaluation of CT numbers, and cut-off values for CT edema were calculated using ROC analysis.

RESULTS
In the visual detection of CT edema, VNC DECT images had a sensitivity of 84%, a specificity of 97%, a PPV of 81% and a NPV of 97% compared to MR as a reference standard; intra- and inter-observer agreements were good to excellent, ranging from k= 0.74 to k= 0.80. CT numbers were significantly different between vertebras with edema on MR and those without (p<0.05)
Neuroradiology (Cerebrovascular Imaging)

Thursday, 10:30 AM - 12:00 PM • N229

SSQ15 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

Moderator
Howard A Rowley, MD *
Moderator
Paul M Ruggieri, MD *

SSQ15-01 • Physiologic Variability in Internal Jugular Venous Caliber: A Retrospective Review

Karen Buch MD (Presenter) ; Raymond Groller ; Rohini N Nadgir MD ; Akifumi Fujita MD ; Osamu Sakai MD, PhD *

PURPOSE
Chronic cerebrospinal vascular insufficiency (CCSVI) is a proposed condition described as intra-luminal stenosis of the internal jugular (IJV) resulting in impeded venous flow from the brain and has been linked to pathologies such as multiple sclerosis (MS). However, calculations of IJV stenosis are vague and typically described in veins with at least a 50% reduction in luminal caliber. The purpose of this study is to assess normal anatomic and physiologic caliber changes of the IJV over its course.

METHOD AND MATERIALS
Following IRB approval, 500 consecutive neck CT angiograms from January-July 2012 were retrospectively reviewed. Images were helically acquired at 1.25mm slice thickness on 64-detector row CT scanners. IJV surface areas were calculated at the jugular foramen, C1-C7 levels, and jugular angles bilaterally. Electronic medical records were reviewed for clinical parameters including age, gender, neurologic history including MS, neck mass, and neck surgery/dissection. Severely motion limited studies, subjects with limited clinical data, history of neck dissections, and known IJV occlusions were excluded. Statistical analysis was performed using a t-test.

RESULTS
383 patients were included (202 females, 181 males), ranging in age from 2-89 years (mean 47.3 years). Mean area was 66 mm² at the jugular foramen, 56.9 mm² at C1, 66 mm² at C2, 80 mm² at C3, 96 mm² at C4, 126 mm² at C5, 164 mm² at C6, 176 mm² at C7, and 128 mm² at the jugular angle. Degree of IJV narrowing was calculated at each vertebral body level using the IJV area at C7 as the denominator: 63% at the jugular foramen, 68% at C1, 62% at C2, 55% at C3, 45% at C4, 28% at C5, and 7% at C6. Statistically significant differences were observed between mean IJV areas at the C1-C5 levels compared to C7 level (p < 0.001).

The IJV demonstrates marked variability in its course in the neck, with areas of narrowing greater than 50% in cervical and skull base regions. Given the normal physiologic variation in the caliber of this vessel, diagnosis and treatment of stenosis should proceed with caution.

CLINICAL RELEVANCE/APPLICATION
Given the marked normal physiologic variation in the caliber of the IJV, diagnosis and treatment of stenosis should proceed with caution.

SSQ15-02 • Arterial Remodeling of Intracranial Atherosclerosis: Detection and Characterization Using 3D High Resolution Black Blood MRI

Ye Qiao (Presenter) ; Jarunee Intrapromkul MD ; Zeeshan Anwar ; Li Liu ; Bruce A Wasserman MD

PURPOSE
To determine the ability and extent of intracranial arteries to accommodate plaque formation by outward (positive) remodeling using 3D high resolution black blood MRI (BBMRI).

METHOD AND MATERIALS
Thirty-one patients (22 male; mean age 57.6±12.2 years) with cerebrovascular ischemic events underwent 3D time-of-flight MRA and contrast-enhanced BBMRI examinations for intracranial atherosclerotic disease at 3T. The 3D BBMRI sequence was acquired using a high resolution black blood MRI (BBMRI).

METHOD AND MATERIALS
Sixty-seven MM patients (male, n=37; mean age, 67.1±10 years; female, n=30; mean age, 68.6±10 years) were examined by 64-detector CT after a mean period of six months of either therapy with bortezomib- (n=33) or lenalidomide (n=19), or follow-up without treatment (n=15). Using a bone mineral calibration phantom and a 3D image analysis system, bone mineral content per tissue volume (BMC/TV), trabecular parameters, and mechanical properties of the third lumbar vertebrae were calculated. The statistical significance of the change with respect to baseline over time was assessed using a two-way analysis of variance with repeated measures. To investigate whether baseline geometric or biomechanical indices predict the subsequent response to treatment, the Spearman rank correlation test was performed for each baseline index with respect to post-treatment changes.

RESULTS
Lenalidomide treatment resulted in significant increases in BMC/TV, trabecular number and CT/FEM-derived estimates of bone strength, while failure load and stiffness decreased in the bortezomib group. Baseline BMC/TV and trabecular spacing predicted lenalidomide-induced bone changes.

CONCLUSION
Lenalidomide treatment promoted significant increases in bone strength. Mechanical properties, assessed by a CT/FEM, provided useful information about treatment response in multiple myeloma.

Lenalidomide and bortezomib have been successfully used in the treatment of multiple myeloma (MM), of which bone disease is a key feature. Bortezomib has been linked to increased bone formation and osteoblastic activity; however, the effect of lenalidomide on bones remains unknown. Therefore, in this study, trabecular microstructural analysis and biomechanics assessed by a clinical CT-based finite element model (CT/FEM) were used to investigate whether lenalidomide affects the microarchitecture of bones.

CLINICAL RELEVANCE/APPLICATION
Lenalidomide treatment promoted significant increases in bone strength. Mechanical properties, assessed by a CT/FEM, provided useful information about treatment response in multiple myeloma.
contrast-enhanced BMBMRI examinations for intracranial atherosclerotic disease at 3T. The 3D BBMRI sequence was acquired using a volumetric isotropic TSE acquisition with the following parameters: TR/TE, 2000ms/38ms; TSE factor, 56 echoes; acquired resolution, 0.4x0.4x0.4 mm³; scan time, 7.5 minutes. Each identified plaque was classified based on location (i.e., posterior vs. anterior circulation). Lumen area (LA), outer wall area (OWA), and wall area (WA) at the most stenotic site and reference site were measured. Normalized wall index (NWI) was calculated as WA divided by OWA. Arterial remodeling index (RI) was calculated as OWA at the lesion site divided by OWA at the reference site, after adjusted for vessel tapering. Arterial remodeling was categorized as: positive if RI >1.05, intermediate if 0.95 =RR =1.05, and negative if RI

RESULTS

One hundred and five plaques were identified in 31 patients, with multiple plaques seen in 23 patients. Forty-two were detected in the posterior circulation (basilar, 19; PCA, 6; and vertebral, 17), and 63 in the anterior circulation (ACA, 9; ICA, 34 and MCA, 20). Compared with anterior circulation plaques, posterior circulation plaques had larger NWI (i.e., plaque burden) (posterior vs anterior: 0.77±0.20 vs. 0.68±0.16, p=0.035), greater RI (posterior vs anterior: 1.22±0.56 vs. 1.04±0.27, p=0.042), and more frequently exhibited positive remodeling (posterior vs anterior: 50% vs.39%). Reliability for wall morphology measurements was excellent (ICCs ranged from 0.95 to 0.98).

CONCLUSION

Arterial remodeling of intracranial atherosclerotic disease appears to be geographic. Compared with anterior circulation arteries, posterior circulation arteries appear to have a greater capacity to remodel in response to plaque formation.

CLINICAL RELEVANCE/APPLICATION

These findings yield important information necessary for the interpretation of angiographic images, as posterior circulation plaques are probably underestimated by angiography.

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**SSQ15-03 • An MRI Pulse Sequence for Whole-brain Bolus Tracking at High Frame Rates: RAZER (RAdial kZ-blipped 3D GRE-EPI for Whole-brain Perfusion)**

**Sumeeth V Jonathan** MS (Presenter) ; **Parmede Vakil** PhD ; **Yong Jeong** ; **Rajiv G Menon** PhD ; **Sameer A Ansari** MD, PhD ; **Timothy J Carroll** PhD

**PURPOSE**

To measure cerebral perfusion, bolus tracking with DSC-MRI demands rapidly acquired T2*-weighted MR images. Current implementations of DSC-MRI are constrained by a temporal resolution of no more than 2 s (0.5 FPS) to adequately characterize a contrast agent bolus, with tradeoffs in SNR and spatial resolution. We introduce RAZER, a pulse sequence that obtains whole-brain DSC-MRI perfusion measurements at 6.2 FPS and 1.7 mm isotropic voxel resolution.

**METHOD AND MATERIALS**

Sequence design: RAZER uses in-plane radial sampling and through-plane 3D GRE-EPI Cartesian sampling to produce a cylindrical 3D k-space. Consecutive frames are acquired in 10.3 s (0.09 FPS) for bolus tracking, but dynamic bolus information is recovered at 0.16 s per frame (6.2 FPS) prior to perfusion analysis using sliding window view-sharing in k-space.

**Subjects:** 1 patient with angiographically-confirmed Moyamoya disease.

**Image acquisition:** In vivo bolus tracking was performed using RAZER and a typical 2D GRE-EPI pulse sequence (vessel size = 1.7 x 1.7 x 5.0 mm³) as a reference standard. RAZER scan parameters: second injection, TE/TR = 36/81 ms, flip angle = 45°, slices = 76, voxel size = 1.7 x 1.7 x 1.7 mm³, repetitions = 12, 3.0 T Tim Trio. Images were acquired with a single-dose injection of 0.1 mmol/kg Gd-DTPA at 4 mL/s. Both acquisitions were automatically processed online to produce parametric maps of relative cerebral blood flow (rCBF), relative cerebral blood volume (rCBV), and mean transit time (MTT).

**RESULTS**

Figure 1 compares coronal, sagittal, and axial perfusion maps in RAZER (a) and the 2D GRE-EPI reference (b) with angiographic assessments (c) consistent with Moyamoya disease. Increased coverage in RAZER allows for fine resolution of the perfusion metrics in the through-plane direction while the reference is blurred. There is strong agreement in perfusion metrics using Bland-Altman correlation (r² = 0.91, mean bias in MTT measurements = -0.01 ± 0.89 sec). Perfusion maps were coregistered prior to correlation using SPM.

**CONCLUSION**

RAZER obtains whole-brain perfusion measurements with good reference standard agreement. Sliding window view-sharing in k-space permits the use of a large temporal resolution for DSC-MRI without sacrifices in SNR and spatial resolution.

**CLINICAL RELEVANCE/APPLICATION**

RAZER is recommended for whole-brain MR perfusion study of central nervous system tumors, stroke, cerebrovascular occlusive disease, and Alzheimer’s.

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**SSQ15-04 • In-Vivo Visualization of the PICa Perfusion Territories with Super-selective Pseudo-continuous Arterial Spin Labeling MRI**

**Nolan Hartkamp** ; **Laurens J De Cocker** MD (Presenter) ; **Michael Helle** * ; **Matthias Van Osch** ; **Jaap Kappelle** ; **Reinoud P Bokkers** MD, PhD ; **Jeroen Hendrikse** MD

**PURPOSE**

To develop the first technique to visualize the cerebellar perfusion territories in-vivo.

**METHOD AND MATERIALS**

The perfusion territories of the vertebral arteries (VAs) were examined in 14 healthy subjects with four super-selective p-CASL MRI sequences (with labeling of both internal carotid arteries and both VAs). The following arterial perfusion territories in the cerebellum were distinguished: (1) territory exclusively fed by one vertebral artery (VA), namely the PICa territory in subjects with normal anatomy; (2) territory exclusively fed by the contralateral VA (contralateral PICa territory); (3) territory fed by both VAs after mixing in the basilar artery (bilateral AICA and SCA territories). The territorial perfusion maps were superimposed on anatomical T1WI and the PICa territories were manually outlined on the T1WI. The perfusion territories were also correlated with the arterial anatomy of the vertebrobasilar system using time-of-flight MR angiography.

**RESULTS**

The vast majority of PICa perfusion territories could be identified. In 10 out of 14 subjects, both PICa perfusion territories could be distinguished. One subject had a missing VA, and one subject had a missing or hypoplastic PICa on one side. Two subjects did not have a discernible PICa territory on one side, either secondary to tiny anastomoses between the PICa and AICA, or either secondary to insufficient mixing of blood in the basilar artery.

**CONCLUSION**

We postulate that a selective labeling of each vertebral artery (VA) allows distinguishing the cerebellar territories that are exclusively fed by one VA (PICa in subjects with normal vascular anatomy) from those territories supplied by the basilar artery (AICA and SCA).

**CLINICAL RELEVANCE/APPLICATION**

The ability to link a cerebellar infarct with a particular perfusion territory may yield information on infarct pathogenesis and may refine treatment planning.

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**SSQ15-05 • 4D Flow MRI Indicates Changes in Intracranial Hemodynamics in Arteries Supplying Art eriovenous Malformations**

**Amir R Honarmand** MD (Presenter) ; **Biraj M Patel** MD ; **Can Wu** ; **Susanne Schnell** ; **Pegah Entezari** MD ; **Parmede Vakil** PhD ; **Michael C Hurley** MBCh ; **Bernard Bendok** MD ; **Ali Shalbani** MD ; **Timothy J Carroll** PhD ; **Michael Markl** PhD ; **Sameer A Ansari** MD, PhD
To evaluate peak velocity (PV) and net flow (NF) in arteries supplying intracranial arteriovenous malformations (AVMs) using 4D flow MRI.

METHOD AND MATERIALS
With IRB approval, baseline 4D flow MRI was performed at 1.5T or 3T MR systems for a prospective study. Flow quantification was performed using ECG gated three-directional velocity encoding with full 3D coverage of the AVM nidus, feeding and draining vessels, and contralateral equivalent normal arteries. 4D flow MRI was acquired in an axial oblique 3D volume using flip angle of 15°, VENC: 100 cm/s, spatial resolution = (1.2-1.6)mm³, and temporal resolution: 44 ms. Data analysis included 3D visualization of the velocity data and flow quantification using time integrated 3D pathlines positioned orthogonal to the vessel by a commercially available software (Ensight, CEI, Inc. Apex, NC). AVM Spetzler-Martin (SM) grade and nidus volume (?/6 · X · Y · Z dimensions) were obtained. Paired sample t test, one-way ANOVA, univariable, and stepwise multiple regression analysis were performed to build predictive models.

RESULTS
Ten patients (7M/3F) with mean age of 40.7 (10-66) years were studied. Hemodynamic parameters of 17 arteries (5 ICAs, 9 MCAs, 2 PCAs, and 1 ACA) supplying the AVM nidus, normal contralateral equivalent arteries, and corresponding sinus draining the AVM were quantified. PV and NF were significantly higher in AVM arterial feeders (AFs) compared with normal contralateral equivalent arteries (EA) (mean: 0.96 Vs. 0.66 m/s, P=0.001; 5.2 Vs. 3.0 ml/cycle, P=0.004, respectively). No significant difference was observed between AFs versus PV, NF, and sinus PV based on AVM SM classification. (P=0.08, P=0.1, P=0.4, respectively). Stepwise multiple regression and univariable models identified nidus volume and EAs PV to be positively correlated with PV in AFs (P=0.01, r=0.6; P=0.003, r=0.7, respectively). NF was the significant factor for predicting PV in EAs (P=0.001, r=0.7). Positive direct correlation was observed between AFs PV and sinus PV (P=0.01, r=0.6).

CONCLUSION
4D flow MRI is feasible for monitoring of cerebral AVM hemodynamic parameters and illustrates subtle, but distinct hemodynamic changes in arterial feeders compared to a normal equivalent arteries.

CLINICAL RELEVANCE/APPLICATION
These findings may have implications in novel characterization schemes for risk stratification based on quantitative flow analysis.

SSQ15-06  Diagnosis of Carotid Artery Dissection with CT: Does the Contrast Material Really Help?
Luca Saba MD (Presenter) ; Eytan Raz MD ; Mario Piga ; Roberto Montisci MD ; Eugenio A Genovese MD

PURPOSE
The purpose of this work was to evaluate if the use of contrast material in the MDCTA study of carotid artery dissection (CAD) modify the diagnostic performance

METHOD AND MATERIALS
One hundred patients (61 men, 39 women; mean age, 51 years; range, 25 - 78 years) 40 with and 60 without CAD, that underwent MDCTA for suspected CAD formed the study cohort. In this study patients from three different groups were included (patients with MR confirmation of CAD, n = 40; patients with MR confirmation of CAD absence, n = 20; patients that underwent MDCTA of carotid arteries for atherosclerosis analysis, n = 40). Three blinded observers with different level of expertise analyzed the randomized basal scan and after 3 months the observers evaluated the same datasets by using basal scans (BS) and after administration of contrast material (CM). Statistical analysis included Receiver Operating Characteristics (ROC) curve analysis and the Cohen weighted test.

RESULTS
The ROC curve analysis showed that for the 3 observers the use of BS versus BS and CM produced an improvement of the diagnostic confidence with AUC values from 0.894 to 0.926 (p value = 0.91) ; from 0.856 to 0.879 (p value = 0.365) ; and from 0.819 to 0.982 (p value = 0.01). The Cohen kappa analysis showed no significant difference in concordance with the use of BS versus BS and CM. The prevalence of uncertain findings was in 16%, 20.5% and 33% in the BS and 15%, 17.5% and 29% in BS and CM for observer 1, 2 and 3 respectively.

CONCLUSION
Results of our study suggest that the use of BS instead the classic BS and CM determines a small reduction in the diagnostic confidence of the readers, that is statistically significant in the only the junior one. Therefore the use of the only BS in the suspect of CAD may help in reducing cost and risk related to the administration of contrast material.

CLINICAL RELEVANCE/APPLICATION
Results of our study suggest that the use of the only basal in the suspect of CAD can be used and this approach may help in reducing cost and risk related to the administration of contrast material.

SSQ15-07  Carotid Artery Stenosis: Comparison of 3D Time-of-Flight MR Angiography and Contrast-enhanced MR Angiography at 3.0T
Ivan Platzek MD (Presenter) ; Dominik A Sieron MD ; Philipp Wiggermann ; Michael Laniado MD

PURPOSE
To compare 3D time-of-flight MR angiography (TOF MRA) and contrast-enhanced MR angiography (CEMRA) for quantification of carotid artery stenosis at 3.0T.

METHOD AND MATERIALS
Twenty-three patients (5 F, 18 m; mean age 61 y, age range 45-78 y) with external carotid artery stenosis detected with Doppler ultrasonography were examined on a 3.0T MR system. The MR examination included both 3D TOF MRA and CEMRA of the carotid arteries. MR images were evaluated independently by two radiologists. Stenosis evaluation was based on a four-point scale: 0 = normal, 1 = mild stenosis (<50% ), 2 = moderate stenosis, 50-69%, 3 = severe stenosis, more than 70% but less than full occlusion, 4 = occlusion). TOF MRA and CEMRA were evaluated separately, with a four-week time interval between evaluation sessions. While evaluating TOF MRA, the readers were blinded for CEMRA images and vice versa. Furthermore, the readers were blinded for other imaging or clinical data. In cases of interrater differences concerning the same MR angiography type, stenosis grade was determined by the readers in consensus. Stenosis grades determined by TOF and CEMRA were compared using the Wilcoxon test. Cohens Kappa was used to evaluate interrater reliability.

RESULTS
At 3.0T, 3D TOF MRA should not be used as replacement for contrast-enhanced MRA of the carotid arteries, as it results in significantly higher stenosis grades, and may lead to inadequate therapy.

CLINICAL RELEVANCE/APPLICATION
The current results imply that TOF MRA at 3.0T should not be used as a replacement for CEMRA, which itself is well validated by comparison with digital subtraction angiography in previous studies.

SSQ15-08  Intraplaque Hemorrhage on Routine 3D-Time-of-Flight MR Angiography Is Strongly Associated with Symptomatic Status in Carotid Artery Stenosis
Hediyeh Baradaran MD (Presenter) ; Hooman Kamel MD ; Atul Mangla MD ; Ankur Pandya PhD, MPH ; Allison Dunning ; Vito Fodera MD ; Pina C Sanelli MD ; Ajay Gupta MD

PURPOSE
To evaluate peak velocity (PV) and net flow (NF) in arteries supplying intracranial arteriovenous malformations (AVMs) using 4D flow MRI.
Intraplaque hemorrhage (IPH) in carotid artery atherosclerosis is strongly associated with previous and future stroke. Carotid plaque imaging has previously relied on high-resolution imaging using dedicated surface coils or MRI sequences not routinely obtained to measure stenosis. Recent reports suggest 3D-time-of-flight (TOF) imaging can accurately predict IPH compared to histopathology. We investigated the association between IPH determined on routinely acquired, 3D-TOF MRA neck images and prior stroke or TIA in patients with high-grade carotid stenosis.

METHOD AND MATERIALS
Subjects were screened after review of consecutive MRA neck exams performed from 8/2009 through 8/2012. Patients were included if they had high-grade carotid artery stenosis (70-99%) on non-contrast 3D-TOF MRA and documentation of prior stroke/TIA and vascular risk factors. IPH was determined by a validated technique assessing carotid plaque signal 50% more hyperintense than adjacent muscle. Assessments were made by two independent, blinded neuroradiologists with a third used as a tie-breaker. Clinical data was determined by consensus of two stroke neurologists. Statistical analysis was performed using univariate and multivariate logistic regression analysis with adjustment of statistically significant covariate risk factors.

RESULTS
After reviewing 4895 consecutive neck MRAs, 51 subjects with 53 carotid arteries met inclusion criteria. Vascular risk factors were not significantly different between groups. IPH was present in 24 carotid arteries. Of patients with IPH-positive exams, 15 had prior events (10 strokes, 5 TIs). Of those with negative exams, 4 had prior events (3 strokes, 1 TIA). In the univariate logistic regression analysis, the OR of the association of IPH to any prior ischemic event was 14.5 (95% CI 3.6-57.6) and the age- and sex-adjusted OR was 14.2 (95% CI 3.3-60.5). The association was preserved across magnet field strengths.

CONCLUSION
Our study demonstrates a strong association between ischemic events and IPH as determined on widely available, standard, large field-of-view neck coils using a 4-minute MRA sequence which is commonly used for screening exams.

CLINICAL RELEVANCE/APPLICATION
With prospective validation of our findings, regular reporting of IPH on neck MRA studies can be used as a risk stratification tool to complement measures of luminal diameter stenosis.

SSQ15-09 • CTA vs. 3T Black-Blood MRI for Identification of Symptomatic Carotid Plaques: A Comparative Study

Jochen M Grimm MD (Presenter) ; Andreas Schindler ; Florian Schwarz MD ; Clemens C Cyran MD * ; Martin Dichgans MD ; Tobias Saam MD * ; Tobias Freilinger ; Maximilian F Reiser MD ; Konstantin Nikolaou MD * ; Fabian Bamberg MD, MPH * ; Chun Yuan PhD *

PURPOSE
The purpose of this prospective comparative study was to evaluate CT angiography (CTA) and black-blood 3T-MRI (bb-MRI) regarding their respective ability to identify symptomatic carotid plaques.

METHOD AND MATERIALS
20 patients with unilateral symptomatic carotid disease who underwent extensive clinical workup at our stroke unit to exclude other causes of ischemic stroke underwent standard CTA and bb-MRI with TOF, pre- and post-contrast fsT1w-, fsT2w- and fsPDw- sequences within 7 days of symptom onset. Both symptomatic and contralateral asymptomatic sides were evaluated. By bb-MRI, plaque morphology and composition and prevalence of complicated type VI lesions (AHA-LT6) with haemorrhage, thrombus and/or ruptured fibrous cap were evaluated. By CTA, plaque type (soft, mixed, hard), plaque density in HU and presence of ulceration and thrombus were evaluated. Sensitivity (SE), specificity (SP), positive and negative predictive value (PPV, NPV) were calculated using a two-by-two table.

RESULTS
For identifying the symptomatic side AHA-LT6 was the best bb-MRI variable and presence of plaque ulceration was the best CTA variable, resulting in a SE, SP, PPV and NPV of 80%, 80%, 80% and 80% for AHA-LT6 as assessed by bb-MRI, 40%, 95%, 65% and 71% for plaque ulceration as assessed by CTA. The SE, SP, PPV and NPV for the combination of AHA-LT6 as determined by bb-MRI and ulceration as determined by CTA was 85%, 75%, 77% and 83%, respectively.

CONCLUSION
Bb-MRI delivered a better sensitivity, NPV and PPV compared to CTA at identifying the symptomatic side, while CTA offered an excellent specificity at the cost of low sensitivity and moderate PPV and NPV. Results were only slightly improved over bb-MRI when combining both techniques.

CLINICAL RELEVANCE/APPLICATION
This study shows that bb-MRI is better suited to detect symptomatic carotid plaques than CTA. A combination of both techniques is only marginally superior to bb-MRI alone.
CONCLUSION
Despite qualitatively normal-appearing white matter tissues, patients with Lennox-Gastaut syndrome have widespread microstructural changes measurable with quantitative DTI. Although the pathologic-anatomic correlation of these findings remains, these regions are strongly suggested to be related to cognitive impairments in these patients.

CLINICAL RELEVANCE/APPLICATION
Fractional anisotropy evaluated using tract-based spatial statistics can be used to show abnormalities in the patients with Lennox-Gastaut syndrome who have normal findings at conventional MR imaging.

SSQ17-02 • Functional Connectivity in Children with Sickle Cell Anemia and Normal Brain MRI

Kathleen J Helton MD (Presenter); Diana Fridlyand BS; Matthew Scoggins PhD; Ping Zou PhD; Jane Hankins MD; Banu Aygun MD; Jane Schreiber PhD; Robert J Ogg PhD

PURPOSE
Children with sickle cell anemia (SCA) are at risk for cognitive impairment, but the etiology of cognitive dysfunction in patients without visible evidence of brain injury remains unknown. We have shown that intelligence quotient in children with SCA is associated with altered blood-oxygenation level dependent (BOLD) functional MRI response to visual stimulation, findings that suggest chronic anemia alters the neural-hemodynamic coupling that supports healthy brain function. We used BOLD fMRI to test the hypothesis that cognitive dysfunction in SCA is associated with altered brain network connectivity.

METHOD AND MATERIALS
Following IRB-approval and written informed consent, 15 untreated children (12.37±3.39 years) with SCA underwent fMRI (resting-state and NBack) and neuropsychological testing (IQ, Wechsler Intelligence Scale for Children, 2003). After realignment, slice time correction, spatial normalization and smoothing(SPM8, http://www.fil.ion.ucl.ac.uk/spm/), spatially independent brain regions with correlated temporal patterns of activity (components) were identified with independent component analysis (ICA) of resting and task data (GIFT link?). Adjacency matrices were constructed based on pair-wise correlation of component time courses. Networks metrics (modularity, cost-integrated average degree, cost-integrated average local efficiency, cost-integrated global efficiency) were analyzed in relation to published healthy normal (N) values, age, and IQ.

RESULTS
Global efficiency (SCA=0.4, N=0.6) and modularity (SCA= 0.16, N=0.4-0.6) were lower than normal, and global efficiency was negatively correlated with modularity (p<0.05).

CONCLUSION
Decline of IQ with age shows adverse affects of disease on cognitive function. Network analysis revealed altered organization of brain networks in children with SCA, and graph-theoretical network metrics reflected abnormal age-related decline in IQ. The connectivity patterns we observed may help to elucidate the mechanism of cognitive dysfunction in SCA.

CLINICAL RELEVANCE/APPLICATION
Functional connectivity analysis holds great promise as a clinical adjunct in future studies of patients with SCA to assess effectiveness of treatment in improving neurocognitive function.

SSQ17-03 • 3T Apparent Kurtosis Coefficient (ACK) in Pediatric Brain: Preliminary Results

Marzia Mortilla MD (Presenter); Antonio Ciccarone MD, PhD; Marco Esposito; Claudio Fonda MD

PURPOSE
Our purpose was to identify a MRI method for quantifying the degree to which water diffusion in biologic tissues is non-Gaussian. DWI depends on the the b-values used during acquisition. At b-values lower than 500s/mm2 the signal attenuation is bi-exponential and it is influenced by both diffusion and perfusion. At b-values higher than 1000 s/mm2 the signal attenuation is influenced by restricted water diffusion and hence allows a non-Gaussian distribution. Diffusion Kurtosis Imaging (DKI) provides quantifiable information about the deviation from Gaussian distribution in water diffusion processes. Our aim was to use DKI in different pediatric brain pathologies in order to evaluate its feasibility in detecting those pathologies.

METHOD AND MATERIALS
The method is an extension of conventional DWI that requires higher b-values. We used 5 b-values: from 0 to 2500 s/mm2 with step 500. Fitting all b-values we were able to discriminate Diffusion and kurtosis parameters. We modified image post-processing procedure and we developed home made software for post-processing and DWI, ADC, ACK maps.

RESULTS
ACK maps revealed additional information for tissue characterization. For example in hypoxic-ischemic lesions ACK revealed more details about pathologic tissue changes and provided some information about prognosis. In brain tumors, ACK maps were used for discriminating low-grade from high grade lesions showing more accuracy than conventional diffusion parameters. The 15 patients with no pathology were used to create a set of normal values for specific anatomic regions.

CONCLUSION
ACK and ADC are non invasive methods to study brain lesions in pediatric patients. Our results suggest that these maps provide a more detailed characterization of neural tissue in clinical context. The post-processing required to generate maps is more time consuming than traditional DWI maps (2 min for each slice) but this acquisition and post-processing method provide more complete characterization of water displacement inside parenchyma in DWI.

CLINICAL RELEVANCE/APPLICATION
The application of DKI in pathological conditions in a pediatric population provides additional information about microstructural tissue changes, differential diagnosis and prognosis.

SSQ17-04 • Alteration of Regional Low-frequency Fluctuation in Very Young Autistic Children: A Sedated-state fMRI Study

Hua Cheng MD (Presenter); Jishui Zhang; Hao Huang PhD; Gaolang Gong; Yun Peng MD

PURPOSE
So far, it remains largely unknown how the regional functional patterns are altered in very young autistic children. The present study aims to determine if there are functional changes in social cognition-associated brain areas in autistic patients at very young stage.

METHOD AND MATERIALS
Sedated-state fMRI data (S-fMRI) of 33 treatment-naive male autism (2-6 years) and 26 age-matched controls were collected from a 3T clinical scanner using EPI sequence. The patients were diagnosed according to the ADI-R. Amplitude of low-frequency fluctuations (ALFF) and fractional ALFF were calculated using the REST software and analyzed in two different frequency bands (low-5:0.01-0.027 Hz; low-4: 0.027-0.073 Hz). To detect the group difference of ALFF and fALFF between autistic children and controls, a general linear model were applied to all voxels in grey matter. Statistical significance were determined by a cluster extent threshold of p<0.05.

RESULTS
We have found significant differences of frequency-dependent ALFF/fALFF in multiple brain regions between autistic children and controls (supplementary figure) which are associated with social cognition. Compared to controls, the patients showed similar decreased patterns in ALFF of both frequency bands and in fALFF of slow-5 band. Interestingly, ADI-R scores showed significant negative correlation with ALFF of slow-4 band in left temporal gyrus (p=0.01) (supplementary figure).
CONCLUSION
Our study reveals the abnormalities of functional activity of very young autistic children in multiple brain regions, which possibly underlies core symptoms of autism. The ALFF in left temporal lobe could be an imaging maker for autism evaluation. Therefore, the ALFF/fALFF analysis based on S-fMRI can be utilized as a potential method to evaluate brain functional development in very young children.

CLINICAL RELEVANCE/APPLICATION
The ALFF under sedated state could be a new imaging marker for evaluating functional abnormalities of autism in very young age.

SSQ17-05 • Biotin-responsive Basal Ganglia Disease (BBGD): Neuroimaging Features before and after Treatment
Hassan Kassem MD ; Sari s Alsuhibani MBBS, MD (Presenter) ; Sherif Abdelfattah MD, PhD ; Fahad Alsheikh ; Ayman H Gaballah MD, FRCP

PURPOSE
The purpose is to assess the clinical and neuroimaging features of a biotin-responsive basal ganglia disease before and after treatment of a subacute encephalopathy and to compare the disease with the other basal ganglia diseases of childhood

METHOD AND MATERIALS
We retrospectively reviewed the clinical, laboratory and neuroimaging features of fifteen (15) genetically proven cases of biotin-responsive basal ganglia. All patients were of arab ancestry and have consanguineous parents . Recessive genetic defect was detected by genetic test . All patients were of arab ancestry and had normal fMRI and MR spectroscopy of the brain . We total of 15 cases were presented with concurrent subacute encephalopathy leading to seizures, extrapyramidal symptoms and coma . MRI of the brain were done in all cases at the onset of symptoms and within a few days after the administration of high doses of biotin (5-10 mg/kg/d).

RESULTS
The brain MRI showed bilateral lesions in the caudate heads in all cases with complete or partial involvement of the putamen. The globus pallidus and cerebellum were spared in all patients. In 12 cases, discrete abnormal signal changes were observed in the mesencephalon, cortical-subcortical regions and thalamus. In 8 cases when the disease was advanced, patchy white matter disease was found. The high signal abnormality of the mesencephalon and cortical-subcortical areas were disappeared after treatment with biotin and thiamine while the caudate and putamen necrosis remained unchanged in all patients including those who became asymptomatic.

CONCLUSION
The neurological features, control of the disease with biotin and the distinctive MRI features should lead to the diagnosis of BBGD. It is important to check for the presence of this disease in children with acute onset extrapyramidal symptoms as therapeutic trial of biotin and thiamine can be lifesaving.

CLINICAL RELEVANCE/APPLICATION
It is important to check for the presence of this disease in children with acute extrapyramidal symptoms or subacute encephalopathy as it can be managed without further neurological deterioration.

SSQ17-06 • Does Ultrasound Texture Analysis of Periventricular White Matter Predict the Periventricular White Matter Injury in Preterm Infants?

Sun Kyung You MD (Presenter) ; Young-Hun Choi ; Sang-Joon Park BA ; Jung-Eun Cheon MD ; Woo Sun Kim MD ; In-One Kim MD

PURPOSE
Periventricular leukomalacia(PVL) is the major cause of neurodevelopmental problems encountered in survivors of premature birth. The aim of this study was to evaluate the ultrasound texture analysis as a potential imaging tool for quantitative assessment of periventricular white matter (PVWM) injury in preterm infants.

METHOD AND MATERIALS
73 preterm infants (median gestational age; 28wks, median birth weight; 905.2g) who were treated in the neonatal intensive care unit and had serial cranial US and brain MR obtained at near term period (38.0±3.7wks) were included in our study. Periventricular echogenicity (PVE) on serial cranial US were evaluated qualitatively by visual grading as grade 1, 2, and 3 compared to echogenicity of the choroid plexus and quantitatively using Gray Level Co-occurrence Matrix (GLCM) method; a second order statistical method of texture analysis. These features were selected based on empirical observation that the normal PVWM exhibits homogenous echotexture, whereas the ischemic PVWM often exhibits heterogeneous echotexture. Four GLCM textural features which represent homogeneity of an image was measured: (1) angular second moment (ASM), (2) inverse differential moment (IDM), (3)contrast, and (4) entropy. Quantitative and qualitative US features of PVE were compared between two groups (group 1: PVL on MRI(10), group 2; no PVWM abnormality on MRI(63)).

RESULTS
All GLCM features did not show statistically significant difference between two groups, although mean value of ASM and IDM were higher in group 1 than those of group 2 (ASM p-value ; 0.176, IDM p-value ; 0.52). Contrast (degree of heterogeneity) and entropy (degree of randomness) were lower in group 1 than those of group 2 (contrast p-value; 0.68, entropy p-value; 0.221). IDM and entropy values of PVE grade 1 (less than choroid plexus) showed statistically significant difference between two groups. (IDM p-value ; 0.006, entropy p-value).

CONCLUSION
Texture analysis using GLCM matrix method may serve as a complementary tool for quantitative assessment of PVE in selected cases of increased PVE. It is still questionable whether US screening of PVWM in premature infants can be a sensitive predictor of the PVWM injury in preterm infants.

SSQ17-07 • Amide Proton Transfer MR Imaging of the Brain in Children at 3T: A Preliminary Study

Hong Zhang MD (Presenter) ; Jinyuan Zhou PhD ; Na X Zhao PhD ; Yun Peng MD

PURPOSE
APT imaging is able to extend the achievable magnetic resonance imaging (MRI) contrast to the protein level. The aim of this study was to investigate APT effect in healthy children.

METHOD AND MATERIALS
Nineteen healthy children were investigated. All subjects were scanned on a Philips 3T MRI scanner (Achieva 3.0T TX). Single-slice APT imaging was acquired. All data processing procedures were performed using the interactive data language (IDL). The MTRasym(3.5 ppm) image was calculated. Regions of interest were carefully chosen by experienced radiologists. The regions of interest were drawn on relatively homogenous white and gray matters of bilateral cerebral hemispheres. SPSS11.5 for Windows was used for data analysis. The distribution of the data was tested for using the Shapiro-Wilk normality test. All values are expressed as mean±standard deviation. Then, paired t-test was done to show if there was significant difference in MTRasym(3.5 ppm) values between white and gray matters. Statistical significance was accepted at p < 0.05.

RESULTS
Fig.1 shows an example of APT images for a volunteer. As shown in Fig.1, the APT signal intensities was greater in gray matter compared to white matter in volunteers. There was no statistically significant difference between the left and the right side of the brain in
Low-dose Temporal Bone CT in Children: Feasibility and Image Quality

Hui Zheng (Presenter) ; Yuhua Li ; Wenjun Cao ; Ming Liu ; Dengbin Wang MD, PhD

PURPOSE
To evaluate the visualization of the temporal bone using low-dose 256-slice CT, we scanned one exsomatized cadaveric head at multiple levels of mAs and kV. This optimized protocol was used to examine pediatric patients. We analyzed the feasibility of low dose temporal bone CT in children and evaluate the image quality and radiation dose of a low-dose versus.

METHOD AND MATERIALS
One exsomatized cadaveric head was scanned repeatedly at three levels tube tensions from 120 to 80kV. And at every kV, multiple mAs were used from 250mAs until the image quality was insufficient. Noise was measured as the standard deviation in HU within the region the brain stem. All databases were subjectively evaluated by 2 experienced radiologists. The visibility of 16 anatomical landmarks was scored using a five point scale. The noise and effective dose were compared with each other. The optimized low dose protocol was used to examine 27 consecutive children. We retrospectively analyzed 36 examinations underwent a standard temporal bone CT acquired with 120kV,250mAs. The image quality and the effective dose were analyzed. Image quality score frequencies were calculated for each group. The children were then divided into 5 groups according to age-specific effective dose conversion coefficient. The effective dose of different age groups were compared in both low and high protocol. And then we compared the effective dose between the two protocols at the same age.

RESULTS
CT radiation dose was significantly reduced when the parameters was selected 100kV,70mAs. Most of the anatomical landmarks were delineated no significantly difference though the increased noise. The frequency of score 5 was significantly lower for the low-dose scans versus high, however the frequency of 4 was significantly higher. The frequency of the scores 1 and 2 was none for both protocols.

CONCLUSION
Low-dose temporal bone CT scans allow an accurate evaluation of middle and inner ear structures in children though reduced image quality compared with that in high-dose scans. The radiation dose was 5-6 times below standard protocol used in daily work. The effective dose for infants is higher than the older children underwent the same protocol.

CLINICAL RELEVANCE/APPLICATION
Postoperative CT of cochlear implants should provide information on the precise localization of the implant and its individual electrode.
PURPOSE
The present study aimed at developing an MRI-based temperature monitoring strategy capable of providing accurate temperature measurements even in the presence of field inhomogeneities. Such inhomogeneities commonly occur near air-tissue transitions, for example, around the sphenoid sinuses, and can significantly degrade the accuracy of temperature measurements.

METHOD AND MATERIALS
The use of a multi-pathway steady-state sequence is proposed here to help detect and correct for susceptibility-induced temperature measurement errors. The two different signal pathways sampled by the sequence lead to temperature errors of different polarity, \( ?T \) and \(-?T\), making it possible to detect and correct for such errors. These two pathways correspond to the so-called fast imaging with steady-state precession (FISP) signal and the inverse-FISP (PSIF) signal. The heating curve from both signal pathways can be measured, on a pixel-by-pixel basis, and a single-variable equation can be solved to evaluate the temperature errors, allowing them to be corrected for. The method was tested in gel phantoms and in a rabbit model.

RESULTS
Measurement errors of several \( ?C \) were observed and corrected for in controlled phantom experiments where known field inhomogeneities were intentionally introduced by de-adjusting high-order shim settings. Temperature errors were also observed and corrected for in a rabbit model, where field inhomogeneities were unavoidable present despite shimming, due to nearby air-tissue interfaces. After the proposed correction scheme was applied on a pixel-by-pixel basis, agreement was obtained between both FISP and PSIF measurements. Errors by up to 20% in temperature elevation (overestimation by \( ?C \)) on a 25 \( ?C \) peak temperature elevation have been observed and avoided.

CONCLUSION
We have demonstrated a method for detecting and correcting for susceptibility-induced temperature measurement errors. The method allows accurate temperature measurements to be performed even near air-tissue interfaces, with potential benefits in prostate, uterus, and brain MR-guidance applications.

CLINICAL RELEVANCE/APPLICATION
The proposed thermometry method allows susceptibility-induced temperature errors to be detected and corrected for. As a result, improved MR guidance may be achieved, during thermal therapies.

SSQ19-02 • Improving Reconstruction Speed for Dynamic MRI Using Parallel Imaging with Combined Coil Compression and Direct Virtual Coil

Kang Wang PhD (Presenter) * ; Scott K Nagle MD, PhD * ; Harald Kramer MD ; Tao Zhang ; Philip Beatty ; Mahdi Rahimi ; Courtney K Morrison ; Frank R Korosec PhD * ; Scott B Reeder MD, PhD ; Dan W Rettmann BS * ; Ersin Bayram PhD * ; James H Holmes PhD *

PURPOSE
Coil-by-coil (CBC) data-driven auto-calibrating parallel imaging has become more widely used for dynamic MR applications, such as dynamic contrast-enhanced (DCE) MR angiography (MRA). However, for high spatial resolution, high parallel imaging factors and high channel count coil array protocols, the image reconstruction time can be clinically unacceptably long. This work demonstrates an initial comparison of combining Coil Compression and Direct Virtual Coil (CCDVC) to significantly reduce reconstruction times vs. the currently used conventional method of CBC in the setting of dynamic contrast enhanced peripheral runoff MR angiography.

METHOD AND MATERIALS
Twenty-four volunteers (7 healthy, 17 with pathology) were imaged and informed consent was obtained prior to all scanning. All scans were conducted on a clinical scanner (3.0T MR750, GE Healthcare), with 48cm FOV, 1.0mm isotropic resolution, 32-channel coil array and parallel imaging factor of 3 (phase) \( \times \) 2 (slice) = 6. Temporal view-sharing was used to generate raw data for each time frame. The same raw data sets were then reconstructed twice: once with CBC and once with CCDVC. Time-resolved images reconstructed using CBC and CCDVC were randomized and blindly scored by two radiologists using a 5-point scale: image 1 much better (clinically significant); image 1 slightly better (not clinically significant); equivalent; image 2 slightly better (not clinically significant); image 2 much better (clinically significant).

RESULTS
The reconstruction times for CCDVC were about 18\% faster than the conventional CBC method (17 sec vs. 311 sec per phase on an offline computer) in the parallel imaging synthesis/FFT/coil combination module. One radiologist scored 18 cases as equivalent, 3 cases as CCDVC slightly better, and 3 cases as CBC slightly better; the second radiologist scored 17 cases as equivalent, and 7 cases as CCDVC slightly better.

CONCLUSION
The combined CCDVC technique was shown to significantly reduce the reconstruction time for high spatial and temporal resolution peripheral MRA, with no significant loss in image quality.

CLINICAL RELEVANCE/APPLICATION
The reconstruction speed for a DCE peripheral MRA scan can be significantly improved by using CCDVC to enable more aggressive clinical protocols or improve clinical workflow.

SSQ19-03 • Exercise System for Using 31-phosphorus MR Spectroscopy to Monitor Phosphocreatine Recovery from Exercise as Index for Mitochondrial Metabolism

Floyd Settles (Presenter) ; Geoffrey D Clarke PhD

PURPOSE
Measurement of mitochondrial function is relevant to aging, diabetes and sports medicine. Phosphorus-31 magnetic resonance spectroscopy (31P-MRS) can be used to evaluate the rate of phosphocreatine (PCr) recovery following exercise as a noninvasive index of the rate of ATP synthesis. The project’s aim is to develop a reproducible measurement technique using an exercise apparatus to quantify PCr recovery in the vastus lateralis muscle (VL).

METHOD AND MATERIALS
The apparatus was designed to exercise the VL with subjects in supine position with a dual-tuned 1H–31P TX/RX surface coil strapped to the thigh. PCr depletion levels and recovery times were measured for 8 minutes following a 5 min period of exercise. Slice-selective 31P-MRS was performed on 5 subjects (4 male, 15-56 y.o.) with TR=3000 ms, NSA=2, BW=2200 Hz. The time for return of PCr values to their half-maximum (T-half) was used as an index for the rate of ATP synthesis. PCr recovery data were fit to the function \( \text{PCr}(t) = \text{PCr}(0)+D[1-exp(-bt)] \) using the Marquardt-Levenberg algorithm (nlsLM function) in the R statistical package, where \( D \) and \( b \) were the fitted variables.

RESULTS
The prototyped apparatus is a compact, single-piece PVC assembly with little mass.

CONCLUSION
The exercise apparatus works, supporting and immobilizing the thigh and surface coil during baseline, dynamic flexion exercise and recovery phases of the protocol. Spectral data acquired consistently demonstrated PCr depletion and recovery in VL across all subjects. Predictable extension of the lower leg is obtained with a constant resistance without the use of large weights.

CLINICAL RELEVANCE/APPLICATION
Noninvasive, reproducible measures of mitochondrial function by a well-characterized in-vivo biomarker can provide insights for the characterization and treatment of metabolic diseases.
SSQ19-04 • Transcranial Magnetic Stimulation-Induced Heating of Deep Brain Stimulation Implants: An Empirical Specific Absorption Rate Evaluation Using a Tissue Equivalent Phantom

Goldie R Boone MS (Presenter) ; Geoffrey D Clarke PhD

PURPOSE
Transcranial magnetic stimulation (TMS) uses electromagnetic induction to generate weak electric currents by application of rapidly changing magnetic fields to depolarize or hyperpolarize neurons in the brain. The potential for induced heating of brain tissues located near bilaterally implanted deep brain stimulation (DBS) electrodes during application of single pulse and repetitively pulsed TMS was investigated. This study provides empirical evidence for the "reasonable assurance of safety" in the FDA's classification of TMS as a Class II (special controls) device.

METHOD AND MATERIALS
TMS was conducted using the MagPro R30 system (MagVenture, Denmark) with a liquid cooled butterfly coil (model Cool-B65). TMS-induced heating was measured using a proprietary phantom and a clinical/research stimulation protocol. Fiber optic thermometry probes captured real-time temperature measurements of the induced heating at the surface of the metallic DBS electrodes during TMS. The three specific aims of this study were to evaluate the 1) spatially localized temperature increase, 2) spatially localized specific absorption rate (SAR), and 3) the average head SAR in the phantom in the absence and presence of the DBS implant over a 6 minute averaging period in saline and gelled-saline solutions at stimulation frequencies of 1 and 5 Hz. The differences in the average temperatures in the presence and absence of bilateral DBS implants were analyzed by ANOVA (p = 0.05, power = 0.80) with Bonferroni correction.

RESULTS
In the clinical/research stimulation orientation, no evidence of induced heating effects was observed above the thermal noise. However, stimulation of the lead loops at 5 Hz in gelled saline at a distance of 0.5 cm from the coil's surface and peak intensity region resulted in temperatures that tripled the spatially localized temperature limit and SAR values that doubled the spatially localized SAR limit. TMS-induced heating effects of this nature may result in localized tissue damage.

CONCLUSION
The observations in this research study support the use of repetitive TMS of patients with a bilateral DBS device implant provided prior knowledge is used to guide surgical lead configuration and careful coil placement during stimulation.

CLINICAL RELEVANCE/APPLICATION
The data support the use of repetitive TMS as a safe adjuvant therapy to surgery and pharmaceuticals in the treatment of neurological movement and major depressive disorders.

SSQ19-05 • How to Improve the Quality and Speed of 3T MR Imaging in Cervical and Lumbar Spine by Multiple RF Transmission?

Chuan Shuai Tian (Presenter) ; Bing Zhang PhD ; Fei Chen MS ; Bin Zhu ; Haiping Yu ; Ming Li ; Danyan Li ; Huiting Wang MS ; Weibo Chen MSc ; Queenie Chan PhD

PURPOSE
We aimed to study how to improve the quality and speed of cervical and lumbar imaging by TX technology compared with single transmission (without TX).

METHOD AND MATERIALS
Thirty-seven healthy volunteers (seventeen (5 male and 12 female), aged 21-55yr (mean 38.47±13.02yr) for cervical; twenty (8 male and 12 female), aged 20-64yr (mean 29.25±8.48yr) for lumbar) were scanned at 3.0T scanner (Achieva TX, Best, the Netherlands), acquiring the T2WI and T1WI images of the cervical and lumbar with and without TX. We compared the parameters, as well as the average signal intensity in different region of interest (ROIs) between the cervical and lumbar MRI with and without TX (Fig.a,b). P values less than 0.05 were considered statistically significant by Paired t-test.

RESULTS
TR was shortened by 1224ms(26.67%) on T2WI, and 97ms (17.64%) on T1WI in lumbar MRI. Packages reduced by 1.5±1 (37.5%), scanning time is shortened by 97.2±31.15s (44.02%). On T2WI of the cervical, the average signal intensity of ROIs 3/4/9 for vertebrae, ROIs 10/11 for fat were increased (P 0.05) have no statistical significance. On T1WI, the average signal intensity of ROIs 1/2 for vertebrae, ROIs 5-8 as the spinal cord, ROI 12 for the pons, ROI 13 for the cerebellum were reduced, ROIs 10/11 for fat were increased (P 0.05) have no statistical significance. On T2WI of the Lumbar, the average signal intensity of ROIs 1-6/10 for vertebrae, ROI 9(on the same level of lumbar 5 ) for fat were reduced; ROI 8(on the same level of lumbar 1) for fat was increased (P 0.05), no statistical significance. On T1WI, the average signal intensity of ROIs 2-6/10 for vertebral, ROI 7 for the spinal cord were reduced; ROI 8 for fat was increased (P 0.05) have no statistical significance.

CONCLUSION
In the cervical and lumbar MRI, multiple-transmit parallel RF transmission can improve B1 homogeneity, shorten TR, reduce local SAR value and scanning packages, thereby improve the image quality and reduce scanning time.

CLINICAL RELEVANCE/APPLICATION
Multiple-transmit parallel RF transmission can improve the image quality and reduce scanning time.

SSQ19-06 • High B-value Diffusion Weighted Imaging in Defining the Infiltration Zone of Cerebral Glioma

Chunhui Jiang BMedSc, MMedSc ; Jian Wang (Presenter)

CONCLUSION
It is demonstrated in this study that DWI may be useful in defining the infiltration zone of glioma, especially with high B-values. Larger studies are needed to prospectively validate the utility of ADC from high B-values DWI scan as a noninvasive imaging biomarker for quantitatively measuring the infiltration zone of glioma.

Background
To evaluate the role of the ADC value in patients with glioma (WHO II-IV) using high B-value diffusion weighted imaging (DWI), as a potential noninvasive quantitative index in defining the boundary of glioma.

Evaluation
18 cases of surgical pathologically confirmed glioma underwent the DWI scan with b=1000 and 3000s/mm² respectively in a 3T MR scanner. The ADC values of the glioma substantial zone, cerebral parenchyma within 0-10/10-20mm radium and the cerebral parenchyma of the opposite sphere are statistically analyzed by SPSS17.

SSQ19-07 • Comparison of Signal as a Function of Position for a 1H/31P Surface Coil Used in Exercise Studies

Erika Ripley (Presenter) ; Geoffrey D Clarke PhD

PURPOSE
MRI-compatible exercise studies are reported in the literature for measuring phosphorus-31 (31P) metabolites in the vastus lateralis muscle (VL). For these studies the thigh is positioned at an angle with respect to the main magnetic field to allow leg movement, which is a non-optimal orientation for the MRS coil. This study determines the performance degradation in the RF coil due to orientation.
METHOD AND MATERIALS
A dual-tuned rigid TX/RX surface coil (Rapid Biomedical, Rimpar, Germany) was used on a 3T MRI system (TIM Trio, Siemens, Malvern, PA) to collect 31P spectra from a leg phantom (15 cm diameter, 1 L plastic cylindrical jug with 10 mM H3PO4) and a small standard (6 mL plastic vial with a 850 mM concentration of methylenediphosphonic acid (MDP)). The standard was positioned on the surface coil and a 1-pulse 31P sequence was performed (TR 8000 ms, 4 NSA, 4 prep scans, BW=3000 Hz). Spectra were taken with the MDP vial at the center of the coil, 5 cm, 8 cm and 10 cm away from the center in the L/R and H/F directions. Measurements were repeated with the leg phantom flat on the table parallel to B0 (0°) and secured to the exercise device at an angle of 38.9° with respect to B0. Spectra were analyzed using jMRUI software to determine the area under each peak. Paired t-tests were used to evaluate the statistical significance (p < 0.05) of the results.

RESULTS
The areas of the MDP peaks were plotted with respect to position. For both orientations, the signal from right to left was symmetric about the center of the coil with the highest signal at ±8 cm. The signals across the coil L/R were reduced by 30% (p=0.015) at 38.9° compared to 0°. Along the z axis, with the phantom flat on the table, the signal was almost symmetric, but spectra obtained at an angle were skewed with the maximum signal at ±8 cm and no signal below -5 cm, an overall ~56% average difference.

CONCLUSION
Signal intensity changes from the acquired phantom data suggest that over 60% of the total signal is lost at the 38.9° angle compared to acquisitions with the coil parallel to B0. Also, most of the signal will come from the portion of the VL muscle that is near the knee-end of the coil.

CLINICAL RELEVANCE/APPLICATION
Signal sensitivity profiles that take into account position and coil orientation must be considered for 31P metabolite quantification in exercise studies.

SSQ19-08 • Cerebrospinal Fluid Fluctuation in the Ventricular System in Idiopathic Normal Pressure Hydrocephalus

Naoki Ohno MS (Presenter) ; Tosiaki Miyati PhD ; Mitsuhiro Mase MD ; Noam Alperin PhD * ; Harumasa Kasai MSc ; Shinnosuke Hirotsubaky ; Makoto Kawano ; Yuta Shibamoto MD, PhD ; Toshifumi Gabata MD ; Osamu Matsui MD

PURPOSE
We have reported that temporal changes in the brain parenchyma's apparent diffusion coefficient (ADC) during the cardiac cycle (ADC) reveal the degree of fluctuation of water molecules likely resulting from arterial inflow (volume loading) during systole, and this information potentially facilitates the diagnosis of idiopathic normal pressure hydrocephalus (iNPH). However, we assessed the ADC change only in white matter. Moreover, several studies have shown that analysis of intraventricular CSF flow can provide the intracranial condition in iNPH. We therefore determined the temporal change in ADC over the cardiac cycle in the ventricular system of iNPH.

METHOD AND MATERIALS
On a 1.5-T MRI, ECG-triggered single-shot diffusion echo planar imaging (b = 0 and 1000 s/mm2) was used with sensitivity encoding and half-scan techniques to minimize the bulk motion. Then ADC image of each cardiac phase were made. Next, a normalized-ADC image was calculated from all cardiac phase ADC images (20 phases) on a pixel-by-pixel basis using the following equation: Normalized-?ADC = (ADCmax - ADCmin)/(ADCmax + ADCmin), where ADCmax and ADCmin represent the maximum and minimum ADC during the cardiac cycle, respectively. We have reported that temporal changes in the brain parenchyma's apparent diffusion coefficient (ADC) during the cardiac cycle (?ADC) reveal the degree of fluctuation of water molecules likely resulting from arterial inflow (volume loading) during systole, and this information potentially facilitates the diagnosis of idiopathic normal pressure hydrocephalus (iNPH). However, we assessed the ADC change only in white matter. Moreover, several studies have shown that analysis of intraventricular CSF flow can provide the intracranial condition in iNPH. We therefore determined the temporal change in ADC over the cardiac cycle in the ventricular system of iNPH.

RESULT
Normalized-ADC of the third ventricle was significantly higher in iNPH compared with the control and atrophic VD groups, whereas there were no significant differences in ADC of all ventricular regions among the groups.

CONCLUSION
Normalized-ADC analysis as a fluctuation MRI in the ventricular system makes it possible to noninvasively obtain more detailed information on the intracranial condition in INPH and thereby possibly assist in the diagnosis.

CLINICAL RELEVANCE/APPLICATION
Fluctuation analysis of the intraventricular CSF makes it possible to noninvasively obtain more detailed information on the intracranial condition in INPH and thereby possibly assist in the diagnosis.

SSQ19-09 • Accurate T1 Relaxivities (r1) of Gadolinium-based Magnetic Resonance Contrast Agents (GBCAs) in Human Whole Blood at 1.5T and 3T

Yaqi Shen PhD, MD ; Christopher G Snyder BS ; Frank L Goerner PhD (Presenter) * ; Regina Moritz ; Val M Runge MD *

PURPOSE
The current available values for T1 relaxation (r1) of Gadolinium based MR contrast agents (GBCAs) at 1.5T and 3T are either provided for non-clinically relevant scenarios or in only a portion of the available GBCAs. This is likely due to the complex nature of obtaining these values. This study determines and compares the r1 values of eight commercially available GBCAs in human whole blood at 1.5T and 3T.

METHOD AND MATERIALS
RESULTS
CONCLUSION
CLINICAL RELEVANCE/APPLICATION
The results of this experiment are the most relevant r1 measurements to a clinical scenario. This will give clinicians a more accurate idea of the enhancement of each GBCA in MR imaging.

Hot Topic Session: MR Quantification Techniques in the Liver (Fat, Iron, Fibrosis)
Thursday, 03:00 PM – 04:00 PM • E350

SPSH52 • AMA PRA Category 1 Credit ™:1 • ARRT Category A+ Credit:1
Moderator
Claude B Sirilin , MD *

SPSH52A • MR Quantification of Liver Fat
Scott B Reeder MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Understand the relative accuracy and performance of US, CT and MRI for the detection and quantification of hepatic steatosis. 2) Understand the fundamentals of emerging confound-corrected MRI methods to quantify liver fat content.
LEARNING OBJECTIVES
1) Understand the fundamentals of MR methods to quantify liver iron. 2) Understand the main advantages and disadvantages of different methods.

ABSTRACT
Assessment of liver iron levels is necessary for detection and quantitative staging of iron overload, and monitoring of iron-reducing treatments. This lecture discusses the need for non-invasive assessment of liver iron, and reviews qualitative and quantitative methods with a particular emphasis on MRI. Methods that are in clinical use, as well as their limitations, are described. Remaining challenges, unsolved problems, and recently introduced techniques to provide improved characterization of liver iron deposition are discussed.

LEARNING OBJECTIVES
1) Briefly review different MR-based techniques to evaluate liver fibrosis. 2) Understand the fundamentals of MR elastography. 3) Understand the performance of MR elastography for evaluating liver fibrosis.

LEARNING OBJECTIVES
1) Describe the role of amyloid and FDG PET imaging for tracking the progression of Alzheimer's disease from preclinical stage to dementia. 2) Properly choose amyloid imaging, MRI and FDG PET for the differential diagnosis of dementia. 3) Learn the appropriate use criteria for amyloid PET.

LEARNING OBJECTIVES
1) To understand the different forms of cardiomyopathy and how they present in CT. 2) To learn about the best imaging strategy for cardiomyopathy in CT.
LEARNING OBJECTIVES
1) Understand the role of CT/MR in determining the etiology of cardiomyopathy. 2) Understand the role of CT/MR in selecting patients for revascularization. 3) Understand the role of CT/MR in selecting patients for device therapy.

LEARNING OBJECTIVES
1) Describe how water and myelin content influence the T1 and T2 relaxation times. 2) Describe the time course and regional variation of brain maturational changes. 3) Use a systematic approach to determine the child's brain age.

LEARNING OBJECTIVES
1) Understanding the classification of congenital brain malformations, particularly cortical malformations. 2) Comprehension of the genetic undertones of congenital brain malformations. 3) Ability to identify imaging appearance of common cortical malformations on brain MR imaging.

LEARNING OBJECTIVES
1) Understand how the characteristics of commonly used abdominal-imaging pulse sequences influence their susceptibility to respiratory artifacts. 2) Explain differences between multi-slice and single-shot pulse sequences. 3) Describe various approaches for suppressing respiratory artifacts. 4) Optimize routine imaging protocols for abdominal MRI.

LEARNING OBJECTIVES
1) Provide background of different available MRI contrast agents and their properties. 2) Discuss safety profiles and concepts related to minimizing risk of NSF. 3) Review common indications for different available MRI contrast agents and their relative strengths and weaknesses.

ABSTRACT
LEARNING OBJECTIVES
1) Learn how to perform high temporal resolution dynamic MR Contrast enhanced imaging. 2) Learn post-processing strategies for high temporal resolution MR data. 3) Review applications of high temporal resolution imaging.

MR Imaging-guided Breast Biopsy (Hands-on Workshop)

LEARNING OBJECTIVES
1) Understand the role of CT/MR in determining the etiology of cardiomyopathy. 2) Understand the role of CT/MR in selecting patients for revascularization. 3) Understand the role of CT/MR in selecting patients for device therapy.
LEARNING OBJECTIVES
1) Establish criteria for MR Image-guided breast biopsy patient selection. 2) Cultivate a working understanding of MR Image-guided biopsy and needle localization instrumentation and implementation. 3) Basic MR Image-guided biopsy and needle localization parameters and requirements for appropriate coil, needle and approach selection. 4) Discuss practice integration issues. 5) Benefits and limitations of availability of MR Image-guided biopsy/needle localization in your practice.

ABSTRACT
This course is intended to provide both basic didactic instruction and hands-on experience in the application of MRI guided breast biopsy and needle localization. Because MRI is having a progressively larger role in the evaluation of breast cancer each year, there has been a tremendous increase in the need for MRI guided biopsy and needle localization of the identified abnormalities, since many of these can only be identified at MRI. This course will be devoted to the understanding and identification of: 1) appropriate patient selection 2) optimal positioning for biopsy 3) target selection and confirmation 4) various biopsy technologies and techniques 5) potential problems and pitfalls.

Clinical Breast MR Imaging (An Interactive Session)
Friday, 08:30 AM - 10:00 AM • E450A

RC815 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

RC815A • Breast MRI: Suspicious Lesions
Christiane K Kuhl MD (Presenter) *

LEARNING OBJECTIVES
1) To review breast MR imaging features used to distinguish suspicious from benign lesions. 2) To understand the appropriate use of the ACR Breast MR lexicon. 3) To review the management of suspicious breast MR findings.

ABSTRACT

RC815B • Breast MRI: BI-RADS 3
Christopher E Comstock MD (Presenter)

LEARNING OBJECTIVES
1) Understand appropriate use of the ACR BI-RADS in MR Interpretation. 2) Review interesting cases using BI-RADS lexicon.

RC815C • MR-guided Biopsy
Carol H Lee MD (Presenter)

LEARNING OBJECTIVES
1) To review technical considerations in MR guided biopsy. 2) To discuss potential pitfalls associated with MR biopsy and how to handle them. 3) To understand appropriate post-biopsy management and follow-up.

Medical Physics 2.0: Magnetic Resonance Imaging
Friday, 08:30 AM - 10:00 AM • S405AB

RC821 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

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

RC821A • Magnetic Resonance Imaging Perspective
Douglas E Pfeiffer MS (Presenter) *

LEARNING OBJECTIVES
1) Understand the history and development of magnetic resonance imaging equipment. 2) Understand the impact of equipment development on testing protocols. 3) Understand the requirements for medical physics support in image quality and safety.

ABSTRACT
Magnetic resonance imaging equipment has developed significantly since its inception. Field strength increases and technology development increase the complexity of the equipment and the need for medical physics and MRI scientist support. This talk will briefly introduce the developments that have taken place and discuss the impact that this development has had on testing and support.

RC821B • Magnetic Resonance Imaging 1.0
Ronald R Price PhD (Presenter)

LEARNING OBJECTIVES
1) Review the image quality metrics that are currently used as part of an MRI system performance report. 2) Discuss how the medical physicist can assist in the development and evaluation of imaging sequences used as part of clinical protocols. 3) To review items that should be included as part of an MRI safety survey. 4) Discuss the steps necessary for establishing and maintaining a routine quality assurance program. 5) Review aspects of AAPM Report No. 100 regarding acceptance testing of new MRI systems. 6) Review modality and system specific requirements for MRI accreditation.

ABSTRACT
MRI 1.0: Magnetic Resonance Imaging Ronald R. Price The purpose of this presentation is to review the current role of the medical physicist in clinical Magnetic Resonance Imaging (MRI). The discussion will first discuss MRI acceptance testing with reference to the recommendations of AAPM Report No. 100 and will specifically include items that should be part of both the initial and annual MRI safety
RB821C • Magnetic Resonance Imaging 2.0

David R Pickens PhD (Presenter) *

LEARNING OBJECTIVES
1) Identify requirements for ongoing quality assurance of ultra-high field MRI systems and hybrid MR/PET systems. 2) Identify the need for new quality assurance tools and testing procedures for advanced systems with many parallel imaging channels. 3) Identify site safety issues for ultra-high field and hybrid MR systems and expanded concerns for patient and staff safety. 4) Understand increased requirements from oversight and accreditation organizations. 5) Identify the need for improved continuing education for medical physicists/MRI scientists.

ABSTRACT
This talk will look into the future of clinical MR imaging and the role of the physicist as the technology of MR imaging evolves. Many of the quality assurance techniques used today will need to be extended to address the advent of higher field imaging systems and dedicated imagers for specialty applications. Included will be the need to address quality assurance and testing for hybrid devices such as MR/PET systems. Many new coil systems will be routinely provided in systems with large numbers of parallel receive channels along with parallel transmit channels. New pulse sequences and acquisition methods, increasing use of MR spectroscopy, and real-time guidance procedures will place the burden on the medical physicist to develop and use new phantoms and test procedures to evaluate clinical imagers. Many of these phantoms will have different potential side effects including potential problems associated with patient and staff safety. New software tools will be available for testing, but these must be understood by the physicist in order that they be used correctly for quality assurance purposes. Finally, new rules, requirements, and regulations undoubtedly will mean that the medical physicist must work closely with staff technologists to keep her/his sites compliant with the latest requirements and must actively keep abreast of these developments.

Interactive Game: Clinical Problems in Body MRI - Case-based Instruction
Friday, 08:30 AM - 10:00 AM • E451B

RC829 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

LEARNING OBJECTIVES
This interactive session will use RSNA Diagnosis Live. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

RC829A • Liver Lesion Differential Diagnosis

Christopher G Roth MD (Presenter) *

LEARNING OBJECTIVES
1) To appreciate and understand the typical imaging appearances of common liver lesions. 2) To understand the algorithmic approach to liver lesion differential diagnosis. 3) To understand how information from the various pulse sequences and contrast agents contribute to liver lesion assessment.

ABSTRACT
Given the ubiquitousness of liver lesions on imaging studies, it is incumbent upon radiologists to accurately characterize these lesions and differentiate benign from malignant. While the vast majority of liver lesions are benign incurring no further treatment or management and their features need to be recognized, the management of indeterminate and malignant lesions ranges from percutaneous biopsy to surgery to chemotherapy and a confident diagnosis or differential diagnosis should be pursued before these invasive measures are undertaken. While many lesions are adequately characterized on other imaging modalities, many require further analysis with MRI and some may initially present at MR imaging. Given the wide array of pulse sequences and protocols and proliferation of MR contrast agents, assimilating all of the necessary imaging information to generate an accurate diagnosis or differential diagnosis can be challenging. MRI is considered the most comprehensive and accurate modality for noninvasive assessment of liver lesions and in the majority of cases, a confident lesion diagnosis is possible based on the composite information from multiple pulse sequences. While many lesions exhibit classic features rendering diagnosis straightforward, lesions occasionally demonstrate unusual or atypical features that may complicate accurate diagnosis and familiarity with these infrequent appearances is important for accurate characterization and discrimination between benign and malignant etiology. The utility of the various MRI pulse sequences and contrast agents will be discussed and a diagnostic algorithm will be presented to help classify and accurately diagnose liver lesions.

RC829B • Pancreatic Cysts - Achieving Consistency and Common Sense

Masoom A Haider MD (Presenter) *

LEARNING OBJECTIVES
1) To be able to perform an MRI protocol for evaluation of pancreatic cystic lesions. 2) To recognize the classic MRI findings for cystic pathologies of the pancreas. 3) To have a pragmatic approach to management recommendations of cystic lesions of the pancreas.

ABSTRACT
With the widespread use of cross sectional imaging cystic pancreatic lesions are being detected with increasing frequency. The dominance of pseudocyst as the commonest type of pancreatic cyst may no longer hold. Radiologists must be familiar with the features of cystic neoplasms. MRI offers excellent tissue contrast for characterization of pancreatic cysts as well as for assessment of relationship to the pancreatic duct which can be helpful for differential diagnosis. A number of MRI features can be used to help guide management and offer likely differential diagnosis and will be presented. At the same time MRI has resulted in increased detection of tiny incidental simple pancreatic cysts for which limited or no followup may be necessary. It is important to recognize that in some cases MRI and other non-invasive imaging methods cannot provide reliable diagnosis as there is substantial overlap in imaging findings between some benign and pre-malignant or malignant cystic neoplasm. These scenarios will be reviewed.

RC829C • Cholangiocarcinoma - Addressing a Difficult Challenge

Kartik S Jhaveri MD (Presenter) *

LEARNING OBJECTIVES
1) To emphasize an optimal MR imaging protocol. 2) To highlight role of MRI in the diagnosis and classification. 3) To demonstrate the role of MRI in staging. 4) To understand limitations of MRI and review mimics of cholangiocarcinoma.

ABSTRACT
Although Cholangiocarcinoma is a rare tumour
Renal MRA at 7T: How Much Gadolinium Do We Need?

**Lale Umutlu** MD (Presenter) *; **Karsten J Beiderwellen** MD; **Michael Forsting** MD; **Mark E Ladd** PhD; **Oliver Kraff** MSc; **Thomas C Lauenstein** MD

**METHOD AND MATERIALS**
12 healthy subjects underwent renal MR angiographic examinations on a 7T MR system (Magnetom 7T), utilizing a custom-built 8-channel RF body coil. Dynamic 3D FLASH data sets were obtained pre contrast and in arterial phase after the application of contrast agent. Examinations were performed at three different time points for injection of three dosages of CA (Gadobutrol, Bayer Healthcare):
- (1) 0.1 mmol/kg body weight (BW),
- (2) 0.05 mmol/kg BW and
- (3) 0.025 mmol/kg BW.

**RESULTS**
Contrast ratios (CR) were measured pre and post agent. Examinations were performed at three different time points for injection of three dosages of CA (Gadobutrol, Bayer Healthcare):
- (1) 0.1 mmol/kg body weight (BW),
- (2) 0.05 mmol/kg BW and
- (3) 0.025 mmol/kg BW.

**CONCLUSION**
The TRICKS images of 38 cases(arterial scales=2 point) showed location and diameter of FDMA,and the TRICKS images of 30 cases(arterial scales=3 point) showed branching pattern at the toe web of FDMA:(1)Location:superficial (8), intramuscular(22 cases),infra-muscular (8 cases), absent(0 cases);(2)Diameter: large(2 cases), medium(25 cases ), and small(11 cases);(3)Branching pattern at the toe web:ramifying type(11 cases),main trunk type(5 cases),fine small branch(14 cases).

**CLINICAL RELEVANCE/APPLICATION**
MR angiography of the dorsalis pedis artery and FDMA was achievable with MR TRICKS sequences, and it was useful for clinical evaluation of FDMA.

**PURPOSE**
The IMI-SUMMIT MRI study assessed whole body cardiovascular MR (WBCVMR) to provide surrogate markers of macrovascular disease in patients with diabetes mellitus. WBCVMR combines whole body contrast enhanced magnetic resonance angiography (WBCE-MRA) and cardiac MR(CMR) in a single examination. We compared WBCVMR in type 2 diabetic and non-diabetic patients, with and without symptomatic cardiovascular disease(CVD).

**RESULTS**
143 datasets were included, of which 87(60%) were male (13 excluded due to incomplete scan/inadequate image quality)., The mean age was 63.9±8.1 years. Mean WBAS were 0.41+/-0.45 (group 1), 0.17+/-0.17 (group 2), 0.49+/-0.4 (group 3), and 0.15+/-0.18 (group 4). Mean LVM(g) were: 61.6 +/-9.7 (group 1), 55.6+/-10.5 (group 2), 60.4+/-10.6 (group 3), and 52.6+/-8.7 (group 4). WBAS correlated with LVM (r=0.41; p

**CONCLUSION**
WBCVMR offers a robust investigation for detecting and quantitating whole body atheroma burden. Extensive arterial disease and silent myocardial scarring can be visualised in asymptomatic diabetic patients.

**Vascular Imaging Series: MR Angiography-Principles and Technique Optimization**

**LEARNING OBJECTIVES**
1) Understand the general principles of contrast-enhanced and time-resolved MR Angiography.
2) Be familiar with sample clinical applications for time-resolved MR Angiography in several vascular beds.
3) Be aware of the major caveats in contrast enhanced MR Angiography at 1.5T and 3.0T and how to avoid them.

**Whole Body Cardiovascular Magnetic Resonance Imaging in the Detection of Occult Disease in Diabetes Mellitus**

**Graeme Houston** MD, FRCR *; **Jonathan Wein-McCall** MBChB, FRCP (Presenter) ; **Suzanne L Duce** PhD ; **Shona Matthew** BSc, PhD *; **Stephen Gandy** ; **Helen Colhoun** ; **Deirdre Cassidy** ; **Gill Reekie** ; **Jil J Belch** ; **Patricia Martin

**PURPOSE**
Type 2 diabetics have an elevated risk of cardiovascular events which can occur in apparently healthy patients. Screening with WBCVMR may identify those at increased risk of future events.
contrast in the aorta and both renal arteries in correlation to adjacent psoas major muscle. Qualitative analysis with regard to delineation of the pre-contrast and post-contrast renal arterial vasculature was performed by two radiologists using a five-point-scale (5=excellent to 1=non diagnostic).

RESULTS
Non-enhanced T1w MRI provided an inherently high signal intensity of vasculature, yielding a good overall pre-contrast arterial delineation (mean 3.65). The application of contrast agent showed improved vessel delineation in subjective ratings of qualitative analysis for all three dosages, yielding comparable results with only minor improvement associated to increased dosage (mean aorta: 0.025Gd 4.4; mean0.05Gd 4.6; mean0.1Gd mean 4.80). Accordingly, quantitative analysis of contrast ratios showed minor increase of mean values with increasing Gadolinium dosage (mean right renal artery: 0.025Gd 0.36; mean0.05Gd 0.38; mean0.1Gd mean 0.42).

CONCLUSION
Our results demonstrate the successful facilitation of a significant dose reduction to one-quarter of the standardized dosage, while maintaining high image quality.

CLINICAL RELEVANCE/APPLICATION
The facilitation of a significant dose reduction to one-quarter while maintaining high image quality, may be of high diagnostic value for MRA examinations in patients with renal impairment.

VSSA61-05 • MR Contrast Agents for Vascular Imaging

Tim Leiner MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) To understand the different classes of contrast agents available for vascular imaging as well as their strengths and weaknesses. 2) To understand both acute and delayed safety concerns associated with administration of MR contrast agents for vascular imaging. 3) To understand proper contrast agent dosing for vascular MR imaging. 4) To understand basic principles underlying successful contrast injection.

ABSTRACT

VSSA61-06 • Gadofosveset-enhanced MR Venography of the Lower Extremities for Evaluation of Venous Reflux Disease: Feasibility and Comparison of Perforator Vein Imaging with Duplex Ultrasound

Andrew R Lewis MD (Presenter); Daniele Marin MD; Holly L Nichols BS; Daniel Geersen; Cynthia K Shortell MD; Charles Y Kim MD *

PURPOSE
Duplex ultrasound (U/S) is the gold standard for imaging of venous reflux disease. CT and direct MR venography (MRV) have shown promising results, but are limited in the degree and extent of superficial vein opacification. Gadofosveset, a blood-pool agent, is uniquely well suited for venous imaging. The purpose of this study is to assess the feasibility of MRV of the deep and superficial venous system and to determine its accuracy in detection of perforator veins.

METHOD AND MATERIALS
Retrospective review of our imaging database from 9/2010 – 9/2012 yielded 58 patients (40 females, mean age 54) who underwent MRV of the abdomen, pelvis, and lower extremities as well as dedicated U/S evaluation of venous reflux disease of one or both legs. Axial MRV images were acquired during the equilibrium phase, approximately 5 minutes after IV gadofosveset injection. The lower extremity deep, superficial, and perforator veins were divided into 11 segments for evaluation. Two radiologists independently rated the visualization score of each venous segment on a scale of 1-4 with 4 being highest. Signal and contrast-to-noise ratios were calculated for the venous segments. The detection of enlarged perforator veins was assessed and compared to sonography.

RESULTS
Analysis was performed on 80 legs that underwent both MRV and U/S. The mean visualization scores for all analyzed venous segments were excellent (3.8–3.9 on a scale of 1–4). The SNR/CNR values were 280/165 for the femoral vein, 230/144 for the above-knee GSV, 394/237 for the below-knee GSV, 303/177 for the small saphenous vein, and 385/240 for superficial varices. 100% of pathologic perforator veins identified on dedicated U/S were detected on MRV. Additional occult enlarged perforator veins were identified on MRV measuring up to 6mm in diameter.

CONCLUSION
MRV with gadofosveset allowed excellent visualization of varices, superficial, and perforator veins of the legs with a high SNR and CNR that was not previously possible with other contrast agents. The exceptional sensitivity for detection of perforator veins may enable improved treatment of venous reflux disease. Additional studies are warranted to correlate MRV findings with disease characterization and treatment outcomes.

CLINICAL RELEVANCE/APPLICATION
The excellent imaging quality of the entire venous system of the lower extremities with gadofosveset-enhanced MR venography may enable a new system for evaluation of venous reflux disease.

VSSA61-07 • MRA at 3T in Peripheral Arterial Occlusive Disease: Comparison of Gadoterate Meglumine - to Gadobutrol-MRA Using DSA as a Standard of Reference: A Randomized European Multicenter Trial

Christian Loewe MD (Presenter) *; Javier Arnaiz Garcia MD; Denis Krause MD; Luis Marti-Bonmati MD, PhD; Manuela Aschauer MD; Armando Tartaro MD; Massimo Lombardi MD *; Marta Burrel MD, PhD; Reynald Izzillo; Michael M Lell MD *

PURPOSE
To assess the diagnostic value of two contrast agents in CE-MRA at 3T in peripheral arterial occlusive disease (PAOD).

METHOD AND MATERIALS
189 patients were included in this double-blind trial. Patients randomly underwent peripheral CE-MRA with 0.1mmol/kg of either gadoterate meglumine (Dotarem®) or gadobutrol (Gadavist®). The primary endpoint was degree of agreement to DSA in stenosis detection and grading of both CE-MRA examinations. A non-inferiority analysis was performed based on two independent centralized readings. Secondary endpoints were specificity, sensitivity, positive/negative predictive values, diagnostic confidence, stenosis length, vessel diameter, signal-to-noise ratio and contrast-to-noise ratio. Safety and treatment recommendation were also recorded.

RESULTS
The non-inferiority was demonstrated for the primary endpoint. The sensitivity in the detection of significant stenosis for Reader 1 was 69.9% in gadoterate meglumine group compared to 71.0% in gadobutrol group (p=0.72), whereas the specificities were 85.0% and 85.2% (p=0.84), respectively. For Reader 2, sensitivities were 61.5% and 62.0% (p=0.77) and specificities were 91.4% and 91.2% (p=0.51). No difference in SNR and CNR was found between both groups (p = 0.72 and p=0.73), respectively as well as regarding the other secondary endpoints. There were no serious adverse events.

CONCLUSION
Contrast media with higher T1 relaxivity have been proposed to be advantageous as far as efficacy is concerned. However, the present study demonstrated the feasibility of PAOD evaluation at 3T and the lack of superiority of gadobutrol over gadoterate meglumine in terms of diagnostic accuracy despite the different Gd-concentrations and T1 relaxivities exhibited by the two contrast agents.
**VSA61-08 ● Non-contrast MRA: TOF and SSFP Based Techniques**

James C Carr MD (Presenter) *

**LEARNING OBJECTIVES**
1) Understand the technical issues underlying non contrast MRA based on TOF and SSFP. 2) Become familiar indications and guidelines for using non contrast MRA. 3) Illustrate applicability of non contrast MRA in a variety of relevant clinical scenarios.

**VSA61-09 ● Comparison of Non-contrast Enhanced SSFP MRA with Gadolinium Enhanced MRA in the Evaluation of the Post-operative Ascending Aorta**

Emily Pang MD (Presenter) ; Gregory P King MD ; Simin Jeddiyan MD ; Anna E Zavodni MD, MPH

**PURPOSE**
The objective of this study was to evaluate the comparability of non-contrast SSFP and gadolinium enhanced MRA sequences in the quantitative and qualitative assessment of the post-operative ascending aorta.

**METHOD AND MATERIALS**
After obtaining Research Ethics Board approval, we conducted a single center retrospective review of the 59 consecutive patients sent for MRI follow-up post ascending aortic replacement surgery between 2007 and 2012. Our analysis included 51 patients (mean age 67 +/- 3 years) with both non-contrast SSFP and gadolinium enhanced MRA sequences (8 patients were excluded due to not having one or both sequences performed). The images were independently evaluated by two cardiovascular fellowship trained radiologists with at least 2 years of experience, who measured the diameter of the thoracic aorta at several points including the root, ascending aorta, arch and descending aorta, as well as assessed for qualitative abnormalities. The datasets were compared using paired T-test, Bland-Altman, and kappa coefficient analysis (statistical significance was determined using a Bonferroni correction for multiple comparisons). Intra and inter-observer variability was also determined.

**RESULTS**
There was no statistically significant difference in measurements between non-contrast SSFP and gadolinium sequences, with the exception of the aortic annulus in patients who did not have valve replacement (p < 0.001). We postulate that this finding was because the 3D gadolinium sequences allowed for measurements of the normally ovoid annulus in more than one dimension. Kappa analysis also demonstrated good agreement with regards to the quantitative observations. Inter and intra-observer variability was excellent (ICC 0.8).

**CONCLUSION**
Our results suggest that using an unenhanced SSFP MRA sequence is comparable to gadolinium enhanced MRA in the quantitative and qualitative evaluation of the post-operative ascending aorta. Adequate and accurate information is obtained from the non-contrast SSFP sequence such that intravenous gadolinium may be rendered unnecessary for surgical follow-up imaging, reducing the risk and inconvenience to the patient, as well as health care costs.

**CLINICAL RELEVANCE/APPLICATION**
Using unenhanced SSFP MRA may be sufficient in the post-operative MR imaging follow up of ascending aorta replacements, omitting the risks and costs associated with IV gadolinium administration.

**VSA61-10 ● Performance of Non-enhanced ECG-gated Quiescent-interval Single Shot MRA (QISS-MRA) at 3 Tesla. A Comparison with Contrast-enhanced MRA and DSA**

Jan Hansmann MD (Presenter) ; John N Morelli MD ; Henrik J Michaely MD * ; Thomas Riester MD ; Johannes Budjan MD ; Stefan O Schoenberg MD, PhD * ; Ulrike I Attenberger MD *;

**PURPOSE**
To evaluate the diagnostic accuracy of a non-enhanced ECG-gated quiescent-interval single shot MR-Angiography (QISS-MRA) at 3T with contrast-enhanced MRA (CE-MRA) and digital subtraction angiography (DSA) serving as the standard of reference.

**METHOD AND MATERIALS**
16 consecutive patients (9 male,7 female, mean age 70±12 years) with peripheral arterial disease stages II-IV underwent a combined peripheral MRA protocol consisting of a large field-of-view QISS-MRA (acquisition time 18 min), continuous-table-movement MRA (acquisition time 62 sec), and an additional time-resolved MRA (acquisition time 96 sec) of the calves. DSA correlation was available in 8 patients. Image quality and degree of stenosis was assessed. Sensitivity and specificity of QISS-MRA was evaluated with CE-MRA and DSA serving as the standards of reference by two readers.

**RESULTS**
328 total segments were assessed. Overall sensitivity and specificity were, respectively, 81.1% and 83.5% for QISS-MRA vs CE-MRA. Relative to DSA, sensitivity for QISS-MRA was high (100% versus 91.2% for CE-MRA) in the evaluated segments; however, specificity was substantially less than that of CE-MRA (76.5% vs 94.6%), p There was no significant difference in image quality between QISS-MRA and CE-MRA at the calf station (p=0.17). For the vasculature of the pelvis and thigh QISS-MRA was rated significantly lower compared to CE-MRA (p<0.001). Interreader agreement was very good for both QISS-MRA and CE-MRA (kappa=0.83 and 0.96 respectively).

**CONCLUSION**
Overall image quality and specificity of QISS-MRA at 3T are diminished relative to CE-MRA, potentially due to long acquisition times. However, when image quality is adequate, the high sensitivity of QISS-MRA may render it useful as a screening examination in patients with contraindications to gadolinium chelate administration.

**CLINICAL RELEVANCE/APPLICATION**
Due to its high sensitivity at 3 Tesla, QISS might serve as screening tool to rule out significant stenoses in patients with impaired renal function.

**VSA61-11 ● Performance of Unenhanced MRA Using Spatial Labeling with Multiple Inversion Pulses Sequence to Depict Transplant Renal Vascular Anatomy and Complications**

Hao Tang (Presenter) ; Daoyu Hu MD, PhD ; Zi Wang

**PURPOSE**
To prospectively evaluate the performance of a new unenhanced magnetic resonance angiography (Unenhanced MRA) sequence, spatial labeling with multiple inversion pulses (SLEEK), to depict transplant renal vascular anatomy and complications in comparison to color doppler ultrasonography (CDUS), digital subtraction angiography (DSA) and intraoperative findings.

**METHOD AND MATERIALS**
75 patients with renal transplant were examined with Unenhanced MRA using SLEEK and CDUS. DSA was performed in 14 patients. Surgery was performed for 7 patients. The ability to present transplant renal vascular anatomy and complications with SLEEK were evaluated by two experienced radiologists, and to correlate the results with CDUS, DSA and intraoperative findings.

**RESULTS**
CONCLUSION
Unenhanced MRA using SLEEK is a reliable diagnostic method for depicting transplant renal vascular anatomy and complications. It is relatively inexpensive and is not associated with renal complications. It can be as a good choice for screening renal vascular anatomy and complications, especially in patients with renal insufficiency.

CLINICAL RELEVANCE/APPLICATION
Unenhanced MRA using SLEEK is a reliable diagnostic method for depicting transplant renal vascular anatomy and complications, especially in patients with renal insufficiency.

VSV61-12 • Hemodynamic Outcome Following Aortic Root Replacement with or without Hemiarch Replacement Assessed by 4D Flow MRI

Edouard Semaan (Presenter) ; Michael Markl PhD ; Chris Malaisrie * ; Alex Barker ; Bradley D Allen MD ; Zoran Stankovic MD ; Patrick McCarthy ; James C Carr MD * ; Jeremy D Collins MD *

PURPOSE
To evaluate aortic hemodynamics using 4D flow MRI following aortic root replacement (AR) or aortic root and hemiarch replacement (AR+HA), comparing to patients following non-mechanical aortic valve replacement (AVR) alone.

METHOD AND MATERIALS
IRB approval was obtained. 31 patients were recruited following open AVR (group 1: AR, n=16, 51±13 yrs; group 2: AR+HA, n=4, 60±10 yrs; group 3: AVR alone, n=11, 69±11 yrs). Aortic blood flow was measured using ECG and respiration synchronized 4D flow MRI (3-directional venc = 150cm/s, 2.0-2.8mm3, temp res 40-44msec) at 1.5 or 3T (Aera, Avanto, or Skyra, Siemens, Erlangen, GE) post-contrast administration. Data analysis included 3D blood flow visualization (EnSight, CEI, USA) based on time-resolved 3D pathlines and systolic 3D streamlines. Helical flow was assessed in the Ascending aorta (AAo), arch, and descending aorta on a 3-point Likert scale (360°). 3D pathlines qualitatively identified the existence of flow jets and the quadrant of flow impingement in the proximal, mid, and distal AAo. Flow uniformity was analyzed by quadrant dichotomizing systolic peak velocities at 1m/s. Peak systolic velocities and acceleration were quantified in 9 planes distributed throughout the thoracic aorta. Groups were compared using the student’s t-test.

RESULTS
4D flow MRI revealed similar helical flow across groups (p>0.05). 72% (9 of 11) of patients in group 3 demonstrated outflow jets preferentially directed towards the anterior wall. Flow profiles were asymmetric in 62%, 100%, and 72% of groups 1-3, respectively. There were significant differences between groups 1 and 2 compared to group 3 for peak acceleration and significant differences between groups 1 and 3 for peak velocities (p<0.05). 4D flow MRI characterized flow in AVR patients. Our preliminary findings demonstrate elevated peak systolic velocities and acceleration in patients with aortic grafts compared to patients with AVR alone. Follow-up studies are warranted to investigate the influence of these findings on ventricular loading and patient outcome.

CLINICAL RELEVANCE/APPLICATION
4D flow MRI demonstrates increased aortic peak velocities and acceleration status-post aortic replacement with graft material, suggesting increased ventricular loading with altered aortic compliance.

VSV61-13 • 3D Cine PC VIPR as a Sensitive Indicator of Post-prandial Hyperemia with an Added Value of Avoiding Vortex and Helical Flow Portions

Masataka Sugiyama (Presenter) ; Yasuo Takehara MD ; Kevin M Johnson * ; Oliver Wieben PhD ; Tetsuya Wakayama PhD * ; Hiroyuki Kabasawa ; Shuhei Yamashita MD ; Harumi Sakahara MD ; Atsushi Nozaki ; Naoki Ooishi

PURPOSE
3D cine PC with vastly undersampled isotropic projection steady-state free precession imaging (VIPR) is a recently developed MR method that can cover full spatial and temporal data of the blood flow velocity. The purpose of our study is two folds i.e., 1) to test if 3D PC VIPR can be used for dietary stress test in detecting the post-prandial hyperemia of the SMA, and 2) to assess the flow patterns within SMA with streamline analysis for finding out the optimum plane to measure correct blood flow.

METHOD AND MATERIALS
All studies were conducted on a 3.0T MR imager with phased array coil. Five healthy volunteers (23 to 53 y.o.) were enrolled. Under 8 hr fasting, 2D cine PC and 3D cine PC VIPR were repeated before and after the intake of 400 Kcal supplementary diet. The measuring planes for the 2D cine PC were placed at the proximal portion, mid curved portion and the distal straight portion of the main trunk of SMA. With 3D cine PC VIPR, retrospective measurements at the corresponding planes were performed and the values were compared.

RESULTS

CONCLUSION
Newly developed 3D cine PC VIPR can be used for dietary stressed SMA flow measurement with an added value of delineating the vortex and helical flow portions in the SMA where the measurement should be avoided.

CLINICAL RELEVANCE/APPLICATION
3D cine PC VIPR is feasible as a dietary stress test for non-obstructive mesenteric ischemia by detecting the post-prandial hyperemia. The beauty of the method is retrospective flow analysis.

VSV61-14 • Non-contrast MRA: Phase-contrast MRA

Scott B Reeder MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Understand the underlying principles of phase velocity MRA. 2) Be familiar with the currently available methods for phase velocity MRA. 3) Be familiar with important applications and examples of phase velocity MRA. 4) Understand current limitations and pitfalls associated with phase velocity MRA.

Breast Imaging (Issues in Screening)

Friday, 10:30 AM - 12:00 PM • E450B

SST01 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A Credit:1.5

Moderator
Susan G Roth , MD

Moderator
Sarah M Friedewald , MD *

SST01-01 • Mammography Outcomes by Screening Interval: Does Biennial Screening Affect Prognosis?
Population SST01-04 • SST01-03 • SST01-02 • Klautau Leite
Laura Heacock

For woman with history of breast carcinoma, breast MRI examination is valuable, especially when a patient has equivocal clinical and with a reasonable recall rate and PPV.

The second breast carcinoma was 90.3%, 48.4% and 77.4%, respectively. The specificity was 95.3%, 93.4% and 95.9%, respectively. The recall rate of MRI was 9.5% and PPV was 59.2%. The sensitivity of MRI, mammography and ultrasound in detecting the carcinomas were detected by MRI. The sensitivity and specificity of MRI in detecting the second breast carcinoma was 91.8% and 92.2%, respectively.

Of the 798 patients, 49 second breast carcinoma was found and the incidence of the second breast carcinoma was 6.1%. Forty-five breast patients were divided into groups 1-3 based on time interval between screening mammograms, defined as 3 years. The three groups were controlled in terms of age, breast density, high risk status, and family history of breast cancer. Audit data as outlined by ACR BI-RADS, including % stage 0 or 1 cancers, % minimal cancer, and % positive axillary lymph nodes, were compared for the three groups. The size of invasive cancers was also compared.

RESULTS
There were 419 screen-detected cancers during the study period. 34 patients were excluded due to unknown screening interval or lack of surgical pathology and 24 patients were excluded for cancer detection on baseline mammography. To adjust for differences in age between groups, patients >75 years were excluded. This resulted in 332 patients, 207 in group 1, 73 in group 2, and 52 in group 3. There was no significant difference in age, breast density, high risk status, family history, or index histology between groups. The % stage 0 or 1 cancer and % minimal cancer did not differ between the groups (p=0.057 and p = 0.498, respectively). The size of invasive cancers was also not statistically different between the three groups (ANOVA, p=0.165). However, lymph node positivity was lowest in group 1, which was a statistically significant difference (8.7% vs. 20.5% and 15.4%, p = 0.002).

CONCLUSION
Screening mammography performed at an interval more than that recommended by the USPSTF significantly reduces the rate of lymph node positivity, thereby improving patient prognosis.

SST01-02 • Incidental Breast Lesions: Factors Associated with Increased Risk of Malignancy and Lack of Follow-up

Eniola T Obadina MD (Presenter); Roberta M Strigel MD,MS; Richard J Bruce MD *; Alejandro Munoz Del Rio PhD; Frederick Kelcz MD, PhD

PURPOSE
To evaluate the rate of malignancy of incidental breast lesions (IBLs) detected on non-breast imaging examinations, factors associated with malignancy, and compliance with recommended follow-up.

METHOD AND MATERIALS
Following IRB approval, a retrospective review of the electronic medical record using keyword search was performed to identify all patients (pts) without a known history of breast cancer who had an IBL detected on a non-breast imaging examination from 9/2008 to 8/2012. Outcomes were determined by follow-up with dedicated breast imaging and results of biopsy, if performed. Imaging modality of detection, IBL size, pt age and location at the time of the exam, follow-up and final outcome were recorded. Rates of imaging follow-up and malignancy were calculated. Kruskal-Wallis and Fisher’s exact tests were used to identify factors associated with malignancy and compliance with follow-up.

RESULTS
293 pts were identified and ranged in age from 14 to 100 years (mean 59.6 years). 36/293 (12%) of pts were in the Emergency Department (ED) at the time of their non-breast imaging exam, 49/293 (17%) were inpatients, and 208/293 (71%) were outpatients. IBLs ranged in size from 0.4 to 7.2 cm (mean 1.53 cm). 242 pts had IBLs detected on CT (83%), compared to 25 pts with MRI-detected IBLs (8.5%) and 25 pts with PET-detected IBLs (8.5%). One pt had an IBL detected on a myocardial perfusion stress test. 121/293 (41%) pts underwent follow-up with dedicated breast imaging. There was a significantly increased rate of noncompliance with follow-up in ED pts (30/36; 83%), compared to 32/49 (65%) inpatients and 110/208 (53%) outpatients (p<0.001).

CONCLUSION
Incidental breast lesions ultimately diagnosed as breast cancers are not rare (21%) and were most likely to represent malignancy if discovered on PET imaging. IBLs discovered as part of an ED visit were the most likely not to undergo follow-up.

CLINICAL RELEVANCE/APPLICATION
Incidental breast lesions identified on non-breast imaging exams represent malignancy in up to 21% of cases, emphasizing the need for dedicated breast imaging follow-up of these incidental findings.

SST01-03 • Surveillance of Women with Personal History of Breast Carcinoma Using MRI

Haifuan Liu (Presenter); Yanqing Hua MD; Huadong Miao; Weijun Peng MD

PURPOSE
To determine the capability of MRI in detecting the second breast carcinoma among women with a personal history of breast carcinoma.

METHOD AND MATERIALS
This retrospective review of breast MRI examinations performed from 2007 to 2011 yielding 798 women who had a personal breast history. Of the 798 patients, 445 had adequate follow up data and 348 had MRI, mammography and ultrasound within 6 months intervals. The sensitivity, specificity of MRI in detecting the second breast carcinoma was calculated. The recall rate and PPV of MRI was also calculated.

RESULTS
Of the 798 patients, 49 second breast carcinoma was found and the incidence of the second breast carcinoma was 6.1%. Forty-five breast carcinomas were detected by MRI. The sensitivity and specificity of MRI in detecting the second breast carcinoma was 91.8% and 92.2%, respectively. The recall rate of MRI was 9.5% and PPV was 59.2%. The sensitivity of MRI, mammography and ultrasound in detecting the second breast carcinoma was 90.3%, 48.4% and 77.4%, respectively. The specificity was 95.3%, 93.4% and 95.9%, respectively.

CONCLUSION
We found that breast MRI surveillance of women with a personal history of breast cancer was clinically valuable in finding malignancies with a reasonable recall rate and PPV.

CLINICAL RELEVANCE/APPLICATION
For woman with history of breast carcinoma, breast MRI examination is valuable, especially when a patient has equivocal Clinical and Imaging Findings.

SST01-04 • Sensitivity, Specificity and Recall Rates for An Abridged Breast MRI Protocol in a Pure High-risk Screening Population

Laura Heacock MS, MD (Presenter); Amy N Melsaether MD; Kristine M Pysarenko MD; Samantha L Heller MD, PhD; Ana P Klautau Leite MD; Linda Moy MD

PURPOSE
In 2009, the U.S. Preventative Services Task Force announced the recommendation for biennial screening mammography for women aged 50-74 years, despite evidence of mortality reduction with annual screening mammography beginning at age 40, as supported by the American College of Radiology (ACR), Society of Breast Imaging (SBI), and American Cancer Society (ACS). The purpose of this study is to use secondary endpoints of tumor size and lymph node positivity to compare the efficacy of screening mammography performed at various time intervals.

METHOD AND MATERIALS
Under IRB approval, a retrospective review of all screen-detected breast cancers between 2007-2010 was performed. Patients were divided into groups 1-3 based on time interval between screening mammograms, defined as 3 years. The three groups were controlled in terms of age, breast density, high risk status, and family history of breast cancer. Audit data as outlined by ACR BI-RADS, including % stage 0 or 1 cancers, % minimal cancer, and % positive axillary lymph nodes, were compared for the three groups. The size of invasive cancers was also compared.
PURPOSE
To evaluate the sensitivity, specificity and recall rates for an abridged MRI protocol.

METHOD AND MATERIALS
A retrospective review of 128 asymptomatic women with 195 findings who had a screening MRI was performed by 2 readers. Each reader was trained with 100 cases with a known cancer in an abbreviated protocol. Initially they evaluated the precontrast T1, first post-contrast T1 and first subtraction T1 post-contrast images blinded to the history and prior films. Then they assessed the images given the above information and once more with the addition of the pre-contrast T2 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 128 women, 22 (17.2%) BRCA carriers, 1 (0.8%) chest radiation, 73 (57%) family history, 20 (15.6%) personal history of breast cancer, 12 (9.4%) had atypia. Mean age was 48 years, range 25-82 years. Mean lesion size was 1.2cm (range 0.3-8cm). Of the 128 exams, 20 (15.6%) were originally assessed as BI-RADS 1, 62 (48.4%) as BI-RADS 2, 24 (18.8%) as BI-RADS 3, 22 (17.2%) as BI-RADS 4. Using the abridged protocol, 26 (20.3%) exams were assessed as BI-RADS 0, 25 (19.5%) as BI-RADS 1, 19 (14.8%) as BI-RADS 2, 28 (21.9%) as BI-RADS 3, 30 (23.4%) as BI-RADS 4. Sensitivity was 100%; 3 cancers (2 DCIS and one invasive cancer) were identified by the readers. However, the specificity was 58% and an additional 31 findings were identified by the readers. Mean time for interpretation for readers was 50 secs (range 0.33-4.5 minutes). Both readers showed a significant increase in confidence (p < .001).

CONCLUSION
An abridged breast MRI in a pure screening population had a high sensitivity but low specificity and high recall rates. The addition of T2 images and prior films helped decrease the recall rate.

CLINICAL RELEVANCE/APPLICATION
In an abridged screening breast MRI exam, the number of sequences necessary to decrease the false-positive findings needs to be further evaluated.

SSTO1-05 • Screening Breast MRI in Patients Previously Treated for Breast Cancer: Diagnostic Yield for Cancer and False Positive Interpretation Rate

Catherine S Giess MD (Presenter); Patricia S Poole MD; Sona A Chikarmane MD; Dorothy A Sippo MD; Robyn L Birdwell MD

PURPOSE
To determine the cancer detection rate and rate of false positive interpretation of screening breast MRI in women previously treated for cancer

METHOD AND MATERIALS
IRB approved, retrospective review of the breast MRI database from 2009-2011 identified 3297 contrast enhanced screening exams, 1498 (45.4%) in women previously treated for breast cancer. MRI reports were reviewed to determine MRI findings, BI-RADS assessments and patient demographics. The longitudinal medical record was reviewed to determine outcomes of short interval surveillance, biopsy results and cancers detected. False positive studies were considered BI-RADS 3 assessments with no evidence of cancer on follow up or BI-RADS 4/5 assessments benign on biopsy.

RESULTS
Patient age ranged from 26-88, mean 54 years. 10.1% (152/1498) exams were performed in known genetic mutation carriers. 11.2% (168/1498) screening exams were assessed as abnormal, including 79/1498 (5.3%) BI-RADS 3 and 89/1498 (5.9%) BI-RADS 4/5. Follow up data for BI-RADS 3 exams included 40 (50.6%) without malignancy by imaging and/or clinical follow up ≥ 24 months; 27 (34.2%) with < 24 months stability, and 12 (15.2%) upgraded to BI-RADS 4/5, with 5 (41.7%) cancers. Cancer rate for BI-RADS 3 lesions was 6.3%; 3 of 5 upgraded cancers occurred in mutation carriers. Biopsy results for BI-RADS 4/5 exams were available in 81 lesions, with 22 (27.2%) cancers. Overall, 27 (1.8%) of 1498 screening MR exams had malignancy diagnosed during the study period. Average time interval from original cancer diagnosis was 7.8 years (range 1-23 years). 24/27 cancers had negative mammograms within 6 months prior to new cancer diagnosis. 7/27 (22%) of cancers were diagnosed in mutation carriers; an additional 8/27 (29.6%) were diagnosed in women with a positive family history.

CONCLUSION
Screening breast MRI in women previously treated for breast cancer detected cancer in 1.8% examinations, with a minority of exams requiring short term surveillance or biopsy, and positive predictive value of 27.2% for biopsies recommended. Nearly half of screen detected cancers in this population occurred in women without a genetic mutation or a positive family history of breast cancer.

CLINICAL RELEVANCE/APPLICATION
Screening breast MRI in women previously treated for cancer detects mammographically occult cancers, with acceptable positive predictive values and low false positive interpretation rates.

SSTO1-06 • Breast MRI Screening in Women Who had Undergone Breast Conserving Therapy for Cancers

Hye Mi Gweon MD (Presenter); Nariya Cho MD; Ann Yi MD; Woo Kyung Moon

PURPOSE
The American Cancer Society reports insufficient evidence to recommend for or against MRI in surveillance of asymptomatic women with a personal history of breast cancer. The purpose of this study, therefore, was to retrospectively investigate the outcomes of the first round of MRI screening in women who had undergone breast conserving therapy for breast cancers.

METHOD AND MATERIALS
Between the years 2009 and March 2012, 808 women who had undergone breast conserving therapy for breast cancers and subsequent screening breast MRI were identified. All women had an annual screening mammogram prior to beginning MRI screening and all the results were negative. Women without at least 12-month follow-up data (n=102) and had metastatic disease (n=2) were excluded. A total of 704 women (median age 48, range 20-72 years) (initial stage 0: 27.3%, stage I: 37.2%, stage II: 30.3%, stage III: 5.3%) with 1069 screening breast MRI examinations (one round: 389, two rounds: 265, three rounds: 50) formed our study group. The reference standard was based on biopsy and/or 12-month follow-up. The cancer detection rate, sensitivity, specificity, and positive predictive value (PPV) based on biopsy performed at the first round screen were analyzed. Median follow-up duration was 18.5 months (range, 12-53 months).

RESULTS
Of the 704 women, cancer was detected at MRI in 10 women (1.4%) at a median interval of 33 months (range, 14-56 months) between surgery and detection. The ten cancers included 7 (70%) invasive cancers and 3 (30%) DCIS and were found in 6 (60%) ipsilateral and 4 (40%) contralateral breasts and were 100% node negative among those staged. The median histologic size of the invasive cancers was 0.8cm (range 0.4-1.4cm). Two (0.3%) interval cancers were found 6 months later by mammography and ultrasound, respectively. The sensitivity, specificity, and PPV of MRI were 83.3% (10 of 12), 98.0% (678 of 692), and 41.7% (10 of 24). 

CONCLUSION
A single MRI screening in women who had undergone breast conserving therapy for cancers detected 14 mammographically occult, node-negative breast cancers per 1000 women.

CLINICAL RELEVANCE/APPLICATION
Previous history of breast cancer therapy is a reasonable indication for breast MRI screening.
While breast MRI has been established as the most sensitive tool for detecting breast malignancy, the increasing number of studies performed has led to a growing number of MRI-guided biopsies. Previous studies demonstrate a highly variable positive predictive value of biopsied foci, ranging from 3% to 28%. This study attempts to evaluate the malignancy rate of suspicious foci identified on screening MRI and to determine if short-term follow-up can be safely performed in lieu of biopsy.

METHOD AND MATERIALS
In this IRB approved, HIPAA compliant retrospective study, 188 MRI-guided core biopsies of foci performed between January 2006 and March 2013 were retrieved from the report search system and reviewed. Suspicious foci identified during screening of the contralateral breast on MRI performed for extent of disease as well as suspicious foci on high-risk screening MRI were included. A focus was considered suspicious if it showed washout or plateau delayed phase kinetics, was the only enhancing focus in that breast or was more prominent than the background parenchymal enhancement. Foci biopsied in the breast ipsilateral to a known malignancy were excluded.

RESULTS
117/188 foci biopsied were in the ipsilateral breast as the known malignancy on MRI performed for extent of disease and were excluded. A total of 71/188 eligible patients were identified, which included 43 suspicious foci in the contralateral breast on MRI performed for extent of disease and 28 foci on high-risk screening MRI. 4/71 (5.6%) suspicious foci were positive for malignancy while 20/71 (28%) were high-risk lesions. Among suspicious foci on high-risk screening MRI, 3/28 (11%) were malignant and 5/28 (17%) had a high-risk pathology. 1/43 (2.2%) foci were malignant in the contralateral breast on extent of disease studies and 15/43 (35%) were high-risk lesions. The malignant and high-risk lesions are more likely to have type 2 and 3 kinetics (p=0.004) compared to benign foci.

CONCLUSION
The malignancy rate of foci is low in the contralateral breast on MRI performed for extent of disease. Given this, it may be reasonable to follow foci in the contralateral breast, instead of recommending biopsy.

CLINICAL RELEVANCE/APPLICATION
As the rate of malignancy for a focus in the contralateral breast on extent of disease MRI is 2.2%, short interval follow up instead of biopsy may be reasonable.
SST05-01 • CT Findings of Bowel Ischemia in Closed-loop Small Bowel Obstruction

Kazuki Nakashima (Presenter); Hideki Ishimaru MD; Toshifumi Fujimoto; Takashi Mizowaki; Yohjiro Matsuoka MD; Masatake Uetani MD; Seigo Kimura; Sachie Yotsumoto; Kazunori Mitarai; Kei Kitamura

PURPOSE
Closed-loop small bowel obstruction (CL-SBO) is associated with a high risk for vascular impairment and considered as a surgical emergency, however, when the bowel is viable, preservation of the bowel is feasible. The aim of this study was to characterize contrast-enhanced CT (CECT) findings predicting bowel necrosis and ischemia in CL-SBO.

METHOD AND MATERIALS
Thirty-five patients with CL-SBO confirmed by laparotomy (n = 34) or multiplanar reconstruction of thin slice CT images (n = 1) were included. On the basis of the surgical findings, these patients were classified into three groups: necrosis group (n = 16) and ischemia group (n = 11), and no ischemia (n = 8). One patient recovered only with conservative management was also included in no ischemia group. Two blinded radiologists retrospectively reviewed CECT including multiplanar reconstruction images, and evaluated 12 CT findings previously reported to be associated with bowel ischemia: (1) wall thickening, (2) target sign, (3) high attenuation of the wall at precontrast CT, (4) wall enhancement, (5) mesenteric edema, (6) whirl sign, (7) enhancement of mesenteric artery and (8) vein, (9) engorgement of the mesenteric veins, (10) small bowel feces, (11) ascites, and (12) intraperitoneal air. Sensitivity and specificity of each finding were compared among the three groups, and logistic regression analysis was performed.

RESULTS
Intraperitoneal air, high attenuation of the wall, reduced enhancement of mesenteric arteries and small bowel feces sign showed high specificities of 100%, 100%, 89% and 89%, however low sensitivity of 25%, 31%, 44%, 31%, respectively, to predict bowel necrosis in CL-SBO. On multivariate logistic regression analysis, reduced enhancement of mesenteric veins and lack of the engorgement of the mesenteric veins were significant for predicting bowel necrosis or ischemia (p<0.05).

CONCLUSION
Reduced enhancement of wall and mesenteric vessels were reliable findings to detect ischemia. On the contrary, engorgement of the mesenteric veins was predictor of viable bowel.

CLINICAL RELEVANCE/APPLICATION
Evaluation of engorgement of mesenteric vein and enhancement of wall and mesenteric vessels would help us to predict bowel ischemia or necrosis in the closed-loop small bowel obstruction.

SST05-02 • Dual Energy CT Improves Visibility of Early Small Bowel Ischemia Compared to Conventional CT in a Swine Model

Theodora A Potretzke MD (Presenter); Christopher L Brace PhD *; Meghan G Lubner MD; Lisa A Sampson *; Bridgett J Willey *; Fred T Lee MD *

PURPOSE
To compare dual-energy CT (DECT) to conventional CT for the detection of early bowel ischemia in a swine model.

METHOD AND MATERIALS
Ischemic bowel segments (n=7) were created in swine (n=4) by surgically occluding distal mesenteric vasculature. Ischemia was confirmed grossly and with Doppler ultrasound. DECT and conventional CT were performed in arterial, portal venous, and delayed phases on a single-source fast-switching dual-energy CT scanner. ROIs of bowel wall attenuation were used to compare contrast-to-noise ratios (CNR) between ischemic and perfused segments on iodine material density and monospectral images at 51keV, 65keV (approximates 80kVp), and 80keV (approximates 120kVp). ANOVA and post-hoc t-tests compared pixel intensities and CNR among segments and imaging groups.

RESULTS
Ischemic bowel exhibited significantly lower attenuation than perfused segments on DECT-iodine material density and 51keV images (P<0.05).

CONCLUSION
DECT significantly improves the visibility of early bowel ischemia compared to conventional CT images. DECT may offer earlier and more confident diagnosis of bowel ischemia especially in the absence of late secondary signs. It may increase the sensitivity and specificity of CT for bowel ischemia.

CLINICAL RELEVANCE/APPLICATION
Mortality from bowel ischemia is high and increases with delay in diagnosis. Dual-energy CT increases the conspicuity of differential enhancement and may allow earlier diagnosis of bowel ischemia.

SST05-03 • Small Bowel Transplantation: MDCT Features of Wall Thickening with Pathologic Correlation

Michael Bazylewicz MD (Presenter); Christine Chan; Sandra J Allison MD; Angela D Levy MD

PURPOSE
To determine if MDCT features of bowel wall thickening allows differentiation between normal bowel, ischemic bowel, rejection, post transplant lymphoproliferative disease (PTLD), and infection in patients with small bowel transplants.

METHOD AND MATERIALS
CT scans (n=57) from isolated and multivisceral small bowel transplant patients (ages 1-62, mean 26) were retrospectively reviewed with consensus reading by two radiologists blinded to pathology results. Patients had endoscopic biopsy within 3 days of CT scanning. Small bowel was assessed for wall thickening, attenuation and enhancement pattern, feces sign, pneumatosis, dilatation, mesenteric edema and adenopathy, ascites, anasarca, vascular patency, and whether the scan was done with oral or IV contrast. Demographic data obtained: age, gender, race, and transplant type. Kappa power analysis determined a goal of 20 patients per group would show at least a 60% correlation exists between groups. For the continuous variable, the differences in the averages were tested and the non-parametric Kruskal Wallis test was used since normality assumptions were not satisfied. Chi-square and Fisher's exact tests were used to investigate the differences for categorical variables. A-p value of

RESULTS
No statistical differences in age (0.69 pediatric, 0.2 adult), race (0.6), or transplant type (0.56). Significant difference between the normal and ischemia subgroup was observed in gender (0.04). No difference was observed in wall thickening (0.29), attenuation (0.66), bowel enhancement pattern (0.66), feces sign (0.1), pneumatosis (0.67), dilatation (0.11), mesenteric edema (0.8), mesenteric adenopathy (0.5), anasarca (0.89), vascular patency (0.5), those with oral contrast enhanced scans (0.23), or those with IV contrast...
enhanced scans (0.59). A general difference between the 5 categories was noted in the category of ascites (0.83), however specific analysis of normal vs. the four abnormal subgroups demonstrated no significant difference (ischemia 0.28, rejection 0.052, infection 0.55, PTLD 0.39).

CONCLUSION
There is no correlation between small bowel wall thickening in patients with small bowel transplant and the common complications including ischemia, rejection, PTLD, and infection.

CLINICAL RELEVANCE/APPLICATION
Small bowel wall thickening on MDCT in small bowel transplants is likely non-contributory in determining an underlying pathologic condition.

**SST05-04 • Cine MR Enterography Grading of Small Bowel Peristalsis: Evaluation of the Antiperistaltic Effectiveness of Sublingual Hyoscyamine Sulfate**

**Peter M Ghobrial MD ; Flavius F Guglielmo MD (Presenter) ; Donald G Mitchell MD * ; Ilana Neuberger MD ; Laurence Parker PhD ; Christopher G Roth MD * ; Sandeep P Deshmukh MD ; Patrick L O’Kane MD * ; Allison Borowski MD**

**PURPOSE**
To use a cine MR enterography (cine-MRE) pulse sequence to assess the effectiveness of a sublingual (SL) antiperistaltic agent, hyoscyamine sulfate.

**METHOD AND MATERIALS**
IRB approval was granted with an exemption for informed consent in this HIPAA compliant retrospective single-institution study. Of the 288 MR enterography exams performed between October 1, 2007 and January 15, 2011, 92 using SL hyoscyamine sulfate for antiperistalsis were included for review, each with cine MRE pre and post medication. These 184 cine MRE sequences were randomized, blinded for treatment, and independently reviewed by five attending abdominal radiologists, who rated the degree of bowel motility of each cine MRE sequence on a five point scale. Pre- and post-medication mean peristalsis ratings, standard deviation, mean difference, and treatment effect sizes were calculated. A repeated measures analysis of variance (ANOVA) test was performed, using a significance threshold of p=0.05.

**RESULTS**
Mean peristalsis ratings ranged from 2.63 to 3.34 before, to 2.36 to 3.03 after medication administration. The mean differences ranged from 0.22 to 0.46, which are treatment effect sizes of 0.10 to 0.18. The decrease in peristalsis observed by the five reviewing radiologists after SL hyoscyamine sulfate administration was significant (df 1/182, f=7.35, p

**CONCLUSION**
While cine MRE sequences show decreased bowel peristalsis after use of SL hyoscyamine sulfate, the small size of the observed treatment effect is likely insufficient to justify its use for MR enterography.

**CLINICAL RELEVANCE/APPLICATION**
While it is possible to detect and quantify decreased bowel peristalsis caused by a sublingual anti-spasmodic agent during cine MRE, the decrease is likely too small to be of clinical significance.

**SST05-05 • Ischemic Colitis: Is There a Relationship between the CT Findings, the Different Etiologies and the Timing of the Disease? A Clinical Study**

**Francesca Iacobellis MD (Presenter) ; Daniela Berritto MD ; Maria Paola Belfiore ; Giuliano Gagliardi ; Mariano Scaglione MD ; Maria A Mazzei MD ; Roberto Grassi MD**

**PURPOSE**
To define the CT findings of ischemic colitis (IC), according to the different etiologies and timing of the disease.

**METHOD AND MATERIALS**
A computerized search of all medical records was used to retrospectively identify 130 patients who were admitted with the suspected diagnosis of IC over a five-year period. From these, 52 patients with IC proven by endoscopy with biopsies or surgical pathology were considered for the enrollment in the present study. Among 52 patients, 32 subjects (17 men and 15 women; median age 74, range 51-94 years) that underwent at least one CT examination, constituted the object of the analysis. Their medical history and CT examinations were retrospectively reviewed.

**RESULTS**
Among the 32 CT examinations performed in the acute phase in 62.5% no defects or occlusion of the superior mesenteric artery (SMA) or inferior mesenteric artery (IMA) was found whereas in 37.5% IMA occlusion was detected. In acute phase in 100% of patients the presence of pericolic fluid was found, undergoing progressive resorption from acute to sub-acute phase if an effective reperfusion occurred; the bowel wall thickening was observed in 28.1% patients in acute phase and in 86.4% patients evaluated in sub acute phase. The unthickened colonic wall was found in all conditions where ischemia is not followed by effective reperfusion, 71.9% of cases, and it was never found in chronic phase, when the colon appears irregularly thickened.

**CONCLUSION**
The results of this study showed that particular attention should be paid in the diagnosis of non-occlusive mesenteric ischemia (NOMI) before reperfusion representing the more difficult form of IC to detect at imaging, diagnostic difficulties may also be encountered in sub acute forms where the colon wall thickening could be misdiagnosed as normal wall with collapsed lumen, and in chronic forms where the irregular thickening of large bowel could be misdiagnosed if the patient’s clinical history is unknown. CT has a crucial role, it allows to define the morpho-functional alterations associated with the IC distinguishing among acute, sub acute and chronic phases and allows to estimate the timing of the ischemic damage.

**CLINICAL RELEVANCE/APPLICATION**
The definition of the CT findings of ischemic colitis in relationship with the etiology and the timing of the disease has a crucial role to ensure a correct diagnosis and an appropriate treatment.

**SST05-06 • Double Contrast-enhanced Ultrasonography Diagnosis of Rectal Lesions with Pathologic Correlation**

**Man Lu PhD (Presenter) ; Zhiqing Cai ; Jun Song ; Bin Song MD**

**PURPOSE**
Recently, transabdominal ultrasonography with a gastrointestinal contrast agent has been used widely in China to detect digestive disorders. Double Contrast Enhanced Ultrasonography (DCUS) combines both a gastrointestinal luminal contrast agent with an intravenous contrast agent for imaging of lesions. The purposes of this pilot study were to assess the value of DCUS in the preoperative diagnosis of rectal lesions.

**METHOD AND MATERIALS**
Of the 227 patients examined, there were 232 rectal lesions (72 rectal adenocarcinomas, 45 adenomas and 15 inflammatory mass). The study using DCUS showed unique vascular patterns in different rectal lesions. Rectal adenocarcinoma revealed earlier AT and TP compared with normal rectal tissue (p < 0.05), earlier AT and higher PI with adenoma, earlier TP and lower PI with inflammatory mass. Rectal adenoma had lower PI compared with normal rectal tissue (p < 0.01). Rectal inflammatory mass had higher PI and earlier AT compared with normal rectal tissue.
Conclusions: DCUS is a valuable technique for differential diagnosis of benign and malignant rectal lesions in patients with pathology diagnosis. The parameters of the enhancement curves reflect the different perfusion status of the rectal lesions.

CONCLUSION
DCUS is a valuable technique for differential diagnosis of benign and malignant rectal lesions in patients with pathology diagnosis. The parameters of the enhancement curves reflect the different perfusion status of the rectal lesions.

CLINICAL RELEVANCE/APPLICATION
DCUS is a valuable technique for differential diagnosis of benign and malignant rectal lesions in patients with pathology diagnosis.

SST05-07 • Neurogenic Bowel Dysfunction in Spinal Cord Injury Patients - Diagnostic Using Functional MRI. A Feasibility Study

Celine D Alt MD (Presenter) ; Cornelia Putz ; Cornelia Hensel ; Bjoern Wagner ; Norbert Wagner ; Hans-Juergen Gerner ; Hans-Ulrich Kauczor MD * ; Lars Grenacher MD

PURPOSE
Neurogenic bowel dysfunction represents a common clinical problem in spinal cord medicine, which severely affects the quality of life following spinal cord injury (SCI). The aim of this study was to evaluate functional MRI as a diagnostic tool to visualize neurogenic bowel dysfunction in SCI patients.

METHOD AND MATERIALS
In this prospective study, 20 Th1-10 SCI patients (AIS A) given written informed consent and the study proposal was approved by the local ethics committee. Examination was performed at a 3T scanner in lateral position with angled legs. The rectum was filled with ultrasonic gel. The protocol included T2w truFISP sequences in tree planes at rest and in sagittal plane during defecation (30 measurements) and T2w turbo spin echo images in sagittal and axial plane. Evaluation included the hiatal width (H-line), the M-line, the anorectal angle (ARA) and the anorectal junction (ARJ). The rectal filling volume and the maximum rectum diameter were noted, until defection procedure started.

RESULTS

CONCLUSION
MR-Defecography is feasible in SCI patients and may help to differentiate between different types of neurogenic bowel dysfunction.

CLINICAL RELEVANCE/APPLICATION
Dynamic MRI may serve as a diagnostic tool to guide therapeutic decision making in SCI patients suffering from neurogenic bowel dysfunction.

SST05-08 • MR Imaging of Perianal Fistulas: Value of Using a Balloon Rectal Double Channel Catheter

Shuohui Yang MD (Presenter) ; Fang Lu MD ; Songhua Zhan MD ; Wenli Tan MD ; Qiong Zhu MD

PURPOSE
To investigate the value of using balloon rectal double channel catheter (BRDCC) for the diagnosis of perianal fistula patients in conventional MRI studies.

METHOD AND MATERIALS
18 perianal fistula patients with BRDCC and 18 patients without BRDCC underwent MR scans with a body coil. The number of fistulas, the internal openings, extensions and abscesses were counted. All MR findings were utilized to evaluate for the classification of the fistulas and compared with the surgery results.

RESULTS

CONCLUSION
By using BRDCC, conventional MRI can provide more information of the fistulas and their routes.

CLINICAL RELEVANCE/APPLICATION
Providing evidences of internal openings, extensions and abscesses of the anal fistula diagnosis and directing the operation of anal fistula.

SST05-09 • Rectal MRI of Fistula-in-ano: Diagnostic Values of Diffusion-weighted Imaging (DWI)

Minho Park MD (Presenter) ; Sung Kyoung Moon ; Seong Jin Park MD, PhD ; Joo Won Lim ; Dong Ho Lee MD ; Young Tae Ko MD, PhD

PURPOSE
To investigate the diagnostic performance of DWI in fistula-in-ano.

METHOD AND MATERIALS
This study included 46 patients who underwent rectal MRI to evaluate fistula-in-ano from March 2011 to March 2012. A history of Crohn's disease (CD) and fistulectomy were reviewed. Two radiologists retrospectively reviewed rectal MRI with consensus three times at 2-week intervals. The first review assessed the presence of perianal lesions, fistula type, and lesion conspicuity with T2WI. The second review assessed fistula conspicuity with CE-FS-T1WI and T2WI. The third assessed fistula conspicuity with DWI with a b-value of 1000 and T2WI. Lesion conspicuity was scored from 1 to 4 as follows: 1, unclear fistula tract; 2, visible fistula tract with unclear margin; 3, distinct fistula tract with partial obscuration; and 4, distinct fistula without obscuration. The lesion conspicuity was compared between CE-FS-T1WI and DWI using the Wilcoxon rank-sum test. Lesion conspicuity according to the clinical history was assessed using the Mann-Whitney U-test.

RESULTS

CONCLUSION
The lesion conspicuity of DWI with a b-value of 1000 was similar to that of CE-FS-T1WI, and significantly better in the patients with CD.

CLINICAL RELEVANCE/APPLICATION
DWI with a high b-value could help to inform clinicians about fistula shape and type.
Spiral GRAPPA Acceleration

SST06-01 • Image Quality on Liver CT Based on Sinogram Affirmed Iterative Reconstruction Algorithm

Boris Schulz MD (Presenter); Boris Bodelle MD; Petra Siebenhandl; Martin Beeres MD; Firas Al-Butmeh; Claudia Frellesen; Thomas J Vogl MD, PhD

PURPOSE
To evaluate efficacy of sinogram affirmed iterative reconstruction technique, regarding noise and image quality on contrast enhanced computed tomography (CT) of the liver.

METHOD AND MATERIALS
CT examinations were performed upon 32 patients (128 slice CT, 120kV, 180mAs, activated tube current modulation, 0.6mm collimation). Each examination was reconstructed at standard filtered back projection (FBP) and 5 different SAFIRE strengths in 5mm images in transversal direction with soft tissue kernel. Image noise was defined as standard deviation (SD) of Hounsfield units (HU) in air, and signal to noise ratio (SNR) of the liver was defined as mean liver HU per liver SD. Subjective image quality was evaluated by three raters using a 5-point scale (1=non-diagnostic image quality, 5=excellent image quality).

RESULTS
Average image noise was 6.2HU (FBP), vs. 5.7HU (SAFIRE 1), vs. 5.0 (SAFIRE 2) 4.4HU (SAFIRE 3), 3.8HU (SAFIRE 4), 3.1HU (SAFIRE 5). SNR of the liver consecutively increased when using the iterative reconstruction algorithms from 8.4 (FBP) to 9.3 (SAFIRE 1) to 10.4 (SAFIRE 2) to 12.2 (SAFIRE 3) to 15.1 (SAFIRE 4) to 17.5 (SAFIRE 5). The differences in image noise and SNR of each SAFIRE-strength to FBP was statistically significant (p<0.05). Sinogram affirmed based iterative reconstruction technique significantly reduces image noise and increases SNR for examinations of the liver. However subjective image quality decreases with strong iterative strengths.

CLINICAL RELEVANCE/APPLICATION
Since subjective image quality decreased slightly with iterative reconstructive techniques, mild iterations are recommended to enhance image quality on liver CT.

SST06-02 • The Clinical Utility of Diffusion-weighted-Imaging of the Abdomen with Ultra-high B-values

Melissa Ong MD (Presenter); Johannes Budjan MD; Stefan Haneder MD; Stefan O Schoenberg MD, PhD *; Ulrike Attenberger MD *; Henrik J Michaely MD *

PURPOSE
To evaluate the clinical utility of diffusion-weighted-imaging (DWI) of the abdomen with ultra-high b-values.

METHOD AND MATERIALS
In this retrospective IRB approved study 46 consecutive patients (30 women, 16 men, mean age 54±17.5) who underwent abdominal MR-exams including a DWI-EPI sequence with b-values of 50, 800 and 2000 s/mm² on a 3T MRI-system (Siemens Skyra) were included. Overall image quality with regard to detection of pathology and degree of artifacts as well as lesion conspicuity in the b800 and b2000 images were compared by two board-certified radiologists (1: preferring b2000; 2: preferring b800; 0: no difference). Quantitative analysis included determination of signal-to-noise ratio of sample tissues including the kidneys and the ventral and dorsal subcutaneous fat.

RESULTS
Reader 1 preferred the b2000 image in 30 (67%) patients, reader 2 in 32 (71%) patients. The b800 image was preferred in only 2 (4%) patients by both readers. Interobserver agreement was k=0.706 for overall image quality. Lesion conspicuity was rated better in the b2000 images in 31 (69%) patients and the b800 images in 1 (2%) patient by reader 1, in 27 (60%) and 2 patients (4%) by reader 2. Measure of agreement was k=0.494 for lesion conspicuity. There were no differences observed regarding artifacts. The signal-to-noise ratio measured 37.47 (±14.96) vs. 15.74 (±4.07) and 41.46 (±16.21) vs. 16.90 (±5.52) in the b800 and b2000-images for the left and right kidney, 9.22 (±3.18) vs. 12.05 (±3.75) and 9.80 (±2.52) vs. 12.14 (±2.93) for the ventral and dorsal fat, respectively.

CONCLUSION
DWI imaging of the abdomen with ultra-high b-values of 2000 s/mm² is feasible for lesion detection with good to acceptable image quality.

CLINICAL RELEVANCE/APPLICATION
Ultra-high b-values should be used in a clinical routine as a feasible tool for lesion detection.

SST06-03 • Multiphasic Contrast Enhanced Free Breathing 3D Imaging and Liver Perfusion Mapping Using Through-time 3D Spiral GRAPPA Acceleration

Yong Chen; Gregory R Lee; Katherine Wright; Mark A Griswold PhD *; Nicole Seiberlich PhD *; Vikas Gulani MD, PhD (Presenter)

PURPOSE
The goal of this work is to demonstrate high spatiotemporal resolution quantitative DCE liver MRI using a 3D stack-of-spirals acquisition, through-time non-Cartesian GRAPPA reconstruction, non-rigid body motion correction, and application of a dual-input single compartment model for quantitative perfusion mapping.

METHOD AND MATERIALS
MRI experiments were performed on a Siemens 3T Skyra scanner with normal volunteers (N = 4), and 0.1 mmol/kg Gadobenate (Multihance, Bracco, NJ) was given. T1-weighted 3D volumes were acquired using a stack-of-spirals gradient echo sequence. 120 volumes were acquired with a temporal resolution of 1.6–1.9 seconds, while the subjects were breathing freely. To accelerate the acquisition, data were undersampled in-plane with a reduction factor of 6, and reconstructed using through-time non-Cartesian GRAPPA. The reconstructed volumes were registered using FMRIB’s Non-linear Image Registration Tool (FNIRT). A dual-input single-compartment model was established to retrieve liver perfusion parameters from DCE-MRI data.

RESULTS
Images with high spatial resolution of 1.9x1.9x3 mm³ are obtained with whole liver coverage. With the high imaging speed of less than 2 sec/volume, a free-breathing scan is achieved, and subtle dynamic changes in contrast enhancement are captured. The free-breathing 3D images were registered with almost no residual motion in liver tissue. Quantitative whole liver 3D perfusion maps were obtained and the perfusion parameters are all in good agreement with published literature from CT and MR.

CONCLUSION
In this study, a high spatiotemporal resolution 3D liver imaging technique was developed using a stack-of-spirals acquisition and through-time non-Cartesian GRAPPA acceleration. This technique allows fast imaging of the whole liver during free breathing and accurate quantification of liver perfusion.
CLINICAL RELEVANCE/APPLICATION
Free-breathing abdominal scans with through-time spiral GRAPPA can provide diagnostic images from patients with difficulty breath-holding and additional quantitative information of liver perfusion.

SST06-04  •  4D Flow MRI with k-t GRAPPA in the Quantitative Assessment of PV Hemodynamics in Patients with Advanced Liver Cirrhosis: Initial Results and Comparison to Age-matched Controls

Zoran Stankovic MD (Presenter)  ;  Edouard Semaan  ;  Michael Markl PhD  ;  Marie Wasielewski  ;  Maria Carr  ;  Robert J Lewandowski MD *  ;  Riad Salem MD, MBA *  ;  James C Carr MD *  ;  Jeremy D Collins MD *

PURPOSE
To qualitatively and quantitatively evaluate blood flow hemodynamics in the portal venous (PV) system of patients with advanced liver cirrhosis compared to age-matched controls at non-contrast 4D flow MRI with contrast-enhanced 4D flow MRI as the standard of reference.

METHOD AND MATERIALS
In an ongoing study, time-resolved 4D flow MRI was applied at 3T (venc=50cm/sec, spatial resolution=2.1x2.5x3.0mm3) with and without a blood pool contrast agent in 20 datasets representing 5 patients with advanced liver cirrhosis (age=55±6years) compared to 5 healthy age-matched controls (age=53±4years). k-t GRAPPA was used with an acceleration factor R=5 to reduce scan time. 3D PV flow visualization based on 3D streamlines and time-resolved particle traces. Flow quantification was performed in the PV system with retrospective extraction of time-resolved peak velocities and net flow over the cardiac cycle. Bland Altman (BA) analyses compared the datasets before and after contrast application (mean bias±2SD).

RESULTS
Quantitative imaging analysis was successfully performed in the PV system with clear resolution of all branches except the superior mesenteric vein in one patient. Quantitative analyses demonstrated similar results before and after contrast for peak velocities (BA:0.012±0.029), while net flow values demonstrated a -7% bias for the non-contrast analysis (BA:-0.141±0.412). Comparing patients with liver cirrhosis and age-matched controls significant differences for peak velocities were seen only in the intrahepatic portal vein before and in the right intrahepatic portal vein branch after contrast application (p<0.012).

CONCLUSION
4D flow MRI enabled quantitation of comprehensive 3D flow characteristics in the portal venous system in patients with liver cirrhosis and visualization of abnormal blood flow hemodynamics. Non-contrast 4D flow MRI analyses demonstrated similar peak velocity assessment compared to a contrast-enhanced acquisition, although net flow was underestimated by 7%; field inhomogeneities may have accounted for the bias in net flow.

CLINICAL RELEVANCE/APPLICATION
4D flow MRI may improve quantification of altered liver blood flow hemodynamics in patients with advanced liver cirrhosis enabling quantitative analysis without Gadolinium based contrast media.

SST06-05  •  Quantification of Hepatic Blood Flow, ADC and Stiffness in Fasting and Post-prandial Conditions: Prospective Study at 3T

Guido H Jajamovich PhD (Presenter)  ;  Hadrien Dyvorne PhD  ;  Ersin Bayram PhD *  ;  Claudia Donnerhack  ;  Richard L Ehman MD *  ;  Bachir Taouli MD *

PURPOSE
Techniques such as MR Elastography (MRE), phase contrast (PC) and diffusion-weighted imaging (DWI) have potential for non-invasive detection of liver fibrosis, cirrhosis and portal hypertension. Since portal flow and liver stiffness (LS) may be altered by food intake, changes in hepatic portal venous flow (PV) flow, PV velocity and liver ADC might be observed and may lead to decreased reproducibility. This prospective study quantifies reproducibility (in fasting conditions) and post-prandial changes in PV flow/velocity, LS, and liver ADC at 3T.

METHOD AND MATERIALS
11 healthy volunteers and 7 patients with HCV cirrhosis were enrolled in this prospective IRB approved study. All subjects underwent 3T MRI (MR750, GE Healthcare), including 2D PC (pulse triggered, VENC=50 cm/s, slice perpendicular to portal vein), axial SS EPI DWI (free breathing, 16 b-values from 0 to 800 mm2/s) and MRE (4 slices through the liver). All subjects were initially scanned twice after 6 hours of fasting to assess reproducibility of each technique, and then scanned again 20 minutes after a 700 Kcal liquid meal. To quantify PV flow and velocity, a ROI was drawn in the PV on PC images. Mean LS and liver ADC were obtained by placing a ROI in the right hepatic lobe on LS maps and diffusion images. The coefficients of variation (CV) were computed for the two scans in fasting state. Wilcoxon paired tests and Mann-Whitney U tests were performed to assess differences in these metrics before and after caloric intake (average from the 2 fasting scans was used for comparison) and between patients and volunteers, respectively.

RESULTS
PV flow, PV velocity, liver ADC and LS showed good to excellent reproducibility in fasting state, with CVs ranging from 3.6%-11.8%. PV flow, PV velocity and LS were all significantly higher in post-prandial state (p<0.012). These results indicate that caloric intake is a factor to consider in interpreting PC-based PV flow/velocity and MRE-based hepatic stiffness measurements. LS can be used to separate cirrhotic patients from healthy volunteers.

CLINICAL RELEVANCE/APPLICATION
Liver blood flow and metabolism (portal venous flow/velocity and liver stiffness) are altered significantly in the postprandial state, showing the importance of undergoing MRI in a controlled state.

SST06-06  •  Start of Hepatocyte Uptake in Gadoxetate Disodium (Gd-EOB-DTPA) Enhanced MRI in Normal Liver Parenchyma

Hanke Schalkx MD (Presenter)  ;  Marijn Van Stralen PhD  ;  Kenneth Coenegrachts MD  ;  M.A.A.J. van den Bosch  ;  Wouter B Veldhuis MD, PhD  ;  Maarten S Van Leeuwen MD, PhD

PURPOSE
To evaluate the enhancement pattern of normal liver parenchyma in contrast-enhanced (CE) magnetic resonance imaging (MRI) using gadoxetate disodium, with special emphasis on the start of the hepatocyte uptake.

METHOD AND MATERIALS
23 patients without chronic liver disease underwent CE-MRI with gadoxetate disodium (Gd-EOB-DTPA, Primovist or Eovist, Bayer, Netherlands) on a 1.5T MRI system (Philips, Best, The Netherlands) using a 4D-THRIVE key-hole protocol [1] resulting in a total of 17 3D-acquisitions up to 20 minutes. After contrast administration of 0.25 mmol/kg gadoxetate disodium at 1 ml/s the first dynamic scan (t=0) was triggered on left ventricle filling. Signal intensity of liver parenchyma was measured on all scans, averaged over 3 regions-of-interest. Parenchymal enhancement was calculated as the relative signal intensity (SI) increase with respect to pre-contrast parenchymal intensity.

RESULTS
The initial, portal phase induced, parenchyma peak with a relative SI of 0.53 (SD=0.18) occurred at mean 37.6 ± 14.3 s. After the initial peak, 12/21 patients (57%) showed gradual increase in enhancement until 20 min. In 2/21 patients (2%) enhancement remained within +/-5% of the initial peak intensity. After the initial peak, 7/21 Patients (33%) demonstrated a decrease in SI of minimal 10% before parenchymal intensity gradually increased up to 20 min. The decrease in enhancement occurred at 68.9s ± 7.8s and max 76 sec.

CONCLUSION
After the initial, dynamic phase induced, parenchyma peak, three different enhancement patterns were observed. Increase in
transient moderate and severe motion artifact in the hepatic arterial phase occurs at a higher rate with gadoxetate disodium than with gadobenate dimeglumine. The lesion-to-liver contrast to noise ratio (CNR) at hepatic arterial phase with each FAs was calculated, as following: CNR = (SI-lesion - SI-liver) / SI-noise. Analysis of variance with the Sheffe method was used to evaluate statistical significance of the differences in RE, SNR and CNR values, according to the each FAs.

RESULTS
The RE values of hepatic parenchyma was significantly different in each FAs (10°, RE=0.73; 20°, RE=0.65; 30°, RE=0.52; p=0.002). The SNR of hepatic parenchyma values was not significantly different in each FAs (10°, SNR=26.3; 20°, SNR=25; 30°, SNR=23.3; p=0.093).

CONCLUSION
Increasing the FA on hepatic arterial phase of BOPTA enhanced MRI affects only relative hepatic parenchyma enhancement.

CLINICAL RELEVANCE/APPLICATION
Hepatic arterial phase with high degree of flip angle on BOPTA enhanced MRI decreased only hepatic parenchyma enhancement and didn't affect contrast noise ratio of the lesion.

SST06-08 • Respiratory Motion Artifact Affecting Arterial-phase Imaging—Comparison of Gadoxetate Disodium and Gadobenate Dimeglumine and Exam Recovery Using Multi-arterial Phase Acquisitions

Jason A Pietryga MD (Presenter) ; Lauren M Burke MD ; Tracy A Jaffe MD ; Mustafa R Bashir MD *

PURPOSE
To compare the rates of moderate/severe respiratory motion artifact on arterial-phase magnetic resonance imaging (MRI) when using gadoxetate disodium versus gadobenate dimeglumine intravenous contrast, and to assess if obtaining multiple arterial phases salvages some studies with motion.

METHOD AND MATERIALS
This is an IRB-approved HIPAA-compliant study. A retrospective search identified consecutive outpatients who had undergone contrast-enhanced MR imaging of the abdomen using either gadoxetate disodium or gadobenate dimeglumine over a period of three months using identical imaging protocols. Three board-certified radiologists (blinded to the contrast agent used) independently reviewed the following T1-weighted series for motion artifact: precontrast, three rapid arterial phases obtained in a single breath hold, portal venous phase, and late dynamic phase. Series were scored for severity of respiratory motion on a scale of 1 (none) to 5 (nondiagnostic), and timing of each arterial phase was assessed. Motion scores were compared between exams obtained with the two contrast agents for: number of exams with new (not present on precontrast phase) moderate (motion =3) or severe (=4) motion on at least one arterial phase, and exams where at least one well-timed late arterial phase had less than severe (motion =1) artifact.

RESULTS
275 qualifying examinations were identified (166-gadoxetate/109-gadobenate). Exams performed with gadoxetate had higher rates of new moderate (42.8% vs. 16.8%, p<0.001) and severe (5.2% vs. 0.9%, p=0.005) motion.

CONCLUSION
Transient moderate and severe motion artifact in the hepatic arterial phase occurs at a higher rate with gadoxetate disodium than with gadobenate dimeglumine. A multi-arterial phase acquisition scheme can recover a proportion of those examinations partially affected by arterial phase motion.

CLINICAL RELEVANCE/APPLICATION
Increased rates of significant motion artifact are seen when imaging the liver in the arterial phase with gadoxetate contrast vs. dimeglumine. Multi-arterial phase acquisition may salvage some exams.

SST06-09 • Liver MRI with Gadofosveset Trisodium

Laurent Milot MD, Msc (Presenter) ; Shoichet Martin MD ; Helen Cheung MD ; Caitlin T McGregor MD ; Megan Snyer ; Masoom A Haider MD * ; Liang Zeng ; Chirag Patel MBBS, MRCP ; George Tomlinson ; Calvin Law MD, FRCPC

PURPOSE
To illustrate the benefits and limitations of liver imaging performed with an intravascular blood pool agent Gadofosveset Trisodium (Gadofos) compared with an extracellular Gadolinium (EcGd) agent Gadobutrol.

METHOD AND MATERIALS
RESULTS
CONCLUSION
Enhancement pattern of background vessels/liver parenchyma and benign lesions is similar for both agents but Ablavar does not accumulate in metastatic lesions over time, a key differentiating feature. Pitfall may exist in some cases of NET.

CLINICAL RELEVANCE/APPLICATION
Liver imaging with Ablavar may help in the characterization of small equivocal liver lesions, especially in the context of patients with known adenocarcinoma.
A New Look at the Female Pelvis: Ultra-high-Field (7T) MR Imaging

Lale Umütlu MD (Presenter) *; Oliver Kraff MSC; Sonja Kinner MD; Anja Fischer MD; Stefan Maderwald PhD, MSc; Michael Forsting MD; Mark E Ladd PhD; Thomas C Lauenstein MD

PURPOSE
MR imaging of the female pelvis has been established in clinical diagnostics for the assessment of possible uterine or ovarian pathologies. The increase of the magnetic field strength to 3 Tesla pelvis MRI has been proven beneficial with regards to improvement of the spatial resolution. Hence, with the successful introduction of 7 T MRI to in-vivo research body imaging, the aim of this study was to investigate the feasibility and diagnostic potential of 7 T contrast-enhanced MR imaging of the female pelvis.

METHOD AND MATERIALS
14 healthy female volunteers were examined on a 7T whole-body MR system (Magnetom 7T, Siemens Healthcare) utilizing a custom-built 8-channel body coil and an 8-channel transmission radiofrequency body coil suitable for RF-shimming. The examination protocol included: 1) T1w fs 2D FLASH 2) T1w fs 3D FLASH 3) T2w TSE. For dynamic imaging, Gadobutrol was injected intravenously and 4 repetitive T1w 3D FLASH sequences were obtained. For visual qualitative image analysis of T1w imaging two readers assessed the delineation of (1) pelvic anatomy, (2) of vasculature, (3) tissue contrast and (4) overall image quality was assessed using a five-point scale (5= excellent vessel delineation to 1= non-diagnostic). For T2w MRI, the zonal anatomy of the uterus and the conspicuity of the ovaries were evaluated. Additionally, image impairment due to artifacts was assessed.

RESULTS
For the T1w sequences, 2D FLASH imaging was rated with higher scores for all assessed structures than 3D FLASH MRI, with highest scores for overall image quality (mean contrast-enhanced 2D FLASH 4.80) and tissue contrast (mean contrast-enhanced 2D FLASH 4.90). T2w TSE imaging yielded a moderate to high delineation of the zonal anatomy of the uterus with mean scores ranging from 3.60 for endometrium to 4.75 for myometrium. Overall image impairment due to artifacts was rated strongest for T2w MRI (2.90) and least for 2D FLASH MRI (mean 4.05).

CONCLUSION
This pilot study of dedicated 7 Tesla MRI of the female pelvis demonstrates the feasibility and potential of in vivo ultra-high-field pelvic imaging, providing good overall image quality and transitioning the associated higher SNR into high spatiotemporal resolution imaging.

CLINICAL RELEVANCE/APPLICATION
The high-quality delineation of anatomical details and non-enhanced vasculature may lead to a more accurate diagnosis of pelvic parenchymatous and vasculature disease using 7T MRI.

Spectrum of Pelvic Venous Congestion in Pudendal Neuralgia in Female Patients

Olga Kalinkin MD (Presenter); Rohit Khanna MD; Diana Atashroo MD; Andrea Chen MD; Michael Hibner MD, PhD

PURPOSE
Pudendal neuralgia is a painful condition with poorly understood etiology. Dilated vessels accompanying the pudendal nerve in anatomically narrowed spaces may cause extrinsic mass effect on the nerve. We are evaluating the presence of pelvic venous congestion in the patients with pudendal neuralgia.

METHOD AND MATERIALS
A retrospective analysis of the dedicated contrast enhanced pelvic MRI examination performed for 146 female patients with pudendal neuralgia clinically assessed by pelvic surgeons specialized in treatment of pudendal neuralgia. Diameter and localization of dilated venous vessels along the course of pudendal nerve in the interligamentous space, Alcock’s canal, at the inferior rectal branch, perineal branch, dorsal clitoral branch, caliber of vessels of the parauterine or paravaginal (in case of hysterectomy) venous plexus were assessed. Correlation of type of pelvic venous congestion with clinical symptom laterality was performed.

RESULTS
Among 146 female patients, 81 patients (55%), aged from 26 to 79 years, were found to have dilated venous pelvic vessels. Supralevator pelvic venous congestion is identified as dilatation of parauterine or paravaginal venous plexus without or with focally dilated vessels along the course of pudendal nerve in 34 and 28 patients respectively. Infralevator pelvic venous congestion as isolated dilated vessels in Alcock’s canal or interligamentous space and focally dilated small branches of pudendal nerves was seen in 13 patients and 6 patients respectively. 57 patients (90%) with supralevator pelvic venous congestion have bilateral site of pain or bilaterality of physical vessels in Alcock’s canal or interligamentous space (infralevator unilateral pelvic congestion) are not associated with laterality of pain or symptoms.

CONCLUSION
Spectrum of pelvic venous congestion in the female patients with pudendal neuralgia is ranging from diffuse supralevator parauterine (paravaginal) venous plexus dilatation to isolated infralevator focal venous dilatation of pudendal veins in Alcock’s canal or interligamentous spaces or small venous varices along the branches of pudendal veins.

CLINICAL RELEVANCE/APPLICATION
Differentiation of supralevator versus infralevator pelvic venous congestion may guide the pelvic surgeon to select an appropriate treatment with gonadal vein ligation versus focal venosclerotherapy.

Urinary Bladder Neck Dysfunction in Male Patients: Evaluation with MRI and with Voiding MR-Cystourethrography

Marco Di Girolamo MD (Presenter); Alberto Trucchi; Ines Casazza; Matteo Cappucci MD; Andrea Tubaro; Vincenzo David MD

PURPOSE
To evaluate with MRI male patients with urinary bladder neck dysfunction, studying the anatomical aspect of bladder neck and performing voiding MR-cystourethrography.

METHOD AND MATERIALS
We have evaluated with MRI 21 male patients with urinary bladder neck dysfunction diagnosed with pressure-flow study. All the patients had undergone US in the month proceeding MRI and patients with BPH were excluded. The MR examinations were performed with an 1.5 Tesla superconductive magnet with the patient placed in supine position and using a phased-array body coil. The patients had urine-filled bladders and sagittal and oblique coronal TSE T2-weighted scans were performed (TR:6250ms; TE:90ms; sl.thick.:3mm; acq.time:3.38s). The oblique coronal scans were parallel to the plane of the bladder neck. 15 patients underwent also voiding MR-cystourethrography performed with T1-weighted spoiled 3D gradient-echo acquisitions on sagittal plane performed (TR:12ms; TE:2.7ms; flip-angle:40°; sl.thickness: 2mm; acq.time:12s) after the filling of bladder lumen with contrast-material-enhanced urine
RESULTS  
The entire MR examination lasted no longer than 10 minutes for each patient. We detected 18 patients with abnormality of smooth muscular structures of the bladder neck and 3 patients with bladder neck cyst. MRI allowed a perfect evaluation of the different smooth detrusor muscles of the bladder neck. In patients with the typical urinary bladder neck dysfunction, we detected the hypertrophy of posterior smooth muscular structures of bladder neck and the kyphosis of prostatic urethra. Only 6 patients were able to perform voiding MR-cystourethrography that showed the characteristic radiological features.

CONCLUSION  
MRI with voiding MR-cystourethrography could be performed in male patients with bladder outlet obstruction in order to visualize the anatomical aspect of the bladder neck. These anatomical information are useful to determine the causes of voiding obstruction, to diagnose urinary bladder dysfunction and to establish the best therapeutic approach.

CLINICAL RELEVANCE/APPLICATION  
MRI with voiding MR-cystourethrography could be performed to diagnose urinary bladder neck dysfunction and can substitute conventional retrograde and voiding cystourethrography.

SST07-04 • The Value of Dynamic Magnetic Resonance Imaging in Interdisciplinary Treatment of Pelvic Floor Dysfunction

Ulrike I Attenerber MD (Presenter) *; John N Morelli MD; Alexander Herold; Peter Kienle MD, PhD; Werner Kleine; Axel Hacker; Christopher Baumann; Julia Heinzlebecker; Stefan O Schoenberg MD, PhD *; Henrik J Michaely MD *

PURPOSE  
To determine the value of dynamic pelvic floor MRI relative to standard clinical examinations in treatment decisions made by an interdisciplinary team of specialists in a center for pelvic floor dysfunction.

METHOD AND MATERIALS  
60 women were included in this IRB approved retrospective analysis. All patients were referred for dynamic pelvic floor MRI by an interdisciplinary team of specialists of a pelvic floor center. All patients were clinically examined by an urologist, gynecologist, a proctologist and colorectal surgeon. The specialists assessed individually and in consensus, whether (1) MRI provides important additional information not evident by physical examination and in consensus whether (2) MRI influenced the treatment strategy and/or (3) changed management or the surgical procedure.

RESULTS  
MRI was rated essential in the treatment decisions of 22/50 cases, leading to a treatment change in 13 cases. In 12 cases, an enterocoele was diagnosed by MRI but was not detected on physical exam. In 4 cases an enterocoele and in 2 cases a rectocele were suspected clinically but not confirmed by MRI. In 4 cases, MRI proved critical in assessment of rectocele size. Vaginal intussusception detected on MRI was likewise missed by gynecologic exam in 1 case.

CONCLUSION  
MRI allows diagnosis of clinically occult enterocoeles, by comprehensively evaluating the interaction between the pelvic floor and viscera. In nearly half of cases, MRI changed management or the surgical approach relative to the clinical evaluation of an interdisciplinary team. Thus, dynamic pelvic floor MRI represents an essential component of the evaluation for pelvic floor disorders.

CLINICAL RELEVANCE/APPLICATION  
In an interdisciplinary center for pelvic floor disorders dynamic pelvic floor MRI leads to a significant change in clinical management.

SST07-05 • Cervical Evaluation by Virtual Hysterosalpingography before Embryo Transfer

Javier Vallejos MD (Presenter); Patricia M Carrascosa MD *; Carlos Capunay MD; Ana Carla L Vasconcelos MD; Mariano Baronio; Jorge M Carrascosa MD

PURPOSE  
To compare cervical catheter test and virtual hysterosalpingography (VHSG) in the evaluation of cervix before embryo transfer.

METHOD AND MATERIALS  
We evaluated 100 patients with history of infertility. The day of examination, a gynaecologist performed a cervical test with a Wallace catheter. Then, patients underwent VHSG performed with a 256-slice CT scanner. CT images were evaluated by a radiologist, and the cervical patency, utero-cervical angle and the presence of cervical pathology were determined.

RESULTS  
There was a good correlation (r=0.92) in cervical patency evaluation between both methods. Unsuccessful cervical catheter test was observed in 35% of patients. In these patients, Virtual HSG detected polyps, adhesions and sinusous cervical canal, while cervix was normal in 23 patients, but the utero-cervical angle was < 90°.

CONCLUSION  
Virtual HSG findings correlate with cervical catheter test in the evaluation of cervical patency. Moreover virtual HSG provides anatomic information useful to identify the probable cause of failure of embryo transfers and prevent them.

CLINICAL RELEVANCE/APPLICATION  
Virtual HSG allows a complete description of the cervical canal, providing important prognostic information to the gynecologist prior to the completion of embryo transfer.

SST07-06 • Value of Contrast Enhanced Sonography in Acute Pelvic Pain in Women and Children: Initial Experience

Sandrine Chapuy (Presenter); Philippe Manzoni MD; Adrian I Kastler MD, MSc; Sebastien L Aubry MD, PhD; Bruno A Kastler MD, PhD

PURPOSE  
To study the feasibility and value of contrast enhanced ultrasound (ECUS) in acute pelvic pain in women and children.

METHOD AND MATERIALS  
Seventeen adnexal torsion were included in this retrospective study (16 patients from 21 days to 58 years, including 3 pregnant women) after local ethics committee approval between 2008 and 2012. ECUS imaging findings were compared to regular non enhanced US and to either pathological findings in case of surgery and to follow up imaging in the remaining cases.

RESULTS  
Thirteen adnexal torsion were confirmed, 9 of which occurred on a pathological ovary. ECUS sensitivity and positive predictive value were 84.6%. We report two cases of false negative and two cases of false positive. Ovary Vascularization assessment was possible in all 13 cases as opposed to 30.8% in Doppler mode, showing hypovascularization of ovary in ECUS in 58.8% against 15.4% in Doppler mode. In the three cases of ECUS performed pregnant women, imaging findings showed no transplacental passage. No adverse events were noted in all cases.

CONCLUSION  
Our study showed that ECUS allowed accurate diagnosis of adnexal torsion in 84.6% of cases. ECUS is a feasible, safe and useful tool in...
the assessment of acute pelvic pain in women and children.

CLINICAL RELEVANCE/APPLICATION
Contrast enhanced US is a useful tool in the early diagnosis of adnexal and provides crucial information on ovary perfusion which may help conservative surgical management

SST07-07 • Comparison of the Pelvic Floor before Pregnancy and 6 Weeks after Delivery: An MRI Study

W. Thomas Gregory MD ; Terri E Rechner MD ; Amanda Holland BS ; Amy S Thurmond MD (Presenter) *

PURPOSE
Pelvic organ prolapse is linked to parity, and for millennia has resulted in stress urinary incontinence and other symptoms which affect large numbers of women and limit their ability to work and socialize. We used MRI to evaluate changes in the pelvic floor before and after a first pregnancy. We compared these changes between those undergoing cesarean delivery and those having a vaginal delivery.

METHOD AND MATERIALS
This is a subgroup from an ongoing prospective cohort study of nulliparous women planning pregnancy. Participants have a standardized evaluation before pregnancy (Visit 1), 6 weeks after delivery (Visit 2), and then 6 months after delivery (Visit 3). At all three visits the participant has an interview with questionnaire, clinical pelvic exam, transperineal and endoanal 3D ultrasound, electromyography (EMG) of the pelvic floor and anal sphincter muscles, and pelvic MRI using a 3 Tesla magnet. This report focuses on MRI findings of the women who have completed Visits 1 and 2.

RESULTS
In 42 women, there was no significant change in bony measurements before and after pregnancy and delivery. There were however significant differences in the soft tissue measurements, including statistically significant inferior position of the bladder neck 6 weeks after delivery in all women, which was related to descent of the puborectalis muscle. This was more pronounced following vaginal delivery (31 women) compared to cesarean delivery (15 women). This was particularly evident during the dynamic maneuvers of kegel and valsalva. Interestingly, the pre-pregnancy values of bladder neck descent were larger in the women who ended up needing cesarean delivery.

CONCLUSION
Our data supports observations that after a first pregnancy women who had a vaginal delivery are 5 to 6 times more likely to have measurable pelvic prolapse then women who had cesarean delivery. Universal cesarean delivery to avoid future pelvic prolapse would not however be either cost effective. The comparison of pelvic structures in the same woman before and after delivery has not been done before, and may help us predict the women in whom the benefits of cesarean delivery for maintaining pelvic support, outweigh the risks.

CLINICAL RELEVANCE/APPLICATION
This is the first large study to image the pelvic floor anatomy in women before and after their first delivery of a child.

SST07-08 • Endometriosis: Is there a Way to Differentiate between Silent Fibrotic Adhesions and DIE with MRI?

Lucia Manganaro MD ; Valeria Vinci MD (Presenter) ; Silvia Bernardo MD ; Paolo Sollazzo ; Maria Eleonora Sergi MD ; Matteo Saldari ; Carlo Catalano MD

PURPOSE
Feasibility of contrast enhanced (CE) MRI with rectal filling to differentiate between recto-sigmoid DIE and silent fibrotic adhesions, and to assess the severity of infiltration.

METHOD AND MATERIALS
From October 2011 and April 2013 We enrolled 18 women coming with either ultrasound or clinical suspect of posterior endometriosis. We performed a pelvic MRI examination on 1,5T system, with intravenous administration of gadobenate dimeglumine (Gd-BOPTA) and rectal filling with ultrasonographic gel. We evaluated the presence of recto-sigmoid involvements and its nature by taking in consideration the different CE behaviour. All patients underwent to laparoscopy within 1 month from MRI.

RESULTS
MRI diagnosed posterior cul-de-sac obliteration in 15/18 patients. 5/15 cases MRI reported fibrotic strand between uterus and rectum. In other 6/15 cases, MRI detected wide nodules (mean diameter 18mm) on the Rectal surface, involving at full depth the muscularis mucosa, these nodules were easily visible thanks to the difference of CE between the lesion and the normal enhancing surrounding muscularis mucosa. In all cases overlying mucosa was intact. In 4/15 cases MRI detected smaller implants on the rectal wall, (mean diameter 8 mm); 3/4 appeared to involve partially the rectal wall, thus were suggestive for DIE; on the contrary 1/3 showed to be clearly remarkable from rectal wall in CE phase, therefore we suggested to be a pseudo-nodular adhesion. MRI findings were compared to laparoscopy, which demonstrated that the small implants suggestive for pseudo-nodular adhesion was indeed a implants of DIE (False negative); 1 case of small implants reported as DIE on MRI revealed to be fibrotic adhesion (False positive). We achieved a 92% sensitivity and a 75% specificity.

CONCLUSION
This study shows that CE MRI and rectal filling are suitable for the diagnosis of recto-sigmoid endometriosis and mainly in differentiating between fibrotic adhesions and DIE. Moreover, CE MRI may allow to detect the severity of infiltration through rectal wall. All these information are important to guide the surgeon towards a resection or shaving of the nodules of DIE, or for the lysis of the adhesions.

CLINICAL RELEVANCE/APPLICATION
CE MRI associated to rectal filling proved to be suitable to differentiate between adhesions and DIE; differentiate between these two type of manifestation is crucial for the surgical planning.

SST07-09 • Diffusion Weighted Imaging in the Evaluation of Hormonal Cyclic Changes in Abdominal Wall Endometriomas

Berhan Genc ; Mecit Kantarci (Presenter) ; Aynur Solak ; Neslin Sahin MD ; Mine Genc ; Hayri Ogul ; Oya Sivrikoz ; Berhan Pirimoglu MD

PURPOSE
To investigate the utility of diffusion weighted (DW) Magnetic Resonance (MR) imaging in the diagnosis of abdominal wall endometrioma (AWE) and to compare ADC values of AWE with uterine endometrioma, during different two phases of menstrual cycle.

METHOD AND MATERIALS
21 women with Abdominal Wall Endometriomas (AWEs) were included in the study. The mean and standard deviation of the apparent diffusion coefficient (ADC) values of normal endometrium/AWE were calculated for menstrual and luteal phases. All examinations were performed with a 1.5 T magnet (b values: 50,400 and 800 mm/s²). The results were analyzed by means Shapiro Wilk, Pearson correlation test, ANOVA test and Paired sample t-test per data.

RESULTS
The ADC values of the endometrium were different in the two phases of the menstrual cycle (menstrual phase: 0.924±0.256; luteal phase: 1.256±0.215) Similarly the ADC values of AWEs were different in these phases (menstrual phase: 0.924±0.171, luteal phase: 1.171±0.195). Both ADC measurements (AWE and uterine endometrium) were significantly lower in the menstrual phase than during the luteal phase and statistical significant difference was observed between menstrual and luteal phase (p < 0.05). There was no significant difference in ADC values between endometrial layer and AWE, in the same phase (p=0.216 for menstrual phase, p=0.104 for luteal phase, paired sample t-test).

CONCLUSION
This is the first large study to image the pelvic floor anatomy in women before and after their first delivery of a child.
This study demonstrated that the DWI features of AWEs were significantly similar to the uterine endometrial tissue in all patients and they show similar cyclic changes on ADC measurements. These preliminary results suggest that ADC values of lesion close to the uterine endometrium may be used to differentiate AWE from the other pathologic conditions of abdominal wall.

**CLINICAL RELEVANCE/APPLICATION**

DWI particularly ADC measurements together with uterine endometrial lining, provide useful information for diagnosis of AWE.

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**SST09-02 • Value of Dynamic Volume Imaging with 320-detector Row CT in the Pre-transplantation Evaluation of Head and Facial Skin Flap: Initial Experience**

**Kaiyuan Xu** (Presenter); **XueLin Zhang; Xing Chen** *

**PURPOSE**

To investigate the value of dynamic volume perfusion CT scanning in the pre-transplantation evaluation of blood supply of head and facial flaps with 320-Detector row computed tomography (CT).

**METHOD AND MATERIALS**

Whole-head dynamic volume perfusion CT scan was performed in 576 patients with a 320-Detector row CT system. All the patients enrolled had normal internal carotid arteries but due to other reasons referred to CT perfusion examination. Volume perfusion data were generated and then analyzed with the body perfusion software. BF (Blood Flow) value of each separate skin flap within the scan region was measured. The numbers of flap arteries and veins that can be found in dynamic CTA images are summarized.

**RESULTS**

We succeeded to measure BF value of each skin flaps in the head or face for all the patients. BF value of the forehead flap, the eyelid flap, the nasal dorsum flap, the buccal flap, the parietal flap, occipital flap, cervical flap was (127 ± 7.7)ml/min, (268.0 ± 31.1)ml/min, (229.0 ± 50.9)ml/min, (678.8 ± 9.5)ml/min, (140.3 ± 5.5)ml/min, (163.8 ± 15.5)ml/min, (123.5 ± 12.5)ml/min, respectively. There are significant difference between the flaps in different region, among which BF value of the buccal flap was the lowest. Arteries and vein of flaps was observed through different phases. Display rate of arteries and vein that can be found on dynamic CTA image was 100% for all flaps.

**CONCLUSION**

Whole-head dynamic volume CT perfusion using 320-detector row MDCT is able to offer effective reference for assessing blood supply and vessel anatomy of different skin flaps for the patient who is going to undergo skin flap autotransplantation. Fusion of perfusion map and CT anatomical images were helpful to the analysis and orientation of flaps.

**CLINICAL RELEVANCE/APPLICATION**

Whole-head perfusion can be used as a method of preoperative assessment of the skin flap perfusion and avoid operation complications effectively, which has the potential to improve prognostic utility.

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**SST09-03 • MRI Displays Affection of the Deep Temporal Artery and the Temporal Muscle in Patients with Giant Cell Arteritis**

**Simon Veldhoen** MD (Presenter) ; **Thorsten Klink** MD ; **Julia Geiger** MD ; **Peter Vaiith** ; **Cornelia Glaser** ; **Thomas Ness** ; **Dirk Duwendag** ; **Marcus Both** MD ; **Thorsten A Bley** MD

**PURPOSE**

Giant cell arteritis (GCA) is a vasculitis of large and medium-sized arteries. Dedicated MRI protocols have been developed to detect vasculitic changes of the superficial cranial arteries noninvasively. This study assesses the involvement of the deep temporal artery and the temporal muscle in MRI of patients with active GCA.

**METHOD AND MATERIALS**

99 patients who received MRI and subsequent temporal artery biopsy (TAB) were included. TAB was positive in 61 and negative in 38 patients. MRI was performed with a 1.5T and 3T. Dedicated protocol included whole-head T2-weighted imaging, arterial and venous phase contrast imaging and magnetization transfer imaging. All patients were followed up for at least six months.

**RESULTS**

MRI displays affection of two different arterial segments of the temporo-mandibular region. The first segment is the superficial branch of the superficial temporal artery which is the source of the superficial temporal muscle - arteries. The second segment is the deep branch of the superficial temporal artery which is the source of the temporal muscle - arteries. MRI displays affection of the temporal muscle - arteries in 64% of the patients with active GCA. Compared with the temporal muscle - arteries, the superficial temporal muscle - arteries were less frequently involved (44% vs 64%, respectively).

**CONCLUSION**

MRI displays affection of the deep temporal artery and the temporal muscle in patients with Giant Cell Arteritis. This finding may be used as a method of noninvasive follow-up of patients with active Giant Cell Arteritis.

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**SST09-01 • Vascular Communications between Donor and Recipient Tissues One Year after Successful Full Face Transplantation**

**Kanako K Kumamaru** MD, PhD (Presenter) ; **Geoffroy C Sisk** ; **Michael L Steigner** MD * ; **Elizabeth George** MBBS ; **Bohdan Pomahac** MD ; **Frank J Rybicki** MD, PhD * ; **Kurt Schultz** RT * ; **Dimitris Mitsouras** PhD ; **David S Enterline** MD * ; **Ericka M Bueno** PhD

**PURPOSE**

To noninvasively study vascular changes that have implications on graft survival and rejection, future surgical planning, and our understanding of the underlying biology changes after full face transplantation.

**METHOD AND MATERIALS**

Three full face transplant patients (single anastomosis bilaterally of artery and vein) for whom clinical findings were previously reported (NEJM 2012; 366:715-22) were, for the first time, evaluated for vascular reorganization 1 year after successful transplantation using a previously described 320 x 0.5 mm detector row dynamic CT angiography protocol (AJNR 2012, Aug 9, PMID 22878008).

**RESULTS**

Consistent, extensive vascular re-organization was observed among the recipients. Diverted external carotid artery (ECA) or facial artery angiograms were found to be perfused from newly opened, elaborate collateral circulation. Using the metric of arterial blood flow (BF) at the temporal region expressed as the percentage of the BF at the internal carotid artery, allograft tissue was slightly less perfused when the facial artery was the only donor artery when compared to an ECA-ECA anastomosis (4.4±0.4% vs 5.7±0.7%). However, allograft BF was higher than the recipient normal neck soft tissue blood flow. Blood flow to the recipient's tongue was maintained, despite the fact that the recipient lingual arteries were not always preserved. On the side where the lingual artery was ligated, blood flow was redistributed from a contralateral artery. Venous drainage was adequate for all patients, including patients for whom the recipient internal jugular vein was Anastomosed in end-to-end fashion on one side.

**CONCLUSION**

Despite extensive surface contact between the donor and the recipient, disruption of recipient's blood supply depends on extensive collateralization rather than new vessel ingrowth from the donor tissues. These findings guide both surgical planning and the assessment of potential complications for larger scale face transplant studies.

**CLINICAL RELEVANCE/APPLICATION**

A single anastomosis bilaterally of artery and vein is adequate for full face transplantation, evidenced by substantial arterial flow demonstrated on dynamic CT angiography.

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**SST09-04 • Neuroradiology/Head and Neck (Advanced Head and Neck Imaging)**

Friday, 10:30 AM - 12:00 PM • N226

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patients. TAB negative patients served as reference group. Contrast enhanced T1-weighted spin-echo images were acquired utilizing 1.5T and 3T MRI scanners at three academic medical centres. Mural contrast enhancement and wall thickening of the deep temporal artery and contrast enhancement of the temporal muscle were defined as their inflammatory involvement and assessed by two radiologists with experience in vasculitis imaging. Correlation analyses between individual MRI results and jaw claudication were performed to test for a concordance of clinical symptoms and MRI findings.

RESULTS
 Patients with active GCA showed inflammatory affection of the deep temporal artery in 34.4% (n=21) and 49.2% (n=30). Bilateral involvement was found in 80% (n=19) and 90.5% (n=24). Temporal muscle involvement was observed in 19.7% (n=12) and 21.3% (n=13), respectively, and occurred bilaterally in all cases. Relative risk for jaw claudication was increased to 2.1 [1.5; 3.1] for GCA patients. Its presence correlated with inflammatory MRI findings in the deep temporal artery (r=0.38; p=0.01) as well as in the temporal muscle (r=0.31).

CONCLUSION
 MRI is able to assess vasculitic changes in the deep temporal artery and in the temporal muscle. Both structures were affected simultaneously in a remarkable number of GCA patients. A substantial correlation of clinical symptoms and MRI results was observed.

CLINICAL RELEVANCE/APPLICATION
 MRI is able to display the involvement of the deep temporal artery and the temporal muscle in patients with active GCA.

SST09-04 • Evaluation of Head and Neck Arteriovenous Malformations with 4D Contrast-enhanced MR Angiography at 3T

Yasuhiko Iryo (Presenter) ; Toshinori Hirai MD ; Mika Kitajima MD ; Yoshinori Shigematsu ; Minako Azuma ; Yasuyuki Yamashita MD *

PURPOSE
 Four-dimensional contrast-enhanced MR angiography (4D CE-MRA) at 3T may replace digital subtraction angiography (DSA) for certain diagnostic purposes in patients with arteriovenous malformations (AVMs) in the head and neck region. The purpose of this study was to compare the agreement between DSA and 4D CE-MRA findings for the evaluation of head and neck AVMs.

METHOD AND MATERIALS
 Six patients with facial AVMs (4 men, 2 women; aged 15 - 83 years, mean 39.2 years) underwent 4D CE-MRA at 3T and DSA. The AVMs were located tongue, lip, scalp, orbit, nose and cheek in one each. 4D CE-MRA combined randomly segmented central k-space ordering, keyhole imaging, sensitivity encoding, and half-Fourier imaging; it yielded total acceleration factor was 88. We obtained 30 dynamic scans every 1.9 sec at an acquired spatial resolution of 0.9×0.9×1.5 mm; the matrix was 256×256. Two independent observers reviewed 4D CE-MRA images with regard to the nidus size, main arterial feeders and venous drainage. The venous drainage was recorded as being extracranial, intracranial, or extra- and intracranial veins. Interobserver and intermodality agreement was assessed by χ² statistics.

RESULTS
 On 4D CE-MRA, the interobserver agreement was excellent for main arterial feeders (κ = 1.0) and good for the nidus size and venous drainage (κ = 0.63 and 0.67, respectively). Intermodality agreement was excellent for main arterial feeders and venous drainage (κ = 0.92 and 1.0, respectively) and good for the nidus size (κ = 0.63).

CONCLUSION
 The agreement between 4D CE-MRA and DSA findings was good to excellent with respect to the nidus size, main arterial feeders and venous drainage in head and neck AVMs.

CLINICAL RELEVANCE/APPLICATION
 4D CE-MRA is a reliable tool for assessing head and neck AVMs, although it is not able to replace DSA for the detailed evaluation.

SST09-05 • Visualization of the Intraparotid Facial Nerve with 3T MRI

Hiroiuki Fujii MD (Presenter) ; Akifumi Fujita MD ; Yukio Kimura MD ; Edward K Sung MD ; Osamu Sakai MD, PhD * ; Hideo Sugimoto MD

PURPOSE
 It is important to know the spatial relationship of the intraparotid facial nerve to a parotid tumor since the location of the tumor influences the duration and difficulty of the surgery. Recently, several study have proposed MRI techniques to visualize the intraparotid facial nerve by 3-dimensional reversed fast imaging with steady-state precession with diffusion weighted imaging (3D-PSIF-DWI) and three-dimensional double-echo steady-state with water excitation (3D-DESSWE). The purpose of this study is to evaluate the visualization of the intraparotid facial nerve with both sequences using 3T MRI, and compare the utility of this application in clinical practice.

METHOD AND MATERIALS
 We evaluated 72 parotid glands of 36 consecutive patients during routine clinical MR examination. We performed both 3D-PSIF-DWI and 3D-DESSWE sequences using our 3T MR scanner (MAGNETOM Skyra, Siemens). Two observers initially assessed the images independently, but later resolved inconsistencies by collaborative review and consensus agreement. The certainty of identifying the intraparotid facial nerve was evaluated and divided into four categories; (1) Excellent: branch of the facial nerve identified; (2) Good: distal facial nerve trunk identified; (3) Fair: proximal facial nerve trunk identified; and (4) Poor: intraparotid facial nerve not identified.

RESULTS
 Both 3D-PSIF-DWI and 3D-DESSWE were successfully obtained in all 36 patients (72 parotid glands). The intraparotid facial nerve was identified in 62 parotid glands (86.1%); Excellent:17, Good:25, Fair:20) with 3D-PSIF-DWI sequence and in 71 parotid glands (98.6%; Excellent:40, Good:15, Fair:16) with 3D-DESSWE sequence.

CONCLUSION
 Using 3T MRI, both 3D-PSIF-DWI and 3D-DESSWE sequences can adequately demonstrate the course of the intraparotid facial nerve. 3D-DESSWE demonstrated better than 3D-PSIF-DWI in visualization intraparotid facial nerve.

CLINICAL RELEVANCE/APPLICATION
 Knowledge about the course of the intraparotid facial nerve in relation to a parotid tumor is important for preoperative planning, and can optimize the surgical approach to prevent facial nerve damage.

SST09-06 • High Resolution Diffusion-weighted MR Imaging in the Head and Neck: A New Approach

Thorsten Klink MD (Presenter) ; Daniel Chong ; Dechen W Tshering-Vogel ; Nedelina Slavova ; Berthold Kiefer PhD * ; Harriet C Thoeny MD

PURPOSE
 To evaluate whether diffusion-weighted MR images acquired with readout-segmented echo planar imaging (RESOLVE) are superior to single-shot echo planar imaging (ssEPI) in the head and neck region.

METHOD AND MATERIALS
 After ethics committee approval and written informed consent, 10 volunteers were prospectively included in our MRI study of the head and neck region. The 3T MR study protocol included axial T2w-TSE, ssEPI, and RESOLVE acquisitions. Image analysis was performed by two independent observers. DWI was qualitatively evaluated by visual assessment using a 10-point score, and quantitatively by measuring SNR and ADC values of various predefined structures. Image distortion was assessed qualitatively and quantitatively by measuring the diameter of anatomical structures on RESOLVE and ssEPI images in comparison to T2w images. The RESOLVE sequence was additionally tested in four patients. Differences were considered statistically significant, when p<0.05 applying the non-parametric Wilcoxon signed-rank test.
RESULTS
Quality of RESOLVE images was significantly higher in comparison to ssEPI (Quality scores, RESOLVE 7.51 ±0.18 and ssEPI 4.50 ±0.32; p

CONCLUSION
DWI of the head and neck acquired with the RESOLVE sequence had superior image quality at comparable SNR and ADC levels in ten healthy volunteers, and were of diagnostic quality in four patients. Significant less image distortion is the key advantage of RESOLVE over ssEPI and may therefore improve image interpretation of DWI in this challenging region.

CLINICAL RELEVANCE/APPLICATION
RESOLVE produced superior image quality and less distortion; this new approach for DWI in the artifact- and distortion-susceptible head and neck region may improve image interpretation.

SST09-07 • Objective Evaluation of Salivary Gland Function Using Diffusion-weighted MR Imaging: Follow-up of Radiation-induced Xerostomia

Yun-Yan Zhang (Presenter); Dan Ou; Xia-Yun He; Weijun Peng MD; Jian Mao BA; Lei Yue

PURPOSE
To investigate the value of diffusion-weighted (DW)-MRI as a noninvasive tool to assess salivary gland function for follow-up of patients with radiation-induced xerostomia.

METHOD AND MATERIALS
A HIPAA-compliant waiver of authorization was granted by the institutional review board. Twenty-three consecutive patients with nasopharyngeal carcinoma were examined with a 3T unit pre-radiotherapy (RT), and 1 week and 1 year post-RT. Clinical xerostomia was also assessed according to the Radiation Therapy Oncology Group/European Organization for Research and Treatment of Cancer morbidity scoring system. A DWI sequence was performed once on the salivary glands at rest, then continually repeated on the parotid glands immediately after oral ascorbic acid stimulation over a mean period of 21 minutes. Apparent diffusion coefficient (ADC) maps for salivary glands before and after stimulation were calculated. The maximum ADC of the parotid glands (pADCmax) and the time to pADCmax (pTmax) during stimulation were also obtained. Findings before and after RT were compared.

RESULTS
CONCLUSION
The ADC value is a sensitive indicator for salivary gland dysfunction, and it changes earlier than clinical xerostomia. DW-MRI is potentially useful for noninvasively evaluating the severity of radiation-induced xerostomia.

SST09-09 • Preliminary Prospective Study on Contrast-enhanced Ultrasound (CEUS) in the Quantitative Assessment of Uveal Melanoma (UM) Response to Gamma Knife Radiosurgery (GKR): Do Changes in Tumor Vascularization Precede Diameter Reduction?

Caterina Colantoni (Presenter); Massimo Venturini MD; Giulio Modorati; Maura Di Nicola; Giulia Agostini; Alessandro Del Maschio MD

PURPOSE
Tumor thickness is worldwide accepted as the most useful parameter to evaluate UM response to GKR, which on average occurs at 12 months. According to the modified response evaluation criteria in solid tumors (mRECIST), in case of hypervascular lesions, changes in quantitative parameters expressing tumor vasculization precede diameter reduction. Our aim was to prospectively analyze CEUS as a tool to quantitatively assess the response of UM to GKR, investigating if changes in quantitative parameters expressing tumor vasculization precede diameter reduction.

METHOD AND MATERIALS
Our study had institutional review board approval, and written consent was obtained. From 2012 to 2013, 10 patients (mean age, 66 years) affected by UM were enrolled and submitted to a complete ophthalmological evaluation before and after GKR. US and CEUS (ATL-Philips, IU-22, 5-9 MHz linear probe; Sonovue, Bracco) were performed by the same experienced radiologist at baseline (b-GKR), 3 (3-GKR), and 6 (6-GKR) months after GKR. UM transverse diameter (TD), thickness (Th), and different quantitative parameters (area under the curve in the wash-in phase; wash-in perfusion index (WiPI); peak enhancement (PE); mean transit time; wash-in rate (WiR); rise time (RT); time to peak) were calculated by the same operator using a dedicated and off-line imaging software (Sonotumor, Bracco). Comparisons between each parameter were made using the Wilcoxon analysis.

RESULTS
At US the mean tumor diameters (TDxTh, mm) were: b-GKR=10.7x8.3, 3-GKR=8.8x7.4, 6-GKR=9.4x6.6, with statistical significance at 6 months (P=.031).

CONCLUSION
CEUS is a feasible and reproducible method for the quantitative assessment of UM vascularization; it showed a reduction in UM
CLINICAL RELEVANCE/APPLICATION
CEUS could be a useful additional tool to conventional US or the first choice technique to monitor UM response to GKR, in order to better predict the long-term survival of patients.

Neuroradiology (Cerebral Ischemia, Hemorrhage and Vessel Wall Imaging)

Friday, 10:30 AM - 12:00 PM • N227

SST10-01 • Does Transfer Status Affect Outcomes in Acute Ischemic Stroke Patients Treated Endovascularly?
Maryam Soltanolkotabi MD (Presenter); Farnoosh Feiz MD; Ali Shaibani MD; Michael C Hurley MBCh; Yvonne Curran MD; Sameer A Ansari MD, PhD

PURPOSE
To study the effect of transfer status on endovascularly treated AIS patients' outcomes.

METHOD AND MATERIALS
We retrospectively analyzed consecutive anterior circulation AIS patients that underwent IAT at 4 institutions from 2006-2011. We excluded patients selected using perfusion imaging. Patient demographics, medical risk factors, presentations, technical, and clinical (NIHSS and mRS scores) outcomes, complications, and mortality were studied. Symptom-onset, groin puncture, and end-of-procedure times were recorded. THRIVE scores were calculated. Successful recanalization was defined as mRS 0-2 at 90 days. Patients were categorized into those who were transferred from outside institutions and those who presented directly to the CSCs.

RESULTS
116 patients were studied. 68 (58.6%) were transferred from outside institutions. Transfers and non-transfers were similar in THRIVE scores (p=0.300), median symptom-onset to groin puncture times (306 vs. 315 minutes; p=0.572), successful recanalization (p=0.574), and symptomatic IC A (13.2 vs. 10.4, p=0.776), but differed by age (59 vs. 69 years; p=0.002), prior stroke (3% vs. 22%, p=0.002), cardiac history (17.9 vs. 36.6%, p=0.040), baseline NIHSS (20 vs. 17, p=0.005), and location of occlusion (45.6% vs. 22.9% IC A, p=0.012). Transfer patients had significantly worse outcomes at 90 days (mRS 0-2: 16.2% vs. 60.4%, p in multivariate analysis, transfer status was an independent predictor of poor functional outcome (adj. OR 0.05, 0.011-0.222), adjusting for relevant covariates.

CONCLUSION
Transferred AIS patients have worse functional outcomes at 90 days than non-transfers, independent of baseline risk factors, stroke severity, time to IAT, and procedural success/complications. Further investigation should focus on residual factors that may contribute to our findings such as baseline/terminal infarct volumes, pre-morbid functional status, and post-stroke care.

CLINICAL RELEVANCE/APPLICATION
Access to intra-arterial therapy (IAT) for acute ischemic stroke (AIS) is limited to comprehensive stroke centers (CSCs) with timely access deemed critical for success. Inter-hospital transfers represent a significant factor affecting outcomes.

SST10-02 • Diffusion Tensor Imaging Study on Wallerian Degeneration of Pyramidal Tract after Pontine Infarction
Miao Zhang (Presenter); Jie Lu MD; Dongdong Rong; Zhillian Zhao PhD; Yanxiang Cao; Kuncheng Li MD

PURPOSE
To investigate dynamic process in Wallerian degeneration (WD) of the pyramidal tract after pontine infarction using diffusion tensor imaging (DTI), as well as its relationship with clinical prognosis.

METHOD AND MATERIALS
Nineteen patients with pontine infarction underwent five DTI examinations during a period of 6 months (7, 14, 30, 90 and 180 days after onset). Clinical neurological assessments were performed. Nineteen healthy control subjects age-sex matched were recruited. The fractional anisotropy (FA) values were measured at medulla, cerebral peduncle, posterior limb of internal capsule and precentral gyrus cortex at five time points. The FA values in the infarcted sides were compared with the contralateral sides and control subjects, and their relationships with clinical scores were analyzed.

RESULTS
The FA values at the medulla, cerebral peduncle, posterior limb of internal capsule and precentral gyrus cortex ipsilateral to infarct significantly decreased progressively with time. This trend was the most significant during 7~14 days after stroke, then it became slow during 14~30 days and stable during 30~180 days after stroke. The relative FA (rFA) values at the medulla and above the pons correlated positively with the Fugl-Meyer (FM) scores in 90 and 180 days. The rFA values above the pons correlated negatively with the modified Rankin scale (mRS) scores in 90 days.

CONCLUSION
DTI can detect secondary WD of pyramidal tract much earlier after pontine infarction. The decreased FA value of pyramidal tract in early stage may predict motor outcome.

CLINICAL RELEVANCE/APPLICATION
It is suggested that the progressive anterograde and retrograde degeneration in the pyramidal tract following a pontine infarct may slow down the process of neurological recovery.

SST10-03 • Functional MRI (fMRI) in Patients with Spastic Hemiplegia after Stroke, Treated with Botulinum Toxin: The Role of ‘Motor Imagery’ in the Demonstration of Central Effects and Brain Plasticity
Alessandro Stecco MD (Presenter); Roberta Matheoud; Stefano Carda; Marco Perchinunno; Emanuele Malatesta; Alessandro Carriero MD; Carlo Cisari

PURPOSE
Botulinum toxin is considered a first-line treatment of focal spasticity in post-stroke patients. The aim of our study is to describe the central nervous system effects of botulinum toxin by a fMRI analysis, assuming that in case of absence of influence, the brain fMRI
Initial Findings of Blood-brain Barrier Permeability in Predicting Delayed Cerebral Infarction in Aneurysmal Subarachnoid Hemorrhage

Jana Ivanidze MD, PhD (Presenter) ; Kartik Kesavabhotla ; Sirish Kishore MD ; Ajay Gupta MD ; Pina C Sanelli MD

PURPOSE
Aneurysmal subarachnoid hemorrhage (aSAH) patients are at increased risk of delayed cerebral ischemia (DCI) resulting in infarction. Since its pathophysiology is not well understood, early detection and treatment of DCI remains challenging. We hypothesize that blood brain barrier permeability (BBBP) increases prior to occurrence of infarction related to DCI. The purpose of this study is to assess whether alterations in BBBP, measured as permeability surface (PS) using CTP, precede development of infarction related to DCI in aSAH patients.

METHOD AND MATERIALS
This is a retrospective study of aSAH patients included in an IRB-approved clinical trial. Inclusion criteria are patients with CTP performed with extended scanning technique for analysis of PS. Exclusion criteria were patients who did not develop an infarction related to DCI, based on follow-up CT. All CTP data were post-processed using CT perfusion 4D software (GE Healthcare) for generation of PS, CBF, CBV and MTT maps. Using the integrated registration tool, the NCCT with the infarction region was superimposed on the CTP maps for correlation with the MTT maps. The analysis on the patients sample confirmed that the motor imagery paradigm showed activation but with a progressive focalization of cerebral activations, in particular a progressive reduction of the supplementary motor area (SMA and Brodmann 6 areas).

RESULTS
A total of 13 patients were included in the statistical analysis with 13 infarction (delayed cerebral ischemia, DCI) regions. PS elevation was observed in all cases in ROI that represented subsequently developed DCI compared to the contralateral brain parenchyma without DCI (mean DCI 0.449; mean control 0.198; p = 0.0002). By contrast, the conventional clinically used CTP parameters CBF, CBV and MTT did not show any significant difference to the contralateral ROI on pre-DCI CTP (CBF mean DCI 15.76; mean control 16.34; p = 0.9296; CBV mean DCI 1.89; mean control 1.54; p = 0.0528; MTT mean DCI 9.76; mean control 7.89; p = 0.0917).

CONCLUSION
These preliminary data show that a relative increase in blood brain barrier permeability compared to the contralateral brain parenchyma appears to precede the development of delayed cerebral ischemia in patients with aneurysmal subarachnoid hemorrhage.

CLINICAL RELEVANCE/APPLICATION
Permeability changes prior to the development of irreversible cerebral infarction may lay the foundation for the development of new treatment strategies targeted towards stroke prevention.
**SST10-06 • 3T High Resolution Vessel Wall Imaging in Acute Perforator Infarction within the Territory of Middle Cerebral Artery**

Younghee Lee MD (Presenter) ; Doran Hong MD ; Hyung Suk Seo ; Bo-Kyung Je MD, PhD ; Sang-II Suh ; Jin Man Jung ; Do Young Kwon ; Moon Ho Park

**PURPOSE**

Recently, 3T high-resolution vessel wall imaging (HRVW) has been introduced to compensate limitation of 3-dimensional time-of-flight magnetic resonance angiography (TOF MRA) which only shows the vascular lumen of intracranial artery diseases by demonstrating wall appearances. We aimed to evaluate the vessel wall characteristics of the ipsilateral middle cerebral arteries (MCA) in acute striatocapsular infarction presumed to be perforator occlusion using HRVW in addition to TOF MRA.

**METHOD AND MATERIALS**

Forty-seven consecutive patients (M:F=31:16, mean age=59.6±12.9 years) with acute striatocapsular infarctions presumed by perforator occlusion, displayed on the DWI, were retrospectively enrolled. According to the lesion diameter, we classified them either 1) perforator arterial infarction (PAI)50%,n=7). Additionally stroke risk factors including atherosclerosis and cardioembolic indicators were assessed.

**RESULTS**

Of the included 47 patients with acute PAI within MCA territory, 25 showed wall enhancement, 10 showed wall thickening, and 9 showed eccentric narrowing. HRVW demonstrated additional vessel wall abnormalities in eighteen (45.0%) from 40 patients classified as normal M1 on TOF MRA, moreover, 12 (41.4%) from twenty-nine patients with PAI< 2cm whose ipsilateral MCA was normal on TOF-MRA. Abnormal vessel wall findings to suggest intracranial atherosclerosis were more commonly depicted by HRVW than TOF MRA in patients

**CONCLUSION**

Based on our preliminary results, HRVW imaging could provide more additional findings to suggest relationship of intracranial atherosclerosis in acute PAI

**CLINICAL RELEVANCE/APPLICATION**

HRVW imaging could provide more additional findings beyond the scope of TOF-MRA.

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**SST10-07 • Temporal Patterns of Intracranial Vessel Wall Imaging Using High Resolution MRI: A Follow-Up Study**

Emmanuel C Obusez MD (Presenter) ; Ferdinand K Hui MD * ; Rula Hajj-Ali ; Stephen E Jones MD, PhD

**PURPOSE**

High-Resolution Magnetic Resonance Imaging (HRMRI) is an emerging tool for evaluating intracranial artery disease. Vessel wall characteristics of intracranial vasculopathy have been described on HRMRI. We investigated HRMRI arterial wall characteristics of non-atherosclerotic intracranial diseases to determine wall pattern changes over a follow up period.

**METHOD AND MATERIALS**

We retrospectively reviewed high resolution 3-tesla MRI vessel wall studies performed on 29 patients with confirmed diagnosis of large to medium cerebral vessel disease over a follow up period. The high resolution vessel wall imaging protocol included black-blood contrast-enhanced T1-weighted sequence with fat suppression and time-of-flight (TOF) MRA of the circle of Willis. Clinical and demographic data and vessel wall characteristics including enhancement, wall thickening, and lumen narrowing were collected.

**RESULTS**

Clinical and radiographic diagnosis included CNS vasculitis (13), RCVS (13), moyamoya (2), intracranial dissection (1). In the CNS vasculitis group, 9 showed smooth, concentric wall thickening and enhancement, 3 with smooth, eccentric wall enhancement and thickening, and 1 without wall enhancement and thickening. Six of 13 had follow-up imaging, 4 showed stable smooth, concentric enhancement and thickening consistent with initial imaging findings and 2 with resolution of initial imaging findings. For RCVS, 10 showed diffuse, uniform wall thickening without and with mild enhancement. Nine of 10 had follow-up imaging, 8 with complete resolution of initial findings. For moyamoya, 2 of 2 patients at initial and follow-up imaging showed severe, irregular, vessel narrowing and occlusion without wall thickening, while 1 of 2 showed patchy wall enhancement. Intracranial dissection showed irregular, eccentric enhancement and wall thickening with a dual lumen separated by an enhancing intimal flap and attenuation of initial findings at follow-up imaging.

**CONCLUSION**

Post-gadolinium high-resolution 3-tesla MRI appears to be a feasible tool in differentiating vessel wall patterns of intracranial arteriopathy over a follow up period.

**CLINICAL RELEVANCE/APPLICATION**

Study of the evolution of HRMRI wall patterns may improve radiographic diagnoses and may serve as a surveillance modality to identify changes in wall morphology with intracranial disease progression.

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**SST10-08 • Wall Enhancement of the Cerebral Arteries after Gadolinium Injection: Evaluation by MRI Using MSDE-3D-TSE Sequence**

Morio Nagahata MD (Presenter) ; Makoto Obara * ; Yasuko Minagawa ; Seina Sato ; Satoko Nagahata MD ; Rei Kondo MD, PhD ; Shinjiro Saito MD, PhD ; Takamasa Kayama MD, PhD

**PURPOSE**

Motion sensitized driven equilibrium (MSDE) method can reduce the intraluminal blood signal, even in the post-contrast MR imaging. In this paper, we investigate the wall enhancement of cerebral arteries after injection of gadolinium using MSDE-3D-TSE sequence.

**METHOD AND MATERIALS**

A retrospective review was undertaken of consecutive 231 Gd-enhanced brain MR examinations with additional post-contrast MSDE-3D-TSE scan from May 2011 to March 2013. MSDE-3D-TSE sequence was performed in three directions (axial, coronal, and sagittal) with a high resolution protocol consisting of T1w 3D-TSE sequence, TR/TE 425/12.8, 50 sections, 0.72x0.95x0.70mm voxel size, and a 384x342-imaging matrix on a 3T Achieva scanner (Philips). Among the 231 brain examinations, we evaluated the wall enhancement of each main arterial segment such as ICA (C1), M1, vertebral artery (VA), and basilar artery (BA) on MSDE-3D-TSE images. All images were analyzed by experienced neuroradiologist and neurosurgeons in consensus and classified as strong wall enhancement (equal to choroid plexus), faint enhancement (increased wall signal than pre-contrast scan), and no enhancement. In this study, we excluded the abnormal arterial segments such as occlusion, existing stenosis, fusiform dilatation, and dissection. Objective vessels of almost-normal morphology, which we could evaluate on post-contrast MSDE images, were 341 ICAs, 310 M1s, 78 VAs, and 122 BAs.

**RESULTS**

Strong wall enhancement, equally to choroid plexus, was observed in 0.88% of ICAs, 3.2% of M1s, 23.1% of VAs, and 0.82% of BAs. Faint enhancement was observed in 5.6% of ICAs, 1.3% of M1s, 30.8% of VAs, and 3.3% of BAs. Strongly enhancing M1 wall was observed only at the affected side of distal cortical embolism or perforating arterial infarcts in our series. Wall enhancement of VA was, however, observed frequently without symptoms suggesting vascular pathology.

**CONCLUSION**

We could evaluate the enhancement of cerebral arterial wall using MSDE-3D-TSE sequence. In MCA, strong enhancement may mean some pathological change. In VA, strong enhancement does not always mean the vascular pathology, although it is often observed.

**CLINICAL RELEVANCE/APPLICATION**

Wall enhancement of normal cerebral arteries revealed by post-contrast MSDE-3D-TSE sequence should be an important data for evaluating the pathological wall enhancement by post-contrast MRI in future.
SST10-09 • Effect of Insurance Status on Imaging Utilization for Acute Ischemic Stroke

Waleed Brinjikji (Presenter); Abdulrahman M El-Sayed, MD, PhD; Jennifer S McDonald, MD; Alejandro A Rabinstein, MD; Harry J Cloft, MD, PhD

PURPOSE

Previous studies have demonstrated that socioeconomic disparities exist in imaging utilization for both acute and chronic disease. We studied a large nationwide database to determine if insurance-based disparities exist in the utilization of imaging for acute ischemic stroke.

METHOD AND MATERIALS

Inpatients with a primary diagnosis of acute ischemic stroke from 11/2005 through 12/2011 were identified from the Perspective database. Patients were stratified into four groups according to insurance status: 1) uninsured, 2) Medicaid, 3) Medicare and 4) private insurance. Utilization rates of head CT, CT perfusion, head MRI, non-invasive head angiography (including head CTA and head MRA), non-invasive neck angiography (including neck CTA and neck MRA), carotid ultrasound, and echocardiography were compared using a chi-squared test. A multivariable logistic regression model adjusting for potential confounding variables was fit to determine the association between insurance status and imaging.

RESULTS

A total of 210212 patients were included in this study. 10396 patients (5.0%) were uninsured, 14243 patients (6.8%) had Medicaid, 153209 patients (72.9%) had Medicare and 32364 patients (15.4%) had private insurance. Utilization rate of MRA/CTA head was 55.9% for private insurance patients compared to 36.1% for Medicare patients (P < 0.001).

CONCLUSION

Significant disparities exist in the utilization of neuroimaging for acute ischemic stroke based on patient insurance status. More research is needed to address these disparities.

CLINICAL RELEVANCE/APPLICATION

Significant insurance-based disparities exist in the utilization of advanced imaging for acute ischemic stroke. Further studies are needed to better understand and address these disparities.

Neuroradiology (Quantitative Neuroimaging)

Friday, 10:30 AM - 12:00 PM • N230

SST11-01 • Geometrical Assessment of the Membranous Semicircular Canals: Using Three-dimensional Reconstructed High Resolution Magnetic Resonance Imaging of the Inner Ear

Ahmed F Emam, MBBCh (Presenter); Nagy N Naguib, MSc; Nour-Eldin A Nour-Eldin, MD, MSc; Mohammed A Alsubhi, BMBS; Thomas J Vogl, MD, PhD

PURPOSE

To estimate the angles between and to assess the length of the Superior (S), Posterior (P), Lateral (L), Crus commune (CC) semicircular canals (SCC) of the Inner Ear using three dimensional (3D) reconstruction of the high resolution MR-Imaging sequences.

METHOD AND MATERIALS

The retrospective study was performed on 2100 SCC’s (in 350 patients with a mean age of 48.5 year). Measurements were performed using 3D reconstruction of a high resolution MR-Imaging ISO-Space sequence with 0.6 mm slice thickness. 3D reconstructions were performed using Advantage Workstation for diagnostic imaging. The assessment was manually performed for each side in all patients. For each side the angles between the superior and posterior SCC (X), between the Superior and lateral SCC (Y) and between the Posterior and lateral SCC (Z) were measured. In addition, the individual length of each SCC and the CC was performed. The mean, standard deviation (SD) and range of each measurement were calculated.

RESULTS

Of the 2100 angles measured 37 were not visualized due to unclear appearance of the SCC in the region of the angle. In addition the length of 163 SCCs was not assessed due to fragmentation or unclear visualization. The angles between the left SCCs showed a mean value of X: 108.31° (SD: 10.15, Range: 77°-145°), Y: 72.11° (SD: 12.28, Range: 41°-116°) and Z: 84.85° (SD: 12.45, Range: 48°-123°). The angles between the right SCCs showed a mean of X: 110.34° (SD: 10.26, Range: 80°-150°), Y: 71.13° (SD: 13.15, Range: 42°-113°) and Z: 85.33° (SD: 13.07, Range: 48°-138°).

The mean length of the Superior, Posterior, Lateral, Crus commune SCC of the left Inner Ear was: S: 19.66mm (SD: 1.64, Range: 14-25mm), P: 21.34mm (SD: 1.99, Range: 17-27mm), L: 13.31mm (SD: 1.48, Range: 8-18mm) CC: 3.78mm (SD: 0.44, Range: 3-5mm). The mean Lengths on the right side were: S: 19.47mm (SD: 1.67, Range: 15-26mm), P: 22.30mm (SD: 2.06, Range: 14-25mm), P: 21.54mm (SD: 1.99, Range: 7.3-27mm), L: 13.31mm (SD: 1.48, Range: 8-18mm) CC: 3.78mm (SD: 0.44, Range: 2.7-5mm).

CONCLUSION

This descriptive study showed that angles between the Semicircular canal planes have a wide range of degrees.

CLINICAL RELEVANCE/APPLICATION

Contrary to previous reports in the literature (that the angle between the SCCs is around 90°) the current study results shows a wide range of variations between the angles.

SST11-02 • Clinical Evaluation of Synthetic Brain MRI at 3.0 Tesla

Michael Nelles, MD (Presenter); Juergen Gieseke, DSc; Dariusch Hadizadeh Kharrazi, MD; Horst Urbach, MD; Hans H Schild, MD

PURPOSE

Prospective intra-individual comparison of synthetic quantitative versus regular MR imaging (MRI) of the brain at 3.0T.

METHOD AND MATERIALS

A 3.0T MR system (Achieva 3.0T TX, Philips Healthcare, The Netherlands) and a stand-alone postprocessing software (SyntheticMR, Sweden) were used to create T1, T2 and FLAIR contrast-weighted synthetic MR images of the brain. The quantitative mapping was based on the QAPMASTER method (*Quantification of Relaxation Times and Proton Density by Multiecho acquisition of a saturation-recovery using Turbo Spin-Echo Readout*), using a multislice, multiecho, and multidelay acquisition with a scan time of 4:50 minutes. 25 consecutive patients underwent MRI of the brain including synthetic quantitative and regular T1, T2 and FLAIR sequences. Contrast ratios (CRs) were calculated between gray matter (GM) and white matter (WM) for synthetic and regular sequences. Diagnostic quality of synthetic MR examinations was scored as follows: Score of 4, excellent (sharp depiction of the GM/WM junction and subcortical GM
DTI Correlates of Cognition in Conventional MRI Normal Appearing Brain in Patients with Vitamin B12 Deficiency

Rakesh K Gupta MD, MBBS (Presenter) ; Pradeep K Gupta MSc ; Ravindra K Garg MD, MBBS ; Bhaswati Roy ; Abhinav Yadav BS ; Yogita Rai PhD ; Ram K Rathore DSc ; Chandra M Pandey PhD ; Ponnada A Narayana PhD

PURPOSE
Deficiency of vitamin B12 may result in neuronal degeneration and brain damage which influences the cognition. We hypothesized that patients with clinical symptoms of subacute combined degeneration (SACD) and biochemical evidence of Vitamin B12 deficiency should have a cognition decline and microstructural brain changes on advanced MRI even when conventional MRI appears normal.

METHOD AND MATERIALS
Patients with SACD of the cord were recruited for the study. Patients underwent nerve conduction velocity and biochemical analysis for serum Vitamin B12, and homocysteine. Hematology including the type of anemia was also performed. All patients with Vitamin B12 deficiency and clinical features of SACD were subjected to the complete imaging cervical spine and brain imaging. Patients with normal brain MRI with or without imaging changes in the cervical spine were included for cognition tests. Based on these criteria, 51 patients and 46 age and sex matched controls were enrolled in this study. 3D-T1 weighted and DTI was performed in all these subjects. FSL based...
RESULTS
No significant changes in grey and white matter volumes were observed in patient compared to control using VBM. Significant reduction of FA and increase in MD and RD values were observed in various brain regions in patients compared to controls. Most of the Neuropsychological score were significantly altered in patients compared to controls and few of these showed significant correlation with FA and RD in some of the brain regions.

CONCLUSION
Decrease in FA and increase in MD and RD results of WM microstructure suggests alteration probably due to demyelination of the fibers secondary to Vitamin B12 deficiency. These patients, though present clinically with SACD, have generalized involvement of the white matter of the CNS and have associated decline in cognition. Correlation of some of the NPT scores with region specific white matter changes confirms that the abnormalities in NPT relate to the changes in the white matter microstructures.

CLINICAL RELEVANCE/APPLICATION
Vitamin B12 deficiency has generalized effect on the CNS white matter even when it manifests as SACD as evidenced by cognition and brain microstructural alteration.

SST11-06 • Reliability of 3D Pseudo-continuous Arterial Spin-labeling MR Imaging for Measuring Visual Cortex Perfusion on Two 3T Scanners
Diandian Huang (Presenter) ; Xin Lou MD, PhD ; Lin Ma MD ; Bing Wu ; Kai-Ning Shi

PURPOSE
The visual cortex cerebral blood flow (CBF) values are closely associated with visual perception. Perfusion MRI can be used to identify patients with ischemic changes of visual cortex who may benefit from reperfusion therapies. The risk of nephrogenic systemic fibrosis, however, limits the use of contrast agents. Our objective was to evaluate the reliability and reproducibility of three dimensional arterial spin labeling (3D pCASL), an alternative noninvasive perfusion technique, to detect CBF of visual cortex in vivo.

METHOD AND MATERIALS
Twelve healthy subjects were scanned three times on two 3.0T MR scanners with 3D pCASL technique. The 1st test and 3rd test were done on scanner-1, while the 2nd test was on scanner-2. Intervals between tests were among 10-15 days. The 3D pCASL data with two post labeling delay time (PLD) of 1.5 and 2.5 seconds was acquired during every scanning. Volumetric T1-weighted images were also acquired for image registration. The CBF values of visual cortex (included brodmann 17, brodmann 18, brodmann 19) were extracted for comparison. The intra- and inter-scanner reliability and reproducibility were evaluated with the intraclass correlation coefficient (ICC) and Bland-Altman plot.

RESULTS
The relative CBF values of visual cortex were 16-84 ml/min/100g (PLD=1.5s) and 27-75 ml/min/100g (PLD=2.5s). Compared with 1st test and 2nd test, the ICC was 0.685 at PLD=1.5s and 0.754 at PLD=2.5s. Compared with 2nd test and 3rd test, the ICC was 0.719 at PLD=1.5s and 0.903 at PLD=2.5s. Higher reliability (ICC=0.829) for PLD 2.5s compared to PLD 1.5s (ICC=0.743) were demonstrated in inter-scanners. At intra- and inter-scanner, the Bland-Altman showed the reproducibility at PLD=2.5s is better than that at PLD=1.5s.

CONCLUSION
Although inter-scanner reliability is slightly lower than intra-scanner, there is a very high similarity of the outcomes at different time from two scanners. The 3D pCASL technique is available for measuring the CBF at visual cortex with high reliability and reproducibility. It should be used for MR research on blood flow of visual cortex at multiple centers.

CLINICAL RELEVANCE/APPLICATION
The 3D pCASL can measure CBF values of visual cortex with high reliability and reproducibility and offers a noninvasive way to access the etiology and diagnosis of posterior visual pathway disease.

SST11-07 • Adaptation and Slow Recovery of Metabolic Activity in Human Visual Cortex Coupled with a Modest Change in Cerebral Blood Flow
Farshad Moradi MD (Presenter) ; Richard B Buxton PhD

PURPOSE
We recently demonstrated sub-additive flow and metabolic response non-linearity in human visual cortex consistent with adaptation. A disproportionately large adaptation of metabolic response compared to blood flow was observed. These results indicate an aspect of metabolic activity corresponding to neural adaptation (or fatigue) that has a different neurovascular coupling from stimulus driven activation. We examine if the adaptable aspect of metabolic activity is coupled with high flow and whether or not it recovers during inter-stimulus intervals.

METHOD AND MATERIALS
Six observers participated in the experiment. CBF and BOLD responses to continuous (46 s) and intermittent (7.6 s on and off x 3) peripheral gratings were measured using a dual gradient-echo optimized multipulse pseudo-continuous arterial spin labeling sequence. A 2x2 design (continuous vs. intermittent, two contrast levels) was used. The difference between initial and final 18 s of activity during each epoch (?CBF vs. ?BOLD) were determined. ?CMRO2 was estimated using a modified calibrated BOLD method.

RESULTS
If the adaptable aspect of metabolic activity is coupled with high flow then the neurovascular-coupling ratio is expected to increase over time with prolonged stimulation in the continuous condition. If the adaptable aspect of metabolic activity recovers during interstimulus intervals then the neurovascular-coupling ratio should remain the same over time in the intermittent condition. A positive change in neurovascular coupling would result a ?BOLD that is disproportionately greater than ?CBF. Contrary to both predictions, ?BOLD was negative compared to ?CBF in all conditions, indicating a significantly lower neurovascular coupling ratio at the end of each epoch compared to the beginning.

CONCLUSION
The adaptable aspect of metabolic activity is coupled with a lower flow modulation compared to the input-driven modulation and does not recover during short inter-stimulus intervals. Our findings are consistent with the hypothesis that cerebral blood flow in human visual cortex is driven by both metabolic activity and visual input via independent mechanisms.

CLINICAL RELEVANCE/APPLICATION
Numerous pathologic conditions affect the regulation of cerebral blood flow. Our results provide insight into physiological modulations of neurovascular coupling and role of adaptation nonlinearity.

SST11-08 • Evaluation of WBAA with Registration-based Cube Propagation for Brain Atrophy Quantification
Martin Lillholm MSc, PhD (Presenter) ; Akshay Pai ; Lauge Sorensen ; Mads Nielsen PhD ; Jon Sparring ; Sune Darkner ; Erik B Dam PhD

PURPOSE
Atrophy for the whole brain and sub-structures is becoming common as study outcome in clinical trials assessing the efficacy of potential treatments of diseases involving dementia. In this study, we evaluated the sensitivity to change related to progression of Alzheimer’s disease of a novel software framework, WBAA.
METHOD AND MATERIALS
The recently defined Alzheimer's disease neuroimaging initiative (ADNI) standardized collection ('ADNI1: Annual 2 Yr 1.5T' at adni.loni.ucla.edu) with 504 subjects (169 normals, 234 mild cognitively impaired, and 101 alzheimer) including baseline and 12-month 1.5T T1 magnetic resonance imaging (MRI) scans was used. The MRIs were processed using longitudinal FreeSurfer and the whole brain atrophy application (WBAA 1.0 by Biomediq) that performs non-rigid registration followed by atrophy estimation quantification using cubic propagation (CP). The WBAA was also evaluated with CP replaced by the common Jacobian integration (JI) method. Sensitivity to change was evaluated by atrophy differences between healthy and Alzheimer subjects quantified using Cohen's D and required sample sizes.

RESULTS
As example, quantifications of the hippocampus atrophies estimated using WBAA were -1.3% and -0.6% for the Alzheimer and healthy subject whereas the ventricle estimates were +9.3% and +4.1%, respectively. Corresponding Cohen's D for WBAA on these two regions were 1.1 and 1.0. For whole-brain, hippocampus, ventricles, and medial temporal lobe, the WBAA Cohen's D were 0.7, 1.1, 1.0, and 1.3. The corresponding sample sizes were 173, 124, 113, and 87. For WBAA with JI, Cohen's D were 0.5, 1.1, 1.0 and 1.2; with sample sizes 230, 139, 112, and 101. For longitudinal FreeSurfer, Cohen's D were 0.7, 1.0, 1.0, and 1.3; with sample sizes 183, 152, 118, and 102.

CONCLUSION
The WBAA using CP for brain atrophy quantification provided sensitivity equal or superior to leading, competing methods. Specifically, the WBAA sample sizes were generally lower.

CLINICAL RELEVANCE/APPLICATION
Unlike longitudinal FreeSurfer, WBAA allows quantification of final atrophy estimates directly after each visit. Adding the matching/improved sensitivity, WBAA seems appropriate for clinical trials.

SST11-09 • Tumor Cellularity and the Extravascular-Extracellular Space: Using Quantitative Imaging to Evaluate Correlation Between ADC and DCE MRI in Human Gliomas, Meningiomas and Cerebral Lymphomas
Hannu T Huhtanpaa MD (Presenter) ; Darryl Hwang PhD ; Naira Muradyan PhD * ; Steven Cen PhD ; Michael Booker ; Alexander Lerner MD ; Deborah Commins ; Anandh G Rajamohanan MD ; Paul E Kim MD ; Orest B Boyko MD, PhD * ; John L Go MD ; Eu-Meng Law MBBS * ; Mark S Shiroishi MD

PURPOSE
The apparent diffusion coefficient (ADC) determined from diffusion tensor (DTI) MR imaging can give an impression of the extravascular-extracellular space (EES) and has been shown to be inversely correlated with tumor cell density. Parametric maps such as the EES fraction (ve) derived from dynamic contrast enhanced (DCE) MRI also characterize EES. The purpose of this study was to determine if there is a correlation between ADC and DCE metrics such as ve, blood-brain barrier transfer constant (Ktrans), Kep (Ktrans/ve), and fractional plasma volume (vp) for gliomas, cerebral lymphomas and meningiomas. Figure 1 demonstrates ADC and ve parametric maps for a glioma.

METHOD AND MATERIALS
18 gliomas (grade I-IV), 2 lymphomas and 5 meningiomas were retrospectively evaluated. DTI and DCE images were acquired during the same MRI exam. DCE-MRI images were postprocessed in CADvue. Metrics extracted from DCE MRI were: ve, vp, Ktrans, and Kep. ADC maps were generated by the MR scanner. DCE and ADC images were co-registered and 3-dimensional regions of interest were drawn on parametric maps. Voxel-wise correlation between ADC and DCE parameters were examined using scatter plots and tested by random effects model. Mean and median values were extracted using Spearman correlation.

RESULTS
Overall, mean ADC correlated negatively with mean ve (r = -0.48, p = 0.03) as well as with median ve (r = -0.52, p = 0.01). The result of voxel level analysis using random effects model did not show significant correlation between ADC and ve (r = 0.09, p = 0.09). No statistically significant correlation was observed between ADC and the other parameters, vp, Ktrans, and Kep.

CONCLUSION
Our results showed a negative correlation between ADC and both mean as well as median ve, and no significant correlation between ADC and the other DCE parameters. This is in agreement with a prior study performed in breast cancer, while another study in breast cancer as well as one in glioblastoma found no correlation. These results likely reflect limitations in our understanding of these metrics though limitations in imaging technique may be confounders.

CLINICAL RELEVANCE/APPLICATION
Determination of the relationship between ADC and DCE MRI metrics such as extravascular-extracellular volume fraction (ve) may provide new imaging biomarkers of brain tumor cellularity
Patients reacted positively to use of the iPad during informed consent, even when used as a simple replacement for a paper form. Nonetheless, clinical images and interactive drawings significantly improved patient understanding and confidence in the procedure to be performed. While videos were considered helpful, they were received less positively by patients, perhaps due to a reduction in interactivity with the provider. The iPad is a useful tool to help build a patient-physician relationship before an interventional procedure.

**CLINICAL RELEVANCE/APPLICATION**
The iPad can be very helpful during informed consent for interventional radiology procedures. It can significantly increase patient understanding, confidence and satisfaction.

**SST16-02 • Radiology Milestones: A Multiyear Study of Resident Experience with Radiologic Procedures at a Large Academic Medical Center**

**Adam B Prater** MD (Presenter) ; **Bradley S Rostad** MD ; **Emily Ebert** BS ; **Rachel Kearns** BS ; **Thomas W Loehfelm** MD, PhD ; **Brent Little** MD ; **Christopher P Ho** MD ; **Mark E Mullins** MD, PhD

**PURPOSE**
The American College of Graduate Medical Education (ACGME) and the American Board of Radiology (ABR) initiated the Radiology Milestones Project in 2012 to create a framework for assessing the competency of radiology residents. An analysis of procedures performed by prior residents might help guide the assessment of procedural competency of current and future residents. Our study documented the most common types and numbers of procedures performed by radiology residents in a large academic center over a ten year period.

**METHOD AND MATERIALS**
Institutional review board approval was obtained. Resident procedure logs from graduating class years 2002 to 2012 were de-identified and organized into a secure electronic database. Summary statistics for each procedure type were calculated.

**RESULTS**
Resident procedure logs consisted of both paper and electronic forms, which varied in the number of resident participation and in the types and numbers of procedures documented. Over a ten year period, 110 residents recorded a total of 13,678 procedures consisting of 70 different procedure types. The most common recorded procedures were visceral catheter insertion, CT-Guided abdominal biopsies and drain placement, fluoroscopic Lumbar puncture, and ultrasound guided thoracentesis, paracentesis and thyroid biopsies. However, the numbers and types of procedures recorded for each resident varied considerably (mean 124 ± 75, max 331, min 15).

**CONCLUSION**
Although a wide variety of procedures are performed by residents during residency, resident procedural experience, as measured by procedure log data, varies significantly between residents even within the same program. This may be due to variability in resident procedural practices and procedures performed as data are manually entered by residents and are possibly underreported. Given the future directions suggested by the Radiology Milestones Project, our findings highlight the need for national guidelines regarding procedure requirements, and a more accurate method of acquiring radiology procedure data.

**CLINICAL RELEVANCE/APPLICATION**
The future of graduate medical education is geared towards data-driven metrics that can accurately depict resident progress and competence.

**SST16-03 • Magnetically Assisted Remote Controlled Endovascular Catheter for Interventional MRI: In Vitro Navigation at 1.5T**

**Aaron D Losey** MS (Presenter) ; **Prasheel Lillaney** ; **Alastair Martin** * ; **Daniel L Cooke** MD ; **Mark W Wilson** MD ; **Maythem Saeed** DVM, PhD ; **Steven W Hetts** MD *

**PURPOSE**
Using real-time MRI for interventional procedures affords a wealth of physiologic and structural information. The promise of endovascular MR guided procedures remains unrealized in part because of the lack of MR compatible catheters and guide wires. Innovative techniques for guiding a catheter in the magnetic field of the MR scanner have been proposed, but limited functionality has been described to date. This study evaluates navigation of a magnetically assisted remote controlled (MARC) catheter compared to guidance without magnetic assistance in vitro at 1.5T.

**METHOD AND MATERIALS**

**RESULTS**
We have developed and tested MARC catheters for endovascular navigation. At angles of 45 degrees or greater magnetic assistance was significantly faster than non-assisted guidance. The MARC catheter provides a novel opportunity to navigate effectively in interventional MRI environment. Preclinical in vivo studies are underway.

**CLINICAL RELEVANCE/APPLICATION**
Real-time MR guided catheter navigation with the MARC catheter could revolutionize minimally invasive procedures by advancing local treatment of stroke, cardiac arrhythmias and solid tumors.

**SST16-04 • Non-enhanced T1-weighted Imaging of the Visceral Arteries at 7 Tesla**

**Anja Fischer** MD (Presenter) ; **Oliver Kraff** MSc; **Stefan Maderwald** PhD, MSc; **Karsten J Beiderwellen** MD; **Thomas C Lauenstein** MD ; **Lale Umutlu** MD *

**PURPOSE**

**RESULTS**

**CONCLUSION**
Non-contrast-enhanced T1w imaging in general and, TOF MRA in particular, appear to be promising techniques for good quality assessment of visceral arteries without the need of contrast media at 7 Tesla.
SST16-05 • MR Lymphangiography in Clinical Diagnostics of Focal Lesions of the Lymphatic Vessel System in Peripheral Lymphedema

Frederik F Strobl MD (Presenter) ; Carolin Burgard ; Mayo Weiss ; Maximilian F Reiser MD ; Mike Notohamiprodjo

PURPOSE
Lymphoceles or focal dermal backflow form part of focal lesions of the peripheral lymphatic system. Focal dermal backflow is a frequent draining mechanism in the imaging of primary and secondary lymphedema and stands for a diffuse leakage of the tracer into subcutaneous tissue. In addition to lymphoscintigraphy, the magnetic resonance (MR) lymphangiography provides a valuable morphological and anatomical gain in information. Patients with this aforementioned disease pattern can benefit from the kind of information in pre- and postsurgical diagnostic procedures. The purpose of this study was to compare findings of MR lymphangiography with those of lymphoscintigraphy in the assessment of focal lesions of the lymphatic vessel system in peripheral lymphedema.

METHOD AND MATERIALS
In this study, 44 consecutive patients with uni- or bilateral lymphedema and lymph vessel transplants of the lower extremities were included. MR lymphangiographies were performed with a 3.0-T fat-saturated three-dimensional gradient-echo MR after gadopentetate dimeglumine injection. Results of MR lymphangiography and lymphoscintigraphy were reviewed separately by a radiologist and a nuclear physician and concordance of the two techniques regarding existence, localization, distribution and confidence were examined.

RESULTS
With lymphoscintigraphy, which constituted the standard diagnostic procedure, focal lesions like lymphoceles or focal dermal backflow could be diagnosed in 23 patients. This result was confirmed by MR lymphangiography in 19 patients. Thus, there exists an excellent sensitivity of 83% and a specificity of 84% for MR lymphangiography. In addition, MR lymphangiography depicted auxiliary information about the anatomical constitution of lymph vessels or lymphoceles and showed a better differentiation between focal multiple or diffuse lesions.

CONCLUSION
Imaging findings of both techniques, the MR lymphangiography and the lymphoscintigraphy, showed an excellent correlation. Due to superior morphological and anatomical resolution, MR lymphangiography provides supplementary information for pre-surgical work-up in patients with focal lesions of the lymphatic vessel system in peripheral lymphedema.

CLINICAL RELEVANCE/APPLICATION
MR lymphangiography can provide 3D anatomical information without radiation exposure. Therefore it is a valuable alternative to lymphoscintigraphy in patients with peripheral lymphedema.

SST16-06 • Thermal versus Mechanical Disruption of Mice Melanoma due to MR Guided HIFU, a Feasibility Study

Martijn Hoogenboom MSc (Presenter) ; Martin J Van Amerongen MSc ; Iringo Kovacs ; Gosse Adema ; Arend Heerschap PhD ; Jurgen J Futterer MD, PhD

PURPOSE
MR guided HIFU is an upcoming technique for non-invasive tumor treatment, however the differences in pathologic and immunologic effects by thermal or mechanical HIFU treatment is uncertain. The purpose of this feasibility study is to differentiate between mechanical and thermal MR guided HIFU ablation and to visualize the different pathologic and immunologic effects.

METHOD AND MATERIALS
Nine C57Bl/6n wild type mice were subcutaneously injected with B16F10 tumor cells at the right femur. After 9-10 days the tumor size was >8x8 mm. A 3MHz, 16 channel phased array HIFU system with an acoustic energy of 43-46W, was placed in a 7T animal MR scanner. An in-house made gelpad and degassed water was used for acoustic coupling.

The ablation process was visualized using MR guided thermometry (FLASH sequence, proton resonance frequency shift method: TR/TE=40/4ms, flip angle 25°, 5 slices, 0.3mm inter-slice distance, voxel size 0.78x0.78x1.5mm3, 3.8s/dynamic, 0.5°C temperature accuracy). Three different treatment strategies (3-6 spots) were applied in each tumor, 3 mice per strategy, respectively. First, continuous wave (CW) mode, 4 seconds ablation. Second, pulsed wave (PW) mode, 120 shots of 20ms, pulse repetition frequency (PRF) of 4. Third, PW-mode, 500shots of 5ms, PRF 4. The mice are sacrificed 3 days after treatment, the tumor is removed for pathological evaluation, using HE-staining.

RESULTS
Temperatures of >35°C, 3D

CONCLUSION
Thermal and mechanical HIFU treatment create different pathologic and immunologic responses, further research is necessary for quantification of these differences.

CLINICAL RELEVANCE/APPLICATION
Pathologic and immunologic effects due to HIFU are still uncertain, before testing on humans a mice set up is created for a good evaluation of these effects.

SST16-07 • MR-guided Focused Ultrasound Ablation of Pancreatic Cancer: A Totally Non-invasive Treatment for Pain Palliation and Tumor Control of Locally Advanced Lesions (Stage III)

Fulvio Zaccagna MD (Presenter) ; Alessandro Napoli MD ; Gaia Cartocci ; Giulia Brachetti ; Fabrizio Boni ; Vincenzo Noce MD ; Luca Bertaccini ; Maurizio Del Monte ; Carlo Catalano MD

PURPOSE
To evaluate the feasibility of MR-guided focused ultrasound (MRgFUS) ablation for pain palliation and local tumor control in selected patients with unresectable primary pancreatic adenocarcinoma.

METHOD AND MATERIALS
6 patients with histologically proven unresectable pancreatic adenocarcinoma, who were clinically unable (n 4) or refused (n 2) to undergo chemo-radiation therapy, underwent MRgFUS treatment on a dedicated 3T unit featuring the ExAblate 2100 system (Insightec). All lesions were evaluated for device accessibility prior to treatment. MRgFUS procedures were performed in general anesthesia with constant breath control. Clinical assessment included evaluation of symptoms severity with visual analogue scale (VAS) before and after treatment. After treatment all patients underwent CT with the same chemotherapy scheme. Imaging follow-up, including both CT and MR examinations, was performed immediately after treatment and at 3 and 6 months in order to evaluate the effects of MRgFUS on the targeted tumor and the absence of procedure-related complications.

RESULTS
Our preliminary clinical experience suggests that MRgFUS is a feasible and repeatable ablative technique in selected patients with unresectable and device-accessible pancreatic adenocarcinoma.

CLINICAL RELEVANCE/APPLICATION
Non-enhanced MRA of visceral arteries at 7 T may bear the potential to be a good alternative to contrast-enhanced MRA, particularly for examination of patients with renal insufficiency.
CLINICAL RELEVANCE/APPLICATION

MRF-US treatment for locally advanced pancreatic tumor is a safe procedure and could be repeated without increase of adverse event risk.

SST16-08 • The Synergy of High-intensity Focused Ultrasound and Low-dose Generic Chemotherapeutic Virtually Eliminates Multi-drug Resistant Solid Tumor Cells

Howard Q Vo MD, MS (Presenter); Yoo-Shin Kim PhD; Brian E O'Neill PhD

PURPOSE

Despite medical advances, multidrug-resistant (MDR) cancers continue to challenge the patients. Their clinical prognoses may further be complicated by the need for additional surgical procedures and/or radiotherapy. In this study, we seek to evaluate a new strategy in which the synergy of high-intensity focused ultrasound (HIFU) and a single low dose of a generic chemotherapeutic is utilized to attack MDR solid tumor cells.

METHOD AND MATERIALS

This strategy is partly an outgrowth of an in-house Phase 4 clinical trial in which MRI-guided HIFU was used to treat uterine fibroids. The clinical procedure was adapted for the 3-day in vitro study during which human uterine sarcoma cell line (MES-SA/Dx5 (ATCC® CRL1977™)), known for resistance to multiple drugs such as Doxorubicin (Dox), was paradoxically treated with Dox.

Day 1: Each data sample consisted of ~20K cells grown inside a well of 8-well glass slides (Lab-Tek). The well was then filled with McCoy's media and incubated at 36 °C for 4h. Afterward each well was sealed and secured onto a fixture before being submerged in a warm degassed water bath. The targets for HIFU therapy are the center points of the 4 quadrants of each well's base. The constant HIFU parameters for each well were acoustic pressure 7MPa, RF 1Hz, focal-zone depth and 30 sec/sonication/center point while duty cycle (DC) ranged 0-60% between the wells. 2h after HIFU treatment, the wells were unsealed and incubated overnight.

Day 2: Cell media for each well was replaced with fresh media containing [Dox] 0-1 ug/mL prior to repeating the HIFU procedure from 24h earlier.

Day 3: After 24h of exposure to Dox, cell survivability study was performed to determine the contributions of HIFU-mediated necrosis and Dox-mediated apoptosis.

RESULTS

Cell survivability decreased by increasing [Dox] or DC. In the Dox-only group (DC 0%), average survivability was 93% for [Dox] 0.5 ug/mL while in the HIFU-only group ([Dox] 0 ug/mL), average survivability was 42% for DC 50%. In contrast, there was virtually no survivability of sarcoma cells for [Dox] 0.5 ug/mL and DC = 50%.

CONCLUSION

The synergy of HIFU and low-dose Doxorubicin was successful in virtually eliminating MDR uterine sarcoma cells.

CLINICAL RELEVANCE/APPLICATION

A combination of HIFU and a low-dose generic chemotherapeutic may be a promising alternative to existing treatments (regular-dose multidrug regimen, surgery or radiotherapy) against some MDR cancers.

SST16-09 • Non-Vascular Interventional Procedures in an Urban General Hospital: Analysis of 2001-2010 with Comparison to the Previous Decade

Peter F Hahn MD, PhD (Presenter) *; Alexander R Guimaraes MD, PhD *; Ronald S Arellano MD; Peter R Mueller MD *; Debra A Gervais MD *

PURPOSE

Non-vascular image-guided procedures such as biopsy and fluid drainage are accepted medical care. Having previously reported an analysis of the 21324 cases in the 1991-2000 fiscal years, we undertook a comparative study of procedures performed by the same abdominal interventional group from October, 2000 through September, 2010.

METHOD AND MATERIALS

With IRB approval a 20-year quality assurance database verified against the radiology information system was queried for procedure location (eg. pleura, liver, bowel, abdomen) and type (eg. biopsy, catheter insertion, transient drainage), demographics and trends. New hospital numbers assigned each year served to normalize for overall hospital activity.

RESULTS

We performed 50195 IR procedures in 24309 distinct patients (M:F 12625:11684; average age 60), 940 procedures in under-20's and 571 in patients 90 or older. 15345, 4377 and 1754 patients had 1, 2 or 3 procedures; 470 had 10 or more. 27 supervising radiologists and 277 individual operators, double the previous decade. Biopsy (4.8% average yearly increase), abdominal drainage (7.3%), paracentesis (12.9%), tube manipulation (13.0%), suprapubic tube insertion (21.0%), and gastrostomy (44.6%) all increased strongly (p<0.01). CLINICAL RELEVANCE/APPLICATION

Referrals for non-vascular IR procedures have doubled over two decades, outpacing growth in new hospital patients and requiring increased resource allocation.

Since some specialized procedures like biliary and renal drainage have not increased proportionately, newly trained operators may have diminished experience with these more demanding cases.

Friday Imaging Symposium: MR Imaging of Common Musculoskeletal Injuries (An Interactive Session)

Friday, 12:30 PM - 03:00 PM • E350

SPMK61 • AMA PRA Category 1 Credit ™:2.5 • ARRT Category A+ Credit:3

Moderator

Mark D Murphey, MD

LEARNING OBJECTIVES

1) To recognize the common patterns of meniscal injuries on MR imaging and their clinical importance. 2) To identify the MR appearance of hip labral tears and patterns of femoroacetabular impingement syndrome (FAI), 3) To describe the common MR patterns and locations of rotator cuff tears and the importance of associated tendon retraction and muscle atrophy. 4) To recognize the patterns of injury and MR appearance associated with cruciate and collateral ligament injuries of the knee.

SPMK61A • MR of the Menisci

Mark D Murphey MD (Presenter)

LEARNING OBJECTIVES

1) To recognize the common patterns of meniscal injuries on MR imaging and their clinical importance. 2) To identify the MR appearance of hip labral tears and patterns of femoroacetabular impingement syndrome (FAI), 3) To describe the common MR patterns and locations of rotator cuff tears and the importance of associated tendon retraction and muscle atrophy. 4) To recognize the patterns of injury and MR appearance associated with cruciate and collateral ligament injuries of the knee.
LEARNING OBJECTIVES
View learning objectives under main course title.

SPMK61B • MR of the Hip Labrum
Donna G Blankenbaker MD (Presenter)
LEARNING OBJECTIVES
View learning objectives under main course title.

SPMK61C • MR of the Rotator Cuff
William B Morrison MD (Presenter)
LEARNING OBJECTIVES
View learning objectives under main course title.

SPMK61D • MR of the Cruciate and Collateral Knee Ligaments
Mini N Pathria MD (Presenter)
LEARNING OBJECTIVES
View learning objectives under main course title.

Disclosure Index

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