Centennial Showcase

Miscellaneous
Sat, Nov 29 12:00 PM - 5:00 PM   Location: Centennial Pavilion, Learning Center

ABSTRACT
Explore an onsite experience to see, hear, and discover the advancements that shaped radiology. The Showcase will feature a historical timeline and a special welcome from a virtual Wilhelm Roentgen. Visitors can explore the Centennial Gallery featuring the stories behind RSNA, and the Cases of the Century, which gives attendees a chance to try their hand at diagnosis using only "vintage" images. Attendees will also have an opportunity to view striking images in the Art and Science gallery and contribute their favorite RSNA memories or celebratory messages in the Memory Book. The Centennial Showcase will be open: November 29, 12:00pm-5:00pm November 30 - December 4, 7:30am-6:00pm December 5, 7:30am-12:30pm

RC801
HRCT of Diffuse Lung Disease: Read Cases with the Experts (An Interactive Session)

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Fri, Dec 5 8:30 AM - 10:00 AM   Location: S406A

Participants
Moderator
Georgeann McGuinness MD : Nothing to Disclose

Sub-Events

RC801A
Movement, Basic Anatomy and Patterns for Differential Diagnosis

Brett M. Elicker MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Understand basic high-resolution CT anatomy and its relationship to disease pathophysiology. 2) Describe common protocols in high-resolution CT and their advantages/disadvantages. 3) Understand the role of radiology in the multi-disciplinary diagnosis of patients with diffuse lung diseases.

RC801B

Patterns: Lines and Cysts

Daria Manos MD, FRCPC (Presenter): Author, Springer Science+Business Media Deutschland GmbH

LEARNING OBJECTIVES
1) Use the terms intralobular septal thickening, interlobular septal thickening, irregular reticulation, parenchymal bands, traction bronchiectasis, lung cysts and honeycombing appropriately. 2) Understand the diagnostic significance of honeycombing, septal thickening and other forms of reticulation. 3) Use imaging features to identify and distinguish causes of cystic air spaces including honeycombing, emphysema and cystic lung diseases such as lymphangioleiomyomatosis, langerhans cell histiocystosis, and lymphoid interstitial pneumonia.

RC801C

Patterns: Nodules and Ground Glass Opacities

Sharyn Leigh Shirley MacDonald MBChB (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Understand that nodules < 10 mm are seen in many conditions and that the differential diagnosis on HRCT is based on the size of the nodules, their appearance, and their distribution. 2) Understand that ground glass opacity is a non-specific pattern that reflects the presence of abnormalities below the resolution of HRCT. 3) Understand that the differential diagnosis of ground glass opacity is based on the clinical history (in particular the duration of symptoms), the distribution of the ground glass opacity, and the presence of associated abnormalities.

RC801D

Read Cases with the Experts

Georgeann McGuinness MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Understand the applications and limitations of HRCT in detecting and characterizing diffuse lung disease through the discussion of expert analysis of unknown cases. 2) Apply correct usage of the HRCT lexicon to specific findings, to better elucidate pathophysiology and to refine differential considerations, by observing experts in HRCT approach unknown cases. 3) Develop diagnosis and management algorithms by working through problematic cases with the expert discussions.

**RC802**

**International Educational Outreach-Challenges and Benefits**

*Refresher/Informatics*

**Participants**

Moderator
Kristen K. DeStigter MD:
Research Grant, Koninklijke Philips NV Consultant, Koninklijke Philips NV Medical Advisory Board, McKesson Corporation

**Sub-Events**

**RC802A  Why and How Radiology Program Directors Should Support a Global Outreach Rotation**
Kristen K. DeStigter MD (Presenter): Research Grant, Koninklijke Philips NV Consultant, Koninklijke Philips NV Medical Advisory Board, McKesson Corporation

**LEARNING OBJECTIVES**

1) Cite the ACGME Diagnostic Radiology (RRC) guidelines for international rotations in radiology. 2) Describe opportunities for resident involvement in global outreach. 3) Describe the challenges that residents and programs face while setting up global outreach rotations.

**RC802B  Thinking Outside the "View" Box: A Radiology Residents Guide to Global Outreach**
Kara-Lee Pool MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Provide residents and practicing radiologists a guide to starting a global health project. 2) Explain how platforms such as film and social media can help navigate the global health world. 3) Why and how Radiology Residents should consider a Global Outreach Elective. 4) Provide examples on how to find funding. 5) Explain how efficient diagnosis based on imaging can save money in resource poor countries.

**ABSTRACT**

Thinking Outside the 'View' Box: How to Integrate Global Outreach into Your Radiology Practice

**RC802C  Radiology Education and Outreach in Southern Africa - Problems and Solutions for Getting Out There**
Savvas Andronikou MBBS (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand the human resource limitations in radiologists and especially pediatric radiologists. 2) Understand the equipment limitations of southern African countries. 3) Solutions in teleradiology: through digitizing and sending for opinion where there is expertise. 4) Understanding the relevance of point of care imaging tests for the field - Ultrasound. 5) Understanding the concept of task-shifting US performance to non-radiologists. 6) Seeing the results of task shifting experiments for interpreting pediatric CXR for TB using different groups and the effect of short focused courses. 7) Perceiving the internet as a learning and accreditation source for developing countries. 8) Understanding limitations of internet in developing countries with regard to availability of computers, bandwidth and expense.

**RC802D  Education and Support Opportunities for Radiology Training Programs in Other Countries: Uganda**
Sam Bugeza MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Discuss the current radiology educational process in Uganda. 2) Describe the challenges for radiology
education, sub-specialization and continuing education in Uganda. 3) Understand the opportunities for collaboration on educational objectives in Uganda.

RC803

Imaging Nonischemic and Ischemic Disease of the Myocardium

Refresher/Informatics

MRI and CT of Cardiac Masses
Phillip Matthew Young MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To review role of MR and CT in assessing cardiac masses. 2) To highlight the potential for detection, characterization, staging, and guiding surgical decision making with cardiac MR and CT through clinical cases. 3) To review some practical tips and tricks to keep in mind when imaging these challenging cases.

Infiltrative Diseases (Amyloid, Hemochromatosis Fabrys, Sarcoid)
Kristopher W. Cummings MD (Presenter): Research Consultant, Biomedical Systems Research Consultant, Medtronic, Inc

LEARNING OBJECTIVES

1) Understand the role of cardiac MR in the evaluation of infiltrative cardiomyopathy. 2) Describe typical patterns and locations of MR late gadolinium enhancement associated with various types of infiltrative disease. 3) Explain the role of noncontrast MR in the evaluation for myocardial iron deposition.

Non Infiltrative Non-ischemic Cardiomyopathies (HCM, Noncompaction, ARVD, Myocarditis, Takatzubo etc.)
Karen Gomes Ordovas MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) To understand how to differentiate ischemic from non-ischemic cardiomyopathies on cardiac MRI. 2) To recognize the cardiac MR findings suggestive of the diagnosis of different types of non-ischemic cardiomyopathies. 3) To identify cardiac MR findings that have a prognostic role in patients with non-ischemic cardiomyopathies.

RC805

Multiple Sclerosis

Refresher/Informatics

Clinical MS Update
Daniel Pelletier MD (Presenter): Consultant, CNS Imaging Consultant, LLC Research Grant, Biogen Idec Inc

Participants

Moderator
Aaron Scott Field MD, PhD: Research Consultant, BioTime, Inc
LEARNING OBJECTIVES

1) Review the most recent MRI dissemination in space (DIS) and time (DIT) diagnostic MS criteria. 2) Review the latest disease-modifying therapeutic options and potential complications (PML). 3) Illustrate the importance of standardized MRI protocols to monitor MS patients.

RC805B  
Advanced Imaging in MS  
Aaron Scott Field MD, PhD (Presenter): Research Consultant, BioTime, Inc

LEARNING OBJECTIVES

1) Recognize the "Clinicoradiological Paradox" in MS and assess the limitations of imaging that contribute to this paradox. 2) Demonstrate how advanced MR imaging can further our understanding of the disease and help guide therapy. 3) Illustrate examples of recent efforts to be more quantitative in the imaging assessment of MS.

RC805C  
Spinal Cord Demyelinating Diseases  
James G. Smirniotopoulos MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Describe an algorithm for evaluating myelitis. 2) Differentiate between ADEM, MS, and NMO. 3) Describe the pathology of viral myelitis.

RC806  
Head and Neck Emergency!  
Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50  
ARRT Category A+ Credits: 1.50  
Fri, Dec 5 8:30 AM - 10:00 AM  
Location: S406B

Sub-Events

RC806A  
Adult Non-Traumatic Emergencies  
Claudia Francoise-Eve Kirsch MD (Presenter): Consultant, Informa plc

LEARNING OBJECTIVES

1) Review and understand the etiology of adult non-traumatic emergencies in the head and neck. 2) Review and understand the critical radiographic manifestations of adult non-traumatic emergencies, emphasizing the critical radiographic anatomical findings seen with emergent findings in the head and neck arising from either vascular, infectious, neoplastic, degenerative, inflammatory, congenital, allergic, and toxic etiologies (VINDICATE). 3) Review the radiographic features and the critical clinical implications of non-traumatic head and neck emergencies, so the radiologist is vindicated in conveying these findings to the referring clinicians leading to improved diagnostic outcomes and treatment.

ABSTRACT

This RSNA refresher course focuses on the adult non-traumatic emergencies in the head and neck arising from vascular, infectious, neoplastic, degenerative, inflammatory, congenital, allergic, and toxic etiologies. This lecture will also focus on understanding the critical radiographic anatomical findings and clinical manifestations, allowing the radiologist to be vindicated when conveying the imaging findings to the referring clinicians.

RC806B  
Pediatric Non-Traumatic Emergencies  
Bernadette L. Koch MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Identify the most common non-traumatic emergencies in imaging the pediatric head and neck. 2) Describe and understand the orbital and intracranial complications of pediatric sinusitis. 3) Identify the most common complications of middle ear and mastoid inflammatory disease. 4) Recognize the most common complications of deep neck infections in children.

RC806C  
Traumatic Head and Neck Emergencies  
Amy F Juliano MD (Presenter): Nothing to Disclose
LEARNING OBJECTIVES

1) Identify the major types of orbital and facial injuries and recognize their imaging appearance. 2) Describe fractures that occur in the temporal bone and important structures that may be compromised, and correlate imaging findings with clinical presentation and symptoms. 3) Analyze laryngeal anatomy in the setting of trauma so as to be able to describe soft tissue and cartilaginous injuries.

**RC807**

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

*Refresher/Informatics*

**GU**

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
Fri, Dec 5 8:30 AM - 10:00 AM  Location: E350

**Participants**

**Evis Sala MD, PhD** (Presenter): Nothing to Disclose
**Mitchell E. Tublin MD** (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

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

**ABSTRACT**

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

**RC808**

**The Usual and Unusual Abdominal Emergencies**

*Refresher/Informatics*

**ER**

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credit: 0
Fri, Dec 5 8:30 AM - 10:00 AM  Location: N227AB

**Sub-Events**

**RC808A**  **Challenge Cases: Uncommon Causes of Acute Abdominal Pain**

**Clint W. Sliker MD** (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Uncommon diseases that may mimic common causes of acute abdominal pain. 2) Atypical manifestations of or complicated common causes of acute abdominal pain.

**RC808B**  **Imaging of Drug Smuggling**

**Ferco H. Berger MD** (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To discuss the socio-economic background of drugs and the different ways of intra-corporeal transportation and packing materials used. 2) To elaborate on the different imaging techniques for detection of illicit drugs trafficking and the findings and the potential lack thereof with different types of imaging modalities. 3) To get familiarized with the complications that can occur and the imaging findings thereof.

**ABSTRACT**
The drugs industry is reported to make up to almost 1% of global GDP and 1/3 of the population has tried illicit drugs in their life, causing a staggering estimated 1 death per hour in Europe alone. Trafficking of drugs occurs by ingestion (body packers) or vaginal/rectal insertion (body pushers). As can be imagined, ingestion / insertion of packets of drugs can cause different kinds of clinical problems, depending on packaging material and type of drug. Detection of packets by screening methods as well as acute and subacute clinical conditions and the depiction thereof by different imaging modalities will be discussed. The participants of this RC will get to know the current developments in both the packets as well as the imaging of their features.

**Non-traumatic Splenic Emergencies**

Michael Nathan Patlas MD, FRCP (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To discuss the use of different cross-sectional imaging modalities for detection of splenic emergencies. 2) To illustrate applications of multi-phasic MDCT in emergency evaluation of patients with acute left upper quadrant pain. 3) To demonstrate the value of specific imaging findings for identifying and characterizing non traumatic splenic emergencies.

**ABSTRACT**

Non-traumatic splenic emergencies are uncommon entities. Patients can present to the emergency room with a sharp left upper quadrant (LUQ) pain related to splenic infarct, ruptured splenic artery aneurysm, splenic torsion or rupture. Alternatively, splenic emergencies are detected during evaluation of patients with fever of unknown origin (splenic abscess, tuberculosis) or non-specific abdominal pain (splenic vein thrombosis). This presentation will discuss the cross-sectional imaging approach to the patient with LUQ pain, differential diagnosis and management options with an emphasis on the interventional radiology techniques.

**active handout**


---

**Pitfalls in Abdominal Imaging**

**Refresher/Informatics**

**RC809**

**Pitfalls in Bowel Imaging**

Douglas S. Katz MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To briefly overview the problem of correct interpretation of the bowel on 'routine' abdominal and pelvic CT. 2) To demonstrate cases of pitfalls and pearls of interpretation of bowel findings on abdominal and pelvic CT. 3) To briefly review the limited literature on this topic.

**Atypical Liver Lesions**


**LEARNING OBJECTIVES**

1) To understand the typical imaging appearance of various focal liver lesions on CT and MR and how they can present in an atypical fashion (i.e. the imaging spectrum).

**Pitfalls in Hepatic Doppler Sonography**

Jonathan B. Kruskal MD, PhD (Presenter): Author, UpToDate, Inc

**LEARNING OBJECTIVES**

1) Discuss the common technical pitfalls that occur when performing the liver Doppler examination, and how these can be mitigated. 2) Discuss the perceptual and interpretive errors that occur when performing the liver Doppler examination, and how these can be minimized. 3) Describe the clinical impact of technical and interpretive errors.
**Pearls and Pitfalls in Pancreatic Diseases**

**Benjamin M. Yeh MD (Presenter): Research Grant, General Electric Company Consultant, General Electric Company**

**LEARNING OBJECTIVES**

1) Understand critical ductal and parenchymal anatomic variants that affect the appearance of the pancreas affected by cancer. 2) Describe the appearance of pancreatic adenocarcinomas and how to report critical structures for local staging of malignancy. 3) Review mimics of pancreatic adenocarcinoma and how to distinguish between benign and malignant disease.

**ABSTRACT**

Pancreatic cancer remains a devastating disease with a poor general prognosis. Understanding of the typical radiological features of pancreatic cancer helps in the detection of early disease that may be curable. While surgical resection carries the hope of cure in patients with resectable disease, accurate radiological interpretation and staging is critical for the appropriate triage of patients with suspected adenocarcinoma and provides the roadmap for surgical intervention. Imaging interpretation also guides palliative therapy that may improve the quality of life. In this course we will cover important anatomical considerations at CT and MRI that allow for rapid accurate interpretation of images in patients with suspected adenocarcinomas. We will review important mimics of malignancy that may require different treatment and improved prognosis. The staging of adenocarcinoma, including structural landmarks important for pre surgical planning will be discussed.

---

**Vascular Doppler (An Interactive Session)**

**Refresher/Informatics**

**RC810**

**Vascular Doppler (An Interactive Session)**

**RC810A Challenges in Carotid Doppler**

**Edward G. Grant MD (Presenter): Research Grant, Bracco Group Research Grant, General Electric Company Medical Advisory Board, Nuance Communications, Inc**

**LEARNING OBJECTIVES**

1) Understand the various forms of extracranial pathology affecting the arteries serving the brain and their diagnostic appearance/criteria as seen by the ultrasound examination. 2) Be familiar with the indications for a cerebrovascular examination and its relationship to correlative imaging. 3) Know the criteria set forth by the Society of Radiologists in Ultrasound Consensus Conference for internal carotid artery stenosis and their rationale.

**active handout**

http://media.rsna.org/media/abstract/2014/13010314/RC810-a Sec .pdf

**RC810B Vertebral Artery Ultrasound: A Gateway to the Great Vessels**

**Mindy Meislich Horrow MD (Presenter): Spouse, Director, Merck & Co, Inc**

**LEARNING OBJECTIVES**

1) Describe normal anatomy and spectral Doppler of the vertebral arteries. 2) Describe the spectrum of Doppler findings of the subclavian steal phenomenon: pre, partial and complete steal. 3) Detect proximal disease in the innominate vessels and aorta using vertebral artery waveforms in combination with carotid waveforms.

**ABSTRACT**

This lecture will demonstrate normal and variant duplex Doppler imaging of the vertebral artery. It will analyze the anatomy of the vertebral-basilar circulation and how it explains the spectrum of subclavian steal syndrome. It will further demonstrate the combination of findings in vertebral and carotid circulations that indicates brachiocephalic disease.

**RC810C Upper and Lower Extremity Veins**

**Leslie M. Scoutt MD (Presenter): Consultant, Koninklijke Philips NV**

**LEARNING OBJECTIVES**
1) Describe the US criteria for diagnosis of DVT in the upper and lower extremities. 2) Discuss common pitfalls in US evaluation of DVT. 3) Discuss current controversies in the US evaluation of DVT such as: acute vs chronic (residual) DVT; use of the D-dimer assay; should the calf veins be evaluated; is it appropriate to do unilateral exams. 4) Describe the role of US in identifying other causes of extremity pain and swelling.

**ABSTRACT**

This lecture will describe the technique and diagnostic criteria for the US diagnosis of DVT in the upper and lower extremities. Common pitfalls in sonographic assessment of DVT will be described as well as current clinical questions in US evaluation of patients suspected of harboring DVT such as: what is the importance of pre-test probability?, what is the role of the D-dimer assay?, how to differentiate acute from chronic DVT?, and should the calf veins be routinely examined? In addition, the US appearance of other causes of extremity pain and swelling will be described as US has been shown to be useful in making alternative diagnoses, which are often important for patient management, in up to 10% of cases.

**RC811**

**Multi-modal Imaging Workup for Alzheimer's Disease, Parkinson's Disease, and Related Disorders: Case-based Approach**

**Refresher/Informatics**

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Fri, Dec 5 8:30 AM - 10:00 AM  Location: S505A

**Sub-Events**

**RC811A**

**FDG PET-CT Findings in Differential Diagnosis of Dementia**


**LEARNING OBJECTIVES**

1) Principle of FDG-PET imaging of cerebral glucose mechanism. 2) Physiological and pathophysiological background. 3) Methodological aspects of FDG-PET imaging in the brain. 4) Differential diagnosis of non-neurodegenerative disorders leading to cognitive impairment. 5) Differential diagnosis between different forms of neurodegenerative disorders. 6) Combination of FDG-PET with other neuroimaging procedures (multimodal imaging).

**RC811B**

**Amyloid PET Findings in Alzheimer's Disease and Related Disorders**

Nicholaas I. Bohnen MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To discuss methodological aspects of fibrillar beta-amyloid PET imaging. 2) To learn about practical interpretation of fibrillar beta-amyloid PET imaging. 3) To understand the long duration of prodromal phase of amyloidopathy and its importance of correlating it with clinical symptoms when reporting on amyloid PET studies. 4) To review the presence of amyloidopathy in non-Alzheimer dementias. 5) The discuss appropriate use criteria for amyloid PET in clinical practice.

**ABSTRACT**

The recent developments of radioligands that visualize fibrillar B-amyloid offer a novel opportunity to study in vivo amyloid protein aggregation. [C-11]-Pittsburgh compound B (PiB) is a widely used investigational PET AB-amyloid ligand; More recently, amyloid PET has been used increasingly in clinical trials for AD therapeutics. Because the short 20-minute half-life of C-11 limits routine clinical use of PiB as a result of the need for an onsite cyclotron, amyloid-binding radiopharmaceuticals labeled with longer lived fluorine-18, with a 110-minute half-life, were developed and commercialized for wide availability. Several of such F-18 compounds, such as florbetapir, flutemetamol and florbetapen achieved approval by the U.S. Food and Drug Administration. The longer half-life of the F-18 compounds allow also more simplified delayed imaging acquisitions. Image interpretation of fibrillar B-amyloid scan will require reader's expertise to recognize the non-specific pattern of white matter radioligand uptake and to distinguish this form gray matter cortical uptake. Readers should also be aware that the build-up of the amyloid protein in Alzheimer disease may precede the clinical development of dementia with up to 15-20 years (so-called preclinical and prodromal phases). In other words, abnormal amyloid build-up can be seen in otherwise cognitive normal individuals. Therefore, scan interpretation should incorporate information of the clinical setting. Readers should also be familiar with novel definition of Alzheimer disease that now for the first time incorporate the use of imaging biomarkers, such as amyloid PET. Recently, a joint committee of the Society of Nuclear Medicine and the Alzheimers Association developed appropriate use criteria (AUC) to allow more judicious use of this new technology. Alzheimer pathology can also be seen with other dementia, such as dementia with Lewy bodies (DLB). Frontotemporal dementia is not characterized by significant amyloidopathy.
LEARNING OBJECTIVES

1) To describe mechanisms of dopamine transporter SPECT imaging. 2) To explain dopamine transporter SPECT procedure. 3) To discuss dopamine transporter SPECT findings in various movement disorders.

LEARNING OBJECTIVES

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

ABSTRACT

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

LEARNING OBJECTIVES

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

ABSTRACT

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

**RC812C**

Mesenteric Ischemia

Iain Donald Craik Kirkpatrick MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

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

**ABSTRACT**

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

**RC812D**

CTA of Gastrointestinal Bleeding

Jorge A. Soto MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

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

**ABSTRACT**

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

**RC813**

Pediatric: CV/Chest

Refresher/Informatics

<table>
<thead>
<tr>
<th>PD</th>
<th>CA</th>
</tr>
</thead>
</table>

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50
Sub-Events

RC813A  Imaging of CHD in the Neonate
Rajesh Krishnamurthy MD (Presenter): Research support, Koninklijke Philips NV Travel support, Koninklijke Philips NV

LEARNING OBJECTIVES

1) Understand the segmental approach to diagnosis and management of congenital heart disease in the neonate. 2) Highlight appropriateness of MRI and CT with regard to technique, pitfalls, indications and critical imaging findings that affect management for common imaging scenarios in neonatal CHD, including coarctation, aortopathy, congenital pulmonary arterial and venous anomalies, heterotaxy, and neonatal palliation of single ventricle. 3) Provide an opportunity for general radiologists, pediatric radiologists and cardiac imagers who have limited exposure to this area in their workplace an opportunity to refresh their pediatric cardiovascular imaging skills in a focused manner.

RC813B  Pre-operative Imaging of Congenital Heart Disease
Randolph K. Otto MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Understand common pediatric cardiovascular pathophysiology and surgical management, including such conditions as aortic coarctation, intra and extra-cardiac shunts, pulmonary arterial and venous anomalies, management of single ventricle, and anomalous coronary arteries. 2) Strengths and weaknesses of CT and MRI, highlighting specific techniques and problem-solving approaches. 3) Demonstrate various techniques for cardiovascular data acquisition, post-processing, analysis, and reporting in order to anticipate and address surgical concerns.

RC813C  Monitoring of Repaired Congenital Heart Disease
J. A. Gordon Culham MD (Presenter): Advisor, MedVoxel System Inc Stockholder, MedVoxel System Inc

LEARNING OBJECTIVES

1) Understand the imaging of residual structural and functional abnormalities that occur after the repair of Congenital Heart Disease. Tetralogy of Fallot and Transposition of the Great Arteries will be emphasized.

Mammographic Interpretation

Refresher/Informatics

RC815

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

RC815A  Analysis of Asymmetries and Distortions
Jessica Wai Ting Leung MD (Presenter): Speakers Bureau, Hologic, Inc Scientific Advisory Board, Hologic, Inc

LEARNING OBJECTIVES

1) Learn the definitions and types of asymmetries and architectural distortion identified at mammography. 2) Understand the imaging evaluation and clinical significance of asymmetries and architectural distortion identified at mammography. 3) Know the pathology correlation of asymmetries and architectural distortion identified at mammography.

ABSTRACT

Asymmetries and architectural distortion are challenging signs of malignancy at mammography.

RC815B  Evaluation of Calcification
LEARNING OBJECTIVES

1) Distinguish major differences between typically malignant and typically benign calcifications on the mammogram. 2) Recognize the appearance of calcifications considered indeterminate in nature on mammography. 3) Develop strategies for followup and management of suspicious calcifications, including the role of other imaging modalities.

ABSTRACT

Calcifications on the mammogram are often the only clue to the presence of malignancy. The appearance of typically benign and malignant calcifications will be reviewed, as well as emerging concepts surrounding those associated with high grade and low grade malignancy, and the importance of distinguishing between these for further treatment and outcomes. Imaging techniques to maximize visualization of calcifications on the mammogram will be outlined. The evolving role of other imaging modalities in the followup and management of suspicious calcifications will also be discussed.

LEARNING OBJECTIVES

1) Define 'high-risk lesions'. 2) Present several of the most common high-risk lesions. 3) Discuss management of the entities presented.

ABSTRACT

The so-called 'high-risk lesions' occupy a gray-zone between benign and malignant diagnoses. They continue to merit discussion as their management can sometimes be confusing and institution-dependent. Adding to this confusion is the occasional addition to or name change among the existing pathological entities. In this session, we will present and discuss several of the most common 'high-risk' lesions and their management.

LEARNING OBJECTIVES

1) Understand the rationale for and growing value of increased personalization of patient interactions in diagnostic radiology. 2) Communicate patient-centered radiology principles to residents and other colleagues. 3) Identify different avenues, including traditional, digital and social media, to engage our patients.

ABSTRACT

Modern medicine has become so complicated and sub-specialized that patients and their families often are confused. Frequently patients are not even aware that a radiologist is providing important services or the nature of those services. Increasingly, patients are turning to the Internet for answers. In the current era of consumer-driven healthcare, patient portals, online health resources and social media, radiologists must provide personal and patient-friendly services and use a variety of means to connect with patients. This course will provide specific examples and strategies for harnessing the power of the Internet and social media to become more patient centered.
Participants
Moderator
Heike E. Daldrup-Link MD: Nothing to Disclose

Sub-Events

RC817A  Hyperpolarized 13C MR—A Complementary Method to PET for Imaging in Vivo Metabolism
Daniel Mark Spielman PhD (Presenter): Nothing to Disclose

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 though obtained with PET. 3) Compare PET versus hyperpolarized 13C MRS sensitivities, spatial resolution, and temporal resolution.

RC817B  PET/MR: Applications in Clinical Imaging
Karin Anna Herrmann MD (Presenter): Consultant, Koninklijke Philips NV

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.

RC817C  The Emerging Clinical Role of Hyperpolarized 13C MR in Prostate Cancer Imaging
John Kurhanewicz PhD (Presenter): Nothing to Disclose

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.

RC818  Interactive Game: Interactive Quiz Cases in Neuro-oncologic Imaging

Refresher/Informatics

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

Sub-Events

RC818A  Spine
James C. Anderson MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Review imaging of tumors of the spine. 2) Identify aspects of spinal tumors that affect staging, treatment and management 3) Highlight roles of various imaging modalities.

ABSTRACT
Review imaging of tumors of the spine
Review aspects of spinal tumors that affect staging, treatment and management
Review roles of various imaging modalities
**RC818B**  
**Head and Neck/ENT**  
Suresh K. Mukherji MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review common head and neck tumors. 2) Identify pertinent imaging findings that show how imaging affects staging. 3) Highlight specific imaging findings that will affect staging, treatment and management.

**ABSTRACT**

Review common tumors of the head and neck. Review imaging findings in head and neck malignancies that specifically change staging. Review the value of imaging in directly affecting management and treatment.

---

**RC818C**  
**Brain**  
Megan Kay Strother MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Identify basic anatomic, pathologic, and physiologic principles as they apply to neuro-oncologic imaging of the brain.

**ABSTRACT**

Five interactive neuro-oncologic cases will be presented in an interactive format. Participants will review basic knowledge and skills that are relevant to the clinical practice of neuroradiology, while evaluating the results of the latest research in neuro-oncologic imaging.

---

**RC821**  
**Medical Physics 2.0: Computed Tomography**  
*Refresher/Informatics*

**LEARNING OBJECTIVES**

1) To understand the current recommendations for computed tomography testing and quality control. 2) To understand impact of accreditation and regulation on CT quality assurance. 3) To understand current dosimetry and dose-reporting considerations.

**ABSTRACT**

Many organizations have contributed to the methodology for testing computed tomography scanners. These have included state regulatory agencies, the Food and Drug Administration, the American Association of Physicists in Medicine, and the American College of Radiology, among many other groups and individuals. These contributions have included many good ideas, but also much confusion as to what is required. Further, the complexity of modern CT scanners has rendered some tests obsolete or difficult to implement. This presentation focuses mainly on the testing delineated by the 2012 American College of Radiology Computed Tomography Quality Control Manual and that required under the Intersocietal Accreditation Commission. Recommended and required tests will be identified but not described in detail.

**Active Handout**


**Sub-Events**

**RC821A**  
**Computed Tomography Perspective**  
Mahadevappa Mahesh MS, PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To reflect on MDCT technology enabling volumetric data acquisition. 2) To evaluate new innovations enabling dose reductions in CT.

**ABSTRACT**

This talk will provide brief overview on the innovations that has led to the development of CT technology (single slice (SDCT) to multiple slices (MDCT)). Past decade saw the rapid evolution in the capability to obtain multiple slices per gantry rotation (4-320 slices). Having achieved the capability to acquire volumetric data (covering entire cardiac anatomy in half of gantry rotation), the race is currently towards acquiring CT images at optimal radiation dose. Volume CT, dual energy CT, Iterative reconstruction, quantitation are some of the new challenges that will be discussed in this talk. 1. CT Technology 1a. MDCT detector configuration 1b. Volume CT -
Wide detector and dual source CT 2. New Challenges 2a. Iterative reconstruction 2b. Dual energy 2c. Dose check

**RC821B**

**Computed Tomography 1.0**

Douglas E. Pfeiffer MS (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) To understand the current recommendations for computed tomography testing and quality control. 2) To understand impact of accreditation and regulation on CT quality assurance. 3) To understand current dosimetry and dose-reporting considerations.

**ABSTRACT**

Many organizations have contributed to the methodology for testing computed tomography scanners. These have included state regulatory agencies, the Food and Drug Administration, the American Association of Physicists in Medicine, and the American College of Radiology, among many other groups and individuals. These contributions have included many good ideas, but also much confusion as to what is required. Further, the complexity of modern CT scanners has rendered some tests obsolete or difficult to implement. This presentation focuses mainly on the testing delineated by the 2012 American College of Radiology Computed Tomography Quality Control Manual and that required under the Intersocietal Accreditation Commission. Recommended and required tests will be identified but not described in detail.

**RC821C**

**Computed Tomography 2.0**

Ehsan Samei PhD (Presenter): Research Grant, Siemens AG Research Grant, General Electric Company Research Grant, Carestream Health, Inc

**LEARNING OBJECTIVES**

1) To become familiar with the major new developments of physics support for clinical CT operations. 2) To understand the need and the definitions of the new CT performance metrics for dose and quality. 3) To understand the testing implications of new CT technologies. 4) To understand the need for operational optimization of CT systems.

**RC823**

**Minicourse: Current Topics in Medical Physics—Clinically Focused Physics Education: Principles to Practice**

**Refresher/Informatics**

<table>
<thead>
<tr>
<th>ED</th>
<th>PH</th>
<th>ED</th>
<th>PH</th>
<th>ED</th>
<th>PH</th>
</tr>
</thead>
</table>

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Fri, Dec 5 8:30 AM - 10:00 AM  Location: S403B

**Participants**

Moderator
Perry Sprawls PhD : Author, Koninklijke Philips NV

**LEARNING OBJECTIVES**

1) Describe the general characteristics of mental knowledge structures for medical imaging procedures that are required for effective clinical applications. 2) Describe activities that contribute to the formation of effective knowledge structures. 3) Identify the different levels of learning and relate them to specific actions that can be performed and potential outcomes. 4) Analyze learning activities for effectiveness and efficiency in producing desired outcomes with available human effort and resources. 5) Identify digital resources that can be used to enhance human performance for both learners and learning facilitators. 6) Integrate physics education into clinical image interpretation sessions. 7) Teach physics concepts in the context of optimizing radiation dose and quality in CT.

**URL’s**

http://www.sprawls.org/clinphys

**Active Handout**


**Sub-Events**

**RC823A**

**Clinically Focused Physics Education: Principles to Practice—Part A**

Perry Sprawls PhD (Presenter): Author, Koninklijke Philips NV

**LEARNING OBJECTIVES**
View learning objectives under the main course title.

**URL's**

http://www.sprawls.org/clinphys

---

**RC823B**

Clinically Focused Physics Education: Principles to Practice—Part B

Phuong-Anh Thi Duong MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under the main course title.

**URL's**

http://www.sprawls.org/clinphys/

---

**RC824**

Publishing in Radiology: What You Always Wanted to Know and Never Asked

*Refresher/Informatics*

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credit: 0
Fri, Dec 5 8:30 AM - 10:00 AM Location: E353A

**Participants**

Moderator
Herbert Y. Kressel MD: Royalties, Bayer AG

Deborah Levine MD (Presenter): Editor with royalties, UpToDate, Inc Editor with royalties, Amirsys, Inc Editor with royalties, Reed Elsevier

Alexander A. Bankier MD, PhD (Presenter): Author with royalties, Reed Elsevier Consultant, Olympus Corporation

Elkan F. Halpern PhD (Presenter): Research Consultant, Hologic, Inc

David F. Kallmes MD (Presenter): Research support, Terumo Corporation Research support, Covidien AG Research support, Sequent Medical, Inc Research support, Benvenue Medical, Inc Consultant, General Electric Company Consultant, Covidien AG Consultant, Johnson & Johnson

**LEARNING OBJECTIVES**

1) Understand on what a manuscript submitted to RADIOLOGY is judged during the review and decision process. 2) Understand why it is important to clearly represent research results so that all parts of the written manuscript clearly reflect the research question. 3) Understand how to organize the inner logic of a manuscript submitted to RADIOLOGY. 4) Illustrate how graphs and charts can be best utilized to appropriately illustrate your results. 5) Understand the common statistical errors in manuscripts and how they can be avoided.

**ABSTRACT**

More than 2000 manuscripts per year are submitted to RADIOLOGY. Despite their variety in their subject matter and content, many manuscripts share common problems in the research design, description, and style which need improvement. The Publication Information for Authors is available on-line at http://pubs.rsna.org/page/radiology/pia. This provides a basic set of guidelines for manuscript preparation and submission. This presentation will complement and extend beyond these guidelines by further illustrating points from the Publication Information for Authors with realistic examples and tangible scenarios based on our experience with the submission, review, and decision making process. The Editor, three Deputy Editors, and statistician of RADIOLOGY will provide practical tips as well as Do's and Don'ts for preparing the major elements of a RADIOLOGY manuscript. In addition, we will discuss the most common statistical problems we encounter in reviewing manuscripts, and discuss the issue of why many published research results turn out to be incorrect. At the end of the session, the registrants will gain an enhanced understanding of the required elements of an original submission, and have a better understanding of common author pitfalls encountered during manuscript review and the editorial process.

**URL's**

http://pubs.rsna.org/page/radiology/pia

---

**RC825**

Quantitative Imaging: Dynamic Contrast Enhanced MRI (DCE-MRI)

*Refresher/Informatics*

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Fri, Dec 5 8:30 AM - 10:00 AM Location: N226
The Physical Principles and Challenges of Dynamic Contrast Enhanced MRI Applications

Edward F. Jackson PhD (Presenter): Nothing to Disclose

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

Clinical Applications of Quantitative DCE-MRI

Michael Vinzenz Knopp MD, PhD (Presenter): Nothing to Disclose

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-qualitative 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.

Oncologic Applications of Quantitative DCE-MRI

Anwar Roshanali Padhani MD (Presenter): Advisory Board, Acuitas Medical Ltd Advisory Board, Siemens AG Speakers Bureau, Siemens AG Researcher, Siemens AG Speakers Bureau, Johnson & Johnson

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 realize 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.

RC827

Value: What Is It, and What Does It Mean for Radiology?

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Fri, Dec 5 8:30 AM - 10:00 AM Location: S502AB

Participants

Moderator
Saurabh Jha MD: Speaker, Toshiba Corporation
Richard Glenn Abramson MD (Presenter): Consultant, ICON plc Board Member, Partners in the Imaging Enterprise LLC

LEARNING OBJECTIVES

1) Understand the difference between uncertainty and risk. 2) Articulate how radiological exams transform uncertainty into risk. 3) Assess the value of converting uncertainty into risk. 4) Apply the techniques discussed to existing and hypothetical radiological exams.

ABSTRACT

How can we put price tags on radiological exams? Many radiological exams serve the purpose of converting uncertainty about a patient’s status into defined risk. When something is uncertain, we both do not know what will happen next and do not know the distribution of possible outcomes. In contrast, with risk, we still do not know what will happen next, but do know the distribution of possible outcomes. This presentation discusses how radiological exams convert uncertainty into risk, and how we can assess the value of the conversion. It concludes by demonstrating how the techniques discussed can be applied to put price tags on both radiological exams that exist today and hypothetical exams that could be invented in the future.

RC829

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

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Fri, Dec 5 8:30 AM - 10:00 AM Location: E353B

Participants

Jeffrey C. Weinreb MD (Presenter): Nothing to Disclose
Emanuel Kanal MD (Presenter): Consultant, Boston Scientific Corporation Consultant, Medtronic, Inc Consultant, St. Jude Medical, Inc Consultant, Bayer AG Investigator, Bracco Group Royalties, Guerbet SA

LEARNING OBJECTIVES

1) Analyze the cause and avoidance of a spectrum of common MR safety issues, including burns. 2) Assess the most current information about the development of NSF (nephrogenic systemic fibrosis) and the possibility of other chronic conditions following GBCA administration. 3) Compare indications and contraindications for MRI on patients with pacemakers, neurostimulators, and other devices with wires or leads. 4) List the factors (including regulation and guidelines) which should be evaluated in order to determine the safety of MRI in patients with implants, devices, or foreign objects.

ABSTRACT

The major potential safety considerations in magnetic resonance imaging relate to those stemming from the static magnetic field, the time varying radiofrequency oscillating magnetic fields, the time varying switched gradient magnetic fields, the contrast agents often utilized in the MR imaging process, sedation/anesthesia and monitoring-related issues unique to the MR imaging environment, and cryogen related potential safety concerns. These can present confounding situations for MR practitioners faced with questions relating to the safety of exposing particular patients and devices, implants, or foreign bodies to MR imaging examinations. This session will introduce and briefly explain the above safety considerations, and highlight specific issues likely to confront MR practitioners in their daily practice by utilizing real-life examples. The methodology and reasoning process used to approach these clinical examples in determining risk-benefit ratios for accepting or rejecting such patients from MR exposure will be stressed. The emphasis will be on not so much the particular examples used, but rather having the attendee feeling more comfortable with the approach to such clinical and research situations in order to better enable them to appropriately address such questions in their own daily practice routines. Audience polling and interaction will be actively utilized throughout this session. This will help enable the attendee to not only hear the opinions of the presenters on the cases being discussed, but also to assess their own responses to the questions being posed relative to that of the other attendees of this session.
Workshop)

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Fri, Dec 5 8:30 AM - 10:00 AM   Location: E263

Participants

A. Orlando Ortiz MD, MBA (Presenter): Nothing to Disclose
Bassem Adeeb Georgy MD, MSc (Presenter): Consultant, Johnson & Johnson Consultant, DFINE, Inc Medical Advisory Board, SpineAlign Medical, Inc Stockholder, DFINE, Inc Stockholder, SpineAlign Medical, Inc Stockholder, Spine Solutions, Inc
Alan L. Brook MD (Presenter): Advisor, Johnson & Johnson Advisor, Medtronic, Inc
Afshin Gangi MD, PhD (Presenter): Proctor, Galil Medical Ltd
Todd Stuart Miller MD (Presenter): Nothing to Disclose
Stanley Golovac MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Describe and demonstrate methods for patient selection, evaluation and technique for Image-guided injection procedures used in spine pain management. 2) These procedures will include epidural steroid injections, nerve root blocks, facet blocks, sacroiliac joint injections, lumbar synovial cyst therapy, radiofrequency ablations. 3) Review procedural complications and how to avoid them. 4) Discuss pertinent anatomy, instruments and pharmacology. 5) These objectives will be accomplished using didactic lectures complemented by procedure videos, supervised hands on lab work with training models and round table case discussions.

ABSTRACT

Neck and back pain complaints are very common in the general population. Radiologists can contribute to the diagnosis and management in patients who are not responding to conservative management. Spine injection procedures can frequently be performed on an outpatient basis with a brief recovery phase. These procedures are performed with imaging guidance, such as a multi-directional fluoroscope or under CT guidance, in order to correctly localize the specific anatomic sites in or about the spine for diagnostic and or therapeutic needle localization. An understanding of patient selection, indications and contraindications, are paramount to the safety and success of these procedures. The diagnostic and therapeutic potential of these procedures is also facilitated by a thorough evaluation of the spine, with respect to both anatomy and potential pathology, with cross sectional imaging techniques as well as other radiologic tests. Communication of these results between the Radiologist and the spine proceduralist will contribute to optimal patient outcomes.

RC832

Aligning Incentives Along the Imaging Value Chain

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Fri, Dec 5 8:30 AM - 10:00 AM   Location: E261

Participants

Geraldine B. McGinty MD (Presenter): Nothing to Disclose
Richard Duszak MD (Presenter): Nothing to Disclose
Giles W. Boland MD (Presenter): Principal, Radiology Consulting Group Royalties, Reed Elsevier

LEARNING OBJECTIVES

1) To understand value-focused healthcare imperatives in the evolution of healthcare delivery systems and how they impact medical imaging. 2) To implement practice changes aligned with Imaging 3.0 so as to maximize the relevance of radiology and radiologists in ongoing health system changes. 3) To improve the delivery of imaging care by focusing on value chain opportunities. (This course is part of the Leadership Track)

ABSTRACT

Although radiology’s dramatic evolution over the last century has profoundly affected patient care for the better, our current system is fragmented with many providers focusing more on technology and physician needs rather than what really matters to patients: better value and outcomes. This latter dynamic is aligned with current national health care reform initiatives and creates both challenges and opportunities for radiologists to find ways to deliver new value for patients. The American College of Radiology has responded to this challenge with the introduction of Imaging 3.0, which represents a call to action to all radiologists to assume leadership roles in shaping America’s future health care system through 5 key pillars: imaging appropriateness, quality, safety, efficiency, and satisfaction. That enhanced value will require modulation of imaging work processes best understood through the concept of the imaging value chain, which will be the focus of this course.

RC850

Fallopian Tube Catheterization (Hands-on Workshop)

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Fri, Dec 5 8:30 AM - 10:00 AM   Location: E260
LEARNING OBJECTIVES

1) Obtain hands-on experience with fallopian tube catheterization using uterine models and commercially available catheters and guidewires. 2) Review the evolution of interventions in the fallopian tubes. 3) Learn safe techniques for fallopian tube recanalization for promoting fertility, and fallopian tube occlusion for preventing pregnancy. 4) Discuss the outcomes regarding pregnancy rate and complications. 5) Appreciate ways to improve referrals from the fertility specialists and expand your practice.

ABSTRACT

Fallopian tube catheterization using fluoroscopic guidance is a relatively easy, inexpensive technique within the capabilities of residency trained radiologists. Fallopian tube catheterization can be used to dislodge debris from the tube in women with infertility, or to place FDA-approved tubal occlusion devices in women who do not desire fertility. The fallopian tube is the 1 mm gateway between the egg and the sperm. Noninvasive access to this structure for promoting, and preventing, pregnancy has been sought for over 160 years. This hands-on course allows participants use commercially available catheters and devices in plastic models for fallopian tube catheterization, and to speak directly to world experts about this exciting procedure.

RC851

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

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Fri, Dec 5 8:30 AM - 10:00 AM Location: E450B

Sub-Events

RC851A  CT/PET: Metabolic Assessment in Reporting
Eric Michael Rohren MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

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

RC851B  Artifacts/Pitfalls/Incidentals
Terence Zekon Wong MD, PhD (Presenter): Advisory Board, Eli Lilly and Company Consultant, Koninklijke Philips NV Advisory Board, Bayer AG

LEARNING OBJECTIVES

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

ABSTRACT

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

RC851C  Select Issues in Abdominal and Pelvic CT/PET
Andrea Grace Rockall MRCP, FRCR (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

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

**RC852**

**Real-time Interventional US (Hands-on Workshop)**

*Refresher/Informatics*

**Participants**

Christopher Allen Molvar MD (Presenter): Nothing to Disclose
Kent T. Sato MD (Presenter): Nothing to Disclose
Robert A. Nemcek MD (Presenter): Consultant, B. Braun Melsungen AG
Robert J. Lewandowski MD (Presenter): Advisory Board, Nordion, Inc Advisory Board, BTG International Ltd Advisory Board, Boston Scientific Corporation Consultant, Cook Group Incorporated
Ramona Gupta MD (Presenter): Nothing to Disclose
Terry David Wilkin MD (Presenter): Nothing to Disclose
Kevin Lee Keele MD (Presenter): Nothing to Disclose
Robert J. Lewandowski MD (Presenter): Nothing to Disclose
Albert A. Nemcek MD (Presenter): Consultant, Cook Group Incorporated
Robert J. Lewandowski MD (Presenter): Nothing to Disclose
Ramona Gupta MD (Presenter): Nothing to Disclose
Terry David Wilkin MD (Presenter): Nothing to Disclose
Kevin Lee Keele MD (Presenter): Nothing to Disclose
Robert J. Lewandowski MD (Presenter): Nothing to Disclose
Albert A. Nemcek MD (Presenter): Consultant, Cook Group Incorporated
Robert J. Lewandowski MD (Presenter): Nothing to Disclose
Ramona Gupta MD (Presenter): Nothing to Disclose
Terry David Wilkin MD (Presenter): Nothing to Disclose
Kevin Lee Keele MD (Presenter): Nothing to Disclose
Robert J. Lewandowski MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Acquire the skill to direct a needle to a target for diagnostic or therapeutic purposes with Real-time US-guidance.

**ABSTRACT**

Participants will have the opportunity to hone their skills in ultrasound guided interventions using phantoms. Experienced practitioners in ultrasound guided intervention will serve as faculty.

**RC854**

**Health IT Tools to Improve Quality and Safety in Radiology (An Interactive Session)**

*Refresher/Informatics*

**Participants**

Moderator
Kevin W. McEnery MD: Advisor, Koninklijke Philips NV

**LEARNING OBJECTIVES**

1) Describe a practical framework for measuring quality and value in radiology to help drive performance improvement initiatives. 2) Using case example, describe how measuring quality and value can improve performance and sustain change inside the radiology department. 3) Using case example, describe how measuring quality and value can improve performance and sustain change across the healthcare enterprise. 4) Panelists will discuss how radiology practices can practically begin to introduce measurements of quality and value and use such measurements to drive and sustain needed change.

**Sub-Events**

**RC854A**

**Measuring Quality in Radiology, A Practical Framework**

Jennifer Willmann Siegelman MD, MPH (Presenter): Consultant, Bayer AG

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**RC854B**

**Using Quality Metrics to Drive Change and Improve Quality in Diagnostic Radiology: Case Example**

Paul G. Nagy PhD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**
**RC854C**

**Using Quality Metrics to Drive Change and Improve Quality Across the Enterprise**

Kevin W. McEnery MD (Presenter): Advisor, Koninklijke Philips NV

**LEARNING OBJECTIVES**

View learning objectives under main course title.

---

**RCA61**

**National Library of Medicine: Save Searches, Get Updates: The Free PubMed My NCBI Tool (Hands-on)**

*Refreshers/Informatics*

- AMA PRA Category 1 Credits ™: 1.50
- ARRT Category A+ Credits: 1.50

Fri, Dec 5 8:30 AM - 10:00 AM  Location: S401AB

**Participants**

- Holly Ann Burt MLIS (Presenter): Nothing to Disclose
- Patricia Devine MLS (Presenter): Nothing to Disclose
- Jamie T. Dwyer MLS (Presenter): Nothing to Disclose
- Stephanie Friree MLIS (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Use My NCBI to personalize PubMed. 2) Understand how to save search strategies and create email alerts. 3) Use filters to link to library full-text articles and to focus PubMed searches. 4) Understand how to save collections of citations including a personal bibliography.

**ABSTRACT**

In this hands-on workshop session, explore the free My NCBI tool in PubMed. Discover how to save search strategies, create email alerts to keep up with the latest publications, create instant links to library full-text resources, and build permanent online bibliographies. Topics covered include creating a free My NCBI account, adding search and library filters to PubMed, using My Bibliography to create an online list of personal publications, and the link between the NIH Manuscript Submission System and PubMed. Important notes on PubMed searching will also be included. The National Library of Medicine (NLM) provides free web access to nearly 24 million citations for biomedical and clinical medical articles through PubMed (available online at PubMed.gov); MEDLINE is a subset of PubMed.

**URL's**

http://nnlm.gov/training/resources/myncbi8.pdf

Handout:Holly Ann Burt


---

**RCC61**

**Optimizing PowerPoint Slides**

*Refreshers/Informatics*

- AMA PRA Category 1 Credits ™: 1.50
- ARRT Category A+ Credits: 1.50

Fri, Dec 5 8:30 AM - 10:00 AM  Location: S501ABC

**Participants**

- William J. Weadock MD (Presenter): Owner, Weadock Software, LLC
- Sarah C. Abate BS (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review the components of an optimal slide presentation. 2) Learn about common errors made in slide preparation and how they can be avoided. 3) Learn about how to improve the quality of a presentation by using optimal different slide backgrounds, font size and color, and image sizes. 4) Learn tips to ensure a smooth presentation.

**ABSTRACT**

Electronic presentations are very common in radiology practice. This hands-on demonstration and questions and answer session will show attendees how to optimize their presentations. The focus will be on the use of slide templates, color selection (font
Interventional Series: Venous Disease

Series Courses

**VSIR61**

**Interventional Series: Venous Disease**

**Series Courses**

- **AMA PRA Category 1 Credits ™:** 3.25
- **ARRT Category A+ Credits:** 3.75
- **Fri, Dec 5 8:30 AM - 12:00 PM  Location: N228**

**Participants**

**Moderator**
Jonathan Matthew Lorenz MD : Nothing to Disclose

**LEARNING OBJECTIVES**

1) Describe the use of unconventional access in central venous occlusion. 2) Describe 2 techniques used to treat mesenteric venous thrombosis. 3) Describe the rationale for balloon retrograde transvenous occlusion (BRTO). 4) List 2 important studies in venous disease.

**Sub-Events**

**VSIR61-01 Unconventional Access—When, Why, How?**
Charles Thomas Burke MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**VSIR61-03 Implantation of Irradiation Stent Combined with TACE for Treatment of Malignant IVC Obstruction Caused by Hepatic Malignant Tumor**
Qing Hui Yang (Presenter): Nothing to Disclose, Jianjun Luo PhD : Nothing to Disclose, Zhiping Yan : Nothing to Disclose, Qin Xin Liu : Nothing to Disclose, Wen Zhang : Nothing to Disclose, Guang Zhi Wang PhD, MD : Nothing to Disclose

**PURPOSE**

To investigate the safety and efficacy of implantation of self-expanding metal stent loaded with I-125:seeds strands combined with transarterial chemoembolization (TACE) for treatment of patients with malignant inferior vena cava (IVC) obstruction caused by hepatic malignant tumor.

**METHOD AND MATERIALS**

From July 2008 to June 2013, the data of 97 patients with malignant IVC obstruction caused by hepatic malignant tumor were retrospectively analyzed. Self-expanding metal stent loaded with I-125 seeds strands was implanted in the obstructive segment of IVC and hepatic lesion was treated by TACE In all patients. The relief rate of symptom related to IVC obstruction, stent patency, overall survival and prognostic factors were analyzed.

**RESULTS**

The technical success rate of irradiation stent implantation was 100%. The patency rate of IVC stents was 98%. The relief rate of syndrome related to IVC obstruction was 98%. During a range of 2-36 months follow-up, the mean and median survival time were 277.6 ± 251.4 days and 203.0 ± 251.3 days, respectively.

**CONCLUSION**

Implantation of self-expanding metal stent loaded with I-125 seeds strands combined with TACE was safe feasible and effective in the treatment of patients with malignant IVC obstruction caused by hepatic malignant tumor.

**CLINICAL RELEVANCE/APPLICATION**

Implantation of self-expanding metal stent loaded with 125I seeds strands combined with TACE is a new therapy model for patients with malignant IVC obstruction caused by hepatic malignant tumor.

**VSIR61-04 Low Energy Endovenous Laser Ablation of Incompetent Saphenous Veins With a 1470-nm Diode Laser and Results of 2-year Follow-up**
Jung Ah Park (Presenter): Nothing to Disclose, Sang Wook Park DDS : Nothing to Disclose, Il Soo Chang : Nothing to Disclose

**PURPOSE**

To demonstrate the 2-year outcomes after low energy endovenous laser ablation (EVLA) of incompetent
METHOD AND MATERIALS

Between January 2011 and July 2013, 236 patients (335 limbs) were treated by EVLA using a 1470-nm laser with LEED of ≤80 J/cm for incompetent saphenous vein under ultrasound- and fluoroscopy-guidance. Patients were evaluated clinically and with duplex ultrasound at 1 week and 1, 3, 6 months, 1 year and 2 years after EVLA for the technical and clinical success and complication rate.

RESULTS

In the 335 limbs, the technical success rate was 100%. The GSV remained occluded in all of 229 limbs (100%) after 1 week, 202 of 203 limbs (99.5%) after 1 month, 157 of 158 limbs after 3 months (99.3%), all of 99 limbs after 6 months (100%), all of 41 limbs after 1 year, and all of 5 limbs after 2 years. The SSV remained occluded in all of 103 limbs (100%) after 1 week, all of 94 limbs (100%) after 1 month, 68 of 69 limbs (98.5%) after 3 months, 40 of 41 limbs (97.5%) after 6 months, and all of 14 limbs after 1 year (100%). Two GSVs and two SSVs were recanalized and they underwent repeated EVLA. No major complication occurred although bruising (21%), pain (15%) and paresthesia (4%) were observed.

CONCLUSION

In the 335 limbs, the technical success rate was 100%. The GSV remained occluded in all of 229 limbs (100%) after 1 week, 202 of 203 limbs (99.5%) after 1 month, 157 of 158 limbs after 3 months (99.3%), all of 99 limbs after 6 months (100%), all of 41 limbs after 1 year, and all of 5 limbs after 2 years. The SSV remained occluded in all of 103 limbs (100%) after 1 week, all of 94 limbs (100%) after 1 month, 68 of 69 limbs (98.5%) after 3 months, 40 of 41 limbs (97.5%) after 6 months, and all of 14 limbs after 1 year (100%). Two GSVs and two SSVs were recanalized and they underwent repeated EVLA. No major complication occurred although bruising (21%), pain (15%) and paresthesia (4%) were observed.

CLINICAL RELEVANCE/APPLICATION

Low energy EVLA using 1470-nm laser with LEED of ≤80 J/cm is an effective, safe, and technically successful option for treating incompetent saphenous veins. Especially, complications like bruising, postprocedural pain, and paresthesia may occur less commonly.

VSIR61-05
Balloon-occluded Retrograde Transvenous Obliteration—What Is It and When Should It Be Done

Wael E. A. Saad MBCh (Presenter): Research Grant, Siemens AG Research Consultant, Siemens AG Consultant, Boston Scientific Corporation Consultant, Getinge AB Consultant, Merit Medical Systems, Inc

LEARNING OBJECTIVES

1) The attendees will understand the indication and contraindications of BRTO. 2) The attendees will understand the concept and basic techniques of BRTO. 3) The attendees will understand how to work-up a potential BRTO. 4) The attendees will understand how to follow-up (imaging and clinically) a patient after BRTO.

ABSTRACT

Abstract: Balloon-occluded retrograde Transvenous obliteration (BRTO) of gastric varices is an evolving procedure in the United States. It is recognized by the ACR appropriateness criteria expert committee as a ‘viable alternative to Transjugular Intra hepatic PortoSystemic Shunts (TIPS)’ in certain anatomical and clinical scenarios. BRTO is a procedure that involves the cathether selection of a gastrorenal shunt (a common hemodynamic and association with gastric varices) from the left rebel vein. This is followed by balloon occlusion of the shunt and sclerosis administration. The sclerosant administration is performed with the intent if filling / sclerosis of the gastrorenal shunt and the gastric varices. The indication of treating gastric varices utilizing BRTO vs. TIPS vs. both is still unclear and requires additional research. The course will address these indications, contraindications and potential combination therapies.

VSIR61-06
5 Papers in 10 Minutes: Important Studies in Venous Disease that Everyone Should Know

Jonathan Matthew Lorenz MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIR61-07
Balloon-Occluded Retrograde Transvenous Obliteration of Gastric Varices with Short Dwell Time of Sclerosant: Results from a Single Center

Clayton W. Commander MD, PhD (Presenter): Nothing to Disclose, Hyeon Yu MD: Nothing to Disclose, Ari Joel Isaacson MD: Nothing to Disclose, Matthew A. Mauro MD: Nothing to Disclose

PURPOSE

To retrospectively evaluate the efficacy and safety of balloon-occluded retrograde transvenous obliteration (BRTO) with sclerosant (balloon) dwell times of less than or equal to one hour in patients with gastric varices.

METHOD AND MATERIALS

saphenous veins with a 1470-nm diode laser
The study comprised 22 patients (12 male; 10 female; mean age 58 years; age range 21-89 years) who underwent a total of 23 BRTO procedures for treatment of bleeding gastric varices at a single institution from August 2007-November 2013. For all patients, the procedure was performed using 3% sodium tetradecyl sulfate mixed with ethiodized oil and air in a 2:1:3 ratio. The maximum dwell time of the sclerosant mixture was 60 minutes. All cases were reviewed using imaging and clinical data available in the medical record as well as by telephone interview.

RESULTS
The mean dwell time of the sclerosant mixture for all patients was 32.7 minutes (range 5-60 min). In 10 patients, additional embolization was performed with coils (n=9) or Amplatzer plugs (n=1), while 12 patients had no additional embolization. The mean sclerosant dwell time in patients with additional embolization was 30 minutes (range 5 - 50 min). Of the 22 patients, 7 were lost to follow-up. The mean period of follow-up was 15.6 months (range 0.1-48 months). Of the 15 remaining patients, 14 (93%) experienced no rebleeding from the treated gastric varices. One patient underwent repeat BRTO procedure due to recurrent variceal bleeding 6 days after initial BRTO. One patient experienced bleeding from esophageal varices after undergoing BRTO. Eight patients underwent follow-up endoscopy and were noted to have significantly improved or no evidence of gastric varices.

CONCLUSION
Our preliminary results suggest that BRTO can be safely performed with sclerosant (balloon) dwell times of less than or equal to one hour with outcomes similar to those reported with longer dwell times.

CLINICAL RELEVANCE/APPLICATION
BRTO can be safely performed with sclerosant (balloon) dwell times of less than or equal to one hour.

VSIR61-08
Safety and Feasibility of Primary Placement of a Constrained Transjugular Intrahepatic Portosystemic Shunt (TIPS)

Erik Maki MD (Presenter): Nothing to Disclose , Ryan Carl Schenning MD : Nothing to Disclose , Daniel Horner : Nothing to Disclose , Khashayar Farsad MD, PhD : Nothing to Disclose

PURPOSE
A clinically significant complication of a transjugular intrahepatic portosystemic shunt (TIPS) is hepatic encephalopathy (HE), which in medically refractory cases requires secondary constraining techniques. We examined the safety and feasibility of creating a primarily constrained TIPS which can then be dilated as needed to create a larger shunt.

METHOD AND MATERIALS
50 cases of primarily constrained elective TIPS at a single institution were retrospectively reviewed. The primary indication for TIPS creation was medically-refractory ascites or recurrent variceal bleeding. After transjugular portal venous access was achieved, a balloon-expandable stent was deployed in the parenchymal tract as an external constraining device. A Gore-Viatorr stent graft was then deployed within the constraining stent, and the stents were balloon dilated to achieve the desired portosystemic gradient. Retrospective chart review was performed to assess safety and feasibility of the procedure.

RESULTS
Technical success was 100%. Symptom resolution occurred in 43(86%) of patients during a mean follow up period of 9.3 months. 13(26%) of patients underwent revision of 9.3 (14%) of their constrained TIPS. Of these, 10(77%) had early dilation of the constraining stent for symptom recurrence and 1(8%) required only restriction for HE. 2(15%) underwent initial dilation for symptom recurrence but then needed restriction for HE. One patient ultimately required shunt occlusion for HE. Stent thrombosis occurred in 4(8%) of patients. There was one post-procedure complication from transfusion of blood products.

CONCLUSION
Primarily constrained TIPS creation is safe and feasible. This technique improves control of the portosystemic gradient at the time of TIPS creation, and enables a small shunt to be created in select individuals, with the easy ability to subsequently increase the shunt as needed with balloon dilation.

CLINICAL RELEVANCE/APPLICATION
Primary placement of a constrained TIPS is a safe and feasible procedure, which improves control of the portosystemic gradient at the time of TIPS placement and during follow-up.

VSIR61-09
Impact of Stent-graft Position on Patency of PTFE-covered TIPS

Charles N. Weber MD (Presenter): Nothing to Disclose , Gregory Jon Nadolski MD : Nothing to Disclose , Michael Christopher Soulen MD : Royalties, Cambridge University Press Consultant, Guerbet SA Research support, Guerbet SA Consultant, BTG International Ltd Research support, BTG International Ltd Consultant, Merit Medical Systems, Inc Speaker, Sirtex Medical Ltd
PURPOSE

Distance from the hepatocaval junction (HCJ) to the hepatic venous (HV) end of transjugular intrahepatic portosystemic shunt (TIPS) created with bare metal stents (BMS) has been shown to impact patency. Now, most TIPS are created with polytetrafluoroethylene (PTFE)-covered stent-grafts. Our study investigates the impact of distance from the HCJ on long-term patency of PTFE-covered TIPS.

METHOD AND MATERIALS

PTFE-covered TIPS placed between 2002 and 2013 were retrospectively reviewed. Clinical and imaging data were collected from the electronic medical record and radiology imaging archive. Distance from HV end to the HCJ was recorded. Primary patency rates were calculated. Differences between groups based on distance from HV end to HCJ were compared using Kaplan-Meier and Cox regression analyses.

RESULTS

300 PTFE-covered TIPS were included in the study. 201 were placed with a single stent-graft while 99 were extended at the HV end with additional BMS (N=70) or PTFE stent-grafts (N=29). No threshold distance between HV end of the TIPS and HCJ was found to impact long-term patency (p-values at thresholds of 0, 5, 10, 15, and 20 mm were 0.92, 0.79, 0.43, 0.36 and 0.24 respectively). Primary patency in TIPS placed with just a single stent-graft versus those using additional stents was 83% vs 71% and 81% vs 60% at 1 and 2 years respectively (p = 0.03). In TIPS created with multiple stents, primary patency of those with BMS versus PTFE-covered extensions was 73% vs 69% and 69% vs 46% at 1 and 2 years respectively (p = 0.28). Regression analysis demonstrated the length by which a TIPS was extended and the final distance of the HV end to the HCJ were not predictors of patency failure (p > 0.1 and p = 0.06 respectively).

CONCLUSION

If the HV end of PTFE-covered TIPS is within 2 cm of the HCJ, the primary patency is not determined by the actual distance from the HCJ nor is it improved by extending the TIPS to the HCJ. If extended, PTFE-covered extensions offer no patency benefit over BMS. The best patency rates occur with single PTFE-covered TIPS.

CLINICAL RELEVANCE/APPLICATION

For PTFE-covered TIPS placed within 2 cm of the HCJ, there is no additional benefit of further shunt extension, potentially reducing added procedure time and cost.
**Participants**

**Moderator**
Lynne S. Steinbach MD : Nothing to Disclose
Lawrence M. White MD, FRCPC : Advisory Board, Siemens AG

**Sub-Events**

**VSMK61-01**  
**Shoulder Instability**  
Lynne S. Steinbach MD (Presenter): Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand normal anatomy related to anterior shoulder instability on MRI. 2) Review role of MR arthrography and ABER positioning. 3) Identify labral and osseous abnormalities associated with anterior shoulder instability as seen on MRI.

**ABSTRACT**

This presentation will cover several aspects of MRI of shoulder instability. Immediate papers that follow include evaluation of Hill Sachs lesions and the ABER position. Along with those concepts, normal variants and abnormalities of the anterior labrum and glenohumeral ligaments will be discussed.

**VSMK61-02**  
**Hill-Sachs Lesion Location: Does It Play a Role in Engagement?**  
Annie M. Wang MD (Presenter): Nothing to Disclose, James S. Babb PhD : Nothing to Disclose, Soterios Gyftopoulos MD : Nothing to Disclose

**PURPOSE**

To see if there is an association between engagement on physical examination and the location of the Hill-Sachs lesion [HSL] as assessed by the modified biceps angle.

**METHOD AND MATERIALS**

62 consecutive patients with a history of anterior shoulder dislocation, who underwent pre-operative MRI and arthroscopy at our institution, and tested for engagement on physical examination [PE] were collected over an 18 month period. The test for engagement was performed at the beginning of the arthroscopy under anesthesia by one of four fellowship-trained shoulder/sports medicine orthopaedic surgeons. Two blinded musculoskeletal radiologists reviewed the MR studies of these patients, noted the presence of a HSL and documented the location of the HSL with the modified biceps angle, which consisted of the angle between the center of the biceps groove and medial margin of the HSL. The angle accounts for the medial extent of the HSL, the portion of the lesion that would first engage onto the glenoid during abduction and external rotation. Statistical analysis included Mann-Whitney test and ROC curve.

**RESULTS**

There were 58 males/4 females with mean age of 30 (range 18-59). 20 patients demonstrated engagement on PE, while 42 did not. All 62 patients had a Hill-Sachs lesion on MRI and arthroscopy. The mean modified biceps angle for the engaging group was 151.5+13.9o, and 142.4+17.3o for the non-engaging group. According to a Mann-Whitney test, the modified biceps angle was statistically significantly higher among patients who had engagement compared to those who did not (p=0.027). Overall, diagnostic accuracy was highest for a modified biceps angle > 149o,which resulted in a sensitivity of 70%/specificity of 67%. According to a receiver operating characteristic (ROC) curve to assess the utility of the modified biceps angle as a test criterion for the detection of patients who had engagement, the area under the curve (AUC) measured 0.67, which was statistically significant (p=0.017) when compared to the AUC associated with random guessing.

**CONCLUSION**

The modified biceps angle, as measured on MRI, was significantly higher in patients who demonstrated engagement on physical examination than in those who did not have engagement.

**CLINICAL RELEVANCE/APPLICATION**

This supports the theory that the location of the Hill-Sachs lesion may play a role in engagement, and may be the Hill-Sachs’ most important characteristic when determining its significance.

**VSMK61-03**  
**Benefit of Additional ABER Series in Direct MR Arthrography of the Shoulder at 3T**  
Aline Maehringer-Kunz MD (Presenter): Nothing to Disclose, Roman Kloeckner MD : Nothing to Disclose, Stephan Mueller-Haberstock : Nothing to Disclose, Christoph Dueber MD : Nothing to Disclose, Karl Friedrich Kreitner MD : Nothing to Disclose

**PURPOSE**

To evaluate the diagnostic benefit of an additional series acquired in abduction and external rotation (ABER)
during direct MR arthrography at 3T.

**METHOD AND MATERIALS**

We analyzed 23 patients with persistent shoulder pain who underwent direct MR arthrography of the shoulder from 03/2010 - 03/2013. After arthrography with diluted Gadolinium-DTPA (0.02mmol Magnevist, Bayer Schering Pharma, Germany), conventional shoulder MRI was performed in axial, sagittal and coronal plane followed by additional series in ABER position. All examinations were performed on a 3T MRI (Trio® and Skyra®, Siemens Healthcare, Germany). Mean patient age was 36 years, 15 were male, 8 were female. Blinded analysis was performed by a senior radiologist with >20 years of experience in shoulder MRI who first analyzed conventional MR arthrography followed by a conjoined analysis of conventional and ABER imaging.

**RESULTS**

ABER series provided additional information in 18 of 23 (78%) patients. Especially pathologies of the superior labrum (n=12), the attachment of the joint capsule (n=12), and the articular surface of the rotator cuff (n=6) were either better displayed or only detectable on ABER images. The implementation of ABER imaging enabled the diagnosis of microinstability or atraumatic instability in 4 of 23 (17%) patients.

**CONCLUSION**

Though only a small series is presented, there may be a potential role of ABER imaging at direct MR arthrography. Especially in patients with suspected superior labral pathologies, partial articular sided tears of the rotator cuff, and microinstability the technique may be beneficial.

**CLINICAL RELEVANCE/APPLICATION**

In all patients with suspected superior labral pathologies, partial articular sided tears of the rotator cuff, and microinstability an additional ABER series should be performed.

---

**VSMK61-04 Use of T1ρ MRI For Assessment of Glenohumeral Joint Cartilage Injury Following Subacute Shoulder Dislocation**

J. Bruce Kneeland MD (Presenter): Nothing to Disclose, Kevin D’Aquila BS : Nothing to Disclose, Vishal Saxena MD : Nothing to Disclose, Joshua Gordon MD : Nothing to Disclose, Anup Singh : Nothing to Disclose, Hari Hariharan PhD : Nothing to Disclose, Brian Sennett MD : Nothing to Disclose, Ravinder Reddy PhD : Nothing to Disclose

**PURPOSE**

To detect injury to glenohumeral articular cartilage following subacute dislocation in the absence of morphologic defects (GLAD) using T1ρ MRI

**METHOD AND MATERIALS**

12 subjects ages 18-40 underwent MRI at 3T using both conventional (FSE) sequences and T1ρ MRI. T1ρ MRI was performed using an anisotropic 3D gradient echo sequence acquired in the coronal plane with 256x256 acquisition matrix and 8 slices with 3.6 mm slice thickness. The sequence was repeated using spin lock pulses of 0-40 msec duration (in 10 msec increments) to permit the pointwise calculation of T1ρ. Humeral and glenoid cartilage were manually segmented and displayed in color-coded images with color dependent on quantitative T1ρ calculations. Comparison of T1ρ values of the humeral and glenoid cartilage in these patients was made to 5 asymptomatic subjects.

**RESULTS**

In comparison to the values in the asymptomatic subjects, the mean T1ρ values of the humeral articular cartilage in patients with subacute dislocations were increased by more than 1 standard deviation, while mean T1ρ values of cartilage in the glenoid were increased by more than 2 standard deviations. These indicate statistically significant increases in T1ρ in these patients.

**CONCLUSION**

T1ρ maps in patients with subacute shoulder dislocation demonstrated a diffuse increase in the value of both the humeral and articular cartilage that was both statistically significant and that indicated on the basis of prior work with cartilage degeneration a significant degneration of the proteoglycan macromolecular matrix

**CLINICAL RELEVANCE/APPLICATION**

Extent and severity of cartilage injury can impact rehabilitation and other conservative means of management following shoulder dislocation

---

**VSMK61-05 Indirect MR Arthrography in Adhesive Capsulitis of the Shoulder: A Clinico-Radiological Correlation**

Bora Yang (Presenter): Nothing to Disclose, Jae Hyuck Yi MD : Nothing to Disclose

**PURPOSE**

The purpose of this study was to evaluate the correlation between indirect MR arthrographic findings and clinical findings, and wheter MR findings can reflect the prognosis in primary adhesive capsulitis.
METHOD AND MATERIALS
We evaluated 69 patients with primary adhesive capsulitis of the shoulder, the mean age was 54.5 years (standard deviation 8.3). Capsular thickness of the axillary pouch, capsular enhancement of the axillary pouch and soft tissue thickening of rotator interval on indirect MR arthrographic images were investigated. Severities of clinical symptom were evaluated by three scoring systems (Simple Shoulder Test, Contant Score, and ASES). Comparing with clinical symptoms after 6 months, we analyzed whether MRI finding correlated with prognosis of adhesive capsulitis.

RESULTS
Capsular thickness and capsular enhancement of the axillary pouch, soft tissue thickening of the rotator interval was significantly higher than normal control group (p < 0.001). Capsular thickness of the axillary pouch was not correlated with clinical symptom by three scoring systems (p = 0.510, 138, 104). In contrast, capsular enhancement of the axillary pouch showed a good correlation with severity of clinical symptom (p = 0.006, 077, 035). Although soft tissue thickening of rotator interval was not correlated with severity of clinical symptom (p = 0.706, 0.612, 0.384), more thickening showed more limitation of motion. Any three findings did not correlate with clinical symptom at 6 months follow-up.

CONCLUSION
On MR arthrography, capsular enhancement of the axillary pouch showed a good correlation with severity of the clinical symptoms although soft tissue thickening of the rotator interval wasn't.

CLINICAL RELEVANCE/APPLICATION
Indirect MRI arthrography could be an ancillary method for evaluating clinical severity of primary adhesive capsulitis.

VSMK61-06 Biceps Tendon and Rotator Interval
Jenny T. Bencardino MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) To review normal anatomy and pathology of the biceps tendon and rotator interval, with an emphasis on MRI.

ABSTRACT
This presentation will review the normal MR anatomy of the biceps tendon and rotator interval as well as the following pathologic conditions: 1) Biceps tendinopathy and tears, 2) Biceps pulley injuries; 3) Rotator Interval laxity and 4) Adhesive Capsulitis.

VSMK61-07 Rotator Cuff Pathology
Brian David Petersen MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) To demonstrate rotator cuff pathology, with an emphasis on MRI.

VSMK61-08 MR Arthrography Characteristics of Partial Articular-sided Supraspinatus Tendon Avulsion (PASTA) Lesion Repaired with Arthroscopy: Comparison with Conservatively Treated Patients
Eun Hae Park : Nothing to Disclose, Seok Hahn MD (Presenter): Nothing to Disclose, Young Han Lee MD : Nothing to Disclose, Sungjun Kim MD : Nothing to Disclose, Ho-Taek Song MD : Nothing to Disclose, Jin-Suck Suh MD : Nothing to Disclose

PURPOSE
To evaluate the accuracy of MR arthrography(MRA) at diagnosis of Partial Articular-sided Supraspinatus Tendon Avulsion(PASTA) lesion in arthroscopically confirmed patients and to retrospectively compare the MRI characteristics of surgically treated patients and conservatively treated patients.

METHOD AND MATERIALS
Institutional review board approval was obtained. In the first session, MRA of 251 patients who underwent arthroscopic repair of supraspinatus tendon from 2011 to 2013 were reviewed and diagnostic accuracy (sensitivity, specificity, positive and negative predictive value) of MRA in PASTA lesion were calculated. In the second session, the MRA of two groups (group 1 = 239 patients who were treated with conservative care, group 2 = 53 patients who underwent arthroscopy) were retrospectively reviewed to assess the following features: vertical grade, transverse location, acromion type, coexisting other rotator cuff tendon tear, biceps tendinopathy, calcific tendinopathy, SLAP lesion, bursitis, Bankart lesion, and osteoarthritis. Student T-test and multivariate logistic regression models were used to determine whether there is difference of MRI characteristics in two groups.
RESULTS

In the first session, the sensitivity and specificity of MRA in diagnosis of PASTA were 77.3% and 88.4%. In the second session, vertical grade of PASTA and coexisting other rotator cuff full thickness tear was the most significant characteristic of two groups. In group 1, 25 of 53 (47.1%) patients were grade 3 whereas 49 of 239 (20.5%) patients were grade 3 in group 2. In group 1, 35 of 53 (66.0%) patients had Coexisting additional rotator cuff tendon tear was present at 35 of 53 (66.0%) in group 1, and 76 out of 239 (31.7%) in group 2, respectively. For PASTAs not combined with other rotator cuff tear, MRI features significantly associated with surgical group included a vertical grade 3 (p = p < 0.001), combined with Bankart lesion (p = 0.01).

CONCLUSION

MRA is accurate in diagnosis of PASTA. When vertical grade 3 and coexisting additional rotator cuff tendon tear is noted in MRA, surgical treatment is likely to be performed so radiologist should pay attention in such findings.

CLINICAL RELEVANCE/APPLICATION

MR arthrography (MRA) is known to be more accurate imaging methods than conventional MRI in assessment of rotator cuff tears.

VSMK61-09  Evaluation of the Subscapularis Tendon on MR Arthrography and Ultrasound: How Accurate Are We in Diagnosis of Tears?

Jung-Ah Choi MD (Presenter): Nothing to Disclose, Eugene Joe: Nothing to Disclose, Eugene Lee: Nothing to Disclose, Hee Seok Jeong MD: Nothing to Disclose, DaeHyun Hwang MD, PhD: Nothing to Disclose

PURPOSE

To evaluate and compare the diagnostic efficacy in diagnosis of subscapularis (SSC) tendon tears on ultrasound (US) and MR arthrography (MRA) and compare between examiners with differing levels of experience.

METHOD AND MATERIALS

198 cases of arthroscopically confirmed rotator cuff tendon tears were prospectively evaluated on MRA and US (by two examiners with differing levels of experience) before arthroscopic surgery. The status of SSC tendons were graded as follows: 0 - normal/tendinopathy, 1 - articular low grade partial tear, 2 - bursal low grade partial tear, 3 - high grade partial/full thickness tear. Arthroscopy was used as the gold standard. Sensitivity, specificity, and agreement were calculated according to each modality, compared between the two modalities, and compared between the two examiners. Agreement between each modality and arthroscopic finding was determined by weighted kappa. Diagnostic values were compared between US and MRA using McNemar’s test.

RESULTS

On arthroscopy, 64 cases had low grade partial tears, 52 had high grade/full thickness tears, 82 showed no tear. The overall weighted kappa for US was 79.63%, whereas it was 81.06% for MRA. For the staff radiologist, the weighted kappa was 81.99% for US, whereas for the fellow, it was 78.38%. The sensitivity and specificity of US for diagnosis of SSC tears were 76.4% and 97.6%, respectively; those of MRA were 82.9% and 98.1%, respectively, with no significant difference for diagnosis of SSC tears. For the staff radiologist, the sensitivity and specificity of US were 86.3% and 97.6%, respectively, whereas for the fellow, the values were 72.8% and 99.5%, respectively.

CONCLUSION

MRA showed slightly better agreement and higher sensitivity for diagnosis of SSC tears although not statistically different. US performed by the staff radiologist had higher sensitivity for diagnosis of SSC tears.

CLINICAL RELEVANCE/APPLICATION

US has comparable diagnostic sensitivity and specificity to MRA in diagnosis of SSC tears; however, sensitivity is higher if performed by a more experienced examiner.

VSMK61-10  Fatty Infiltration and Traction Suprascapular Neuropathy: Evaluation of Rotator Cuff Muscles with Differing Nerve Supply with MR Chemical Shift Fat Quantification

Sonia Lee MD (Presenter): Nothing to Disclose, Robert Lucas: Nothing to Disclose, Drew Lansdown: Nothing to Disclose, Lorenzo Nardo MD: Nothing to Disclose, Thomas M. Link MD, PhD: Research funded, General Electric Company Research funded, InSightec Ltd, Lynne S. Steinbach MD: Nothing to Disclose, C. Benjamin Ma MD: Nothing to Disclose, Roland Krug PhD: Nothing to Disclose

PURPOSE

To assess traction suprascapular neuropathy in rotator cuff muscles by comparing fatty infiltration in muscles supplied by suprascapular nerve to that of axillary nerve in subjects with and without severe retraction.

METHOD AND MATERIALS
After IRB approval, nine consecutive patients with retraction to the glenoid (severe retraction, SR) and nine age and rotator cuff tendon tear sized matched control subjects with less retraction (LR) were included. All subjects underwent routine clinical 3 Tesla non-contrast shoulder MR exam with additional chemical shift 6 point dixon IDEAL sequence for fat quantification. Rotator cuff muscles fat fractions were calculated by averaging the manually drawn region of interest on four consecutive sagittal fat fraction maps in each rotator cuff muscle at the scapular Y-view following previously published protocol. The average age, rotator cuff tendon tear size, degree of retraction and rotator cuff muscle fat fraction of SR were compared to LR using student t-test.

RESULTS

No significant difference was present in age or over all rotator cuff tear size between the two groups, SR and LR (65.1 vs. 67.4 years, P 0.27 and 4.9 vs. 4.9 cm, P 0.52). Average tendon retraction in SR and LR were 5.1 cm and 3.0 cm (P < 0.001). All patients had full thickness full width tear of supraspinatus tendon. SR group had larger infraspinatus tear (P 0.05), and smaller subscapularis tear size(P 0.07) compare to LR. SR showed increased muscle fat in not only supraspinatus (22.2 vs. 12.8 %, P 0.03* ), but also in infraspinatus (22.3 vs. 13.0 %, P 0.05) and subscapularis (19.9 vs. 12.3 %, P 0.08) to a similar degree despite less subscapularis tendon involvement. Teres minor fat fraction did not increase with rotator cuff tendon retraction (SR vs. LR, 6.3 vs. 8.6 %, P 0.84).

CONCLUSION

Significant elevation in fatty infiltration was seen in those with severe retraction in all rotator cuff except for teres minor supplied by axillary nerve. These results support supraspinatus neuropathy as significant contributor of muscle fatty infiltration.

CLINICAL RELEVANCE/APPLICATION

Rotator cuff fatty infiltration, an indicator of poor post-surgical outcome, is not only affected by tendon tear but also significantly affected by neuropathy. MR fat quantification provides reliable and accurate assessment to study the association and possible causation of muscle infiltration, tendon pathology and nerve involvement.

VSMK61-11 Postoperative Technical Considerations

Kenneth A. Buckwalter MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Define the best imaging technique for post-operative patients. 2) Understand how to reduce post-operative artifacts at CT. 3) Understand how to reduce post-operative artifacts at CT.

VSMK61-12 Comparison of New CT Metal Artifact Reduction Technique to Filtered back Projection for Evaluation of Shoulder Arthroplasties: A Prospective Study


PURPOSE

To compare a new prototype CT reconstruction technique for reduction of artifacts from metal implants called Iterative Metal Artifact Reduction (IMAR) with standard filtered back projection (FBP), both quantitatively and qualitatively.

METHOD AND MATERIALS

40 patients undergoing total shoulder arthroplasties were enrolled in a prospective study. Preoperative CT scans were performed with varying standard clinical protocols with FBP reconstructions. All postoperative scans were performed on one of three CT scanners (Definition Flash, Definition Edge or Definition AS+, Siemens, Erlangen, GE) with a standard protocol (140 kVp, 300 mAs, 0.6 mm collimation, effective pitch 0.5 - 0.9). FBP and IMAR images reconstructed using same kernel (B30 - smooth), slice thickness (2 mm) and slice interval (2 mm). After randomization and blinding, 2 musculoskeletal radiologists independently evaluated the bone (glenoid), bone metal interface and soft tissue (supraspinatus and subscapularis tendons) structures in each case. Using a 10 point scoring system, each structure was evaluated for the degree of streak artifact (1=none to 10=marked) and diagnostic confidence (1=no confidence to 10=high confidence). The accuracy and variance of attenuation near hardware was also measured quantitatively in the bone (glenoid), soft tissue (deltoid muscle) and subcutaneous fat as the absolute difference between the mean HU within a region of interest (ROI) near hardware on the postoperative scan and the mean HU within a ROI in the same location on the preoperative scan.

RESULTS

Qualitatively, both readers graded IMAR images with significantly lower streak artifact and significantly higher diagnostic confidence scores than FBP images for all of the structures (p<0.001) (Table 1a). Quantitatively, the attenuation near hardware was statistically significantly closer to preoperative attenuation for IMAR than FBP (p<0.001) (Table 1b) and the variance between preop and postop attenuation was significantly lower for IMAR than FBP.
CONCLUSION

IMAR was superior to FBP in reducing metal artifact both qualitatively and quantitatively in patients with total shoulder arthroplasties with more accurate and less variable attenuation, less streak artifact and improved diagnostic confidence.

CLINICAL RELEVANCE/APPLICATION

IMAR is a promising new CT metal artifact reduction technique that improves visualization of tissues near hardware compared to standard CT technique.

VSMK61-13  Reconstruction of Glenoid Defects Using a Statistical Shape Model

Anish Ghodadra MD (Presenter): Nothing to Disclose, Alex Rothy: Nothing to Disclose, Aaron Bois: Nothing to Disclose, Morgan Jones MD: Nothing to Disclose

PURPOSE

Present methods used to estimate glenoid bone loss in recurrent shoulder instability rely on imaging of the contralateral shoulder or simple estimations of glenoid shape (e.g. a circle). The purpose of this work was to develop a robust method to reconstruct the original shape of the anterior glenoid rim following a glenoid defect using statistical shape modeling.

METHOD AND MATERIALS

Fifty-eight pairs of human glenoids (age 15-35) from the Hamman-Todd Collection (Cleveland, OH) were digitized using a 3-dimensional laser scanner. Using custom Matlab software, 2-dimensional glenoid contours were generated. The contours were then resampled to have a fixed number of points for all glenoids. Seventy percent (n = 81) of the glenoid contours were then randomly selected as a training set for generation of a statistical shape model using principal component analysis of the covariance matrix of the coordinates along the contours. The remaining 35 glenoid contours were used for model validation. Anterior glenoid defects were simulated in 5% increments in the anterior-posterior direction. The statistical shape model was then fit to the remaining points in the contours using an iterative algorithm seeking to minimize mean error in the contour fitting.

RESULTS

Principal component analysis yielded five major modes of variation in glenoid shape. Mode 1 corresponded to radius of the posterior half of the glenoid. Mode 2 described the radius of the anterior glenoid. Mode 3 corresponded to the size/curvature of the superior glenoid. Mode 4 described the depth of the glenoid notch and Mode 5 described the curvature of the anterior/superior portion of the inferior glenoid rim. The root mean square median error in defect contour reconstruction was 0.95 mm (Quartiles: 0.6 and 1.7) with a 90th percentile of 2.7 mm and a maximum of 3.5 mm. Figure 1 shows four randomly selected glenoids with defects and their reconstructions.

CONCLUSION

We were able to successfully reconstruct the contours of glenoid defects using a statistical shape model with a relatively small margin of error. This technique could be used to estimate the original contours of glenoid defects thereby aiding in their surgical reconstruction.

CLINICAL RELEVANCE/APPLICATION

This technique could allow accurate estimation of the amount of bone loss which can help predict the failure rate of soft tissue reconstruction and inform the decision between soft tissue and bony reconstruction procedures.

VSMK61-14  Postoperative Shoulder

Lawrence M. White MD, FRCPC (Presenter): Advisory Board, Siemens AG

LEARNING OBJECTIVES

1) To review expected imaging findings and complications after shoulder surgery.

RCC62  Managing Radiology IT in the EHR World

Refresher/Informatics

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Participants
Moderator:
  J. Raymond Geis MD : Nothing to Disclose

LEARNING OBJECTIVES
1) Identify EHR components relevant to radiology. 2) Understand how to assess and use those components to your advantage. 3) Discover potential and pitfalls of EHRs.

Sub-Events

RCC62A  Radiology in the EHR World: What You’ll Need to Know
Keith J. Dreyer MD, PhD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Learn what challenges are faced by radiology departments and practices as hospital systems continue to make the move towards enterprise EHR deployment. 2) Understand how radiology IT and informatics solutions can interface with EHR solutions and manage the gaps and overlaps in EHR deployment.

RCC62B  EHR/RIS Optimization of Imaging Workflow for the Enterprise
Peter B. Sachs MD (Presenter): Advisor, Koninklijke Philips NV

LEARNING OBJECTIVES
1) Review the typical radiology department work flow in an EMR environment. 2) Identify the key work flow items that may require optimization. 3) Identify the key components necessary to carry out optimization. 4) Review examples of optimizations carried out at the author’s institution. 5) Discuss the impact these optimizations have had on radiology workflow/efficiency and patient care.

ABSTRACT
The development and deployment of electronic medical records has resulted in a significant impact on radiology workflow both positive and negative. Moving from paper driven to an electronic processes requires a highly functional, multi-disciplinary team to address break-fixes as well as optimizations. This presentation will review the optimal structure of the team and then discuss the requisite skill sets of the team members to ensure getting the most out of the EHR to drive high quality, efficient, patient-centered work flow in the radiology department.

RCC62C  Electronic Health Record Driven Workflow for Diagnostic Radiologists - You Might Actually Want This
Cree Michael Gaskin MD (Presenter): Author with royalties, Oxford University Press Author with royalties, Thieme Medical Publishers, Inc

LEARNING OBJECTIVES
1) Present EHR driven workflow for the diagnostic radiologist at the speaker’s institution. 2) Discuss radiologist engagement in EHR implementation for radiology-centric optimization. 3) Discuss impacts of EHR driven workflow on diagnostic radiologists' efficiency and quality of care delivery as well as user satisfaction.

ABSTRACT
Electronic Health Records (EHRs) are touted to improve the quality and efficiency of clinical care. As a result, EHR-meaningful use legislation has been passed in the U.S. to financially incentivize adoption of this technology. Still, some radiologists remain skeptical that the benefits of EHRs are applicable to their practice and some fear that the technology could even unnecessarily complicate their workflow. One newer model for integrating EHRs into radiologists' practice is to use an EHR to drive diagnostic radiologist workflow, rather than the more traditional or widespread models of PACS driven or third-party RIS driven workflow. This newer model provides opportunity to leverage EHR technology and data for the benefit of radiology-related care delivery. This presentation shares a radiologist-centric viewpoint from one institution which has successfully adopted EHR-driven workflow for diagnostic radiologists. Though the process of implementation is touched upon, the presentation focuses on the resultant clinical workflow and the impacts on quality, efficiency, and radiologist satisfaction.

RCC62D  PACS and Radiologist Workflow in a Multi-Enterprise Environment
Gary J. Wendt MD, MBA (Presenter): Medical Advisory Board, McKesson Corporation Stockholder, TeraMedica, Inc Medical Advisory Board, HealthMyne Owner, WITS(MD), LLC

LEARNING OBJECTIVES
1) Understand workflow challenges for a radiologist operating a multi-enterprise environment. 2) Understanding requirements for environments with a single versus multiple medical record numbers. a. PACS b. Dictation systems. c. EHR. 3) Using a master patient index to link patient's across sites.

ABSTRACT
As a radiology department expands across multiple organizations there are several challenges that are created. Among these is the capability of the PACS, dictation systems and electronic medical record to operate in a single versus a multiple medical record number environment. These challenges are complicated further if there...
is no master patient index to link patient’s across the multiple sites. All of these need to be taken into
color consideration prior to attempting to deploy a single workflow solution in multiple environments. Some
possibilities that are discussed include using systems that function in a multiple medical record number
environment, making changes to the demographic information in an interface engine or simply guaranteeing
that each site uses unique identifiers. The benefits of having a single workflow solution across multiple
environments is significant and helps to justify the cost of implementing in maintaining this type of
environment.

**SST01**

**Breast Imaging (Multi-Modality Imaging)**

*Scientific Papers*

**SST01-01**

**Cost-Effectiveness of Screening Mammography in an Organized Program- A Modelling Study**

Martin J. Yaffe PhD (Presenter): Research collaboration, General Electric Company Founder, Matakina
International Ltd Shareholder, Matakina International Ltd Co-founder, Mammographic Physics Inc, Nicole
Mittmann PhD : Nothing to Disclose, Natasha K. Stout PhD : Nothing to Disclose, Anna N. Tosteson :
Nothing to Disclose, Amy Trentham-Dietz : Nothing to Disclose, Oguzhan Alagoz PhD : Consultant,
Renaissance Rx

**PURPOSE**

To examine the effect of screening regimen (age to begin and discontinue screening and interval between
screens) on cost effectiveness and cost utility of screening in the context of modern imaging technology and
therapies within an organized screening program as delivered in Canada

**METHOD AND MATERIALS**

We modified the validated University of Wisconsin CISNET Breast Cancer Simulation Model to estimate breast
cancer incidence and mortality on an unscreened Canadian population. After calibrating the model using
empirical data on the sensitivity and specificity of mammography, we calculated cancer incidence versus age
and 'stage' for several screening scenarios and created a distribution of receptor positivity for hormone
receptors and HER2. Outcomes for therapy, administered according to current practice guidelines, were
predicted based on published data. For each scenario we calculated the number of breast cancers, deaths and
years of life lost due to premature death. We factored the quality of life into our analysis by weighting with
utilties and disutilities associated with various health states related to breast cancer, to express results in
quality-adjusted life-years (QALY). We considered both the costs of screening and treatment to the health care
system and the additional costs to society such as loss of productivity. Finally, we performed a sensitivity
analysis with respect to parameters associated with screening and costs of screening and therapy.

**RESULTS**

Compared to No Screening, routine screening provided mortality reductions of 20-50%. Evaluating outcomes in
terms of life-years gained rather than lives saved shifted the benefit toward younger ages to begin screening.
In general the more screens a woman had between ages 40 and 74, the greater the reduction in mortality and
the more LYG and QALYs gained, but the greater the cost to the health care system, the number of abnormal
recalls, negative biopsies and presumably the amount of overtreatment.

**CONCLUSION**

Screening reduces breast cancer mortality and is cost effective by modern standards ($70K-$100K/QALY). The
cost of screening examinations is the largest single cost factor in a breast cancer care program, but the average
total lifetime cost per woman for screening and care of $4000 is reasonable compared to other health
interventions.

**CLINICAL RELEVANCE/APPLICATION**

The model provides guidance for optimizing effectiveness and use of resources in a screening program.

**SST01-02**

**Relevance of Additional Mammography and Ultrasonography for Newly Diagnosed Breast Cancer Patients (BI-RADS 6)**
PURPOSE

This study aims to determine if repeat diagnostic mammography (DM) and ultrasonography (US) performed at a tertiary cancer referral center for patients with newly diagnosed breast cancer yields incremental cancer detection.

METHOD AND MATERIALS

An institutional review board-approved retrospective, single institution database review was performed on 1000 patients diagnosed with primary breast cancer from January 1 to December 31, 2010. All patients had DM and US at an outside institution prior to referral to our cancer center. Exclusion criteria were prior breast MRI/PET-CT, prior excisional surgical biopsy, neoadjuvant chemotherapy, or stage IV disease. Data collected included tumor size, nipple/chest wall/skin involvement, regional nodal involvement, multifocal/multicentric (MF/MC) and contralateral (CL) disease, and surgical treatment (segmentectomy or mastectomy). The gold standard for diagnosis of malignancy was biopsy cytopathology and histopathology.

RESULTS

Final analyses included 404 patients. Median patient age was 54 years, range 21 to 92; median tumor size 2.4 cm, range 0.4 to 18. A total of 147 breast biopsies were performed in 109 women; 211 nodal biopsies in 173 women. PPV3 (positive predictive value for biopsies) was 45%. Upon initial referral to our center, 353/404 (87.4%) patients had unifocal (UF) disease, 22 (5.4%) MC, 26 (6.4%) MF, and 3 (0.7%) CL. Repeat DM and US yielded 292/404 (72.3%) patients with UF disease, 54 (13.4%) MC, 49 (12.1%) MF and 9 (2.2%) CL. Surgical management changed from segmentectomy to mastectomy in 50/404 (12.4%) patients. Additionally, 9.6% (5/52) stage 0, 39.2% (62/158) stage I, and 44.6% (33/74) stage II patients were upstaged leading to a total upstage rate of 25% (100/404 patients). Restaging was more likely for older patients compared to younger (p=0.004), African-American or Hispanic patients compared to Caucasian or Asian (p=0.0008), ER- patients compared to ER+ (p=0.02), and HER2+ patients compared to HER2- (p=0.004).

CONCLUSION

Repeat DM and US in newly diagnosed breast cancer patients in a tertiary cancer center yields significant incremental cancer detection which impacts locoregional treatment.

CLINICAL RELEVANCE/APPLICATION

Rigorous staging work-up with DM and US in dedicated breast imaging centers may reduce disease burden underestimation in breast cancer patients and contribute to cost minimization of health care delivery.

SST01-03

Developing Asymmetry on Mammography: Histopathologic Findings and Effect of Correlative MRI and US on Management

Allyson Louise Chesebro MD (Presenter): Nothing to Disclose, Catherine Streeto Giess MD: Nothing to Disclose, Nicole S. Winkler MD: Nothing to Disclose, Robyn L. Birdwell MD: Nothing to Disclose

PURPOSE

To determine outcomes for developing asymmetries on diagnostic mammograms and the impact of correlative ultrasound (US) and breast magnetic resonance imaging (MRI) on clinical management.

METHOD AND MATERIALS

IRB approved, retrospective review of our mammography database from 1/1/2009 to 12/31/2012 identified 2354 diagnostic mammograms classified as "focal asymmetry", 521 with prior studies and prospectively classified as BIRADS 0, 3, 4, or 5. Retrospective image review of these 521 studies identified 202 developing lesions that met the BIRADS definition of asymmetry (one view) or focal asymmetry (two view), henceforth collectively "developing asymmetries". Patient demographics, correlative US and MRI, and outcomes were obtained from the longitudinal medical record.

RESULTS

Mean patient age was 56 years (range 31-82). 187/202 (92.6%) had targeted US with 75 correlates, 3 equivocal correlates, and 109 without correlate. BIRADS assessment after diagnostic mammography included 21 BIRADS 0, 121 BIRADS 3, and 60 BIRADS 4 or 5 (34.2%) had breast MRI, including all 21 BIRADS 0, 40 BIRADS 3 (33 for index lesion, 7 for other indications) and 8 BIRADS 4 or 5 lesions. An MRI correlate was present in 28/69 (40.6%) lesions. Biopsy was performed in 73 (36.1%) of 202 lesions, 31 (42.5%) malignant and 42 (57.5%) benign. Thirteen malignancies received BIRADS 3 (N=12) or BIRADS 0 (N=1) assessment on diagnostic mammography; an US correlate was absent in 10, present in 2, and US was not performed in 1. Eight (61.5%) of these 13 malignancies had MRI, 6 at diagnostic evaluation and 2 at ≥6 month follow up, all resulting in BIRADS 4 upgrade. The other 5 were diagnosed 1-12 months later. Malignancies included 14 IDC, 8 ILC, 5 mixed IDC/ILC, 4 DCIS. Of 129 non-biopsied lesions, 80 (62.0%) were stable for ≥24 months, 39 (30.2%) had <24 months follow up, and 10 (7.8%) were lost to follow up.

CONCLUSION

Developing asymmetries were malignant in 15.3% cases and often lacked an US correlate. Diagnostic breast MRI can guide BIRADS assessment for developing asymmetries considered incomplete or probably benign after diagnostic mammography. Cancers with lobular pathology represented nearly half of malignancies.
CLINICAL RELEVANCE/APPLICATION
Developing asymmetries on mammography should be viewed with suspicion, despite lack of an US correlate. Diagnostic breast MRI can help guide assessment and management.

SST01-04

Comparison of the Clinical, Imaging, and Histopathologic Features of Screen Detected vs Interval Cancers on Breast MRI

Sarah Stamler MD (Presenter): Nothing to Disclose, Janice S. Sung MD : Nothing to Disclose, Christopher E. Comstock MD : Nothing to Disclose, D. David Dershaw MD : Nothing to Disclose, Kirti Magudia PhD : Nothing to Disclose, Elizabeth A. Morris MD : Nothing to Disclose

PURPOSE
To compare the clinical, imaging and histopathologic features of MRI screen detected (SCA) and interval cancers (IC).

METHOD AND MATERIALS
Retrospective review of 28,061 breast MRIs performed between 2005-2010 identified 120 SCA and 48 IC (cancer diagnosed within 364 days after a negative MRI). Medical records were reviewed for age at diagnosis, risk factors (family or personal history of breast cancer, BRCA status, prior high risk lesion), and tumor histopathology. For IC, the method and time interval from the negative MR were determined. Statistical analysis was performed using Prism software (GraphPad Software). The unpaired t and one-way ANOVA tests were performed to determine p-values.

RESULTS
Median age at diagnosis was 53 years for SCA and 50 years for IC. IC were not associated with any risk factor or tumor subtype (p>0.36). Mean size of invasive cancers was 0.8 cm for SCA and 0.7 cm for IC. SCA were highly associated with invasive cancers (SCA: 87/120, 73%, IC: 18/48 , 37%, p

CONCLUSION
Screening MRI preferentially detects invasive cancers and intermediate and high grade DCIS. Most IC after a negative MRI are detected as mammographic calcifications, representing low to intermediate grade DCIS. No clinical or histopathologic features are associated with the development of IC.

CLINICAL RELEVANCE/APPLICATION
Tumor biology of MRI SCA differ from IC. Women undergoing breast cancer screening with mammography and MRI may benefit from alternating screening at 6 month intervals, regardless of BRCA status.

SST01-05

The Relationship of Obesity, Mammographic Breast Density, and Magnetic Resonance Imaging Features in Patients with Breast Cancer

Jennifer Gillman (Presenter): Nothing to Disclose, Jennifer Chun MPH : Nothing to Disclose, Shira Schwartz : Nothing to Disclose, Freya Schnabel MD : Nothing to Disclose, Linda Moy MD : Nothing to Disclose

PURPOSE
Obesity in post-menopausal women is associated with elevated breast cancer risk and mortality. The purpose of this study was to evaluate the relationship between body mass index (BMI), mammographic breast density, background parenchymal enhancement (BPE), and fibroglandular tissue (FGT) in women with newly diagnosed breast cancer. We further analyzed how obesity related to disease stage, clinical breast exam, and screening frequency.

METHOD AND MATERIALS
This study was IRB approved and HIPAA compliant. The Breast Cancer Database was queried for patients with both a mamrogram and breast MRI between January 2010 and December 2011. Variables of interest included BMI, age, family history of breast cancer, atypical hyperplasia, lobular carcinoma in situ (LCIS), tumor characteristics, mammographic breast density, BPE, FGT, menopausal status, use of chemoprevention, and screening behavior. Statistical analyses included descriptive statistics, analysis of variance (ANOVA), linear regression, and Pearson's chi-square. BMI was analyzed as a continuous variable, as well as a dichotomous variable (BMI < 25 kg/m2 and BMI ≥ 25 kg/m2).

RESULTS
A total of 187 women were analyzed, with a median age of 51 years (range 22-87). BMI was significantly associated with advanced stage (p=0.014), lower mammographic density (p < 0.0001), lower BPE (p < 0.0001), higher FGT (p=0.0004) and non-palpable lesions (p=0.04), independent of age and menopausal status. 58% of women underwent annual screening mammography exams.

CONCLUSION
In our study, higher BMI was associated with decreased breast density, decreased FGT, and increased BPE. Higher BMI was also associated with advanced breast cancer stage, and cancers that were non-palpable on clinical exam. Therefore, overweight and obese patients may benefit from regular screening with mammography.

CLINICAL RELEVANCE/APPLICATION
Obese and overweight women are more likely to have non-palpable, advanced stage breast cancer. Since this
population also has lower breast density, obtaining regular screening mammograms is essential.

**SST01-06**

**Isolated Axillary Lymphadenopathy on Screening Mammography: Does Unilateral versus Bilateral Matter? Experience at a Tertiary-care Referral Center with Radiologic-pathologic Correlation**

Mougnyan Cox MD (Presenter): Nothing to Disclose, Upasana Joneja MD: Nothing to Disclose, Angela Hou: Nothing to Disclose, Rashmi Balasubramanya MD: Nothing to Disclose, Tara Raquel Eisenberg MD: Nothing to Disclose, Annina Nicholas Wilkes MD: Nothing to Disclose

**PURPOSE**

Axillary lymphadenopathy (ALD) in the setting of an otherwise normal screening mammogram may be benign or malignant in etiology. While several authors have investigated the clinical relevance of ALD, no study has addressed the implications of unilateral versus bilateral ALD. In our study, unilateral and bilateral ALD were studied separately in an attempt to further risk-stratify patients for subsequent work-up.

**METHOD AND MATERIALS**

After Institutional Board Review approval, a retrospective review of screening mammograms at our institution from the year 2006 to 2013 was performed. Patients with isolated ALD were classified according to whether ALD was unilateral or bilateral. Ultrasound examination of the axilla was recommended in all cases with ALD. Further clinical history obtained from the primary care provider and patient records. Most patients were subsequently referred for biopsy after final interpretation of mammogram and ultrasound. Biopsy results were reviewed when available.

**RESULTS**

65 patients with ALD and otherwise normal mammograms were identified. 54 patients returned for subsequent work-up. Of the 54 patients, 19 (35%) had bilateral ALD and 35 (65%) had unilateral ALD. In the patients with bilateral ALD, 10 out of 19 cases (53%) were due to malignancy, all of which were hematologic (lymphoma). The most common hematologic malignancy was chronic lymphocytic leukemia (CLL), found in 8 out of 19 patients with bilateral ALD. No cases of occult breast metastases were found in patients with bilateral ALD. There were 8 patients with bilateral ALD over the age of 60, and every single case was due to lymphoma. 35 patients had unilateral ALD, of which 8 cases (23%) were due to malignancy. The most common malignancy was occult breast metastasis, found in 5 patients (14%). The other 3 patients with malignant unilateral ALD had lymphoma.

**CONCLUSION**

Bilateral ALD appeared to have a higher risk of malignancy, mostly hematologic. Unilateral ALD had a lower risk of malignancy overall, but most of the malignancies in this group were occult breast metastases. Patients over the age of 60 presenting with bilateral ALD have a high risk of lymphoma, and biopsy should be pursued in all cases.

**CLINICAL RELEVANCE/APPLICATION**

Bilateral lymphadenopathy on screening mammography has a high incidence of hematologic malignancy, particularly in patients over the age of 60.

**SST01-07**

**18F-FDG Uptake on Preoperative PET/CT may Predict Axillary Lymph Node Metastasis in ER-positive/HER2-negative and HER2-positive, but Not in Triple-negative Breast Cancer**

Jin You Kim MD (Presenter): Nothing to Disclose, Suck Hong Lee: Nothing to Disclose, Suk Kim MD: Nothing to Disclose, Ji Won Lee MD: Nothing to Disclose

**PURPOSE**

To evaluate the relevance of breast cancer subtype for the value of tumor FDG uptake for predicting axillary lymph node (ALN) metastasis in patients with invasive breast cancers.

**METHOD AND MATERIALS**

A total of 671 patients (mean age 52.6 years, range, 23-88 years) with invasive breast cancer (mean size 2.5 cm, range, 1.0-11.7 cm) who underwent preoperative 18F-FDG PET/CT and curative surgery were identified between January 2011 and December 2013. By using immunohistochemistry, tumors were divided into three subtypes: estrogen receptor (ER) positive/human epidermal growth factor receptor 2 (HER2) negative, HER2-positive, and triple-negative. Tumor FDG uptake, expressed as maximum standardized uptake value (SUVmax) and clinicopathological variables were analyzed. Multivariate regression analysis and receiver operating characteristic analysis were performed to identify the significant factors that were associated with ALN metastasis.

**RESULTS**

ALN metastasis was present in 187 (40.6%) tumors of 461 ER-positive/HER2-negative tumors, 54 (55.7%) of 97 HER2-positive tumors, and 38 (33.6%) of 113 triple-negative tumors. Tumor SUVmax, mean tumor size, histologic grade, and Ki-67 status were significantly associated with ALN metastasis. At multivariate analysis, tumor SUVmax (adjusted odds ratio [OR] =1.046, P = 0.022) and tumor size (adjusted OR =1.608, P < 0.001) were independent significant variables associated with ALN metastasis after adjusting for potential confounding variables. The area under the receiver operating characteristic curve was 0.71 (P < 0.001). In subset analyses,
the association was significant for the ER-positive/HER2-negative (P < 0.001) and HER2-positive tumors (P = 0.001). No association was found for the triple-negative tumors (P = 0.36).

**CONCLUSION**

Tumor SUVmax on preoperative 18F-FDG PET/CT may be an independent prognostic factor for ALN metastasis in patients with invasive breast cancer, especially in ER-positive/HER2-negative and HER2-positive subtype, but not in triple-negative subtype.

**CLINICAL RELEVANCE/APPLICATION**

Tumor FDG uptake for predicting axillary lymph node metastasis is effective in ER-positive/HER2-negative or HER2-positive tumor but is inaccurate in triple-negative breast cancer.

---

**SST01-08**

**Preoperative Tamoxifen Treatment in Breast Cancer Patients with Moderate or Marked Parenchymal Enhancement: Could It Decrease Background Parenchymal Enhancement and Improve the Accuracy of Cancer Extent Evaluation?**

Taehee Kim MD, PhD (Presenter): Nothing to Disclose, Seon Young Park MD: Nothing to Disclose, Young Keun Sur MD: Nothing to Disclose, Doo Kyung Kang MD: Nothing to Disclose

**PURPOSE**

We want to evaluate whether the background parenchymal enhancement (BPE) would decrease after preoperative tamoxifen treatment in breast cancer patients with moderate or marked BPE. Also, we want to evaluate if it could reduce false positive rate and improve the specificity of MRI.

**METHOD AND MATERIALS**

From October 2013 to March 2014, twenty-five premenopausal patients with moderate or marked BPE on preoperative MRI were included in the image analysis. These patients underwent preoperative MRI twice, before and after tamoxifen intake. Mean treatment period with tamoxifen was 9 days (range, 5-33days). The signal intensity of the parenchyma was measured using four ROIs around the index cancer, and at the middle of the parenchyma of contralateral breast. Suspicious enhancing lesions besides index cancer were evaluated, around the index cancer, in other quadrant of ipsilateral breast, and in contralateral breast.

**RESULTS**

Among twenty-five patients, eight patients showed marked BPE and seventeen patients showed moderate BPE. On qualitative analysis, all 8 patients with marked BPE and 7 of 17 patients with moderate BPE showed BPE decrement after tamoxifen treatment. On quantitative analysis, the mean degree of parenchymal enhancement decreased from 93.5% to 73.4% after tamoxifen treatment. Tumor margins were non-visualized in 6 patients initially, which became distinct after tamoxifen treatment. Suspicious enhancing lesions besides index cancer were evaluated, around the index cancer in 12 patients, in other quadrant of ipsilateral breast in 3 patients, and in contralateral breast in 8 patients. These enhancements showed disappearance after tamoxifen treatment, resulting as a normal looking parenchyma.

**CONCLUSION**

Preoperative tamoxifen treatment in breast cancer patients with moderate or marked BPE could reduce false positive diagnostic rate and help to evaluate the accurate cancer margin and extent.

**CLINICAL RELEVANCE/APPLICATION**

Preoperative tamoxifen treatment can decrease background parenchymal enhancement (BPE), and is recommended in breast cancer patients with moderate or marked BPE for reduction of false positive diagnostic rate and accurate evaluation of cancer margin and extent.

---

**SST01-09**

**Does Breast Arterial Calcifications on Mammography Predict Elevated Risk of Developing Symptomatic Coronary Artery Disease?**

Tamuna Chadashvili MD, PhD (Presenter): Nothing to Disclose, Priscilla Jennings Slanetz MD, MPH: Nothing to Disclose, Diana Litmanovich MD: Nothing to Disclose, Ferris M. Hall MD: Nothing to Disclose

**PURPOSE**

To examine whether breast arterial calcifications (BAC) seen on mammography correlates with coronary artery calcium score, as a potential marker for increased risk of developing symptomatic coronary artery disease (CAD).

**METHOD AND MATERIALS**

Retrospective review of the imaging database at our institution identified 145 female patients who underwent coronary CT within a year of mammography. The mammograms were reviewed by breast radiologists who were blinded to patients'coronary calcium scores. The CT calcium score was calculated by multiplying area of calcification by weighted value assigned to its highest Hounsfield unit and summed for all lesions. Calculated scores were risk stratified for developing CAD as follows: 0-no risk; 1-10-minimal; 11-100-mild; 101-400-moderate; >400-high risk. Percentile distribution of calcium score.
adjusted by age, gender and race, was calculated based on results of the Multi-Ethnic Study of Atherosclerosis (MESA). The calcium scores and corresponding percentiles were correlated with BAC. Cardiac risk factors such as, diabetes, hypertension, hyperlipidemia, family history of CAD and smoking, were recorded for each patient. Data was analyzed using X2 tests and multiple logistic regression analysis.

RESULTS

BAC correlated with coronary calcium score of >11 (p=0.0001), corresponding to mild or greater risk of developing CAD. Specifically, calcium score of >11 was seen in 68% (25/37) of patients with BAC and 31% (41/128) of patients without BAC. Accounting for race, gender and age, presence of BAC showed statistically significant correlation with percentile scores of >25. Namely, 70.4% (19/27) of patients with BAC vs. 44.6% (41/92) of patients without BAC showed percentile score of >25. Statistically significant association was observed of BAC with diabetes (p=0.01) and chronic renal disease (p=0.005). BAC showed no significant association with hyperlipidemia, hypertension, smoking and family history of CAD.

CONCLUSION

BAC predicts coronary artery calcium score of >11, which indicates mild or greater risk of developing CAD. Statistically significant correlation exists between BAC and cardiac risk factors, namely diabetes and chronic renal disease. Our study suggests that BAC on mammography can be utilized as a potential marker for increased risk of developing CAD.

CLINICAL RELEVANCE/APPLICATION

BAC on mammography is a noteworthy finding, as it correlates with coronary calcium score, elevated risk of CAD and cardiac risk factors.

SST02

ISP: Cardiac (Non-ischemic Cardiomyopathy)

Scientific Papers

<table>
<thead>
<tr>
<th>MR</th>
<th>CA</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMA PRA Category 1 Credits™: 1.50</td>
<td></td>
</tr>
<tr>
<td>ARRT Category A+ Credits: 1.50</td>
<td></td>
</tr>
</tbody>
</table>

Fri, Dec 5 10:30 AM - 12:00 PM   Location: SS02AB

Participants

Moderator
Karen Gomes Ordovas MD : Nothing to Disclose
Moderator
Phillip Matthew Young MD : Nothing to Disclose
Moderator
Charles S. White MD : Nothing to Disclose

Sub-Events

SST02-01 Quantification of Diffuse Myocardial Interstitial Fibrosis in Thalassemia Major with Cardiac Magnetic Resonance Imaging

Kate Hanneman MD (Presenter): Nothing to Disclose, Elsie Nguyen MD : Nothing to Disclose, Dinesh Thavendiranathan MD : Nothing to Disclose, Richard Ward MSc, MRCP : Grant, Novartis AG Grant, Apotex, Inc, Andreas Greiser PhD : Employee, Siemens AG, Issac Y. Yang : Nothing to Disclose, Marshall Stephen Sussman PhD : Nothing to Disclose, Bernd J. Wintersperger MD : Speakers Bureau, Bayer AG Speakers Bureau, Siemens AG

PURPOSE

We sought to quantify left ventricular (LV) myocardial interstitial fibrosis in patients with thalassemia major using cardiac MRI based extracellular volume fraction (ECV), and to correlate ECV with the degree of myocardial iron overload.

METHOD AND MATERIALS

In this prospective case-control study, myocardial T1 mapping was performed at 1.5T pre- and 12 minutes post-contrast administration using a prototype modified Look-Locker inversion recovery (MOLLI) technique in patients with thalassemia major receiving regular transfusions (n=30; 53% male, 34.6±9.5 years) and healthy volunteers (n=10; 50% male, 31.5±4.4 years). Standard cine SSFP, late gadolinium enhancement (LGE), and T2* mapping were also performed. LGE (>5SD threshold), ECV and T2* were analyzed for each myocardial segment (AHA 16 segment model). Same day hematocrit values were used for ECV calculation. Statistical analysis included two-sample t-test, Pearson correlation, and ANOVA with Tukey’s post-hoc analysis.

RESULTS

LV end-diastolic volume (89.8±15.7ml/m2 and 99.8±15.3ml/m2, p=0.12) and ejection fraction (60.5±6.3% and 60.1±3.1%, p=0.83) were not significantly different between patients and volunteers. Pre-contrast T1 values were lower in patients compared to volunteers (892.5±117.9ms vs. 1005.5±33.5ms, p=0.005), and correlated strongly with T2* values (r=0.89, p<0.001). After a significance difference between groups (p=0.002, ANOVA), post hoc analysis demonstrated higher ECV in patients with prior history of iron overload (T2*<20ms, n=19, 31.5±2.9%) compared to those without (n=11, 28.3±3.4%, p=0.030) and volunteers (27.1±0.1%, p=0.003). There was no difference in ECV between patients without iron overload and volunteers...
ECV correlated with same-day T2* (r = -0.33, p = 0.04), but had better correlation with lowest historical T2* (r = -0.49, p = 0.007). Segmental LGE among patients was low (median 0.6%; range 0.3-2.1%), and did not correlate with ECV (r = -0.040, p = 0.81).

**CONCLUSION**

In patients with thalassemia major, cardiac MRI demonstrated elevated ECV in keeping with diffuse interstitial myocardial fibrosis related to iron overload. Patients without a history of iron overload had no evidence of fibrosis despite receiving regular transfusions.

**CLINICAL RELEVANCE/APPLICATION**

Early aggressive chelation therapy may be warranted in patients receiving chronic transfusions to prevent diffuse interstitial myocardial fibrosis due to myocardial iron overload.

---

**SST02-02**

The Cumulative Effect of Doxorubicin on the Change of Myocardial Extracellular Volume Fraction Measured by Contrast Enhanced Magnetic Resonance Imaging in Dilated Cardiomyopathy Rabbit Models; Histopathology Analysis and Electron Microscopic Findings

Yoo Jin Hong MD : Nothing to Disclose , Donghyun Hong MS : Nothing to Disclose , Chul hwan Park MD (Presenter): Nothing to Disclose , Byoung Wook Choi MD : Nothing to Disclose

**PURPOSE**

To examine the change of myocardial extracellular volume (ECV) fraction using contrast enhanced magnetic resonance imaging in rabbit during the dilated cardiomyopathy modeling and to investigate the correlation between ECV and the degree of fibrosis and electron microscopic findings in dilated cardiomyopathy rabbit (DCR) models.

**METHOD AND MATERIALS**

DCR (male adult New Zealand White rabbit, 3-4 kg) models were made by injecting doxorubicin (Doxorubicin Hydrochloride, Cayman) with doses of 1.0mg/kg twice a week for maximal 16weeks. Every rabbit underwent cardiac MRI pre- and post- T1 mapping using modified Look-Locker inversion recovery (MOLLI) sequence, LGE, and cine MRI on a clinical 3-T cardiac magnetic resonance (CMR) system before drug administration (Control group) and at 6th , 12th , and 16th week after drug administration (DCR modeling) On MRI, ECV was calculated at the septum using the myocardial pre, post T1 value, LV blood pool T1 value, and hematocrit(Hct) as follows: ECV = [(1/T1post-contrast myocardium)-(1/T1pre-contrast myocardium)/(1/T1post-contrast blood)-(1/T1pre-contrast blood)] × (1-Hct). Fibrosis was quantitatively measured by image J (V. 1.47, NIH, Bethesda, MA) with digital images of specimens stained with picrosirius red. For electron microscopic findings, specimens were obtained at interventricular septum and lateral wall.

**RESULTS**

Three pre-model and fifteen post-models (five: 6-week, three; 12-week, seven; 16week models) were included. The mean ECV values significantly increased from the 6th week (pre vs. 6th week vs. 12th week vs. 16th week; 29.4±2.0 vs. 31.8±3.4 vs. 36.1±5.4 vs. 40.1±4.1, p-value<0.05). There was a good correlation between myocardial ECV measured by cardiac MRI and the degree of fibrosis (r=0.75, p-value<0.001). On electron microscopy, myocyte hypertrophy, mitochondrial swelling, pleomorphism and Z band disruption were noted. Collage bundle and strands were significantly increased in extracellular space in 12 and 16 week model specimens.

**CONCLUSION**

The ECV measured by contrast enhanced MRI in DCR models significantly increased from 6th week and ECV showed good correlation with histologic fibrosis.

**CLINICAL RELEVANCE/APPLICATION**

MR ECV is a noninvasive useful method for a quantification of diffuse myocardial fibrosis which can replace endomyocardial biopsy.

---

**SST02-03**

Assessment of Extracellular Volume Fraction in Doxorubicin Induced Dilated Cardiomyopathy Rabbit Models Using Dual Energy Computed Tomography: Comparison with Contrast Enhanced Magnetic Resonance Imaging and Histologic Findings

Yoo Jin Hong MD (Presenter): Nothing to Disclose , Donghyun Hong MS : Nothing to Disclose , Chul hwan Park MD : Nothing to Disclose , Jin Hur MD : Nothing to Disclose , Young Jin Kim MD : Nothing to Disclose , Hye-Jeong Lee MD : Nothing to Disclose , Sae Rom Hong MD : Nothing to Disclose , Young Joo Suh MD : Nothing to Disclose , Yun Jung Kim MD : Nothing to Disclose , Dong Jin Im : Nothing to Disclose , Byoung Wook Choi MD : Nothing to Disclose

**PURPOSE**

To validate extracellular volume (ECV) fraction using dual energy computed tomography (CT) and to compare it with contrast enhanced magnetic resonance imaging (MRI) and histologic findings.

**METHOD AND MATERIALS**

Dilated cardiomyopathy rabbit (DCR, male adult New Zealand White rabbit, 3-4 kg) model was made by injecting doxorubicin (Doxorubicin Hydrochloride, Cayman) at doses of 1.0mg/kg twice a week for 16weeks. Every rabbit underwent both dual-energy CT (Siemens Somatom, Forchheim) and cardiac MRI (Siemens Magnetom, Erlangen) within two hours with pre-/post- T1 mapping using modified Look-Locker inversion recovery (MOLLI) sequence, LGE, and cine MRI on a clinical 3-T system. Rabbits underwent CT and MRI
examination before drug administration (Control group) and two week interval until 16 weeks after DCR modeling. CT ECV was quantitatively assessed by measuring Hounsfield units (HUs) in the septum in a short-axis view on iodine maps with the following equation ECV= \((\Delta HU_{myocardium}/\Delta HU_{blood}) \times (1 - \text{hematocrit (Hct)})\), \(\Delta HU_{post-contrast} - \Delta HU_{pre-contrast}\). MR ECV was also calculated at the same area using the following equation: ECV = \(\frac{1/T1_{post-contrast myocardium}}{1/T1_{post-contrast blood}}\)\times(1-Hct)

RESULTS

Three control and seventeen DCR model were included. The mean CT ECV values were significantly elevated at the 6th week and continued to rise until the 16th week of the DCR modeling (pre vs. 6 weeks vs. 16 weeks; 28.1±2.2 vs. 35.3±6.8 vs. 41.5±1.4, p-value<0.05) and there was a good correlation between CT ECV and MR ECV \((r=0.803, p<0.001)\) and between CT ECV and degree of fibrosis \((r=0.79, p<0.001)\).

CONCLUSION

Dual energy CT is a noninvasive feasible study to measure diffuse myocardial fibrosis quantitatively using CT ECV without misregistration error.

CLINICAL RELEVANCE/APPLICATION

CT ECV using dual energy CT is a noninvasive useful method for a quantification of diffuse myocardial fibrosis which can replace endomyocardial biopsy.

SST02-04

Extracellular Volume Fraction in Dilated Cardiomyopathy Patients without Obvious Late Gadolinium Enhancement: Comparison With Healthy Control Subjects

Yoo Jin Hong MD : Nothing to Disclose , Chul hwan Park MD (Presenter): Nothing to Disclose , Young Jin Kim MD : Nothing to Disclose, Jin Hur MD : Nothing to Disclose, Hye-Jeong Lee MD : Nothing to Disclose, Sae Rom Hong MD : Nothing to Disclose, Young Joo Suh MD : Nothing to Disclose, Yun Jung Kim MD : Nothing to Disclose, Dong Jin Im : Nothing to Disclose, Tae Hoon Kim MD : Nothing to Disclose, Byoung Wook Choi MD : Nothing to Disclose

PURPOSE

To evaluate whether the extra-cellular volume fraction (ECV) measured using cardiac MRI can detect myocardial tissue changes in dilated cardiomyopathy (DCM) without late gadolinium enhancement (LGE).

METHOD AND MATERIALS

Forty-one DCM patients (26 men, 15 women; mean age, 52.8 ± 16.4 years; range, 17–84 years), and 10 healthy volunteers (7 men, 3 women; mean age, 53.5 ± 4.0 years; range, 48–60 years) underwent pre- and post- T1 mapping using a modified Look-Locker inversion recovery (MOLLI) sequences, LGE, and cine MRI on a clinical 3-T cardiac magnetic resonance (CMR) system. LGE-MR findings were used to divide DCM patients into two groups: Group A had no apparent LGE, and Group B had LGE apparent in at least one segment. The average ECV of left ventricle (LV) myocardium (16 segments) was calculated in short-axis view using the myocardial T1 value, LV blood pool T1 value, and hematocrit as follows: ECV = \(\frac{(1/T1_{post contrast myocardium} - 1/T1_{pre-contrast myocardium}) \times (1-Hct)}{(1/T1_{post-contrast blood}) - (1/T1_{pre-contrast blood})}\).

RESULTS

Among the 41 DCM patients, 22 were in Group A, and 19 were in Group B. The mean ECV of DCM patients \((n = 41, 568 segments, 30.7% ± 5.9)\) was significantly higher \((p < 0.001)\) than that of the control group \((n = 10, 157 segments, 25.6% ± 3.2)\). When ECV was correlated with LVEF measured by cine MRI, the ECV was inversely related to LVEF in Group A \((r = -0.551, p = 0.008)\), Group B \((r = -0.525, p = 0.021)\), and Group A+B \((r = -0.550, p < 0.001)\).

CONCLUSION

The ECV measured by MRI could be a useful parameter in evaluating diffuse myocardial changes in DCM patients.

CLINICAL RELEVANCE/APPLICATION

The results of our study showed that quantification of the ECV using CMR was an effective method for detecting myocardial changes in DCM patients, even in cases where LGE was not apparent in the myocardium. The ECV measured using the T1 mapping technique could be a useful non-invasive tool to replace endomyocardial biopsy.

SST02-05

Increased Myocardial Extracellular Volume Fraction in Diabetic Patients Is Associated with LV Diastolic Dysfunction: A CMR Feasibility Study

Diabetes (DM)-related myocardial changes of myocardial fibrosis and collagen deposition may lead to increased myocardial extracellular volume fraction (ECV) and myocardial stiffness. In this study, we hypothesize that increased ECV measured with quantitative CMR methods in DM patients will correlate with LV diastolic dysfunction.

**METHOD AND MATERIALS**

17 DM patients (6 males, age 63±10 years old) without macrovascular complications were examined on a 1.5T MR system. A short-axis SSFP stack was used to determine LV function, a pre-contrast T1 prep or a modified Look-Locker sequence was performed in a mid-LV level from which a T1 map and average LV systolic function of LVEF, LVESV, LVEDV, LVSV and LVM were derived. No focal LGE was observed in this patient cohort. 8 of 17 subjects had ECV > 30% (38±9%) and the other 9 subjects had ECV < 30% (23±5%). There is no statistically significant difference (P>0.05) in LV systolic function of LVEF, LVESV, LVSV and LVM between the increased ECV and normal ECV group. However, a statistically significant difference (P<0.05) was observed among diastolic functional parameters of TPFR and PFR, with significantly longer TPFR (344±148 vs 156±32 ms) and lower PFR (220±50 vs. 295±74 ml/s) observed in the increased ECV group. Also a statistically significant difference (P<0.05) was observed in pre-contrast T1 measurements.

**CONCLUSION**

Increased ECV was observed in diabetic patients with preserved systolic function and this was associated with altered LV diastolic function. The increased ECV may indicate the presence of diffuse interstitial fibrosis and myocardial stiffness, thus limiting the LV diastolic relaxation.

**CLINICAL RELEVANCE/APPLICATION**

Quantitative T1 mapping may be useful for the detection of increased ECV which is associated with LV diastolic dysfunction.

---

**SST02-06**

Cardiac Computed Tomography versus Cardiac Magnetic Resonance for Characterization of Left Atrium Anatomy before Radiofrequency Catheter Ablation of Atrial Fibrillation: Impact on Radiation Exposure and Outcome

**PURPOSE**

The aim of this study is to compare the procedural characteristics, overall radiation exposure and clinical outcomes between radiofrequency catheter ablation (RFCA) of atrial fibrillation (AF) guided by image integration with CCT versus CMR.

**METHOD AND MATERIALS**

400 consecutive patients with drug-refractory paroxysmal or persistent AF were randomized to CT (Group 1: N: 200; mean age: 61±10.9 yr; male:155) or MR (Group 2: N: 200; mean age: 59.7±10.4 yr; male:166) for evaluation of LA before RFCA. CT was performed with 64-slices scanner (Discovery CT 750HD, GE Healthcare, Milwaukee, WI) and MR was performed with 1.5-T scanner (Discovery MR450, GE Healthcare, Milwaukee, WI) using a non-triggered contrast enhancement MR angiography sequence. All patients were treated by image integration-supported RFCA. LA diameter, LA volume, pulmonary veins anatomy and ostial dimensions, procedural characteristics, overall radiation exposure and rate of AF recurrence were measured in the two groups.

**RESULTS**

The two groups were homogeneous in terms of demographic characteristics, cardiovascular risk factors, prevalence of persistent AF, medical therapy and echocardiographic characteristics. The mean follow-up was similar (557±302 vs 523±265 days, respectively, p=0.24). Group 1 showed higher LA volume versus group 2 (174±46 vs 101±40 ml, p<0.001). The procedural characteristics [fluoroscopy time (32.6±16.0 vs 35.0±16.6 min, p=0.15)] procedural duration (180.2±59.0 vs 182.8±53.5 s, p=0.65), pulmonary veins identified (4±0.1 vs. 3.9±0.2, p=0.08); pulmonary veins targeted (3.9±0.4 vs 3.9±0.4, p=0.03); pulmonary veins isolated (3.9±0.4 vs 3.9±0.4, p=0.93) and the rate of AF recurrence (29% vs 46%, p=0.5) were similar between the two groups. Group 1 showed a higher overall cumulative radiation exposure (40.4±23.7 vs 32.8±23.5, p<0.005), and LA volume measured by MR was the most robust independent predictor of AF recurrence at multivariate analysis (HR: 1.08 (1.01-1.15), p=0.02).

**CONCLUSION**

Increased ECV was observed in diabetic patients with preserved systolic function and this was associated with altered LV diastolic function. The increased ECV may indicate the presence of diffuse interstitial fibrosis and myocardial stiffness, thus limiting the LV diastolic relaxation.

Quantitative T1 mapping may be useful for the detection of increased ECV which is associated with LV diastolic dysfunction.
MR integration-supported RFCA procedure seems to be associated with a lower overall cumulative radiation despite similar outcome in comparison with CT-guided RFCA.

**CLINICAL RELEVANCE/APPLICATION**

MR imaging is a good guide for atrial fibrillation ablation procedure.

### SST02-07

"Heart of Brightness" – Delayed Enhancement Detection using Motion Corrected (MOCO) Phase Sensitive Inversion Recovery (PSIR) Imaging in Non-Ischemic Cardiomyopathy

Oisin Jude Flanagan MBChB, MRCPI (Presenter): Nothing to Disclose, Shivraman Giri PhD: Employee, Siemens AG, Bruce Spottiswoode: Employee, Siemens AG, Sven Zuelpirdhoff PhD: Employee, Siemens AG, Xiaoming Bi PhD: Nothing to Disclose, Maria Carr: Nothing to Disclose, Michael Markl PhD: Nothing to Disclose, Jad Marwan Bou Ayache MD: Nothing to Disclose, Markel Deja Ferrer, Botelho MD: Nothing to Disclose, Jeremy Douglas Collins MD: Consultant, B. Braun Melsungen AG, Robert R. Edelman MD: Research support, Siemens AG Royalties, Siemens AG, James Christopher Carr MD: Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA

**PURPOSE**

To improve image quality and diagnostic confidence in characterizing non-ischemic delayed enhancement (DE) sequences in all patients, including those with irregular cardiac rhythms and poor breath-holding ability.

**METHOD AND MATERIALS**

28 consecutive out-patients (11F, 17M age 25-84 years, mean 62.2) with possible non-ischemic cardiomyopathy were referred for cardiac MRI on a 1.5T system (MAGNETOM Aera, Siemens AG, Erlangen, Germany). Two standard PSIR sequences of free breathing single shot steady state free precession (FB single shot SSFP) and breath hold (BH) turboflash (TF) were performed as well as a prototype sequence FB MOCO SSFP. This latter sequence used respiratory motion compensation based on nonrigid image registration and motion corrected averaging to enhance SNR. The anonymized Images were independently graded by two blinded experienced cardiovascular radiologists for image quality (1 to 5), diagnostic confidence (1 to 3), the presence of DE (using a 16 segment model). Each segment was analysed for location of DE (subendocardial, midmyocardial or subepicardial) and finally for segmental artefact.

**RESULTS**

15 of 28 patients showed non-ischemic DE. Image quality for FB single shot SSFP, BH TF and FB MOCO SSFP were 3.80, 3.15 and 3.87 respectively. Diagnostic confidence was 2.63, 2.35 and 2.70 and the number of segments degraded by artefact was 41, 112 and 34. Total DE segments detected were 92, 119 and 112 in an approximate distribution of 68% subendocardial, 24% midmyocardial and 3% subepicardial across all three techniques.

**CONCLUSION**

FB MOCO SSFP had higher image quality and diagnostic confidence and less artifact than both FB single shot SSFP and BH TF. It detected more DE than FB single shot SSFP. BH TF detected the most DE but with the lowest image quality and diagnostic confidence and the most artefact. This suggests that in non-ischemic cardiomyopathy, FB MOCO SSFP is overall superior to FB single shot SSFP and superior to BH TF in the large number of cases where BH TF images are poor.

**CLINICAL RELEVANCE/APPLICATION**

As increasingly sicker patients undergo cardiac MRI, robust motion corrected images are needed to combat their poor breathholding and fast or irregular rhythms. This sequence provides this and will be increasingly important over time.

**SST02-08**

Cardiac Keynote Speaker: Non-ischemic Cardiomyopathy—Techniques and Applications

James Christopher Carr MD (Presenter): Research Grant, Astellas Group Research support, Siemens AG Speaker, Siemens AG Advisory Board, Guerbet SA
T1-, T2-Mapping and Extracellular Volume Quantification for the Diagnosis of Subclinical Acute Cellular Rejection in Patients after Heart Transplantation Using Magnetic Resonance Imaging

Lysann Hildebrand MD (Presenter): Nothing to Disclose, Clara Frank: Nothing to Disclose, Matthias Gutberlet MD, PhD: Nothing to Disclose

PURPOSE
To evaluate if cardiovascular magnetic resonance (CMR) is a suitable method for identifying subclinical acute cellular rejection (ACR) requiring treatment in patients post heart transplantation (HTx), using T1- and T2-Mapping techniques as compared to conventional CMR techniques for inflammation assessment using endomyocardial biopsy (EMB) as the standard of reference.

METHOD AND MATERIALS
Thirty-five CMRs were performed in 20 patients (mean age 53±11 years, 24 male) using a 1.5T scanner compared to EMB. The CMR protocol included a T2w STIR-sequence to calculate the myocardial edema ratio (ER), a T1w spinecho and inversion recovery sequence for global relative (gRE) and late gadolinium enhancement (LGE), as well as a modified Look-Locker inversion-recovery (MOLLI) sequence before and 15 minutes after administration of 0.1 mmol/kg/body weight of Gadobutrol (Gadovist, Bayer HealthCare Pharmaceuticals, Berlin, Germany) i.v. for T1-quantification and a free-breathing, navigator-gated multi-echo sequence for T2-quantification. T1- pre- and postcontrast, T2- and ECV-maps were calculated with the software (cv42, Calgary, Canada).

RESULTS
No or a mild ACR (ISHLT <1B) was revealed in 20/35, ACR requiring treatment in 15/35 EMBs. The area-under-the-curve (AUC) of the receiver operating characteristic (ROC) analysis were only 0.54 for the ER and 0.52 for gRE, but 0.65 for native T1-Mapping, 0.66 for ECV, 0.73 for T2-Mapping and 0.78 for postcontrast T1-Mapping. Similar to myocarditis the best cut-off values for ER were ≥2 and for gRE ≥4.5. The best sensitivity and specificity (%) could be achieved with T2-Mapping using a cut off 65ms (73/70), for T1-Mapping postcontrast using a cut off of 342ms (73/70) and for ECV with a cut off of 42 (67/70), respectively. Native T1-Mapping using a cut off of 1060 ms achieved a very high sensitivity (87%) but only low specificity (45%).

CONCLUSION
Especially T2- and T1-Mapping postcontrast as well as ECV quantification seem to be promising tools to identify subclinical ACR in patients after HTx, better than the calculation of the ER and gRE. This may help to potentially reduce, if not eliminate, the need for EMB in these patients.

CLINICAL RELEVANCE/APPLICATION
In patients post HTx, CMR using T1- and T2-Mapping techniques is a suitable method for identifying subclinical ACR requiring treatment.

Diagnostic Performance of the Combined CT Protocol of Coronary CT Angiography and Dynamic Myocardial CT Perfusion Imaging to Assess Obstructive Coronary Artery Disease

Yuki Tanabe (Presenter): Nothing to Disclose, Teruhito Kido MD, PhD: Nothing to Disclose, Takahiro Yokoi: Nothing to Disclose, Shintaro Tsuruoka: Nothing to Disclose, Naoki Fukuyama: Nothing to Disclose, Takuya Matsuda: Nothing to Disclose, Rami Yokoyama: Nothing to Disclose, Masashi Nakamura: Nothing to Disclose, Yoshiko Nishiyama MD: Nothing to Disclose, Masao Miyagawa MD, PhD: Nothing to Disclose, Teruhito Mochizuki MD: Nothing to Disclose

PURPOSE
The aim of this study was to evaluate the diagnostic performance of the combined CT protocol of coronary computed tomography angiography (CCTA) and pharmacological stress dynamic myocardial CT perfusion (CTP) to identify obstructive coronary artery disease (CAD).

METHOD AND MATERIALS
The study group comprised 32 patients (mean age 68.1±7.8 years) who underwent ATP stress dynamic CTP using 256-slice multi detector row CT and myocardial perfusion imaging (MPI) (SPECT or cardiac MRI) prior to invasive coronary angiography (ICA). Dynamic CTP (whole heart datasets over 30 consecutive heart beats in systole) was acquired with prospective ECG gating, and subsequently CCTA scan was performed. We evaluated the diagnostic performance of the combined protocol of CCTA and quantitative CTP assessment for detecting obstructive CAD. Obstructive CAD was defined as stenosis>=50% on ICA with corresponding perfusion defect on MPI. Quantitative CTP assessment was performed with myocardial blood flow (MBF) index (mL/g/min), which was calculated by Patlak plots analysis. Results of the MBF index were compared with the results of MPI by receiver operating characteristic (ROC) analysis. The uncertain vessels on CCTA because of calcium and motion artifacts were assumed as having significant stenosis >=50% on ICA. The combined protocol was classified positive if MBF was less than the cut-off point on CTP in areas corresponding to coronary stenosis >=50% on CCTA. The combined protocol was negative if no stenosis >=50% were detected on CCTA or if MBF were more than the cut-off point in areas supplied by vessels with significant stenosis or uncertain finding on CCTA.
RESULTS
In comparing quantitative CTP assessment with MPI, area under the ROC curve and the optimal cut-off point were 0.86 and 1.28 (mL/g/min) and sensitivity, specificity, positive predict value (PPV) and negative predict value (NPV) were 88.1%, 79.6%, 77.1% and 89.6% on a vessel level. The combined CT protocol had sensitivity of 87.8%, specificity of 83.6%, PPV of 80% and NPV of 90.2% for detecting obstructive CAD.

CONCLUSION
The combination of CCTA and quantitative CTP assessment allows comprehensive, obstructive and precise assessment of obstructive CAD with single modality.

CLINICAL RELEVANCE/APPLICATION
The combined protocol of CCTA and CTP may be non-invasive useful tool for assessment coronary artery disease by one time CT examination.

Coronary Calcium Scores are Underestimated at a Large Body Size: A Multivendor Phantom Study
Martin J. Willeminke MD (Presenter): Nothing to Disclose, Bronislaw Abramiuc: Nothing to Disclose, Niels R. van der Werf: Nothing to Disclose, Tineke Petra Willems MD, PhD: Nothing to Disclose, Marcel Greuter PhD: Nothing to Disclose, Tim Leiner MD, PhD: Speakers Bureau, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Bracco Group

PURPOSE
Recent guidelines from the American Heart Association recommend coronary calcium scoring (CCS) with computed tomography (CT) for patients at low-to-intermediate and intermediate cardiovascular risk. Previous studies have shown that obesity is related to increased CCS. With the increasing prevalence of obesity it is essential to assess whether CCS is performed adequately in heavy patients. However, the effect of body size has not been evaluated yet on routinely used protocols of current state-of-the-art CT systems. The purpose of the current study is to evaluate the effect of body size on CCS as assessed with new-generation CT systems from the four major vendors.

METHOD AND MATERIALS
An anthropomorphic chest phantom containing 100 small calcifications (diameters 0.5-2.0 mm) was evaluated with and without an extension ring using routine protocols of state-of-the-art CT systems from four vendors. The extension ring was used to mimic a heavy patient. Image acquisition was repeated five times with small translations and/or rotations. Routine acquisition protocols for both medium and heavy patients were used. CCS was quantified as Agatston and mass scores with software from the same manufacturer as the CT systems.

RESULTS
The medium sized phantom resulted in median (interquartiles) Agatston scores of 10 (9-35), 113 (72-133), 34 (30-37) and 87 (85-89) for Philips, GE, Siemens and Toshiba, respectively. Mass scores were 4 (3-9), 18 (14-21), 8 (8-9) and 20 (20-20) mg, respectively. Adding the extension ring resulted in reduced Agatston scores for all vendors (17-86%) and mass scores for three vendors (11-86%). Median Agatston scores decreased to 9 (5-10), 16 (15-20), 27 (24-32) and 45 (29-53) units, and median mass scores increased for Philips to 4 (4-6) and decreased for the other vendors to 2 (2-4), 8 (7-8) and 10 (8-13) mg, respectively.

CONCLUSION
This multivendor phantom study showed that CCS is underestimated up to 86% at a larger body size. Therefore, a correction factor should be used for CCS of heavy patients, or image acquisition protocols should be standardized across platforms of different vendors.

CLINICAL RELEVANCE/APPLICATION
Body size is an important determinant of the coronary calcium score and may impact perceived risk for future cardiovascular events.

The Utility of Cardiac CT in Evaluating Left Ventricular Diastolic Dysfunction
Anto Sedlic MD : Nothing to Disclose, Elena Scali MD (Presenter): Nothing to Disclose, Savvas Nicolaou MD : Nothing to Disclose, John R. Mayo MD : Speaker, Siemens AG

PURPOSE
Left ventricle (LV) diastolic dysfunction in the setting of heart failure with preserved ejection fraction is a diagnostic and therapeutic challenge with significant associated morbidity and mortality. Diastolic dysfunction is associated with abnormal LV relaxation or increased LV stiffness. Although catheterization is the gold standard in evaluation of diastolic dysfunction, the diagnosis is usually made by echocardiography. In patients undergoing retrospective cardiac computed tomography angiography (CTA), functional data can be used to quantify LV volume over time to measure the rate of LV diastolic filling in diastolic dysfunction.

METHOD AND MATERIALS
20 patients undergoing cardiac CTA were reviewed for CT evidence of diastolic dysfunction. All patients had diastolic dysfunction on echocardiography with preserved systolic function. Retrospective CTA was performed and LV filling curves were obtained from the functional images by application of post-processing software. LV volume was measured at 5% intervals over the cardiac cycle. LV volume versus time was plotted and the slope measured at various points in diastole to compare LV filling velocity. LV filling rates in early diastole, after mitral valve opening, was compared between patients with diastolic dysfunction and patients with normal diastolic function. LV filling due to left atrial contraction (A wave) was also measured in both groups and quantified as percent of total stroke volume.

RESULTS

In patients with diastolic dysfunction, early LV filling is impaired. Comparing patients with preserved LV ejection fraction, the early diastolic LV filling rate was measured at 218.4 ml/sec (95% CI: 199.7 to 237.5) compared to 308.6 ml/sec (95% CI: 278 to 338.6) for normal controls. LA contraction (A wave contribution) was also demonstrated to contribute to LV stroke volume filling to a greater extent in the diastolic dysfunction group, however, initial results did not demonstrate a statistically significant difference in volume.

CONCLUSION

Initial results demonstrate that functional cardiac CTA can identify patients with left ventricular diastolic dysfunction and may have a role in the assessment and quantification of diastolic dysfunction.

CLINICAL RELEVANCE/APPLICATION

Diastolic dysfunction is a diagnostic challenge that can be identified and quantified with functional cardiac CTA.

SST03-05

A Systematic Evaluation of Three Different Cardiac T2-mapping Sequences at 1.5 and 3T in Healthy Volunteers


PURPOSE

One of the main challenges of the T2-mapping technique is the high variability of the T2 relaxation times leading to difficulties in discriminating "still physiologic" from "already pathologic" in the case of myocardial edema. As the T2 relaxation times vary significantly depending on field strength, sequence and other influence factors, the purpose of this study was to compare three different T2-mapping sequences at 1.5T and 3T in healthy volunteers (HV) and to investigate the influence of cofactors on the T2 relaxation times.

METHOD AND MATERIALS

Until today, we enrolled 16 HV. Each HV was examined on a clinical 1.5T and 3T scanner in immediate succession in the morning. A third scan was performed on the 1.5T scanner in the evening of the same day. In each examination three different T2-mapping sequences were performed at a basal, midventricular and apical slice in short axis view: Multi Echo Spin Echo (MESE), T2-prepared balanced Steady State Free Precession (T2prep; Giri et al., 2009) and Gradient Spin Echo (GraSe). Segmented T2-Maps were generated for each slice according to the AHA 17-segment model.

RESULTS

The cofactor "heart rate" proved to have significant impact on the measured T2 relaxation times. Therefore, correction for this cofactor was performed for all further statistical analyses. Significantly lower T2 relaxation times were observed between the T2prep sequence and all other sequences at 3T (p < 0.001) and at 1.5T (p < 0.05 for T2prep vs. MESE and p < 0.001 for T2prep vs. GraSe). The GraSe sequence resulted in significantly higher T2 relaxation times compared to MESE at 3T (p < 0.005) and at 1.5T (p < 0.001). Comparing T2 relaxation times between 1.5 and 3T significant differences were found for T2prep and GraSe (p < 0.001). No significant daytime variations were observed between the morning and evening scans.

CONCLUSION

The evaluation of different T2 mapping sequences at 1.5 and 3T in the heart of healthy volunteers represents a systematic approach to cardiac T2-mapping and underlines the need for dedicated reference maps for each sequence and field strength, as well as the need for a correction of the cofactor "heart rate".

CLINICAL RELEVANCE/APPLICATION

Myocardial edema is an important factor in several cardiac diseases. Cardiac T2-mapping promises to be a quantitative approach in edema imaging, overcoming some limitations of qualitative edema assessment.

SST03-06

Quantitative Coronary Plaque Burden and Contrast Density Difference from Coronary CTA Predict Ischemia by SPECT in Men and Women


PURPOSE

We aimed to investigate if quantitative plaque burden and luminal contrast density differences measured from
Diagnostic Performance of Myocardial Blood Flow Index Derived from Dynamic Computed Tomography Perfusion Image: Comparison with Invasive Coronary Angiography, SPECT and Cardiac MR Myocardial Perfusion Image

Yuki Tanabe (Presenter): Nothing to Disclose, Teruhito Kido MD, PhD : Nothing to Disclose, Takahiro Yokoi : Nothing to Disclose, Shintaro Tsuruoka : Nothing to Disclose, Naoki Fukuyama : Nothing to Disclose, Takuya Matsuda : Nothing to Disclose, Rami Yokoyama : Nothing to Disclose, Masashi Nakamura : Nothing to Disclose, Yoshiko Nishiyama MD : Nothing to Disclose, Masao Miyagawa MD, PhD : Nothing to Disclose, Teruhito Mochizuki MD : Nothing to Disclose

PURPOSE
The aim of this study was to evaluate the feasibility of myocardial blood flow (MBF) index derived from whole heart dynamic myocardial perfusion imaging using 256-slice multi detector row computed tomography (256-slice MDCT) with adenosine triphosphate (ATP) stress.

METHOD AND MATERIALS
This study group comprised of 52 patients (mean age 68.7±7.5 years, males, 73.1%) who underwent ATP stress dynamic myocardial CT (CTP) perfusion scans without table movement by using 256-slice MDCT with an 8-cm detector. Moreover, all patients underwent invasive coronary angiography (ICA) (44 patients), single-photon emission CT myocardial perfusion imaging (SPECT-MPI) (20 patients) or cardiac magnetic resonance myocardial perfusion imaging (CMR-MPI) (24 patients). Stress dynamic CTP (whole-heart datasets over 30 consecutive heart beats in systole without spatial and temporal gaps) was acquired with prospective ECG gating (effective radiation dose: 10.6 mSv). MBF index (mL/g/min) was calculated by Patlak plots analysis. Results of the MBF index were compared with the results of ICA, SPECT-MPI or CMR-MPI by receiver operating characteristic (ROC) analysis. Significant stenosis in ICA was defined as more than 75%. SPECT-MPI and CMR-MPI were assessed visually for detecting myocardial ischemia according to the AHA 16-segment model. In all cases, CTP was accomplished without severe side effects. On a vessel-based model, area under the ROC curve (AUC) and the optimal cut-off point (mL/g/min) were 0.841, 1.28 for ICA, 0.852, 1.13 for SPECT-MPI and 0.867, 1.28 for CMR-MPI. Sensitivity, specificity, positive and negative predictive values and accuracy were 82.8%, 73.5%, 74.6%, 82.0% and 78.0% for ICA (132 vessels), 75.0%, 90.9%, 75.0%, 90.9% and 86.7% for SPECT-MPI (60 vessels) and 82.9%, 86.5%, 85.3%, 84.2% and 84.7% for CMR-MPI (72 vessels).

CONCLUSION
Quantitative assessment by MBF index is useful for non-invasive evaluation of the severe coronary artery stenosis and myocardial ischemia.

CLINICAL RELEVANCE/APPLICATION
MBF index derived from dynamic myocardial CT perfusion imaging may enable non invasive, obstructive and precise assessment of coronary artery disease.
Regional myocardial strains have the potential for earlier quantification and detection of cardiac dysfunction compared with global geometric measurements. Although image modalities such as tagged and CSENC MRI can provide motion information of the myocardium, they are not common practices in clinical routine. Therefore, accurate strain estimation from more available cardiac CT can be beneficial.

**METHOD AND MATERIALS**

As cardiac CT can only provide motion information of salient features such as heart surfaces, additional information is required. For physiologically plausible and clinically applicable strain estimation, we propose to use a hyperelastic biomechanical model. Four canine cardiac CT sequences with artificially induced myocardial infarction were used for evaluation. Each cardiac cycle (0.52-0.89s) has 20 frames with voxel size < 0.3x0.3x1 mm3. The infarced regions were identified by experts using perfusion CT on the American Heart Association nomenclature (17 zones). Image segmentation and meshing were performed at end-diastole to provide the finite element (FE) model of the heart. Deformable image registrations based on B-spline interpolation and mutual information were performed on the whole sequence to provide the motion information on the heart surfaces. The displacements between frames were enforced as boundary conditions to the FE model, and hyperelastic biomechanics was applied to compute the quantitative myocardial strains.

**RESULTS**

The estimated zonal first principal strains at end-systole are consistent with the infarction manually identified by experts, with the average Cohen’s kappa as 0.77+/-.022. The average strain value of the 22 infarcted zones is 0.13+/-.007, and that of the 46 normal zones is 0.37+/-.017 (p<0.0001).

**CONCLUSION**

With the use of the hyperelastic biomechanical model, myocardial strains can be quantified from the motion of the salient cardiac features extracted from images. The consistency between the expert identification and the estimated strains shows that this framework is promising for cardiac diagnosis.

**CLINICAL RELEVANCE/APPLICATION**

Cardiac CT is commonly available in clinical routine and the regional myocardial strains estimated from CT have the potential for early quantification and detection of cardiac dysfunction.

**Purpose**

To show that standard gadolinium dose administration (in mmol/kg) results in biased post-contrast T1 values which can result in erroneous interpretation of results even after normalizing for dose, time and GFR. After application of the corrected dose values based on accurate estimates of blood volume, the results show a dramatic change.

**METHOD AND MATERIALS**

605 subjects who had undergone T mapping using the MOLLI sequence were retroactively selected from the MESA study based on availability of a complete set of physiological parameters. Precontrast blood and myocardial T1 values were corrected for heart rate bias. Post-contrast blood and myocardial T1 values obtained at time=12min and dose=0.15 mmol/kg were normalized for slight differences in dose and for GFR using an analytical model. The given dose in mmol/kg was then adjusted based on an accurate estimate for blood volume proposed by Lemmens (Obesity Surgery 2006;16:773-776). The adjusted values of dose were again used to normalize post-contrast blood and myocardial T1 values for dose and GFR. Post contrast blood T1 values were compared with subject BMI using Pearson correlation. As an example of how this bias can affect interpretation, we analyzed post-contrast myocardial T1 values before and after dose adjustment for subjects with metabolic syndrome (METS, n=177) and with no METS (n=428) using Student’s t-test.

**RESULTS**

Post-contrast blood T1 showed a strong correlation with BMI (R = -0.257, P<0.001) prior to adjustment for dose (based on blood volume) and no significant correlation after correction based on Lemmens estimate for blood volume (R = -0.011, P=0.79). Post-contrast myocardial T1 showed significant differences between METS and non-METS groups (P<0.0001) prior to dose adjustment and no significance (P=0.96) after correction.

**CONCLUSION**

Contrast based on mmol/kg overestimates dose at higher BMIs. A correction for dose based on accurate blood
volume estimate is proposed. Multiple linear regression analysis models can reveal significant relationships and correct for covariates. However, there can be confusion whether both BMI (risk factor for METS) and T1 (measure of fibrosis) could be used as independent measures of METS. Our analysis helps circumvent an erroneous and confusing deduction.

**CLINICAL RELEVANCE/APPLICATION**

Standard contrast dosing (in mmol/kg) needs to be corrected for bias due to BMI which can lead to erroneous interpretation based on post contrast T1 values.

---

**SST04**

**Chest (Dual Energy: Spectral CT/Vascular)**

**Scientific Papers**

<table>
<thead>
<tr>
<th>CT</th>
<th>BQ</th>
<th>VA</th>
<th>CH</th>
</tr>
</thead>
</table>

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50
Fri, Dec 5 10:30 AM - 12:00 PM  Location: E451B

**Participants**

**Moderator**
- Myrna Cobos Barco Godoy MD, PhD : Nothing to Disclose

**Moderator**
- Jens Vogel-Claussen MD : Nothing to Disclose

**Sub-Events**

**SST04-01**

**Quantification of MRI Derived Regional Pulmonary Parenchymal Perfusion and Cardiac Function for Assessment of Hemodynamic Changes before and after Pulmonary Endarterectomy in Patients with Chronic Thromboembolic Pulmonary Hypertension**

Christian Olaf Schoenfeld MD (Presenter): Nothing to Disclose, Serghei Cebotari MD : Nothing to Disclose, Jan Hinrichs MD : Nothing to Disclose, Julius Renne MD : Nothing to Disclose, Marcel Gutberlet DiplPhys : Nothing to Disclose, Andreas Voskrenzhev : Nothing to Disclose, Tobias Welte MD : Nothing to Disclose, Marius Hooper : Nothing to Disclose, Axel Haverich : Nothing to Disclose, Frank K. Wacker MD : Research Grant, Siemens AG Research Grant, Pro Medicus Limited, Jens Vogel-Claussen MD : Nothing to Disclose

**PURPOSE**

An established method for treatment of patients with chronic thromboembolic pulmonary hypertension (CTEPH) is pulmonary endarterectomy (PEA). The aim of the study is to evaluate the surgical success after PEA by means of cardio-pulmonary MRI.

**METHOD AND MATERIALS**

16 patients (53±17 years; 9 male) with CTEPH were examined with a 1.5T MRI before and 17±12 days after PEA. After contrast medium bolus administration the lung was evaluated with a dynamic 3D FLASH sequence (TWIST) with an update rate of 1.2s per 3D data set and the pulmonary blood flow (PBF) was determined using a deconvolution algorithm. Furthermore, the left (LV), right ventricular (RV) function and cardiac mass were determined. Mean pulmonary artery pressure (mPAP) was measured before and after PEA by right (r.) heart catheterization. Means ± SD, paired t-test.

**RESULTS**

Regional PBF after PEA increased significantly in: total lung parenchyma by 48% (37.3±12.8 to 55.1±19.4ml/min/100ml, p=0.001), r. upper lobe (UL) by 29% (p=0.048) (cardiac output (CO) adjusted: 2% (p=0.873), the middle lobe by 70% (p=0.003)(CO adjusted: 30%, p=0.079), the r. lower lobe (LL) to 74% (p=0.003) (CO adjusted: 36% (p=0.02), LV by 25% (p=0.01) (CO adjusted: 5% (p=0.653) and the IL by 59% (p<0.001) (CO adjusted: 25% (p=0.008). After PEA RV mass decreased by 17% (46.5 to 38.5g/m², p=0.006). Ventricular mass index decreased by 19% (0.69 to 0.56, p=0.001) and RV function increased: RV end-diastolic volume by -14.6% (91.0 to 77.7ml/m², p=0.037), RV end-systolic volume by -38% (63.7 to 39.5ml/m², p=0.0008), RV ejection fraction by +25% (40.2 to 50.2%, p=0.0004). Cardiac index increased by 28% (2.8 to 3.3l/min/m², p=0.01) and LV systolic eccentricity index decreased by 19% (1.84 to 1.49, p=0.02) as a sign of improved pulmonary hemodynamics after PEA. Mean mPAP decreased significantly by 44% (45.4 to 25.4 mmHg, p<0.0001) after PEA.

**CONCLUSION**

Improvement of PBF is observed predominantly in the lower lungs 2 weeks after PEA: Even after adjusting for CO regional PBF improved in bilateral lower lobes and ML. Increased flow after PEA in bilateral upper lobes was proportional to increased CO in response to decreased pulmonary pressures in our patient cohort.

**CLINICAL RELEVANCE/APPLICATION**

In patients with CTEPH quantitative cardio-pulmonary MRI is a novel noninvasive clinical tool for comprehensive patient assessment pre and post PEA.
Evaluation of Monoenergetic Reconstruction on Pulmonary Angiography Using Spectral Detector CT

Andrew Sher MD : Research Grant, Koninklijke Philips NV, Abed Ghandour MD : Nothing to Disclose, Amar Dhanantwari : Employee, Koninklijke Philips NV, Luis Alberto Landeras MD : Institutional Grant support, Koninklijke Philips NV, Prabhakar Rajiah MD, FRCR (Presenter) : Institutional Research Grant, Koninklijke Philips NV

PURPOSE
Utilize the novel Spectral Detector CT (SDCT) system to retrospectively augment pulmonary artery enhancement on routine chest CT and assess whether resulting image sets enable diagnostic evaluation of pulmonary vasculature.

METHOD AND MATERIALS
29 patients underwent routine contrast-enhanced chest scans with SDCT (Philips Healthcare) following 70 ml IV contrast. 21 studies not in ideal angiographic phase were chosen, defined as not achieving attenuation greater than 200 HU in the main pulmonary artery. Monoenergetic image sets from 40 to 180 keV were retrospectively created. Images were assessed at fixed window level (30) and width (450). A 5-point scale measured subjective evaluation of central and peripheral arterial enhancement and image noise (1=Non-diagnostic, 5=Excellent). An ideal image set was chosen, defined as the highest energy set with attenuation greater than 200 HU in the main PA and a subjective image evaluation of diagnostically acceptable. At ideal energy, mean attenuation, noise, and signal-to-noise ratios of 9 ROIs throughout the pulmonary vasculature as well as subjective image quality were compared to the standard 120 kVp study. Paired t-test and Wilcoxon signed-rank test were used for analysis.

RESULTS
The mean optimal monoenergetic level was 53 keV ± 7.3. Optimal reconstructions showed higher attenuation than 120 kVp studies (241 ± 81 vs. 133 ±53 HU; p<.001). Image noise was significantly higher in monoenergetic studies (47.7±86.4 vs. 22.6 ±23.7; p<.001), while overall SNR remained significantly higher (13.1 ± 9.5 vs. 10.3 ± 6.4; p <.05). Subjective vascular enhancement within monoenergetic images was higher than 120 kVp images (Central: 4.2 ± .4 vs. 1.9 ± .8; p<.001, Peripheral: 4.6 ±.5 vs. 1.6 ± .7, p<.001). Subjective image noise was higher on monoenergetic images (4.4 ± .7 vs. 4.9 ± .3, p<.05) however all studies maintained diagnostic acceptability.

CONCLUSION
Optimal monoenergetic energy reconstruction of routine chest CT obtained on SDCT significantly increased pulmonary arterial enhancement and SNR, achieving attenuation levels comparable with pulmonary angiographic exams and maintaining diagnostic acceptability.

CLINICAL RELEVANCE/APPLICATION
SDCT enables creation of an optimal image set of the pulmonary vessels that can allow creation of CTPA from a routine or low-dose chest CT.

Comparison of 35-second and 100-second Scan Delays for Contrast Enhanced Routine Dual Energy CT of the Chest: Lesion and Vascular Enhancement

Alexi Otrakji MD (Presenter): Nothing to Disclose, Subba Rao Digumarthy MD : Nothing to Disclose, Roberto Lo Gullo MD : Nothing to Disclose, Jo-Anne O. Shepard MD : Consultant, Agfa-Gevaert Group, Cristy Savage RT : Nothing to Disclose, Mannudeep K. S. Kaira MD : Nothing to Disclose

PURPOSE
To compare performance of routine dual energy chest CT (DECT) for lesion and vascular enhancement at 35 and 100 seconds scan delays following administration of intravenous iodinated contrast media.

METHOD AND MATERIALS
Our study included 52 adult patients who underwent contrast enhanced routine DECT CT of the chest on dual source MDCT(Somatom Definition Flash,Siemens)or single source 64-row MDCT(GE 750HD Discovery,GE).Of these 26 patients (mean age 64±11years,M:F12:14,mean weights75 ±19 kg)received 80 ml of 370mg% iodinated intravenous contrast(2-3 cc/seconds)and were scanned at 35 second fixed delay.The remaining sex- and gender-matched 26 patients(mean age 67±12years,M:F 12:14,mean weights74 ±19 Kg) were scanned at 100 second delay following administration of the same contrast agent(370mg%,80 ml,44ml of contrast injected at 0.6ml/second followed by 36ml contrast at 1.8ml/second) using the identical DECT technique.Blended,monoenergetic(60 kev),and material decomposition image (iodine/ pulmonary blood volume and virtual non contrast (VNC)) were generated for all patients.HU (in main pulmonary artery (MPA)),CTDI vol and DLP were recorded .

RESULTS
There was no significant difference between weights and radiation dose of the patients undergoing DECT at 35- or 100-second scan delay (p>0.1).DECT at 100 seconds demonstrated significantly better contrast enhancement compared to prior CT examinations (in 20/53 pulmonary abnormalities) as compared to DECT at 35-second scan delay (better in 16/20).Optimal to excellent quality was noted in DECT at 100 seconds for all image types (100% Mono60 Kev, iodine, and VNC images)With none to minimal contrast related artifacts in most patients.There was superior iodine subtraction on VNC images on DECT performed with 100 seconds delay compared to those at 35 seconds (p<0.0001). Vascular contrast enhancement in MPA at 100 second scan delay 33±173 HU.
CONCLUSION

DECT of the chest at 100 second scan delay allows better lesion enhancement, fewer artifacts and superior quality of material decomposition images as compared to standard 35 second scan delay. Pulmonary arterial enhancement is not compromised due to split bolus contrast injection technique used for longer scan delays.

CLINICAL RELEVANCE/APPLICATION

Fixed delay split bolus DECT gives enough time for lung lesions to enhance which improves the diagnostic characterization of these lesions, without compromising the vascular enhancement.

SST04-04

Spectral CT Characteristics of Iodine, Bismuth, and Tungsten Based Contrast Media with an Energy-Resolving Photon-Counting Detector


PURPOSE

Recently developed energy resolved photon-counting detectors allow high Z materials to be effectively separated based on their absorption characteristics in the energy range of interest. Importantly, this allows contrast agents (CA) that contain different materials to be separated based on the incident X-ray spectrum. The aim of this study was to evaluate the characteristics and optimal combination of three different contrast agents by using a research prototype CT unit with small pixel counting photon detectors.

METHOD AND MATERIALS

To demonstrate proof-of-principle, experimental bismuth, tungsten and iodine CA were introduced into a chest phantom utilizing a two-threshold energy resolved photon-counting detector. Standard tube voltage (120kV) and tube current (80mAs) were applied with a photon counting detector using energy thresholds of 25keV and 65keV allowing reconstruction into three energy bins: 25keV to 120keV, 65keV to 120keV and 25keV to 65keV. Region of interest analysis was performed to assess attenuation patterns, contrast to noise ratios and identify optimal contrast agent combination for discrimination by the photon counting detector.

RESULTS

The CT acquisitions revealed strong contrast enhancement within the chest phantom with excellent contrast to noise ratios and differentiation of photon energies for each contrast agent by the photon counting detectors. Contrast materials could be uniquely identified by their characteristic attenuation profile at each energy threshold. Based on attenuation characteristics and contrast to noise ratios, the optimal contrast agent combination for scanning with photon counting detector CT technology appears to be iodine and tungsten with energy bins corresponding to an average X-ray energy of 62.5keV and 73keV.

CONCLUSION

The separation of three simultaneously administered contrast agents is feasible with the use of an energy selective, photon counting detector in CT. Spectral CT has the potential to enable distinct characterization of contrast agents in a chest phantom with the optimal contrast agent pair being iodine and tungsten with detector energy bins corresponding to an average X-ray energy of 62.5keV and 73keV.

CLINICAL RELEVANCE/APPLICATION

The separation of contrast agents with different pharmacokinetics utilizing photon counting technology may lend itself to a variety of beneficial applications in future contrast enhanced CT.

SST04-05

Diagnostic Quality and Limitations of Dual Energy CT of the Chest in Large Adult Patients

Alexi Otrakji MD (Presenter): Nothing to Disclose, Mannudeep K. S. Kalra MD: Nothing to Disclose, Efren Jesus Flores MD: Nothing to Disclose, Roberto Lo Gullo MD: Nothing to Disclose, Jo-Anne O. Shepard MD: Consultant, Agfa-Gevaert Group, Subba Rao Digumarthy MD: Nothing to Disclose

PURPOSE

There are little data to support use of DECT of chest in large patients. The purpose of our study was to evaluate the performance of dual energy routine chest CT in large patients for providing required diagnostic information and image quality.

METHOD AND MATERIALS

Our study included 45 patients (M:F 31:14, mean age 53±13 years, mean weight 130±14 kg) who underwent contrast enhanced chest CT using dual energy protocol on 128-slice dual source MDCT (Somatom Definition Flash, Siemens) or single source 64-row MDCT (GE 750HD Discovery) scanners. Inclusion criteria for the study included consecutive patients over 114 kg (>250 lbs) who underwent routine contrast enhanced CT of the chest with DECT. Following DECT image series were generated for each patient - monoenergetic 60 keV, 100 keV,
pulmonary blood volume (PBV) and virtual non contrast (VNC). All image series were assessed qualitatively for thoracic abnormality, level of pulmonary arterial enhancement, diagnostic quality, image noise, and artifacts. The CTDIvol and DLP were recorded and compared to 60 weight matched patients who underwent routine chest CT with single energy on the same scanners.

RESULTS

Radiation dose for patients who underwent chest DECT(10 ±2.4mGy, 350±67mGy.cm) was significantly lower as compared to the weight matched single energy chest CT(15±2.6mGy, 576±147mGy.cm) (p<0.001). Pulmonary arterial enhancement was optimal to excellent in 84% patients(38/45) up to lobar level and in 71%(32/45) patients in segmental branches. There was significant reduction in image noise and artifacts at the level of the tracheal carina and diaphragm on 100 Kev images compared to the 60 kev images (p<0.001). There was a significant improvement in acceptable diagnostic quality with 100 Kev (93%) compared to 60 Kev images (76%). Excellent or optimal diagnostic quality was noted in 80% of patients on PBV and VNC images, but was limited or suboptimal in other larger patients due to marked beam hardening artifacts.

CONCLUSION

Routine chest CT with dual energy technique can provide optimal diagnostic information and diagnostic quality in most large patients at lower radiation dose compared to the single energy chest CT. 100 kev images are helpful in reducing noise and artifacts.

CLINICAL RELEVANCE/APPLICATION

Routine chest CT with dual energy technique needs additional higher kev (100) images for obtaining optimal diagnostic information in large patients.

Iodine Content Measurement with Spectral CT Imaging as a New Quantitative Tool? Assess the Esophageal Microcirculation in Patients with Liver Cirrhosis

SST04-06

Ruyi Bao MD (Presenter): Nothing to Disclose, Zhiyong Li: Nothing to Disclose, Ailian Liu MD: Nothing to Disclose

PURPOSE

To quantitatively investigate the blood flow of esophageal wall and its change induced by liver cirrhosis by measuring effective iodine content (eIC) in the lower esophagus with spectral CT imaging.

METHOD AND MATERIALS

Thirty-five patients with liver cirrhosis (including 15 cases compensated cirrhosis and 20 cases decompensated cirrhosis) and sixteen normal volunteers, who had no detectable intrinsic lung and heart disease, underwent GSI scanning to collect iodine-water concentrations with a standard injection protocol. We measured eIC values of the esophageal wall in the lower esophagus. The hepatic artery index (HAI) was then calculated by the changes of the iodine-water concentrations in liver parenchyma from the artery to portal vein phase. We quantitatively evaluated the difference of eIC values between normal volunteers and different type cirrhosis by T-test and the correlation between eIC values and HAI with Pearson correlation test.

RESULTS

Mean eIC values of the esophageal wall in the lower esophagus in decompensated cirrhosis group, compensated group, normal control group were 38.00±11.72, 15.64±9.60 and 11.18±4.62 mg/ml, respectively. Mean eIC values in decompensated cirrhosis group was significantly higher than that in compensated group (t=5.13, p=0.00) and that in normal group (t=7.14, p=0.00), indicating more blood flow of the esophageal wall by decompensated cirrhosis. Mean HAI in decompensated and compensated group was 0.28±0.20 and 0.15±0.90 respectively. There was strong positive correlation between HAI and mean eIC values (r=0.43, P=0.04).

CONCLUSION

The findings of this study suggest that effective iodine content of the esophageal wall may reflect esophageal blood perfusion, which is useful to quantitatively evaluate esophagus blood flow change and esophageal varices in patients with liver cirrhosis.

CLINICAL RELEVANCE/APPLICATION

Esophageal varices have been recognized as an important complication in patients with cirrhosis. A better quantitative evaluation of pathophysiologival change underlying cirrhosis helps to guide its treatment. Spectral CT imaging may become a new quantitative tool.

Detection of Pulmonary Embolism on CT: Improvement Using a Model-based Iterative Reconstruction Algorithm Compared to a Filtered Back Projection Algorithm

SST04-07


PURPOSE

...
To determine if a model-based iterative reconstruction (MBIR) improves diagnostic confidence and detection of pulmonary embolism (PE) compared to hybrid iterative reconstruction (HIR) and filtered back projection (FBP) reconstructions in patients undergoing CT pulmonary angiography (CTPA).

**METHOD AND MATERIALS**

The study had IRB approval and was HIPPA compliant. 50 patients underwent CTPA at 100kV using departmental protocol. 22/50 patients had studies positive for PE as determined by two radiologists not involved in the reader study. The 50 studies were reconstructed with FBP, HIR (iDoseL3, Philips), and MBIR (IMR, Philips). Noise, attenuation, and contrast-to-noise (CNR) were recorded. After image randomization, five thoracic radiologists and two thoracic radiology fellows graded each study on a scale of 1 (very poor) to 5 (ideal) in four categories: diagnostic confidence, noise, PA enhancement and plastic appearance. Readers also marked each study for the presence or absence of PE. Parametric and non-parametric data were analyzed with a repeated measures ANOVA and Friedman's ANOVA, respectively. After Bonferroni correction, significance of pairwise comparisons was set at p<0.0167.

**RESULTS**

CNR of MBIR (19.7) was significantly higher than CNR of FBP (7.1) and HIR (10.3, p<0.0001 for both). Pooled sensitivity for detection of PE was 76% (117/154), 78.6% (121/154), and 82.5% (127/154) using FBP, HIR, and MBIR, respectively. With MBIR, detection of PE significantly increased compared to FBP (p=0.016). Detection of PE was not significantly higher with MBIR than HIR (p=0.045). Due to the non-significant increase in FP studies using HIR and MBIR (p=0.153), accuracy with MBIR (88.6%), HIR (87.1%), and FBP (87.7%) was similar. Compared to FBP, MBIR led to a significant subjective increase in diagnostic confidence, noise, and enhancement in 6/7, 6/7, and 7/7 readers, respectively. Compared to HIR, MBIR led to significant subjective increase in diagnostic confidence, noise, and enhancement in 5/7, 5/7, and 5/7 readers, respectively. All seven readers graded MBIR as having a significantly increased plastic appearance compared to both FBP and HIR.

**CONCLUSION**

MBIR led to a significant increase in PE detection compared to FBP. MBIR led to qualitative improvements in diagnostic confidence compared to both FBP and HIR.

**CLINICAL RELEVANCE/APPLICATION**

In CTPA, MBIR can be safely integrated into clinical practice and can increase detection of PE.

---

**Enhancement Characteristics of the CTPA Test Bolus Curve: Use in Predicting Right Ventricular Dysfunction and Mortality in Patients with Acute Pulmonary Embolism**

**SST04-08**

**PURPOSE**

To evaluate the value of CT pulmonary angiography (CTPA) test bolus curve data to predict mortality in patients with pulmonary embolism (PE) in comparison with conventional methods of right ventricular (RV) dysfunction.

**METHOD AND MATERIALS**

The study was approved by our IRB and is HIPAA-compliant. We consecutively evaluated each CTPA study performed with a test bolus technique in a 2-year period. Time-density curve was derived from each test bolus. For comparison, left and right ventricular dimensions (area, diameter) were measured using CT data. A cardiologist blinded to the clinical and other imaging data reviewed a subset of the corresponding echocardiographic images to assess for RV dysfunction. Demographic data, mode of treatment, and patient outcome information were gathered using electronic medical records. Test bolus and anatomic data were correlated with PE-related mortality.

**RESULTS**

71 patients (34 men and 37 women, average age 54.4 years) who had a CTPA performed using a test bolus technique were diagnosed with acute pulmonary embolism. Factors that were significantly correlated with PE-related mortality were: age > 60 years, RV/LV diameter > 1.5, RV/LV area > 1, bolus curve upslope time > 6 seconds, and 50% downslope time > 6 seconds. Sensitivity/specificity for the last two parameters were 100%/69% and 80%/86%, respectively.

**CONCLUSION**

Data from the CTPA timing bolus curve provides predictive power similar to that of conventional methods of assessing right ventricular dysfunction for PE-related mortality.

**CLINICAL RELEVANCE/APPLICATION**

To the best of our knowledge, scant attention has been paid to the characteristics of the test bolus curve and their implications in assessing the severity of pulmonary embolism. Thus, the purpose of this study is to determine whether test bolus parameters obtained in conjunction with CTPA have predictive value equal to or greater than image-based anatomical parameters for predicting PE-related mortality.
Assessment of Regional Xenon-ventilation, Perfusion and Ventilation-perfusion Mismatch Using Dual-energy Computed Tomography in COPD Patients

Hye Jeon Hwang MD (Presenter): Nothing to Disclose, Joon Beom Seo MD, PhD: Nothing to Disclose, Sang Min Lee MD: Nothing to Disclose, Sang Young Oh MD: Nothing to Disclose, Namkug Kim PhD: Stockholder, Coreline Soft, Inc, Taekjin Jang: Nothing to Disclose, Jae Seung Lee: Nothing to Disclose, Sei Won Lee: Nothing to Disclose, Yeon-Mok Oh MD, PhD: Nothing to Disclose

PURPOSE
To assess the feasibility of combined xenon-enhanced ventilation (V) and iodine-enhanced perfusion (Q) dual-energy CT (DECT) for the evaluation of regional V and Q status in COPD.

METHOD AND MATERIALS
Fifty-two male patients with COPD (mean age 67.9) were prospectively enrolled. Combined V and Q DECT imaging was performed. Virtual noncontrast image, V map, and Q (pulmonary blood volume) map were anatomically co-registered with deformable registration and evaluated with in-house software. After the normalization of the V and Q values of each pixel, V/Q ratio map and VQmin map, which is a map of smaller value between V and Q in each pixel, were additionally generated. For visual analysis, regional V, Q, and V/Q ratio pattern was determined as decreased, normal and increased, in combination of the regional disease patterns including emphysema, bronchial wall thickening and normal at each segment. Mean V, Q, V/Q ratio, VQmin values and standard deviation of V/Q ratio (V/Qsd) of each patient were quantified and compared with PFT parameters, such as FEV1, FEV1/FVC, and DLco with Pearson correlation test.

RESULTS
At visual analysis, while segments with normal parenchyma showed matched V/Q ratio pattern, segment with bronchial wall thickening commonly showed mismatched pattern. There was no dominant V/Q ratio pattern at emphysema area. At quantitative analysis, mean V, Q, V/Q ratio, VQmin values showed significant positive correlation with PFT parameters \((r = 0.290 \sim 0.815, p < 0.05)\). V/Qsd showed significant negative correlation with PFT parameters \((r = -0.439 \sim -0.736, p < 0.001)\). VQmin values showed the best correlation with PFT \((r = 0.483 \sim 0.815, p < 0.001)\).

CONCLUSION
Visual and quantitative assessment of regional V, Q, V/Q ratio, VQmin is feasible with combined V and Q DECT imaging, with significant correlation with PFT results in COPD patients. Assessment of disease pattern at conventional CT images may not represent regional V, Q and V-Q mismatch.

CLINICAL RELEVANCE/APPLICATION
Regional structural abnormalities, ventilation and perfusion status can be assessed simultaneously with combined xenon-enhanced ventilation and iodine-enhanced perfusion DECT.
METHOD AND MATERIALS

Twenty-two pathologically proven intramucosal gastric carcinoma patients who had undergone spectral CT imaging were reviewed retrospectively to generate conventional 140-kVp polychromatic images (group A) and monochromatic images with energy levels from 40 to 140 keV (group B) during the arterial phase (AP) and the venous phase (VP). The tumor to gastric wall contrast to noise ratio (CNR) and mean image noise were calculated and compared using two-sample t test between group A and group B. The lesion detection rate, reader's confidence and reader's subjective evaluation of image quality were recorded.

RESULTS

Monochromatic images at energy level of 53 ± 3 keV had highest CNR and the lowest mean noise was found to be at energy level of 70 ± 3 keV. Compared to group A, group B monochromatic images with energy level of 40 to 70 keV had significantly higher CNR (p<0.05) and significantly lower image noise (p<0.05) during both AP and VP. The lesion detection rate and readers subjective evaluation of image quality were significantly higher for group B at monochromatic energy levels of 40 to 70 keV.

CONCLUSION

Monochromatic images at energy levels of 40 to 70 keV can increase detection of intramucosal gastric carcinoma with no degradation in image quality.

CLINICAL RELEVANCE/APPLICATION

Monochromatic images at energy level of 40 to 70 keV increases the conspicuity of early gastric carcinoma decreasing the rate of false negative CT findings.

PURPOSE

The objective of this study was to evaluate the application of CT spectral imaging in preoperative T staging of gastric cancer.

METHOD AND MATERIALS

Fifty-two patients with gastroscopically confirmed gastric cancer were included prospectively and underwent preoperative multiphase-enhanced CT scans. Spectral imaging was performed in the arterial phase, automatic tube current modulation was adopted in the portal venous and delayed phases. Regions of interest (ROIs) were placed within the tumor, stomach wall, peripheral and distant fat to determine the optimal monochromatic image with the highest contrast-noise-ratio (CNR) between the cancer and surrounding tissues. Spectral curves of those ROIs were obtained. Two radiologists interpreted polychromatic and optimal monochromatic images of 52 patients and assessed T staging independently. With the reference of postoperative histopathological findings, T staging accuracy were compared between poly- and monochromatic images. Inter-observer agreement was calculated by kappa statistics.

RESULTS

Preoperative T staging accuracy of gastric cancer by spectral imaging (82.69%, 43/52) was significantly higher than that of polychromatic CT images (71.15%, 37/52)(P =0.031). In terms of each T stage, diagnostic accuracy of spectral imaging was slightly better in T1/3 stages and identical in T2/4 stages compared with that of polychromatic images. Inter-observer agreement (Kappa value) was improved from 0.562 (polychromatic images) to 0.768 (spectral imaging).

CONCLUSION

CT spectral imaging generating optimal monochromatic images with highest CNR and spectral curves of the tissues, can improve preoperative T staging accuracy of gastric cancer.

CLINICAL RELEVANCE/APPLICATION

CT spectral imaging can replace traditional CT scan in preoperative T staging of gastric cancer with higher diagnostic accuracy without more radiation dose.
the perigastric fat tissue adjacent to the tumor lesion and correlate their value for differentiating between T3 and T4 staged gastric carcinoma.

**METHOD AND MATERIALS**

Fifty-four patients with pathologically proven T4 (group A) and T3 (group B) staged gastric carcinoma who had undergone spectral CT imaging (Discovery CT750 HD) were retrospectively selected. Material Decomposition (MD) image of these cases were reconstructed for measuring IC, nIC and WC of perigastric fat tissue adjacent to the lesion during Arterial phase (AP) and Venous phase (VP). Two-sample t tests were used to compare the three parameters between group A and group B during AP and VP. Receiver operating characteristic (ROC) was used to determine the threshold of nIC for differentiating T3 and T4 staged gastric carcinoma.

**RESULTS**

Significantly higher IC and nIC values were obtained in group A than in group B (IC -0.72±2.01 vs. -7.00±0.31 µg/cm³ in AP; 0.15±2.18 vs. -5.00±2.21 µg/cm³ in VP; nIC 0.03±0.22 vs. -0.07±0.31 in AP; 0.22±0.42 vs. -0.10±0.65 in VP) (P<0.05). There was no significant difference in water concentration during both AP and VP (P>0.05). Setting the threshold of nIC at -0.048 during AP and -0.015 during VP, the sensitivity of serosal invasion was 85.2% and 82.3% respectively and specificity of serosal invasion was 87.6% and 82.3% respectively.

**CONCLUSION**

The iodine concentration of perigastric fat adjacent to the tumor is significantly higher in cases of T4 staged gastric carcinoma to that of T3 staged gastric carcinoma and can be regarded as a definitive sign of serosal invasion.

**CLINICAL RELEVANCE/APPLICATION**

Iodine concentration of perigastric fat tissue adjacent to tumor accurately detects serosal invasion and can be implemented in CT staging of gastric carcinoma preoperatively.

---

**SST05-04**

The Analysis of CT Missed Peritoneal Metastasis in Gastric Cancer: A Region-by-Region Comparison with Diagnostic Laparoscopy

Lei Tang MD (Presenter): Nothing to Disclose, Zi-Yu Li: Nothing to Disclose, Ying-Shi Sun MD, PhD: Nothing to Disclose, Fei Shan: Nothing to Disclose, Xiaoting Li: Nothing to Disclose, Jia-Fu Ji: Nothing to Disclose

**PURPOSE**

To explore the characteristics of the CT missed peritoneal metastasis (PM) of gastric cancer through the region-by-region comparison with diagnostic laparoscopy findings.

**METHOD AND MATERIALS**

Total of 251 consecutive patients with advanced gastric cancer and diagnosed as free of PM by spectral CT enrolled in the study. All of the patients were performed diagnostic laparoscopy to verify the findings on CT. If PM detected during laparoscopic exploration, the exact metastasis location would be recorded and compared with CT findings. The target observation regions included the omentum, diaphragm, transverse mesocolon, parietal peritoneum and hepatogastric ligament. The concerning signs included smudge sign, uncertain small nodules and thickening of the parietal peritoneum. The smudge sign was further divided into (1) mild type: slightly and evenly increased fat density appeared as ground glass opacity (GGO), (2) moderate type: unevenly increased fat density, with patchy-like or intensive GGO, (3) severe type: unevenly and obviously increased fat density, with multiple strands, curls sign or blurred small nodules. The demonstration rates of the above signs on spectral CT would be compared and analyzed between PM positive and negative patients.

**RESULTS**

Forty-six patients were confirmed as PM positive through laparoscopic exploration. Through the region-by-region comparison, there was still no any suspected CT sign in 16 patients. Total of 43 abnormal regions in 30 patients with PM detected during laparoscopic exploration, the exact metastasis location would be recorded and compared with CT findings. The concerning signs included smudge sign, uncertain small nodules and thickening of the parietal peritoneum. The smudge sign was further divided into (1) mild type: slightly and evenly increased fat density appeared as ground glass opacity (GGO), (2) moderate type: unevenly increased fat density, with patchy-like or intensive GGO, (3) severe type: unevenly and obviously increased fat density, with multiple strands, curls sign or blurred small nodules. The detection rate of the above signs on spectral CT would be compared and analyzed between PM positive and negative patients.

**CONCLUSION**

Smudge sign is the most common finding in CT missed PM patients with gastric cancer, paying attention to this sign will contribute to the early detection of peritoneal metastasis.

**CLINICAL RELEVANCE/APPLICATION**

The study retrospectively analyzed the suspect sign of CT missed peritoneal metastasis in gastric cancer, which may contribute to the early detection of peritoneal metastasis.

---

**SST05-05**

New Insights in the Management and Prognosis of Gastric Cancer: The Innovative Role of Pre-treatment Apparent Diffusion Coefficient

Francesco Giganti MD (Presenter): Nothing to Disclose, Luca Albarello: Nothing to Disclose, Alessandro Ambrosi: Nothing to Disclose, Carlo Staudacher MD: Nothing to Disclose, Alessandro Del Maschio MD: Nothing to Disclose, Francesco Aldo De Cobelli MD: Nothing to Disclose

**PURPOSE**

The study retrospectively analyzed the suspect sign of CT missed peritoneal metastasis in gastric cancer, which may contribute to the early detection of peritoneal metastasis.
Purpose: Treatment options for gastric cancer (GC) range from endoscopic mucosal resection to radical surgery at its most invasive. These are used alone or in combination with neo-adjuvant therapy (NT). Despite multiple strategies, prognosis still remains poor regardless. The aim of our study was to investigate the role of apparent diffusion coefficient (ADC) as a potential biomarker in the evaluation of the aggressiveness of GC.

Method and Materials: Approval for this study was obtained from our Institutional Ethics Committee and written informed consent was obtained from each patient. From October 2009 to December 2013, 99 patients (66 men - 33 women; mean age 67.45 ± 11.41 years) with biopsy-proven disease (24 Siewert II-III and 75 gastric cancers) were examined with a 1.5T MR system including T1, T2 and DWI (b values 0-600 s/mm²) sequences. ADC measurements were obtained from regions of interest traced on T2 and DW images and automatically copied on the ADC map. 70/99 patients (70.7%) were directly treated with surgery while 29/99 patients (29.3%) were submitted to NT beforehand. All participants were followed up for a median of 18 months. Pathological ADC, tumor location, pT, pN, surgical approach and histotype were investigated by univariate and multivariate analysis using Cox regression model and Kaplan-Meier curves.

Results: At the end of the follow up, 66 (66.6%) patients were alive and 33 (33.4%) had died. Median overall survival was 36 ± 4 months. Considering all the variables, we observed that ADC values below 1.5 x 10⁻³ mm²/s could predict a negative prognosis both in the total population (n=99, p

Conclusion: Our preliminary study suggests the potential role of ADC as a quantitative biomarker reflecting the aggressiveness of GC. ADC may provide useful information on life expectancy and might be added to the current validated prognostic parameters for pre-operative risk stratification.

Clinical Relevance/Application: ADC may provide useful information on life expectancy and might be added to the current validated prognostic parameters for pre-operative risk stratification.

SST05-06 Dynamic Contrast-enhanced MRI in Gastric Cancer: Correlation of Perfusion Parameters with Pathological Prognostic Factors

Ijin Joo MD (Presenter): Nothing to Disclose, Jeong Min Lee MD: Research Grant, Guerbet SA Equipment support, Siemens AG Research Grant, Bayer AG, Joon Koo Han MD, PhD: Research Consultant, Samsung Electronics Co Ltd

Purpose: To investigate the feasibility of dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) for perfusion quantification of gastric cancers, and to correlate DCE-MRI parameters with pathological prognostic factors.

Method and Materials: This prospective study was approved by our institutional review board, and informed consent was obtained from each patient. Twenty-seven patients with gastric cancers underwent free-breathing radial DCE-MRI at 3T scanner followed by surgery. Quantitative DCE-MRI parameters (Ktrans, Kep, Ve, and iAUC) of gastric cancer and normal wall were measured. DCE-MRI parameters of gastric cancer were compared with those of normal gastric wall by using paired t-test. The relationship between DCE-MRI parameters and pathological prognostic factors of gastric cancers including T- and N-staging, histological grades, and grades of epidermal growth factor receptor (EGFR) expression were evaluated by using the Student t-test or the Spearman rank correlation test.

Results: DCE-MRIs were of diagnostic quality in 22 patients (22/27, 81.5%), and failed in 5 patients due to bowel peristalsis. Ve and iAUC were significantly higher in gastric cancer than normal gastric wall (P<.05). Ve was significantly correlated with T-staging (rho=0.49, P=.02), and was significantly higher in poorly-differentiated carcinoma than well- or moderately-differentiated carcinoma (P<.05). Ktrans was significantly correlated with grades of EGFR expression (rho=0.466, P=.03). None of DCE-MRI parameters of gastric cancer showed significant difference according to N-staging.

Conclusion: DCE-MRI is technically feasible for quantification of perfusion dynamics of gastric cancers, and to correlate DCE-MRI parameters with pathological prognostic factors.

Clinical Relevance/Application: Perfusion characteristics of gastric cancers can be quantitatively measured by free-breathing DCE-MRI, and DCE-MRI parameters may provide prognostic information in patients with gastric cancers.

SST05-07 The Correlation of Iodine Concentration in Spectral CT and Pathological Regression in Gastric Cancer to Neoadjuvant Chemotherapy: A Pilot Study

Lei Tang MD (Presenter): Nothing to Disclose, Zi-Yu Li: Nothing to Disclose, Ying-Shi Sun MD, PhD: Nothing to Disclose, Jia-Fu Ji: Nothing to Disclose, Xiaoting Li: Nothing to Disclose, Zhong-Wu Li: Nothing to Disclose, Xiao-Peng Zhang MD: Nothing to Disclose

Purpose: To investigate the feasibility of dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) for perfusion quantification of gastric cancers, and to correlate DCE-MRI parameters with pathological prognostic factors.
To investigate the potential of iodine concentration (IC) determined by spectral CT in the response prediction of gastric cancer to preoperative neoadjuvant chemotherapy (NC).

METHOD AND MATERIALS

The institutional review board approved this prospective study. All patients signed the written informed consent. Twenty enrolled patients with advanced gastric cancer underwent spectral CT examination twice (1 week before NC and after 2 cycles of NC), with anisodamine and effervescent granules administered to guarantee the shape consistency and stability of gastric wall. Spectral CT imaging was performed with fast tube voltage switching between 80 and 140kVp during a single rotation. The percentage changes of the tumor size (%ΔCWT) and the IC values on arterial phase (%ΔIC-a) after NC were calculated on the 70keV monochromatic and iodine-based material decomposition images, respectively and compared among different response groups. The pathological regression grades 1-3 were defined as 50% residual tumor per tumor bed, respectively. Grade 1 was defined as good response (GoodR) and Grades 2-3 as poor response (PoorR). The diagnostic efficacies of the two parameters were evaluated using ROC curves.

RESULTS

The decrease rate of %ΔIC-a in the GoodR group was higher than that of the PoorR group (-0.59 [-0.76, -0.20] vs. -0.11 [-0.75, 0.92], P=0.012). No significant difference was observed between GoodR and PoorR with regard to %ΔCWT (-0.16 [-0.65, 0.20] vs. -0.04 [-0.40, 0.13], P=0.779). The AUCs of ROC were 0.857 and 0.542 for %ΔIC-a and %ΔCWT respectively, in the response prediction of gastric cancer to NC. Taking the decrease rate of %ΔIC-a > 52.9% as the cutoff value to identify good responders, the sensitivity was 0.857 and specificity was 0.833. Taking the decrease rate of %ΔCWT > 17.4% as the cutoff value to judge good responders, the sensitivity and specificity values were 0.643 and 0.500, respectively.

CONCLUSION

The change of the tumor IC after neoadjuvant chemotherapy measured by spectral CT has good correlation with pathological regression of gastric cancer, which has better prediction efficacy than tumor size.

CLINICAL RELEVANCE/APPLICATION

The iodine concentration in spectral CT has potential in the response prediction of gastric cancer to neoadjuvant chemotherapy, which may provide personalized information for treatment.

SST05-08

Comparative Imaging Analysis of Epstein - Barr Virus-associated Gastric Lymphoepithelioma-like Carcinoma versus Conventional Gastric Adenocarcinoma

Seon Young Park MD (Presenter): Nothing to Disclose, Young Chul Kim MD : Nothing to Disclose, Tae Sun Han : Nothing to Disclose, Young Keun Sur MD : Nothing to Disclose, Jei Hee Lee MD : Nothing to Disclose, Jai Keun Kim MD : Nothing to Disclose

PURPOSE

Primary gastric lymphoepithelioma-like carcinoma (LELC) is a rare type of undifferentiated gastric adenocarcinoma with better prognosis than the conventional gastric adenocarcinoma. We analyzed the clinical and radiologic features of Epstein-Barr virus (EBV)-associated LELC to determine the computed tomography (CT) features that differentiate it from conventional gastric adenocarcinoma.

METHOD AND MATERIALS

Between January 2004 and December 2012, clinical and radiologic features of 39 EBV-associated LELCs were compared with that of 36 conventional gastric adenocarcinomas. Independent t-test was used to evaluate the difference in patient age between EBV-associated LELC and conventional gastric adenocarcinoma. Sexual distribution, lesion detectability, multiplicity, presence of lymph node metastasis, location, gross appearance, lesion thickness and margin, presence of round edge, contrast enhancement pattern, and degree of contrast enhancement were compared using Chi-square test.

RESULTS

Male predominance (male to female ratio=31:8) was seen in patients with EBV-associated LELC with statistical significance (p < 0.001). The most common location of EBV- associated LELC was the upper third of the stomach with statistical significance (p=0.0001). There was a statistically significant difference in the presence of uniform peripheral thickness between both groups; 30 patients (88.24%) with EBV- associated LELCs and 13 (40.63%) with conventional gastric adenocarcinomas (p=0.001). EBV - associated LELCs demonstrated well-defined margins (n=29; 85.29%) more often than conventional gastric adenocarcinomas (n=19, 59.37%; p=0.0369). There was a statistically significant difference in the presence of a round edge between both groups; 25 patients (73.53%) with EBV- associated LELCs and 15(46.87%) with conventional gastric adenocarcinomas (p=0.0497).

CONCLUSION

The radiologic features including tumor location in the upper third of the stomach and, presence of uniform peripheral thickness with round edge ("pizza crust sign") can be helpful in differentiating EBV- associated LELC from conventional gastric carcinoma on CT scans.

CLINICAL RELEVANCE/APPLICATION

Clinical and radiologic features of EBV-associated LELC in out study can be helpful in differentiating EBV-associated LELC from conventional gastric carcinoma on CT scans.

SST05-09

Leiomyoma of the Gastric Cardia: Differentiation from Gastrointestinal Stromal Tumor on CT

Leiomyoma of the Gastric Cardia: Differentiation from Gastrointestinal Stromal Tumor on CT
PURPOSE

To describe the computed tomographic (CT) findings of leiomyoma and gastrointestinal stromal tumor (GIST) originated from the gastric cardia and to identify the features that differentiate each other.

METHOD AND MATERIALS

The institutional review board of our institution approved this retrospective study and waived the requirement for patient informed consent. CT images of pathologically proved leiomyomas (n = 26) and GISTs (n = 19) in the gastric cardia were retrospectively reviewed. Analysis of the CT findings included evaluation of whether the tumor involved the esophagogastric junction (EGJ), contour, surface, border, growth pattern, enhancement pattern, and enhancement grade of the tumor, as well as the presence of low intralocular attenuation area, presence of calcification or hemorrhage and presence of surface dimple or ulcer. The attenuation of each lesion, the long diameter (LD), the short diameter (SD), and the LD/SD ratio were measured. Among these findings, statistically significant variables were determined by using the \( \chi^2 \) test (to compare the categorical variables), the Student t test (for quantitative analysis), and the receiver operating characteristic (ROC) curve (to determine the optimal cutoff of the LD/SD ratio and attenuation value).

RESULTS

EGJ involvement, homogeneous enhancement pattern, intermediate or low enhancement degree, absence of intralocular low attenuation and absence of surface dimple or ulcer were found significant for differentiating leiomyoma from GIST of the gastric cardia (P < .05 for each finding). LD/SD ratio >1.2 and attenuation value \( \leq 71.2 \) HU yielded sensitivities of 84.6% and 61.5%, and specificities of 52.6% and 84.2%, respectively at ROC curve analysis. When at least three of these seven criteria were used in combination, the sensitivity and specificity were 8% (2 of 26) and 100% (19 of 19). When all seven criteria were used, the sensitivity and specificity were 8% (2 of 26) and 100% (19 of 19).

CONCLUSION

By using specific CT criteria, leiomyoma and GIST in the gastric cardia can be differentiated with a high degree of accuracy.

CLINICAL RELEVANCE/APPLICATION

Knowledge of differentiating CT characters between the two submucosal tumors help avoiding unnecessary surgery or determining the appropriate surgical procedure.
Preoperative MRI examinations were performed for 63 patients with suspected EHCC. The examinations included T2-weighted imaging, coronal fast imaging employing steady-state acquisition (FIESTA), MRCP and DWI sequence with different b values (500, 1000 and 1200 s/mm²). All cases were confirmed by histopathological diagnosis. Two radiologists in consensus reviewed MRCP imaging and combined MRCP and DWI imaging with ADC maps, and apparent diffusion coefficient (ADC) value, signal-noise ratio (SNR), contrast-to-noise ratio (CNR) and signal-intensity ratio (SIR) under various b values were calculated.

RESULTS
There were significant differences in sensitivity (74.4% vs 94.9%), specificity (75% vs 100%) and accuracy (74.6% vs 96.8%) between MRCP alone and combined MRCP and DWI with a b value of 1000 s/mm² (P<0.05). There was also a significant difference in ADC, SNR, CNR and SIR under various b values (P<0.05).

CONCLUSION
For diagnosing EHCC, the use of combined MRCP and DWI shows a better diagnostic performance; the b value of 1000 s/mm² is the most appropriate for DWI on 3.0T MRI.

CLINICAL RELEVANCE/APPLICATION
The use of combined MRCP and DWI can improve diagnostic performance for extrahepatic cholangiocarcinoma (EHCC). DWI can also provide additional clinically important information and is recommended to patients presenting with an EHCC or suspected EHCC.

SST06-02
Usefulness of Imaging Criteria for Distinguishing Autoimmune Cholangiopathy from Primary Sclerosing Cholangitis or Bile Duct Malignancy


PURPOSE
A recent study (AJR 2014 Mar;202(3):536-43) proposed specific imaging criteria for differentiating autoimmune cholangiopathy (IAC) from primary sclerosing cholangitis (PSC) or other biliary diseases. The purpose of this study was to determine the diagnostic performance of these imaging criteria for diagnosis of autoimmune cholangiopathy.

METHOD AND MATERIALS
Medical records search between 10/2008-10/2013 identified 10 patients (8M, 2W, mean age 61, range 34-82) with clinically and biopsy proven IAC. Ten cases of PSC (5M, 5W, mean age 51, range 22-65) and 4 cases of primary biliary cancer (1M, 3W, mean age 63, range 56-69) were randomly selected for comparative analysis. Three blinded and fellowship-trained abdominal radiologists, (experience 7-25 years), reviewed either MRI with MRCP (n=17) or CT and ERCP (n=7) for the following imaging predictors of IAC: single wall bile duct thickness > 2.5 mm; continuous biliary involvement, gallbladder involvement, absence of liver disease, peribiliary mass, pancreatic and renal abnormalities. Each radiologist provided imaging-based diagnosis of IAC, PSC, or biliary malignancy and sensitivities and specificities were recorded. Association of each imaging predictor for IAC compared with non-IAC (PSC or primary biliary malignancy) was determined by using Fisher’s exact test, P < 0.05 to indicate a significant association.

RESULTS
For diagnosis of IAC, mean (range) sensitivity and specificity was 79% (70-90%) and 83% (78-86%), respectively. The strongest imaging predictors for distinguishing IAC vs. non-IAC were: pancreatic abnormalities: 73% vs. 9% (P, 0.001-0.01); continuous biliary involvement: 80% vs. 43% (P, 0.01-0.20); single wall bile duct thickness > 2.5 mm: 73% vs. 40% (P= 0.01-0.41); and absence of liver disease: 80% vs. 57% (P=0.17-1).

CONCLUSION
Imaging predictors of IAC demonstrate moderately high sensitivity and specificity for distinguishing IAC from PSC or biliary malignancy. Pancreatic abnormality demonstrated the most significant association with IAC. Single wall bile duct thickness, continuous biliary involvement, and absence of liver disease demonstrate trends towards association with IAC.

CLINICAL RELEVANCE/APPLICATION
Pancreatic abnormalities, thickened bile duct wall, continuous biliary stricturing, and absence of liver disease favor a diagnosis of IAC. However, it remains difficult to distinguish IAC from PSC or biliary malignancy based on imaging features alone.

SST06-03
Value of Gadoxetate Disodium Enhanced MRI in Patients with Primary Sclerosing Cholangitis (PSC) for Assessment of Hepatic Function

Jan Hinrichs MD: Nothing to Disclose, Henrike Lenzen: Nothing to Disclose, Frank K. Wacker MD: Research Grant, Siemens AG Research Grant, Pro Medicus Limited, Kristina Imeen Ringe MD (Presenter):
**SST06-04**

**Growth Rate of Biliary Cystadenomas: Value of Short Term Follow-up Imaging**

Adeel Rahim Seyal MD : Grant, Siemens AG, Keyur Parekh MD : Grant, Siemens AG, Vahid Yaghmai MD (Presenter): Nothing to Disclose

**PURPOSE**

To determine growth rate of biliary cystadenoma to estimate suitable follow-up imaging interval.

**METHOD AND MATERIALS**

The HIPAA compliant retrospective study was IRB approved. Patients with histopathologically proven primary or recurrent biliary cystadenoma with at least two cross-sectional imaging studies (CT and/or MR scans) performed were included. Comparison was done with simple liver cysts. Volume of biliary cystadenomas and liver cysts was calculated and growth kinetic parameters were analyzed using doubling time (DT) and reciprocal of doubling time (RDT) where DT=(T2 -T1)xlog2/(logV2-logV1) and RDT=1/DT. Positive RDT indicates growth while negative RDT indicates regression.

**RESULTS**

Eleven pathologically proven biliary cystadenomas were evaluated in 9 adult patients (all females). Eleven hepatic cysts in another 9 adult patients were also evaluated. Median [interquartile range (IQR)] baseline volume for cystadenoma and liver cysts was 20.1 ml (8.7, 190.3) and 2.1 ml (1.0, 3.3) respectively. Mean interscan interval for cystadenoma and liver cysts was 319.9 days (range 25 - 787) and 543 days (range 13 - 1812) respectively. All cystadenomas (100%) showed increase in size with mean RDT of 0.87 ± 0.7. Median (IQR) DT was 581.5 days (319.2, 1661). Liver cysts had mean RDT of 0.45 ± 1.1 and median (IQR) DT of 4223 days (1425, 16152). RDT was significantly different between two groups (P = 0.0081).

**CONCLUSION**

Slow growth of biliary cystadenomas suggests that short frequency follow-up imaging of less than one year to monitor change in size of these lesions may not be indicated.

**CLINICAL RELEVANCE/APPLICATION**

Biliary cystadenomas grow very slowly and may be followed on imaging.
PURPOSE
Magnetic resonance cholangiopancreatography (MRCP) is widely used as a noninvasive, accurate test for suspected choledocholithiasis. Current ACR guidelines recommend contrast-enhanced MRCP, but in hospitalized patients the full protocol may increase costs, scan time, and patient discomfort with questionable benefits. We compared performance of a potential short protocol with non-contrast MRI/ HASTE MRCP to contrast-enhanced MRI/3D MRCP.

METHOD AND MATERIALS
We retrospectively evaluated 69 standard contrast-enhanced abdominal MRI/MRCP for suspected bile duct stones in inpatients. Two radiologists first used only non-contrast sequences including 2D coronal/axial HASTE, followed by the entire exam with post-contrast sequences and 3D MRCP. Readers noted perceived need for contrast, presence of common bile duct (CBD) stone, CBD dilatation, cholangitis, or other causes of acute biliary obstruction. Reader agreement and confidence were assessed. We also tested clinical factors predicting need for contrast in biliary assessment. ERCP, intraoperative cholangiogram or documented clinical resolution served as reference standard.

RESULTS
In 69 patients, 21 had confirmed choledocholithiasis, 4 had acute hepatitis, and 2 had clinical cholangitis. Both noncontrast and contrast-enhanced image sets resulted in high accuracy for bile duct stone (88-91% vs 87-90%); there was no significant difference in accuracy, sensitivity, specificity, NPV, PPV for either reader for any feature assessed with or without contrast (p>0.6). Reader agreement was excellent for non-contrast and contrast-enhanced detection of CBD stones (k=0.84, 0.77) and CBD dilatation (k=0.71, 0.61). 1 reader reported increased confidence (p

CONCLUSION
For hospitalized patients with suspected choledocholithiasis, performance of noncontrast MRI with HASTE MRCP may be equal to contrast-enhanced MRI/3D MRCP; a shorter test would offer potentially increased patient tolerability and reduced hospital costs.

CLINICAL RELEVANCE/APPLICATION
For inpatients with suspected choledocholithiasis, an abbreviated non-contrast MRI with HASTE MRCP may offer a faster exam with no compromise in diagnostic test performance.
Gallstone Characterization Using Dual Energy Computed Tomography and Correlation with in-vitro Phantom Study

Young Hwan Lee MD : Nothing to Disclose, Youe Ree Kim MD (Presenter): Nothing to Disclose, Seong Hyun Wee MD : Nothing to Disclose, Dong-Ho Bang MD : Nothing to Disclose, Kwon-Ha Yoon MD, PhD : Nothing to Disclose

PURPOSE
The aim of this study was to differentiate cholesterol gallstone from calcium gallstone using dual energy CT (DECT) and to correlate with in-vitro phantom study.

METHOD AND MATERIALS
We retrospectively analysed 95 gallstones in 48 patients with in-vitro and clinical DECT. Semi-quantitative infrared spectroscopy (FTIR) was performed to confirm the chemical composition of the stones. According to the FTIR results, gallstones were divided into calcium and cholesterol stones, we measured Hounsfield units (HU) of the gallstones at 80, 100, 140 kVp image sets of in-vitro DECT and calculated sensitivity for stone detection. We also measured HU values of the 60 stones (25 cholesterol stones, 35 calcium stones) at 100, 140, Mixed kVp sets and virtual non-enhanced (VNE) images of clinical DECT and calculated sensitivity for stone detection. Finally we compared the HU values of stones on each image sets.

RESULTS
Gallstones were confirmed as 45 cholesterol stones in 23 patients and 50 calcium bilirubinate stones in 25 patients on FTIR. On in-vitro DECT analysis, cholesterol stones were identified with 100%, 84%, 96% sensitivities and calcium stones were identified with 98%, 99%, 98% sensitivities at 80, 100, 140 kVp image sets. Cholesterol stones showed hypoattenuation at 80 kVp (76%), hyperattenuation at 140 kVp (51%). Calcium stones showed hyperattenuation at all of image sets (98%). There were statistically significant at all of the comparative quantitative analyses of 80/100 kVp, 80/140 kVp and 100/140 kVp sets (for cholesterol stones, P<.001; for calcium stones, P<.001). On clinical DECT image analysis, detection sensitivities of cholesterol stones were 62%, 77%, 60%, 93% and sensitivities of calcium stones were 97%, 97%, 97%, 97% at 100, 140, mixed kVp, VNE image sets, respectively. There were also statistically significant at comparative quantitative analyses of 100/140 kVp set for cholesterol stone (P=.049), of 100/140 kVp and 100/mixed kVp sets for calcium stones (P=.001, P=.001)

CONCLUSION
Cholesterol stones usually showed iso- or hyperattenuation at high kVp images than low kVp images and calcium stones showed hyperattenuation at all kVp images of DECT. VNE images of clinical DECT were useful to detect cholesterol gallstones.

CLINICAL RELEVANCE/APPLICATION
Dual energy CT can be used to differentiate gallstone components with different kVp setting and detection of cholesterol gallstones can be improved on virtual non-enhanced images of DECT.

A Comparative Study of Conventional Ultrasonography (USG) and Contrast-enhanced Ultrasonography (CEUS) in the Diagnosis of Gallbladder Diseases- A Study from Northern India

Mohd Khalid MBBS, MD (Presenter): Nothing to Disclose

PURPOSE
To compare the diagnostic performance of conventional and contrast-enhanced ultrasonography in characterizing gallbladder lesions.

METHOD AND MATERIALS
40 patients with gallbladder disease were examined using conventional ultrasonography (USG) followed by contrast-specific harmonic imaging mode (CEUS) after injection of Perflutren-lipid microsphere suspension. Lesions were characterized based on their echogenicity, enhancement pattern in the early and late vascular phases (heterogeneous or homogeneous enhancement and hyper, iso, hypo or non-enhancing in relation to adjacent normal liver), intralesional vascularity (branched, linear, dotted or none) and intactness of underlying gallbladder wall. Final diagnosis was established by histopathology and the results were analyzed statistically.

RESULTS
There was an obvious female preponderance (67.5%) among the patients examined. Gallbladder malignancy (adenocarcinoma) was diagnosed in 12 patients (30%), all of whom were above the age of 40 years. USG detected 18 patients with chronic cholecystitis, 2 with inflammatory polyps and 10 cases of malignancy with sensitivity, specificity, accuracy, negative predictive value (NPV) and positive predictive value (PPV) of 83.33%, 82.14%, 82.5%, 92% and 66.67%, respectively with regards to diagnosis of malignancy. Based on CEUS findings, a diagnosis of chronic cholecystitis was made in 24 patients, inflammatory polyp in 4, adenomyomatosis in 1 and malignant lesion in 11 with sensitivity, specificity, accuracy, NPV and PPV of 100%, 97.5%, 97.5% and 100% and 100%. Heterogeneous enhancement was observed in a majority of the malignant lesions (91.67%) in comparison to 39.28% among benign lesions. Malignant lesions had a...
predominant branched intralesional vascular pattern (58.23%) as opposed to a predominant dotted pattern in benign lesions (87.5%). Gallbladder wall disruption was seen in all the patients with malignant lesions (100%), while only one patient (3.57%) with benign disease (chronic cholecystitis) demonstrated the same.

CONCLUSION

Contrast-enhanced ultrasound may be a useful tool in the evaluation of gallbladder disease, particularly of malignant lesions.

CLINICAL RELEVANCE/APPLICATION

This study emphasizes the superiority of CEUS in the evaluation of gallbladder lesions in a population which shows a high incidence of malignancy using Perflutren-lipid microsphere suspension.

Gangrenous Cholecystitis versus Uncomplicated Acute Cholecystitis: Which CT Findings Differentiate between the Two?

Wei-Chou Chang MD (Presenter): Nothing to Disclose, Yuxin Sun : Nothing to Disclose, En-Haw Wu MD : Nothing to Disclose, So Yeon Kim MD : Nothing to Disclose, Liqin Zhao MD : Nothing to Disclose, Benjamin M. Yeh MD : Research Grant, General Electric Company Consultant, General Electric Company

PURPOSE

To evaluate the diagnostic accuracy of CT findings for differentiating gangrenous cholecystitis from uncomplicated acute cholecystitis, with histopathological findings as reference standard.

METHOD AND MATERIALS

Our Institutional Review Board approved this retrospective study. We retrospectively reviewed 141 consecutive patients over a 4-year period with histologically proven gangrenous cholecystitis or uncomplicated acute cholecystitis. Of the 141 patients, those who received percutaneous drainage before CT scan were excluded, (n=15). We reviewed the CT scans to record the transverse gallbladder diameter, the presence of intraluminal membranes, or mural striation. We recorded the presence of gallbladder-wall enhancement (on contrast enhanced CT) and hyperdense wall (on unenhanced CT) on a 3-point scale (1, definitely absent; 2, probably present, 3, definitely present). Univariate and multivariate logistic regression was used to correlate with histopathology.

RESULTS

Of the total 126 patients, 28 cases (22.2%) had gangrenous and 98 had uncomplicated acute cholecystitis at histopathology. CT findings of gallbladder distension (n= 26 of 28 versus 38 of 98, p< .001), intraluminal membranes (n= 9 of 28 versus 8 of 98, p= .001), mural striation (n= 14 of 28 versus 12 of 98, p< .001), probability of decreased gallbladder-wall enhancement (absent, probably, and present, n= 2, 4, 14 of 28 versus 53, 24, 5 of 98, p< .001), probability of hyperdense wall on non-contrast images (absent, probably, and present, n= 2, 4, 3 of 28 versus 27, 9, 2 of 98, p= .01), and fluid accumulation (n= 6 of 28 versus 7 of 98, p= .03) were more often seen in gangrenous cholecystitis than in uncomplicated acute cholecystitis. At multivariate analysis, gallbladder distension (odds ratio, OR, 31.4, p< 0.01), mural striation (OR, 9.5, p< 0.02) and decreased gallbladder-wall enhancement (OR, 10.6, p< 0.02) independently predicted gangrenous cholecystitis.

CONCLUSION

A markedly distended gallbladder with mural striation and decreased wall enhancement is highly specific for gangrenous cholecystitis at CT.

CLINICAL RELEVANCE/APPLICATION

Pre-operative CT findings of marked gallbladder distension and decreased wall enhancement are highly predictive of gangrenous cholecystitis.
Perfusion Quantification Using Dynamic Contrast-enhanced US: Which File Format Should We Use?

Rana Al Rouhban MD (Presenter): Nothing to Disclose, Sebastien Mule: Nothing to Disclose, Stephane Oudard, MD, PhD: Nothing to Disclose, Anne-Marie Tissier MD: Nothing to Disclose, Olivier Helenon: Nothing to Disclose, Jean-Michel Correas MD: Advisory Board, Koninklijke Philips NV Speaker, Bracco Group Investigator, Bracco Group Speaker, SuperSonic Imagine Speaker, General Electric Company

PURPOSE
To evaluate the correlation between perfusion parameters estimated from raw data (linear data; device-specific format) and AVI and DICOM files (compressed data; device-free format) in dynamic contrast-enhanced ultrasound (DCE-US) studies, knowing that raw data format requires processing with proprietary software while DICOM and AVI format can be processed using independent software.

METHOD AND MATERIALS
The therapeutic response of 15 patients with metastatic renal cell carcinoma treated with sunetinib was assessed using DCE-US in this prospective study, after signing the approved consent form. 151 cineloops were acquired after a 2.4 mL bolus injection of BR1 (SonoVue®, Bracco, Milano, Italy) and simultaneously stored in RAW data, DICOM and AVI formatted files. A specific version of the “EchoPerf” software was developed to simultaneously adjust perfusion kinetics (bolus) from three regions-of-interest (ROI) by a simple mathematical model (gamma-variate) and to estimate four perfusion parameters (Mean transit time=MTT, Peak enhancement=PE, and Perfusion index=PI) from the three file formats. Data provided by the DICOM and AVI formats were linearized according to the US manufacturer recommendations. Correlation between functional perfusion parameters was calculated using the Pearson correlation test. A p-value below 0.05 was considered significant.

RESULTS
Correlation between raw data-derived estimates and AVI and DICOM-derived estimates was >> 0.94 for all perfusion parameters (p < 0.05). Higher values were found using DICOM files versus AVI files, without any statistical significance. The amplitude of the signal obtained and thus the values of the perfusion parameters for the RAW format were consistently higher due to increased dynamic range with 2 additional bits.

CONCLUSION
Functional perfusion parameters estimated with DCE-US from different file formats are strongly correlated when the appropriate linearization function is used. However, the same format should be kept for the entire follow-up study. The use of raw data is not mandatory and third-party quantification softwares can be developed.

CLINICAL RELEVANCE/APPLICATION
Any file format (raw, DICOM or AVI) can be used in recording digital cineloops for further perfusion quantification in DCE-US as long as the appropriate linearization function is used and the same format kept identical in all follow-up evaluation studies.

Testis Shear Wave Elastography: Preliminary Experience Based on 200 Patients Testis Shear Wave Elastography: Preliminary Experience Based on 200 Patients


PURPOSE
To establish normal testis shear wave elastography (SWE) findings, including artifacts and limits and to illustrate the several patterns and elasticity values found in the case of testis tumors, infertility and varicocele.

METHOD AND MATERIALS
200 patients referred for a testis ultrasound examination were studied using B-mode harmonic imaging, color-Doppler US (CDUS) and dynamic SWE using the Aixplorer platform (Supersonic Imaging, Aix-en-Provence, France) with a high-frequency linear transducer (SL15=4 MHz). For each patient and testis, the following data were collected: - testis volume, echogenicity, presence of varicocele (with and without valsalva maneuver), stiffness with 3 quantitative measurements using a Region-of-Interest (ROI; in kPa) - in the presence of a mass: size, echogenicity, vascularity and the highest stiffness value measured in the lesion. A Student’s t-test was performed to compare each pathological group; p < 0.05 was considered to represent a statistically significant difference.

RESULTS
In the normal population, the color coding inside the SWE ROI was homogeneous using a scale of 30 kPa. The normal testis stiffness was very low: 2.4±0.5 kPa. The periphery of the gland and the hilum exhibited higher stiffness values. In the case of lesions, the mean ± SD stiffness values were for: malignant tumors (n=7) 61.6±46.7 kPa; burned out tumors (n=4) 18±8.7 kPa; benign proved tumors (n=2) and nodules with benign features and follow-up period over 1 year (n=6) 4.1±1.9 kPa; infertility and severe testis hypotrophy (n=46, testis volume <10 mL) 2.2±0.94 kPa; obstructive status (n=7) 2.4±0.43 kPa; varicocele (n=30) 2.4±0.6 kPa and 2.3±0.6 kPa with and without Valsalva maneuver respectively. No statistically significant difference was found between varicocele and normal testis.. Stiffness values were significantly higher in malignant tumors and burned-out tumors compared to that of normal testis stiffness (p=0.026 and p=0.018 respectively) and benign tumors (p=0.030 and p=0.024 respectively). Limitations included stiffness assessment in cryptorchidism.

CONCLUSION
Difficulties in distinguishing benign and malignant tumors and stiffness assessment. Further limitations in...
SWE of the testis is a novel imaging technique that can be used for stiffness measurement. Despite the limited number of benign and malignant lesions, a statistically significant difference was found between these populations.

**CLINICAL RELEVANCE/APPLICATION**

SWE will be helpful to discriminate benign from malignant testis tumors.

**Hemodynamic Features from Corpus Cavernosum Perfusion CT for Additional Diagnostic Information in Patients with Erectile Dysfunction: Initial Experience**

Yong Sun (Presenter): Nothing to Disclose, Zhiqin Du: Nothing to Disclose

**PURPOSE**

To evaluate the value of penis perfusion CT for providing hemodynamic features information in patients with erectile dysfunction.

**METHOD AND MATERIALS**

17 patients (average 36.3 years) with clinically suspected vascular erectile dysfunction underwent penis perfusion imaging by using a 256-slice CT scanner. All images were transferred to a commercially available workstation (Extended Brilliance Workspace) for analysis. 3D CT angiographic images generated from perfusion source data were obtained in all patients. The hemodynamic changes of corpus cavernosum were analyzed on perfusion parameter maps.

**RESULTS**

Penile arterial vascular abnormalities including stenosis, interruption and occlusion were observed in 11 patients. Bilateral hypo-perfusion was observed in 1 case with bilateral vascular abnormality, 1 case with unilateral penile vascular abnormality, and 1 case without penile vascular abnormality. Ipsilateral hypo-perfusion was observed in 6 cases with unilateral penile vascular abnormalities, bilateral hyper-perfusion was observed with 1 case of unilateral penile vascular abnormality.

**CONCLUSION**

Hemodynamic features of corpus cavernosum can be assessed by CT perfusion method, and can provide additional diagnostic information to penile vascular changes for erectile dysfunction patients.

**CLINICAL RELEVANCE/APPLICATION**

Perfusion CT is a noninvasive, quantitative assessment method, and providing the corpus cavernosum microcirculation hemodynamic information.

**Application of Gemstone Spectral Imaging in Differential Diagnosis of Bladder Cancer and Prostate Hyperplasia**

Chen Anliang (Presenter): Nothing to Disclose, Ailian Liu MD: Nothing to Disclose, Jinghong Liu: Nothing to Disclose, Shifeng Tian: Nothing to Disclose, He Qing Wang MSc: Nothing to Disclose, Ye Ju: Nothing to Disclose, Yijun Liu: Nothing to Disclose, Renwang Pu MBBCh, FRCP: Nothing to Disclose

**PURPOSE**

To explore the application value of gemstone spectral imaging (GSI) in the differential diagnosis of bladder cancer and prostate hyperplasia.

**METHOD AND MATERIALS**

This study was approved by the Ethics Committee in our hospital and all patients provided the informed consent. A retrospective analysis was performed in 118 male patients who received pelvic GSI in our hospital from July 2011 to February 2013. Polychromatic CT value and 40~140keV (interval: 10keV) monochromatic CT values were measured in both groups, and then get GSI curves, the effective atomic number and its distribution peak value. The results were analyzed with independent sample t-test. The ROC curve was generated using the monochromatic energy level (keV) at which the biggest difference in CT value was observed between two groups, then the area under curve (AUC) was calculated, and analyzed the diagnostic performance of AUC.

**RESULTS**

There was a statistically significant difference in CT value between bladder cancer and prostate hyperplasia group at 40~90keV, which was biggest at 40keV ((84.67±21.38)HU vs. (62.86±13.99)HU). The AUC, maximum Youden index and diagnostic threshold of CT value were 0.817, 0.595 and 73.365HU, and the sensitivity and specificity were 77% and 82.5% (40keV). The slope of bladder cancer GSI curve was markedly greater than that of prostate hyperplasia (k=-0.51 vs. -0.30); the differences in effective atomic number((8.00±0.20) vs. (7.82±0.14)) and peak value((8.00±0.21) vs. (7.83±0.17)) were significant statistically.

**CONCLUSION**
The bladder cancer and prostate hyperplasia had different characteristic on spectral CT imaging. Low keV energy image of CT values play an important role in the identification, and the larger spectral curve slope point out the lesions from the bladder. Effective atomic number and its peak value in the differential also has a certain role. And spectral CT imaging with multiple parameters can distinguish these two types of disease with a higher accuracy compared to the hybrid energy CT imaging.

**CLINICAL RELEVANCE/APPLICATION**

HDCT-GSI post-processing data have a good clinical application in the differential diagnosis of posterior wall bladder cancer and prostate hyperplasia with intravesical protrusion.

**SST07-05**

**Evaluation of Intra and Extratesticular Lesions with Real TIme Elastography (RTE): Comparison of Strain Ratio (SR) versus Colour Map Visual Elasticity Score (VES)**

Eleni Konstantatou MD, MSc (Presenter): Nothing to Disclose, Asif Iqbal MBBS: Nothing to Disclose, Cheng Fang MBBS, BSC: Nothing to Disclose, Paul Singh Sidhu MRCP, FRCP: Speaker, Bracco Group Speaker, Siemens AG Speaker, Hitachi, Ltd

**PURPOSE**

The aim is to illustrate whether a correlation exists between the SR and the VES of the RTE colour map for testicular and extratesticular lesions and whether a statistical significant difference between SR calculated in benign versus malignant lesions occurs.

**METHOD AND MATERIALS**

The scrotal lesions analyzed were retrieved from a departmental database of testicular sonographic investigations. All patients were examined by a single experienced operator in accordance to departmental protocol, employing standard techniques for RTE, using a linear 9MHz transducer Preirus, Hitachi Inc, Tokyo. The RTE images were retrospectively reviewed and the visual map was scored according to a grading scale (1-soft to 6-hard). The SR of the lesions stiffness was calculated at the time of scanning. Pearson’s correlation coefficient (PCC) was calculated.

**RESULTS**

Over a 4-year period, 88 patients (median age 37.5y, range18-83y) underwent testicular sonographic evaluation for acute (n=21) and non-acute (n=67) conditions. There were intratesticular malignant lesions (n=25), benign intratesticular lesions (n=50) and benign extratesticular lesions (n=15) with size range 2-50mm. The diagnosis was confirmed with histology (n=51) or follow up (n=37) which showed resolution or stability of the lesion. The calculated mean SR for the benign lesions was 8.68 (range 0.37-89.92) and the mean VES was 4 (range1-6, ≤3 n=24 and >3 n=41). The mean SR for the malignant lesions was 13.74 (range 1.44-92.6) and the mean VER was 4.6 (range 1-6, ≤3 n=6 and >3 n=19). The strength of correlation between SR and colour map VER was summarized by PCC with the following values: for all lesions the r= 0.38; for malignant the r=0.4 and for benign lesions the r=0.36. All Pearson’s correlation coefficients proved to be statistically significant.

**CONCLUSION**

RTE is a useful adjuvant tool to B-Mode imaging of scrotal pathology, but it is not possible to stand alone with B-mode to improve diagnostic accuracy. There may be a need to add further techniques of parametric ultrasound imaging to the evaluation to improve the accuracy.

**CLINICAL RELEVANCE/APPLICATION**

Elastography is a relatively new adjuvant sonographic technique which improves diagnostic accuracy, but it cannot stand alone in clinical practice.

**SST07-06**

**Diffusion Imaging of Gynaecological Neoplasms as Aids to Characterization**

Emily Lemoniati MBBS (Presenter): Nothing to Disclose, Tina Mistry MBBS, FRCR: Nothing to Disclose, Vivek Malhotra MD: Nothing to Disclose, ANDY COADY MBBS: Nothing to Disclose, Malcolm Padwick MD: Nothing to Disclose, Anwar Roshanali Padhani MD: Advisory Board, Acuitas Medical Ltd Advisory Board, Siemens AG Speakers Bureau, Siemens AG Researcher, Siemens AG Speakers Bureau, Johnson & Johnson

**PURPOSE**

To describe and assess quantitative parameters derived from diffusion weighted (DWI), diffusion tensor (DTI) and diffusion kurtosis (DKI) imaging for characterization of gynaecological masses.

**METHOD AND MATERIALS**

Retrospective evaluation of 76 scans in women with gynaecological masses was performed. Multi-directional (b-values: 0 and 800 s/mm2) and 3 scan-trace (b-values: 100, 1100, 1600 s/mm2) DW sequences were evaluated. Regions of interest (ROI) measurements of muscle-normalized b800 signal intensity (nb800SI), apparent diffusion coefficient (ADC0-800), fractional anisotropy (FA0-800) and kurtosis coefficient (Kapp100-1600) of masses, urine and gluteal muscle were correlated with histology and compared using descriptive statistics and non-parametric distribution statistics (Kruskal-Wallis Test).
RESULTS

10 benign and 20 malignant endometrial lesions, 8 cervical cancers, 17 benign and 9 malignant ovarian lesions, 9 fibroids, 3 sarcomas were compared with 75 gluteus medius muscle and 73 urine measurements. Significant differences (p=0.003) in nb800SI values were identified between endometrial lesions (benign: mean 3.4 (±1.6) and malignant: mean 6.0 (±1.0)). Malignant endometrial and cervical lesions had lower ADC values than benign endometrial lesions (p<0.001). No ADC difference was seen between benign and malignant ovarian masses. Malignant lesions had lower FA values (endometrial cancer: mean 0.18 (±0.06), cervical cancer: mean 0.17 (±0.05)) in comparison to benign myometrial lesions (mean 0.22 (±0.15)) and muscle (mean 0.36 (±0.06)). Benign lesions had greater FA values in comparison to muscle (7 lesions) and malignant lesions (12 lesions). Malignant cervical and endometrial lesions had higher Kapp values than benign endometrial, myometrial and ovarian lesions (p=0.002). Significant differences in Kapp values for malignant versus benign endometrial lesions were noted (2.1 (± 0.04) and 1.2 (± 0.04); p=0.002).

CONCLUSION

Quantitative diffusion parameters have some discriminatory value for characterizing gynaecologic masses despite overlapping values related to necrosis and cystic change. The organised stroma of benign lesions is noted on DTI. DKI can reflect the high cellular complexity of malignant masses.

CLINICAL RELEVANCE/APPLICATION

Quantitative pelvic diffusion MRI using DWI, DTI and DKI is technically feasible. They should be evaluated for their ability to assist in the characterization of gynaecological masses.

SST07-07

Clinical Application of Low kVp from kV Assist in Combination with Adaptive Statistical Iterative Reconstruction (ASiR) in Computed Tomography Urography (CTU)

Zhigu Zhou (Presenter): Nothing to Disclose, Qingguo Wang: Nothing to Disclose, Yan Feng: Nothing to Disclose

PURPOSE

To evaluate the image quality by low kVp from kV assist in combination with ASiR in CTU.

METHOD AND MATERIALS

We retrospectively analyzed 45 patients which underwent CTU with kV assist switched on, on a multi-detector CT scanner (Discovery CT750 HD, GE healthcare). Before confirming CT scan, kV assist software allowed optimal kVp being selected automatically according to the scout view. The patients were divided into 2 groups for analysis retrospectively. Group A took 80 or 100kVp (n=32, BMI<28) and images were reconstructed with 50%ASiR. Group B (n=13, BMI≥28) took 120kVp and images were reconstructed with FBP respectively. The main parameters of protocol were setup with a baseline of noise index at 12, auto mA range at 100-700mA and rotation time at 0.5s. Measure CT values and SD values of bilateral renal pelvis and subcutaneous fat tissue on abdomen, and calculate mean CNR and mean SNR of bilateral renal pelvis. Record CTDIvol and DLP of each patient. Use Student T test to analyze all data.

RESULTS

The mean CT value of bilateral renal pelvis in group A was significantly higher than in group B (271.35±57.60HU vs 221.80±35.28HU), (p

CONCLUSION

kV assist software allowed low kVp(80 or 100 kVp) apply for small patients. In combination with 50%ASiR , low kVp got better image quality and 44% radiation dose reduction than 120kVp with FBP in CTU.

CLINICAL RELEVANCE/APPLICATION

For small shape patients in CTU, low kVp token by kV assist combination with 50%ASiR , better image quality and lower radiation dose were accomplished than patients with 120 kVp and FBP. They simplified examination and improved quality.

SST07-08

Evaluation the Stretched Exponential Model of Non-Gaussian Analysis of Diffusion Weighted Imaging in the Grading of Cervical Cancer

Hui Li: Nothing to Disclose, Yuan Qu: Nothing to Disclose, JIE JIANG: Nothing to Disclose, LINCHUAN ZHANG (Presenter): Nothing to Disclose

PURPOSE

To investigate the utility of stretched exponential model with multi b-values DWI in the grading of cervical cancer.

METHOD AND MATERIALS

22 female patients with cervical cancer prior to the treatment were recruited and underwent pelvic MR examination in this study. 12 out of 22 patients were diagnosed with stage IIB cervical cancer and 10 with stage IIB cervical cancer. DWI was acquired on the sagittal plane with 12 b values (0, 20, 50, 100, 200, 400,
Parametric maps of distributed diffusion coefficient (DDC, a quantification of intravoxel distribution of apparent diffusion coefficients) and the stretching parameter (α, reflects the heterogeneity of intravoxel water diffusion rates) were generated. ROIs encompassed the whole tumor area. Mann-Whitney U-test was performed to determine if there was any statistically significant difference between the two parameters extracted from stage IIIB cervical tumors and those from stage IIB cervical tumors using a P-value level of 0.05.

RESULTS
Mean values of DDC and α showed significantly differences between IIIB cervical cancers and IIB cervical cancers (P<0.05). DDC was significantly higher in IIIB cervical cancers compared to the stage IIB tumor group (P<0.05), which suggested that IIIB cervical cancers contained a lower number of distinct intravoxel proton pools compared to IIB cervical cancers. The α value was significantly lower in IIIB cervical cancer group compared to IIB cervical cancer group.

CONCLUSION
Stretched exponential model demonstrated capability to differentiate cervical cancer, where the DDC and α value may be the considerable parameters for the grading of cervical cancer.

CLINICAL RELEVANCE/APPLICATION
Stretched exponential model of non-Gaussian analysis is a valuable approach for the grading of cervical cancer.

Prevalence of Fallopian Tube Pathology in Infertile Women. CT Virtual Hysterosalpingography Findings

Patricia M. Carrascosa MD: Research Consultant, General Electric Company, Carlos Capunay MD: Nothing to Disclose, Javier Vallejos MD, MBA (Presenter): Nothing to Disclose, Mariano Baronio: Nothing to Disclose

PURPOSE
Infertility has been assigned mainly to fallopian tube pathology. The objective of this presentation is to show the prevalence of tubal pathology in patients with diagnosis of infertility who has performed a CT virtual hysterosalpingography (CT-VHSG).

METHOD AND MATERIALS
We evaluated 10465 consecutive patients (age 35+/-4.7 years old) with diagnosis of infertility by CT-VHSG. Exams were carried out with a 64-,128- and 256-slice CT scanners using the following technical parameters: slice thickness, 0.6 mm; reconstruction interval, 0.325mm; 100-150 mAs and 80-120 kV. After cleaning the vagina with povidone-iodine solution, a speculum was placed and a plastic cannula was inserted in the external cervical ostium. A volume of 10-20 ml of a hyposmolar dilution at 70% was instilled to the uterine cavity with a power injector. Once acquired images were reprocessed using 2D and 3D reconstructions. The fallopian tubes were classified as: 1) Normal, 2) Pathologic. The pathologic tubes were also subdivided in those with ampullar dilatation, hidrosalpinx, intratubal stenosis, intratubal polyps, tubal pathologic displacement, negative peritoneal contrast spillage (negative Cotte test).

RESULTS
The scan time was 2.1+/-1.3 sec. The complete study duration was 27+/-8 minutes. The mean radiation dose was 0.7 mSv. From 10465 patients, a total of 20905 fallopian tubes were available for evaluation. There were 17548 (84%) normal and 3357 (16%) pathologic fallopian tubes. Pathologic findings included: occlusion, negative Cotte test, ampullar dilatation, hidrosalpinx, intratubal stenosis, intratubal polyps, abnormal position, blocked peritoneal contrast spillage.

CONCLUSION
In patients with infertility referred to a CT-VHSG, only the 16% of the fallopian tubes were pathologic. For that reason, the importance of an integral diagnostic procedure that accurately evaluates the tubes but also the uterus (cervix and body) is mandatory to discard other pathologies. In the daily practice, there’s a general overestimation of fallopian tube pathology.

CLINICAL RELEVANCE/APPLICATION
CT Virtual Hysterosalpingography provides a complete, minimally invasive evaluation of the female reproductive system, with an accurate evaluation of the fallopian tubes, using bidimensional, tridimensional and endoscopic views.
**Novel Binomial Off-Resonant Rectangular (BORR) Pulse for MRI Retrobulbar Vessel Imaging**

**SST08-01**

**PURPOSE**

Retrobulbar vessels, such as ophthalmic artery (OA) and vein (OV), central retinal artery (CRA), posterior ciliary arteries (PCA) and lacrimal artery (LA), are critical to maintain the eye’s normal function. Disrupted blood flow in these vessels can lead to severe vision loss. However, these vessels are difficult to image with MRI. Here we demonstrate a novel water selective excitation method, namely Binomial Off-Resonant Rectangular (BORR) pulse, for obtaining high resolution retrobulbar vascular maps.

**METHOD AND MATERIALS**

Nine healthy volunteers (5 males, 31±3 y/o) were enrolled in the study with written consents. All data were collected on a Siemens 3T Verio scanner with product 32ch head coil. The BORR GRE sequence was scanned sagittally with TR/TE = 11/3ms, 0.5mm isotropic voxels; BORR pulse duration τ= 1.6ms, flip angle = 12°, and frequency offset Δf = 140Hz. This configuration gives whole brain coverage and excellent fat suppression. For comparison, 3D TOF MRA (with and without fat saturation [FS], or water excitation [WE]), 2D TOF, Linear Subtraction (LS) MRA and CE MRA were also performed. All scans were configured to have similar parameters (e.g. voxel size, bandwidth, etc.). All final results were reoriented to axial plane and processed with Maximal Intensity Projection (MIP) over a 4mm thickness.

**RESULTS**

As shown in the figure, the BORR pulse reliably suppresses all orbital fats, while preserving high vessel signal with sharp edges. In contrast, none of other MRA methods, including CE-MRA and LS MRA which have proven to work well for cerebral vessels, achieved similar performance in showing the vessels.

**CONCLUSION**

With our new BORR method, we have shown for the first time the high resolution MR images of the retrobulbar vessels, which has not been revealed by any existing MRA methods. This is because these vessels are buried in fatty tissues that show high signal in most MRA methods, and routine fat suppression or water excitation approaches also affect blood signal. The BORR method, on the other hand, has very robust and thorough fat suppression while preserving high blood signal. Therefore we have demonstrated the promising capacity for imaging retrobulbar vessels of the BORR method.

**CLINICAL RELEVANCE/APPLICATION**

We demonstrate a novel MRA method to reveal retrobulbar orbital vessels with high resolution, clearly revealing major vessels such as OA, OV, PCA and CRA to enable direct evaluation of the blood supply to the eyes.

---

**The Usefulness of Acoustic Structure Quantification Values in the Evaluation of Diffuse Thyroid Disease**

**SST08-02**

**PURPOSE**

To evaluate the diagnostic value of acoustic structure quantification(ASQ) for the diagnosis of diffuse thyroid disease (DTD). To identify cut-off levels of ASQ values in the differentiation of DTD and normal thyroid. To identify any difference in the subgroups of DTD between thyroid function and ASQ values.

**METHOD AND MATERIALS**

ASQ values were retrospectively analyzed from 439 lobes of 234 patients. The DTD group was divided into five subgroups (Hashimoto’s thyroiditis, painless thyroiditis, subacute thyroiditis, postpartum thyroiditis, and Grave’s disease). ASQ values were used to assess the echogenicity of thyroid. ASQ results included both qualitative visual results as well as quantitative results. The results are shown as occurrence in the C2m histogram(modified chi-squared distribution) with the mode, average, ratio, blue-mode, and blue-average. ROC curve analysis was performed to assess the diagnostic value of ASQ values for DTD, and cut-off values were obtained for the differentiation of DTD and normal thyroid gland function. The trends between thyroid function and ASQ values were evaluated. Concordance correlation coefficients of ASQ values were obtained.

**RESULTS**

The mean ASQ values in patients with DTD were significantly greater than normal thyroid(p=0.000). The areas under the ROC curves for the ratio, average, blue-average, mode, and blue-mode were 0.93, 0.91, 0.90, 0.87,
and 0.87, respectively. The cut-off values of the ratio, average, and blue-average in the DTD diagnosis were >0.27, >116.7, and >130.7, respectively. The sensitivity were 84.0, 85.3, and 79.1% and specificity were 96.6, 83.0, and 93.2%(ratio, average, and blue-average, respectively). A significant difference in ASQ values was found according to the hormonal status(p=0.000). Trend analysis showed a quadratic trend between the hormonal status and ASQ values. The concordance correlation coefficient of obtaining ASQ values was very good.

**CONCLUSION**

ASQ values can provide objective and quantitative non-invasive analysis of thyroid echogenecity. ASQ value determination can be an objective guide to differentiate DTD from normal and has good diagnostic value for clinical application in the diagnosis and monitoring of DTD.

**CLINICAL RELEVANCE/APPLICATION**

(dealing with ultrasonography) "ASQ can provide objective and quantitative analysis of thyroid echogenicity. This exam is recommended for diagnosis and monitoring of diffuse thyroid disease."

### SST08-03

**Impact of Image Orientation on Measurements of Thyroid Nodule Stiffness Using Shear Wave Elastography**

Manjiri K. Dighe MD (Presenter):  Research Grant, General Electric Company, Jeff Thiel:  Nothing to Disclose, Daniel S. Hippe MS :  Research Grant, Koninklijke Philips NV Research Grant, General Electric Company

**PURPOSE**

To compare stiffness measurement within a thyroid nodule using Shear wave elastography (SWE) on transverse (T) and longitudinal (L) images.

**METHOD AND MATERIALS**

After IRB approval, elastograms were obtained by (SWE) from 77 individuals, with a total of 96 thyroid nodules. SWE data was acquired without any external compression using the Supersonics Aixplorer machine. Elastograms were acquired in the transverse (T) and longitudinal (L) orientation. 1 reader blinded to pathology results drew regions of interest (ROIs) covering the entire nodule within each image. The mean stiffness value (SV) was recorded from each ROI and averaged across each nodule for each orientation separately. Nodule SVs were compared between orientations using the Wilcoxon signed-rank test for bias and the concordance correlation coefficient (CCC) for agreement. In those with final histopathology results available, receiver operating characteristic (ROC) curve analysis and the area under the ROC curve (AUC) were used to evaluate how well SVs from each orientation could discriminate malignant and benign lesions.

**RESULTS**

Mean nodule SVs were 19.3 ± 15.5 kPa on T images and 22.1 ± 20.8 kPa on L images. There was a statistically significant but small bias in measurements between orientations of 2.8 kPa (p=0.003). The SD of differences was 13 kPa and CCC=0.74. After removing two large values, these dropped to 9.9 kPa and CCC=0.52. In the subset of 41 nodules with histopathology available, the AUC for discriminating malignant and benign lesions was 0.76 (p=0.002) using T images and 0.70 (p=0.01) using L images (p=0.28 for the difference).

**CONCLUSION**

There was moderate agreement in mean stiffness values measured using transverse and longitudinal orientation but only a small bias. Measurements from both orientations had similar performance in discriminating malignant and benign lesions. Using either orientation for characterizing thyroid nodules is feasible.

**CLINICAL RELEVANCE/APPLICATION**

Similar diagnostic performance using Shearwave elastography was achievable using transverse and longitudinal orientations, which provides flexibility in imaging patients with short necks or difficulty in laying on the examination bed with an extended neck.

### SST08-04

**Iterative Model Reconstruction Algorithm in Low kVp (80) Parotid CT Scan for Visualization of Adipose Tissue Deposition in Sjögren’s Syndrome**

Changwei Ding (Presenter):  Nothing to Disclose, Xiao Mei Lu MMed :  Employee, Koninklijke Philips NV, Ping Wang MD, MS :  Nothing to Disclose, Qiyong Guo MD :  Nothing to Disclose

**PURPOSE**

To investigate the ability of low dose parotid CT scan using an iterative model reconstruction (IMR) algorithm to detect the distinctive adipose tissue deposition in Sjögren’s syndrome.

**METHOD AND MATERIALS**

Eighteen patients with confirmed Sjögren’s syndrome were scanned using a 256-slice CT for visualization of the parotid gland. This protocol was approved by hospital ethics committee and written informed consent was obtained from each patient. Among these patients, five underwent routine dose scan (120 kV and 200 mAs) and filtered back projection algorithm was used for image reconstruction (RD-FBP group), and thirteen patients under low dose scan (80 kV, 200 mAs, 71% dose reduction), and iDose4 (level 5) and IMR (level 1) algorithm was used respectively for image reconstruction (LD-iDose4 group and LD-IMR group, respectively). The image noise (measured in semispinalis capitis) was compared between RD-FBP group and LD-iDose4 and LD-IMR group. The images of LD-iDose4 group and LD-IMR group were read blinded by two experienced radiologists in consent for evaluation of the adipose tissue deposition in the parotid gland according to these features: detectability, interface contrast to parotid parenchyma, and density contrast to parotid parenchyma {1 (poor) to 5 (excellent)}.
RESULTS

The image noise in the LD-IMR group was significantly lower than in the LD-iDose4 and RD-FBP groups (4.36±0.96, 6.92±1.11, and 5.77±1.44, respectively, P<0.05). There was no significant difference in the detectability of adipose tissue between LD-IMR and LD-iDose4 groups (P>0.05). The LD-IMR group displayed clearer boundary between adipose tissue and parotid parenchyma and offers higher density contrast than the LD-iDose4 group (P<0.05).

CONCLUSION

IMR algorithm reduced the noise of low dose parotid CT scan, even lower than RD-FBP, increased the interface and density contrast of adipose tissue and parotid parenchyma, so offered stronger ability to detect adipose tissue deposition in the parotid gland of patients with Sjögren’s syndrome.

CLINICAL RELEVANCE/APPLICATION

IMR can improve the image quality of low dose CT scan, increase the contrast resolution between different tissues, and thereby enhance the ability to detect lesions.

SST08-05

Single Contrast Bolus vs Radiation Dose: Can Combined Chest & Neck CT Examinations Use One Topogram?

Jie Zhang PhD (Presenter): Nothing to Disclose, Jessica L. Cornett: Nothing to Disclose, Karsten D. Colwell: Nothing to Disclose, Gerald Ball Broussard MD: Nothing to Disclose, Edward Joel Escott MD: Royalties, Thieme Medical Publishers, Inc Researcher, Athersys, Inc Grant, Athersys, Inc Researcher

PURPOSE

Currently we treat Computed Tomography (CT) chest and neck examinations as separate scans, using two separate topograms and dividing the contrast 60/40. Depending upon the patient’s body habitus this amount of contrast for each scan may not be sufficient to opacity the vessels properly. Acquiring one topogram with the arms up then having the patient move their arms up/down during the chest/neck scan allows one bolus of contrast to be administered, but has the potential to increase radiation. The purpose of this study is to investigate the difference in patient radiation dose for combined chest and neck CT examinations when one topogram with the arms up is used, compared with two separate topograms with the arms up and down respectively.

METHOD AND MATERIALS

Between 2/1/2014 and 4/5/2014, patients who received a CT chest and neck examination in the same session and same CT scanner were randomly separated into two groups. One group followed the conventional two topogram scenario with proper arm positioning while the other group kept the arms up for the combined topogram. The first group received the divided 60/40 bolus contrast while the second group received only one contrast bolus. During scan acquisition for the second group the arms were positioned out of the scan field-of-view (FOV). Automatic Exposure Control (e.g., CareDose4D) remained on for CT scanning. Volume CT Dose Index (CTDIvol) for the chest and neck CT scans was recorded, respectively. Patient Body Mass Index (BMI) was also recorded.

RESULTS

The CTDIvol and BMI of 23 patients were collected, 11 with two separate topograms and 12 with one topogram. Our preliminary comparison shows there is no significant difference in either CTDIvol of the neck (p=0.24) or BMI (p=0.51) with either topogram technique. This may be mainly due to the use of AEC (CareDose4D) which adjusts tube current in real time. CTDIvol of the chest was not compared since in either situation the arms are not included within the chest on the topogram.

CONCLUSION

One topogram with the arms up can be used for combined CT chest and neck examinations to allow the use of a single contrast bolus. With the appropriate use of AEC, there is no significant increase in the radiation dose to patient.

CLINICAL RELEVANCE/APPLICATION

One topogram can be used for combined chest and neck CT examinations to enable the use of a single contrast bolus without a significantly increased patient dose.

SST08-06

Application of the Dual Energy CT Scan for Differentiation of Parathyroid Gland from Thyroid Gland Based on Enhancement Characteristics

Laleh Daftaribesheli MD (Presenter): Nothing to Disclose, Emad Ahmadi MD: Nothing to Disclose, Omid Khalilzadeh MD, MPH: Nothing to Disclose, Rajiv Gupta PhD, MD: Nothing to Disclose

PURPOSE

Compared to thyroid, parathyroid is hypothesized to uptake more amounts of iodine after iodine contrast injection, and to have more rapid iodine washout in delayed images. The aim of this study was to ease the distinction of parathyroid from thyroid gland in CT images by comparing the changes of iodine content in these two glands over time after iodine contrast injection. Using dual-energy CT, we also aimed to minimize radiation exposure by eliminating the pre-contrast phase.

METHOD AND MATERIALS
We retrospectively studied seven CT angiograms of head and neck that had been performed for vascular assessment of patients. The imaging protocol included iodine contrast injection followed by one post-contrast dual-energy CT image and one delayed image after injection. We defined regions of interest over parathyroid and thyroid gland, computed the iodine content in these regions using dual-energy CT post-processing software, and subtracted the iodine content in delayed image from that of the post-contrast image. This iodine content change was then compared between thyroid and parathyroid glands.

RESULTS

Our study includes 5 males and 2 females with the mean age of 67. Our analysis showed that the iodine content decrease from post-injection to delayed image was 6.2 ± 1.8 for parathyroid gland, and it was 2.1 ± 2.1 for the thyroid gland. The figure shows the changes of iodine content over time in both parathyroid and thyroid glands, as well as the defined regions of interest for two representative cases.

CONCLUSION

Using a two-phase dual energy CT scan (post-contrast and delayed phase), parathyroid tissue can be distinguished from thyroid gland based on the pattern of iodine content changes between the phases.

CLINICAL RELEVANCE/APPLICATION

Difference between iodine content of post-contrast image and delayed post-contrast image in the parathyroid and thyroid tissue might enable clinicians to differentiate the two tissues reliably. Distinction of parathyroid from thyroid tissues in dual-energy CT images might be facilitated by superimposing computed images on the CT image that are encoded based on changes of iodine content from post-injection to delayed-phase images.

SST08-08

Establishing Normative Values of Dual-energy CT Parameters in Head and Neck Tissues and Comparison to Benign and Malignant Tumors

Ashok Srinivasan MD (Presenter): Author, Amirsys, Inc , Hideomi Yamauchi MD : Nothing to Disclose , Mark Alan Buehler MD : Nothing to Disclose , Matthew Spector : Nothing to Disclose , Suresh K. Mukherji MD : Nothing to Disclose , Mitchell M. Goodsit PhD : Research collaboration, General Electric Company

PURPOSE

1. To establish the normal range of dual energy CT derived parameters for normal tissues in the head and neck.
2. To evaluate the differences in dual energy CT parameters amongst normal tissues, benign and malignant neoplasms.

METHOD AND MATERIALS

Institutional review board approval was obtained. All adult CT neck scans performed on a 64 slice GE CT (HD750, Milwaukee, WI) with dual energy CT (Gemstone spectral imaging, GSI) from November 2009 to February 2014 were included. Scans with significant artifact or poor contrast bolus were excluded. Post-processing was performed by an experienced neuroradiologist on a GE-AW workstation by placing multiple ROIs in normal tissues including the parotids, submandibular glands, floor of mouth, tongue base, lymph nodes, paraspinal muscle and in known tumor tissue (either benign or malignant). The parameters measured included HU at 70keV, effective Z and iodine-water concentrations. Mean, S.D. and range were calculated for each of these parameters within normal tissues and were then compared to the parameters measured in benign and malignant tumors using independent samples t-test. Scatterplots of effective Z against each of the other parameters were also created to analyze if benign and malignant tissues could be reliably separated using these parameters.

RESULTS

Patients with 17 benign and 24 malignant tumors were included. The mean and SD of effective Z and iodine-water concentration (in mg/cc) in normal tissues, benign and malignant tumors are listed in Table 1. Significant differences in effective Z and iodine-water concentrations was noted between benign and malignant neoplasms (p=0.001, 0.001 respectively) and between malignant neoplasms and all normal tissues but not between benign tumors and normal tissues. The scatterplots of effective Z versus HU at 70 keV showed good separation of benign and malignant tumors.

CONCLUSION

Our study reveals that dual energy CT may help in distinguishing both benign and malignant tumors from each other, and differentiating malignant tumors from normal tissue in the head and neck.

CLINICAL RELEVANCE/APPLICATION

Dual energy CT can be an additional tool to conventional imaging in characterizing head and neck lesions.

SST08-09

Thyroid Evaluation with a Novel Microvascular Flow Technique

Priscilla Machado MD : Grant, Toshiba Corporation Equipment support, Toshiba Corporation , Sharon Rebecca Segal DO : Nothing to Disclose , Andrej Lyshchik MD, PhD : Nothing to Disclose , Flemming Forsberg PhD (Presenter) : Equipment support, Toshiba Corporation Research collaboration, General Electric Company Research collaboration, Analogic Corporation Research collaboration, Toshiba Corporation Speakers Bureau, Toshiba Corporation

PURPOSE
To evaluate the flow imaging capabilities of a new prototype ultrasound (US) image processing technique (SMI; Toshiba Medical Systems, Tokyo, Japan) for depiction of microvascular flow in normal thyroid tissue and thyroid nodules compared to standard color and Power Doppler imaging (CDI and PDI).

**METHOD AND MATERIALS**

SMI is a novel, microvascular flow imaging mode implemented on the Aplio 500 US system (Toshiba). SMI utilizes advanced clutter suppression to extract flow signals from large to small vessels and depicts this information as a color overlay image or as a monochrome map of flow. Ten (10) healthy volunteers and 22 patients, with 25 thyroid nodules, scheduled for US guided fine needle aspiration were enrolled in this prospective study. Subjects underwent US examination consisting of grayscale US, CDI and PDI followed by color and monochrome SMI and pulsed Doppler. In the volunteers, pulsed Doppler guided by the 4 flow modes determined the lowest velocity measurable within the normal thyroid microvasculature and results were compared using a one-way ANOVA. Two radiologists independently analyzed still images and digital clips scoring overall flow detection, vessel branching details and noise on a subjective scale of 1 (worst) to 10 (best). Scores were compared (on a per nodule basis) using a non-parametric Wilcoxon signed rank test.

**RESULTS**

For the volunteers SMI captured microvasculature with lower velocity than CDI and PDI (2.2 ± 0.35 and 2.1 ± 0.32 cm/s vs. 2.6 ± 0.44 and 2.8 ± 0.77 cm/s; p < 0.012). In all cases SMI showed microvascular flow with significantly higher image scores and provided better depiction of the vessel branching details compared to CDI and PDI (SMI scores > 5.4 and CDI/PDI scores < 4.9; p < 0.0001). Clutter noise was significantly higher in monochrome SMI mode than in the other modes, including color SMI (monochrome SMI scores < 4.5 while others were > 6.4; p < 0.001).

**CONCLUSION**

The novel SMI mode consistently showed more detailed thyroid flow with smaller branches and lower velocities than CDI and PDI.

**CLINICAL RELEVANCE/APPLICATION**

This new flow mode may be useful for providing a better understanding of the vascularity of thyroid nodules.
RESULTS
We included 175 patients (89 male, mean age 78.2 years). Mean follow-up time was 40.4 months, resulting in 7070 patient-years of follow-up. Overall 36 MACE occurred in the cohort during follow-up (12 myocardial infarctions or revascularizations, 6 strokes, 18 cardiovascular deaths; event rate =xx%/year). CPS was significantly higher in subjects with compared to subjects without MACE (6.8±3.5 vs. 4.5±3.4, p =5 (p

CONCLUSION
Patients with an age >60 years and a burden of intracranial artery calcification have an increased risk for the occurrence of cardio- or cerebrovascular events.

CLINICAL RELEVANCE/APPLICATION
Intracranial artery calcifications, which can be easily detected on non-contrast-enhanced CT scans of the head, might be a prognostic factor to determine the risk for a future cardio- or cerebrovascular events in older patients.

A New Automated Method for Magnetic Resonance Perfusion Weighted Imaging Using a Local Arterial Input Function and Contrast Agent Leakage Correction

Donald Robinson Cantrell MD, PhD (Presenter): Nothing to Disclose, Thomas Anthony Gallagher MD : Nothing to Disclose, Timothy J. Carroll PhD : Nothing to Disclose

PURPOSE
MR Perfusion Weighted Imaging (MR-PWI) supplements anatomic sequences by providing functional information regarding the hemodynamic status of the brain. Standard MR-PWI protocols employ singular value decomposition to deconvolve the arterial input function (AIF) from the relaxivity time curve. However, standard models are limited by their inability to account for differences in bolus arrival time (BAT), bolus dispersion, and contrast leakage. Local AIF techniques have addressed the problems associated with delayed BAT and bolus dispersion (Lee et al, 2010, MRM 63: 1305), but have not addressed leakage, an important hemodynamic parameter in the imaging of CNS malignancies (Boxerman et al, 2006, AJNR 27: 859). In the present work, we introduce a new fully automated local AIF perfusion technique that incorporates leakage effects, making it broadly applicable to both ischemia and malignancy.

METHOD AND MATERIALS
A per-voxel AIF was modeled with a gamma-variate function. The residue function was modeled with a mono-exponential. Leaking contrast was defined to be proportional to the cumulative integral of the intravascular concentration time curve. Parameter values were inferred with Bayesian Markov Chain Monte Carlo simulations. The automated algorithm was implemented in C/C++ and parallelized with the Message Passing Interface to execute in parallel on a user-defined number of CPUs.

RESULTS
The model was applied to a pilot series of patients with Moyamoya disease and CNS malignancy. In patients with Moyamoya disease, the MTT derived by standard deconvolution is confounded by bolus delay. However, the local AIF technique directly accounts for delayed BAT, and the resulting MTT prolongation is reduced compared to the standard approach. In patients with glioblastoma multiforme, tumors demonstrate variable heterogeneity with some components characterized by pronounced hyperperfusion, and other components characterized by increased vascular permeability. All of these hemodynamic properties are simultaneously inferred by our new technique.

CONCLUSION
A new local AIF technique that incorporates leakage effects has been developed, and it is broadly applicable to the evaluation of both ischemia and malignancy.

CLINICAL RELEVANCE/APPLICATION
This work outlines a new local AIF technique for MR Perfusion that corrects for the effects of contrast leakage and is broadly applicable to the evaluation of both ischemia and malignancy.

Proof of Concept: Potential of Normal Saline (NS) as a Safe Exogenous Contrast Agent for Perfusion MRI of the Brain


PURPOSE
Gadolinium-based contrast agents can have risks including nephrogenic systemic fibrosis, allergic reactions and limitation of use during pregnancy. Normal saline (NS) is a nontoxic sodium chloride water solution that can significantly increase the MR relaxation times of blood via hematocrit reduction. The purpose of this study was to test in-vivo the potential of NS as a safer, brain perfusion exogenous contrast agent.

METHOD AND MATERIALS
This HIPAA compliant prospective study was approved by the IRB of our hospital. MRI was performed at 1.5T (Achieva, Philips Healthcare): head array and body coil for RX/TX. Three and five patients were scanned with an IR-EPI and IR-TSE sequence, respectively. The IR pulse sequence was run during and after the NS injection for
up to 5min: 100cc of NS were power injected into antecubital veins at 3-4cc/s. Images were processed with Mathcad (2001i, PTC, Needham, MA) algorithms to map maximum enhancement (maxENH), area under the curve (AUC), time-to-peak (TTP), and mean-transit-time (MTT) (Fig. 1a). These maps were used to identify visually the areas showing significant NS injection related signal. Regions of interest (ROI) were drawn in areas of high injection related effects as well as areas without these effects and graphed as a function of time.

RESULTS

NS injection-related enhancement effects were observed in all patients, particularly in highly vascular intra- and extra-cranial tissues and also in periventricular white matter. Relative signal change in cortical gray matter and periventricular white matter were observed in the 10-30% range and these enhancement effects lasted for several minutes post injection (Fig. 1b). All recruited patients completed the NS injection plus the dynamic-IR-MRI scan without any adverse effects, or expressing discomfort.

CONCLUSION

A measurable perfusion effect of up to 30% change relative to baseline has been demonstrated in-vivo in the human brain using NS as a contrast agent. The contrast mechanism is believed to be an alteration of the T1 relaxation time resulting from hematocrit reduction. To the best of our knowledge, this is the first report of the use of NS for dynamic contrast enhanced MRI.

CLINICAL RELEVANCE/APPLICATION

This demonstrates the viability of NS as a measurable, safe, practical, and inexpensive T1 contrast agent for dynamic perfusion MRI. The described methodology could be used with patients with Gd contraindications.

SST09-04

Progression of Brain Atrophy and White Matter Hyperintensities in Cerebral Small Vessel Disease. Estimates of Sample Size to Detect Treatment Effects

Philip Benjamin MBBS (Presenter): Nothing to Disclose , Andrew J. Lawrence : Nothing to Disclose , Andrew Mackinnon MD, MRCP : Nothing to Disclose , Eva Zeestraten : Nothing to Disclose

PURPOSE

Brain volume and white matter lesions have been suggested as a surrogate marker of disease progression for use in clinical trials in cerebral small vessel disease (SVD). If these MRI findings are to be used as a reliable surrogate markers in clinical trials, power calculations are required not only to determine the sample sizes needed to show therapeutic efficacy, but also to help identify the most feasible outcome measures. We used serial brain magnetic resonance imaging (MRI) to prospectively evaluate the rate of brain atrophy and white matter hyperintensity (WMH) growth in SVD and investigated the sample sizes required to demonstrate a reduction in the rate of disease progression.

METHOD AND MATERIALS

Data from the prospective SCANS study of patients with SVD was used for this analysis (n=121). SVD was defined as a clinical lacunar stroke with an anatomically corresponding MRI defined lacunar stroke as well as confluent leuoaraiosis. Multimodal MRI was performed yearly for a period of 3 years. Percentage whole brain volume change relative to baseline was measured directly using a registration based method (SIENA). WMHs were segmented and volumes were calculated at each timepoint in individual subject space by summing binarised corrected segmentations.

RESULTS

For a 3 year trial duration the mean (SD) rate of whole brain atrophy was -1.985%(1.958). The mean (SD) percentage growth of WMH (WMHp) was 1.912% (1.168). Based on these figures, to detect a 25%, 20% and 15% treatment effect on brain atrophy at 80% power the minimum sample sizes required were 494 (247 in each arm), 766 (383 in each arm) and 1358 (679 in each arm) respectively. For WMH growth, the minimum sample size required to detect a 25%, 20% and 15% treatment effect at 80% power was 172 (86 in each arm), 270 (135 in each arm) and 476 (238 in each arm) respectively.

CONCLUSION

Whole brain volume change is measurable prospectively in SVD and is higher than the reported rate of atrophy in normal ageing. Whole brain volume change is therefore a feasible outcome measure for use in clinical trials in SVD although sample sizes are still moderate. Considerably smaller sample sizes are required if WMH volume is used as an outcome measure, however the impact of WMHs on cognitive impairment and disability in SVD remains uncertain.

CLINICAL RELEVANCE/APPLICATION

Markers of disease progression in cerebral small vessel disease

SST09-05

Intracranial Hypotension and Sinus Vein Thrombosis - Causal or Casual Association?

Ruth Eliahou MD (Presenter): Nothing to Disclose , Asaf Honig MD : Nothing to Disclose , Ronen Leker MD : Consultant, MedyMatch Technology Ltd , John Moshe Gomori MD : Consultant, Medymatch Technology
Intracranial hypotension (IH) is an increasingly recognized clinical entity with distinct clinical and imaging features. The associated venous distention and sluggish venous flow in IH has been linked to sinus vein thrombosis (SVT). Iatrogenic direct lumbar punctures (LP), spinal anesthesia (SA) or indirect punctures due to epidural anesthesia (EA) are common causes of IH. We studied the occurrence of SVT in patients post LP.

**METHOD AND MATERIALS**

We retrospectively reviewed the imaging and clinical findings of post LP patients with SVT in our institution between 2003 and 2013.

**RESULTS**

Eighty patients who presented to our institution in the past 10 years with acute sinus vein thrombosis were identified. Ten of them, all females (ages 22 -52) were found to have an LP 3-7 days before developing SVT. 8 women were post-partum with EA, and two had SA for meniscal surgery and hysterectomy. All patients had postural headaches. CT and MR scans of all ten patients were positive for SVT. In addition, five patients (50%) also showed one or more IH related MR findings: low cerebellar tonsils, decreased mamillo-pontine distance, diffuse pachymeningeal enhancement, thin bilateral subdural fluid collections. Post- partum and postoperative states are known to be hypercoagulable conditions. Subsequent coagulograms revealed underlying hypercoagulable tendencies in all ten patients.

**CONCLUSION**

Clinical and imaging data point to a direct association between IH and SVT. In post-partum women who underwent recent spinal or epidural anesthesia, with diagnosis of SVT one should look for IH. Coexistence of underlying IH may have therapeutic implications.

**CLINICAL RELEVANCE/APPLICATION**

There is a strong association between postpartum SVT and IH, caused by recent spinal anestheia Postpartum SVT should initiate imaging and clinical search for underlying IH.

**Evaluation of the Atherosclerotic Wall of intracranial Aneurysms Using Hybrid of Opposite-contrast Magnetic Resonance Angiography (HOP-MRA)**

Yuji Akiyama (Presenter): Nothing to Disclose , Toshinori Matsushige : Nothing to Disclose , Yoshiko Iwakado : Nothing to Disclose , Yoko Kaichi : Nothing to Disclose , Tokunori Kimura PhD : Nothing to Disclose , Kazuo Awai MD : Research Grant, Toshiba Corporation Research Grant, Hitachi Ltd Research Grant, Bayer AG Research Consultant, DAIICHI SANKYO Group Research Grant, Eisai Co, Ltd

**PURPOSE**

Hybrid of opposite-contrast magnetic resonance angiography (HOP-MRA) is a new technique that combines the advantages of 3D time-of-flight (TOF) MRA and flow-sensitive black-blood (FSBB) MRA. Theoretically, HOP-MRA demonstrates atherosclerotic plaques in intracranial aneurysms. The purpose of this study was to investigate whether HOP-MRA demonstrates atherosclerotic plaques in intracranial aneurysms.

**METHOD AND MATERIALS**

This prospective study included 13 patients (6 men, 7 women; median age 63 years, range 24-76 years) with 15 aneurysms. The same neurosurgeon with 15 years of experience confirmed the macroscopic findings on all aneurysms. The median maximum diameter of the aneurysms was 5.1 mm (range 2.8-14.1 mm). All images were acquired on a commercially available 3T MR scanner (Vantage Titan 3T; Toshiba Medical Systems) with a 16-channel head coil. For HOP-MRA we used a 3D GRE double-echo sequence. The scan parameters were: TR, 21 ms; TE1, 3.3 ms; TE2, 13.9 ms; flow dephasing gradient (b=0.3s/mm2); flip angle, 20; field of view, 24 cm; slice thickness, 1 mm; number of partitions, 60; 192 X 256 matrix; and 2 NEX. We measured the relative signal intensity (RSI) of the high-intensity area to the background low-intensity area inside the aneurysm.

**RESULTS**

During surgery, 6 aneurysms were classified as grade A, 4 as grade B, and 5 as grade C. The mean RSI for grade A, B, and C was 4.65±1.53 (standard deviation), 1.42±0.69, and 0.93±0.16, respectively. There was a statistically significant difference between grade A and B (p=0.028, Steel-Dwass multiple comparison), grade A and C (p=0.017), and grade B and C aneurysms (p=0.038).

**CONCLUSION**

The relative signal intensity in intracranial aneurysms on HOP-MRA images accurately correlated with the presence and extent of atherosclerotic plaques.

**CLINICAL RELEVANCE/APPLICATION**

HOP-MRA is a promising modality for predicting the degree of atherosclerotic change in the cerebral arteries.
Perfusion and Neck CT Angiography

Marcel Oei (Presenter): Researcher, Toshiba Corporation, Rashindra Manniesing: Research funded, Toshiba Corporation, Rieneke van den Boom MSc: Research Grant, Toshiba Corporation, Willem Jan Van der Woude: Research Grant, Toshiba Corporation, Bram Van Ginneken PhD: Stockholder, Thirona BV Co-founder, Thirona BV Research Grant, MeVis Medical Solutions AG Research Grant, Canon Inc Research Grant, Toshiba Corporation Research Grant, Riverain Technologies, LLC, Frederick Jan Anton Meijer MD: Nothing to Disclose, Mathias Prokop MD, PhD: Speakers Bureau, Bayer AG Speakers Bureau, Bracco Group Speakers Bureau, Toshiba Corporation Speakers Bureau, Koninklijke Philips NV Research Grant, Toshiba Corporation

PURPOSE

One-Step-Stroke imaging is a CTP acquisition in which one volumetric scan is substituted by volumetric neck CTA, using a toggling table technique and a single dose of contrast agent (see figure). It is not clear how missing one time point of the CTP acquisition to obtain the neck CTA will affect the perfusion maps and which time point is best suited for neck CTA. We determined the optimum timing of neck CTA with the least effect on cerebral perfusion maps.

METHOD AND MATERIALS

20 consecutive patients with suspicion of ischemic stroke were scanned with a clinical CTP head protocol using a 320-row CT scanner. A neck CTA takes maximal 4s, therefore omitting one time point of the CTP with 2s scan interval is sufficient. The One-Step-Stroke protocol was simulated from the original protocol by eliminating one acquisition at various time points. The elimination of one acquisition of CTP simulates the acquisition of the neck CTA. For every patient one volumetric acquisition was deleted, starting from the bolus arrival time up to the fifth time point after the arterial peak determined from the middle cerebral artery (MCA). Corresponding perfusion maps were calculated. Percentage errors were calculated for all perfusion parameters (CBF, CBV, MTT) in basal ganglia and white matter per time point and per patient. Bolus tracking is simulated by using the enhancement curves in the MCA to derive relative thresholds (40-100HU). The relative thresholds were used to determine the time point resulting in the smallest error across all patients.

RESULTS

A volumetric CTP scan deleted 2s after reaching a threshold of 40-70HU kept the absolute percentage errors of all perfusion parameters below 10% in all patients. A relative threshold of 70HU for bolus tracking of the CTA gave the lowest absolute percentage errors for CTP parameters (mean <3.0%, maximum always <7.5%) for acquiring the neck CTA. Estimated average enhancement at CTA, measured in the MCA, was 302HU (range 198-408HU).

CONCLUSION

Our simulations suggest that the One-Step-Stroke protocol does not significantly alter absolute perfusion values and creates high enhancement in the carotids, if the neck CTA is acquired 2s after a threshold of 70HU in the MCA.

CLINICAL RELEVANCE/APPLICATION

One-step stroke imaging is a single exam sequence where the neck CTA is part of the CTP. One-Step-Stroke imaging has the potential to replace CTA and CTP which saves radiation dose and contrast agent dose.

The Evaluation of Image Quality of Intracranial Aneurysms by Dual Energy CTA with SPS Technique as well as SAFIRE Reconstruction

Yaying Yang (Presenter): Nothing to Disclose, Bin Yang: Nothing to Disclose, Wei Zhao: Nothing to Disclose

PURPOSE

To investigate the image quality (IQ) of intracranial aneurysms by dual energy CTA with selective photon shield (SPS) acquisition and SAFIRE reconstruction.

METHOD AND MATERIALS

80 patients suspected with intracranial aneurysms were randomly assigned for CTA examinations as follows: Group 1: tube voltages80kV/sn140kV; tube currents200mAs/100mAs; SAFIRE was applied.. Group 2: tube voltages 80kV/ sn140kV, tube currents 300mAs/150mAs. The other parameters are the same. The IQ (subjective as well as objective IQ) and radiation dosage of the two groups were compared. In the meanwhile, the location, numbers and morphology of aneurysm in addition to neck display degree and neck size of the two groups were compared.

RESULTS

There was no significant difference on SNR between the two groups (P>0.05), however, the noise was lower in group 1 compared to group 2 (P

CONCLUSION

With SPS technique in combination with SAFIRE, radiation dose could be reduced while IQ and diagnostic accuracy are increased in the detection of intracranial aneurysms by CT DE mode.
CLINICAL RELEVANCE/APPLICATION

Very well

**SST09-09**

**Investigation of Accuracy of Hemodynamics and Wall Shear Stress for Intracranial Arteries Obtained from MR Fluid Dynamics (MRFD) using 3D Cine Phase-contrast MR Imaging**

Haruo Isoda MD, PhD : Stockholder, Flowtech Research, Inc, Kazushige Ichikawa : Nothing to Disclose, Atsushi Fukuyama : Nothing to Disclose, Yoshiaki Komori : Nothing to Disclose, Yasuo Takehara MD (Presenter) : Research Grant, Hitachi, Ltd, Takashi Kosugi : President, R'Tech Co, Ltd, Yuki Onishi : Nothing to Disclose, Shinji Naganawa MD : Nothing to Disclose

**PURPOSE**

Cerebral arterial hemodynamics is thought to play an important role in aneurysmal initiation, growth and rupture. MR fluid dynamics (MRFD) using 3D cine phase-contrast MR imaging (3D cine PC MRI) would be a promising technique for assessment of hemodynamics. The purpose of our study was to validate the accuracy of hemodynamics and wall shear stress (WSS) obtained from MRFD using two phantoms.

**METHOD AND MATERIALS**

We ran blood-mimicking fluid through a 3 mm-diameter straight tube with a steady flow measuring about 2.50 ml/sec and performed 3D cine PC MRI using 3T MR system. We performed MRFD by Flova software and compared analyzed time averaged volume flow rates (VFRs) with values measured with a digital Coriolis flowmeter and also compared WSS with theoretical values. We also performed MRFD for a left internal carotid artery-posterior communicating artery aneurysm (IC-PC An) model with blood mimicking fluid for three different steady VFRs in an internal carotid artery (ICA) set at 7.59 ml/sec, 4.63 ml/sec and 2.84 ml/sec. We compared analyzed time averaged VFRs in ICA, anterior cerebral artery (ACA) and middle cerebral artery (MCA) with values measured with the flowmeters. We also compared our software-calculated velocity components and WSS with values obtained from computational fluid dynamics (CFD) and calculated correlation coefficients. We also compare MRFD and CFD streamlines.

**RESULTS**

In the straight tube phantom, relative errors of time averaged VFR and WSS were 4 % and 6 %, respectively. In the cerebral artery phantom, relative errors of time averaged VFRs in ICA,ACA and MCA were 10 %~30 %. correlation coefficients of velocity components in ICA were 0.60~0.94 and those of WSS in ICA were 0.68~0.72. Correlation coefficients of velocity components in IC-PC An were 0.58~0.94, and that of its WSS was 0.34~0.63. Distribution of WSS and streamlines in MRFD and CFD were similar.

**CONCLUSION**

Accuracy of time averaged VFR obtained from MRFD was relatively good in this phantom study. Although accuracy of WSS obtained from MRFD was poor in IC-PC An in the model, it was good in a straight tube phantom and ICA. WSS and streamlines patterns obtained in MRFD were similar in CFD.

**CLINICAL RELEVANCE/APPLICATION**

(dealing with MRFD using 3D cine PC MRI) 'Although WSS might not be accurate; VFR, distribution of WSS and streamlines were relatively good in MRFD in cerebral arteries.'
PURPOSE

To evaluate a new approach for the reconstruction of high-quality 3D angiographic datasets based on the pixel-by-pixel application of wavelet transforms on CT perfusion data in the time domain.

METHOD AND MATERIALS

Cerebral CT perfusion data of 14 consecutive patients with suspected stroke but no ischemia on follow-up MRI and without any other pathology that could alter the cerebral hemodynamics were included in this study. All patients were examined at multi-detector CT systems acquiring 32 dynamic phases (temporal resolution: 1.5s) of 99 slices (total slab thickness 99mm) at 80kV/350mAs. Typically, 35 mL of iomeprol-350 were injected at flow rate of 4.5 mL/s. Angiographic datasets were calculated after initial rigid-body motion correction using (a) temporal maximum intensity projections (tMIP) (E.J. Smit et al. Radiology 2012) and (b) the proposed wavelet method performed with the commonly used Paul-wavelet (order 4). In the latter approach, we calculated the wavelet power spectrum of the time-attenuation curves for each pixel and displayed the maximum of this spectrum as angiographic signal intensity. Both approaches were compared with respect to the contrast-to-noise ratio (CNR) relative to surrounding tissue of 16 different vessel segments, and qualitatively using a 5pt Likert scale (0 non diagnostic, 4 excellent) with respect to image quality by two blinded and experienced readers.

RESULTS

The CNR for the wavelet reconstruction (580.2±474.5) was significantly higher than for the tMIP approach (60.7±31.0, Wilcoxon test p < 0.00001). Qualitatively, our new method performed significantly better than the tMIP approach with mean scores of 3.7/3.7 (reader 1/reader 2), inter-observer Cohen’s κ=1 vs. tMIP scores of 2.8/2.9, κ=0.594 (p<0.001/p=0.001).

CONCLUSION

A ten-fold increase of contrast-to-noise ratio can be achieved for intracranial vessels by using wavelet transforms of intracranial CT perfusion datasets compared to currently used tMIP methods. The higher CNR and the resulting increase in image quality (plus method-inherent bone subtraction) are especially important for the assessment of small peripheral branches as well as for leptomeningeal collateral vessels.

CLINICAL RELEVANCE/APPLICATION

Using wavelet transforms, angiographic data with excellent image quality can be obtained from dynamic CT perfusion data, potentially allowing to omit a separate CT angiography examination.

Performance of Integrated Circuit Detectors in Head CT: Objective and Subjective Image Quality in Comparison to Conventional Detector Design

Harald Brodoefel MD (Presenter): Nothing to Disclose, Andreas Korn: Nothing to Disclose, Benjamin Bender: Travel support, Bayer AG, Rafeeque A. Bhadelia MD: Nothing to Disclose, Peter Heiss MD: Nothing to Disclose, Ulrike Ernemann: Nothing to Disclose

PURPOSE

While technical evolution of CT has primarily been oriented by improvement of speed, volume coverage and image quality, a continued rise in study numbers and heightened public awareness of radiation associated cancer risks have initiated a recent quest for significant reduction of radiation dose. A new CT detector with integrated electric components and shorter conducting pathways has recently been introduced to decrease system inherent electronic noise. The purpose of this study was to assess the potential benefit of such integrated circuit detector (ICD) in head CT by comparing objective and subjective image quality in low-dose exams with a conventional detector design (CDD).

METHOD AND MATERIALS

Using a conventional detector, reduced dose non-contrast head CT (255 mAs, effective dose 1.7 mSv) was performed in 25 consecutive patients. Following transition to ICD on the same CT scanner, 25 consecutive patients were scanned using identical imaging parameters. Data sets in both groups were reconstructed with iterative reconstruction (IR) and filtered-back-projection (FBP). Images were assessed in terms of quantitative (e.g. signal-to-noise ratio, contrast-to-noise ratio or image sharpness) and qualitative image quality (e.g. noise texture, overall image quality, artefacts).

RESULTS

Acquisition of head CT using ICD increased signal-to-noise ratio by 14% and 17% in grey (10.0±1.6 versus 11.4±2.5; p=0.02) and white matter (8.2±0.8 versus 9.6±1.5; p=0.0002). The associated improvement in contrast-to-noise ratio was 12% (2.0±0.5 versus 2.2±0.6; p=0.12). In addition, there was a 51% increase of objective image sharpness (582±85 versus 884.5±191 change in HU/Pixel; p<0.0001). Compared to standard acquisitions, subjective grading of noise as well as overall image quality scores were significantly improved with ICD (2.1±0.3 versus 1.6±0.3, p<0.0001; 2.0±0.5 versus 1.8±0.3, p=0.001). Streak artifacts in the posterior fossa were substantially reduced (2.3±0.7 versus 1.7±0.5; p=0.004).

CONCLUSION

At the same radiation level, acquisition of head CT with integrated circuit detectors achieves superior objective and subjective image quality.
**CLINICAL RELEVANCE/APPLICATION**

Improvement of image quality through electronic noise reduction is additive to recent benefits from iterative reconstruction algorithms and the combination of strategies has the potential for further and significant reduction of patient dose.

---

**SST10-03 Gemstone Spectral Imaging Dual-energy CT with and without Metal Artifact Reduction Software for Dental Reconstruction Artifact**

**Jihoon Cha MD (Presenter): Nothing to Disclose, Hyung-Jin Kim MD: Nothing to Disclose, Sung Tae Kim MD: Nothing to Disclose, Yi Kyung Kim MD: Nothing to Disclose, Mina Song PhD: Nothing to Disclose, Pyoun Jeon: Nothing to Disclose, Keon Ha Kim: Nothing to Disclose, Hong Sik Byun MD: Nothing to Disclose**

**PURPOSE**

To assess the usefulness of gemstone spectral imaging (GSI) dual-energy CT (DECT) utilizing metal artifact reduction software (MARS) to reduce dental reconstruction artifact

**METHOD AND MATERIALS**

The DECTs were performed by using fast kV-switching GSI between 80 and 140 kV in 20 patients with metallic dental prosthesis. The CT data were retro-reconstructed with/without MARS, and with synthesised monochromatic energy in the range of 40 - 140 keV. For the qualitative analysis, two radiologists evaluated 70 keV and 100 keV images with and without MARS for tongue and bilateral buccal and parotid areas by using a 4-point scale with the larger point being considered to have the better image quality. The margin and internal architecture of metallic denture were also assessed with a 3-point scale. The locations and characteristics of MARS-related artifact if any were also recorded. For the quantitative analysis, manually-drawn region of interests (ROIs) were placed in the tongue and bilateral buccal and parotid areas and the ratios of standard deviation (SD) of Hounsfield unit (HU) measured at each area were compared between with and without MARS in the range of 40 - 140 keV.

**RESULTS**

The GSI-MARS reconstruction markedly reduced the dental reconstruction artifacts in the buccal area (score of 1.55 without MARS vs. 3.10 with MARS for 70 keV, P<0.001, ratio of SD=56%), and the tongue (score of 1.30 without MARS vs. 2.25 with MARS for 70 keV, P<0.001, ratio of SD=38%). Parotid area did not show significant artifact reduction (score of 3.35 without MARS vs. 3.50 with MARS for 70 keV, ratio of SD=101%). The margin and internal architecture of the metal were more clearly delineated with MARS (score of 1.00 without MARS vs. 2.75 with MARS for 70 keV, P<0.001). MARS-related artifacts were most commonly occurred in the deep center of the neck, including retropharynx, pre- and paravertebral space and spinal cord. Metal artifacts were reduced slightly more in the high keV images than in the low keV images (score of 2.25 with 70 keV+MARS vs. 2.45 with 100 keV+MARS for tongue, P=0.042).

**CONCLUSION**

Dual-energy CT with GSI-MARS can reduce dental metal-related artifacts and improve delineation of the prosthesis and periprosthetic region.

**CLINICAL RELEVANCE/APPLICATION**

Dual-energy CT with GSI-MARS can reduce dental reconstruction artifacts and may improve the image quality by better delineation of the anatomic structure.

---

**SST10-04 Growth in Ownership of CT Scanners among Otolaryngologists and Neurologists in Recent Years: How Important Is It?**

**David C. Levin MD (Presenter): Consultant, HealthHelp, LLC Board of Directors, Outpatient Imaging Affiliates, LLC, Vijay Madan Rao, MD: Nothing to Disclose, Laurence Parker PhD: Nothing to Disclose, Andrea J. Frangos MPH: Nothing to Disclose**

**PURPOSE**

To study recent trends in acquisition of CT scanners for their offices by otolaryngologists (ENTs) and neurologists. Both specialties have become increasingly interested in acquiring their own advanced imaging equipment. This is of concern to policymakers and payers, as well as neuroradiologists, because it creates an opportunity for self-referral.

**METHOD AND MATERIALS**

The nationwide Medicare Part B databases for 2002-2012 were our data sources. All CPT codes for diagnostic CT were selected. Medicare’s physician specialty codes were used to identify claims submitted by ENTs and neurologists. Ownership of the units on which scans were performed was determined by tabulating global and technical component CT claims from those specialties, but excluding professional component claims. Data for other specialties were also studied.

**RESULTS**

In 2002, there were 8123 CT scans performed on Medicare patients on units owned by ENTs. This rose to a
peak of 48,813 in 2009 (+501%), then declined to 40,121 in 2012 (-18% vs 2009). In 2002, there were 6773 Medicare CT scans performed on units owned by neurologists. This rose to a peak of 13,016 in 2009 (+92%), then declined to 7729 in 2012 (-41% vs 2009). Some of the recent declines were due to CT code bundling. Several other nonradiologic specialties performed more CTs on scanners in their offices than ENTs or neurologists. For example, 2012 CT totals for primary care physicians were 120,473; for urologists 92,375; for cardiologists 62,638; and for other internal medicine specialists 147,164. Radiologists’ total office volume in 2012 was 1,393,181.

CONCLUSION

During the previous decade, ENTs were more aggressive than neurologists in acquiring CT scanners for their offices. Medicare CT scans on in-office units owned by ENTs grew 501% from 2002-2009. Growth among neurologists was considerably less (92%). Volumes of CTs done on in-office units owned by the 2 specialties declined after 2009, but the decline was proportionately less among ENTs (18% vs 41% for neurologists). In spite of the growth of in-office CT ownership by the 2 specialties after 2002, their total volumes were small compared with those among several other clinical specialties and among radiologists. It does not appear that they will threaten the role of neuroradiologists in the near future.

CLINICAL RELEVANCE/APPLICATION

not applicable.

SST10-05

Low-Tube-Voltage 80-kVp Head and Neck CT in Routine Clinical Practice: Evaluation of Diagnostic Accuracy and Interobserver Agreement

Julian Lukas Wichmann MD (Presenter): Nothing to Disclose, Johannes Kraft: Nothing to Disclose, Eva-Maria Noske: Nothing to Disclose, Iris Burck MD: Nothing to Disclose, Jan-Erik Scholtz: Nothing to Disclose, Claudia Frellesen: Nothing to Disclose, Jens Wagenblast MD: Nothing to Disclose, Josef Matthias Keri MD: Research Consultant, Siemens AG Speakers Bureau, Siemens AG, Ralf W. Bauer MD: Research Consultant, Siemens AG Speakers Bureau, Siemens AG, Boris Bodelle MD: Nothing to Disclose, Thomas Lehert MD: Nothing to Disclose, Thomas Josef Vogl MD, PhD: Nothing to Disclose, Boris Schulz MD: Nothing to Disclose

PURPOSE

To evaluate a low-tube-voltage 80-kVp computed tomography (CT) technique for head and neck imaging in routine clinical practice regarding its effects on diagnostic accuracy and interobserver agreement.

METHOD AND MATERIALS

This retrospective study was approved by the institutional review board, and the requirement to obtain informed consent was waived. Three radiologists individually analyzed exclusively the 80-kVp scans of 170 patients with a variety of pathologies who had undergone head and neck dual-energy CT. Reviewers were unblinded only to the clinical indication for CT, but otherwise blinded to any other information or image data, and were asked to state a single final relevant diagnosis. Results were compared with the ultimate diagnosis in the medical record charts, histopathology results, or CT reports based on standard blended 120 kVp image series. Diagnoses were grouped as squamous cell carcinoma (SCC) associated (n=110, presence / absence of primary / recurrent SCC or metastatic lymph nodes), lymphoma-associated (n=40, presence / absence of primary / recurrent lymphoma), and benign (n=20, e.g. abscess, sialolithiasis). Sensitivity, specificity, positive and negative predictive values (PPV, NPV) were calculated. Interobserver agreement was evaluated using intraclass correlation coefficients (ICC).

RESULTS

The overall sensitivity, specificity, PPV and NPV were 94.8%, 93.0%, 95.9%, and 91.1%, respectively. Further divided grouped results were also consistently high for SCC-associated (94.8%, 89.1%, 94.3%, 90.1%), lymphoma-associated (95.0%, 100.0%, 100.0%, 95.2%) and benign (94.3%, 93.3%, 98.2%, 85.7%) diagnoses. Global interobserver agreement was almost perfect (ICC, 0.82; 95% confidence intervals: 0.76-0.86). The calculated average dose-length-product was reduced by 48% with 80-kVp acquisition compared to the cumulative dose from the standard dual-energy scan (135.5 mGy•cm vs. 282.2 mGy•cm, P<0.001).

CONCLUSION

Low-tube-voltage 80-kVp head and neck CT provides sufficient image quality with high diagnostic accuracy and interobserver agreement in routine clinical practice especially for follow-up imaging of SCC or lymphoma and has the potential to significantly decrease radiation exposure.

CLINICAL RELEVANCE/APPLICATION

Low-tube-voltage 80-kVp CT acquisition provides diagnostic image quality for head and neck imaging in routine clinical practice with a significant reduction of radiation exposure.

SST10-06

Comparison of Knowledge-based Iterative Model, Hybrid Iterative and Filtered Back Projection Reconstruction Techniques in Brain CT: Impact of Thin Slice Imaging

Takeshi Nakaura MD (Presenter): Nothing to Disclose, Yuji Iyama MD: Nothing to Disclose, Masafumi Kidoh: Nothing to Disclose, Shinichi Tokuyasu RT: Employee, Koninklijke Philips NV, Kazunori Harada: Nothing to Disclose, Yasuyuki Yamashita MD: Consultant, DAIICHI SANKYO Group, Shouzaburou Uemura

...
PURPOSE

Image noise is a serious problem in brain CT because of the requirements for contrast resolution. Previous report suggested that the recent introduced knowledge-based iterative model reconstruction (IMR) is able to reduce image noise, offer accurate CT attenuation, and enable improvement in low-contrast detectability. The purpose of this study was to evaluate the usefulness of IMR in brain CT especially with thin slice images.

METHOD AND MATERIALS

This prospective study received institutional review board approval; prior informed consent to participate was obtained from all patients. This study enrolled 34 patients who underwent brain CT. We reconstructed axial images with filtered back projection (FBP), hybrid-iterative reconstruction (HIR) and knowledge-based-IMR with 1 and 5 mm slice thickness. We compared the CT number, image noise, contrast, and contrast noise ratio (CNR) between the thalamus and the internal capsule and the rate of increase of image noise in 1 mm thickness images from 5 mm thickness images between the reconstruction methods with the Holm test. Two independent readers assessed image contrast, image noise, image sharpness and the overall image quality of the 1mm thickness images with each reconstruction technique on a 4-point scale.

RESULTS

There were significant differences in the CT numbers between IMR and the other reconstruction techniques (p<0.01). The image noise was significantly lower with knowledge-based-IMR (2.4 HU ± 0.3) compared to FBP (4.9 HU ± 0.5) and HIR (4.1 HU ± 0.4) (p<0.01). The contrast and the CNR between the thalamus and the internal capsule were significantly higher with IMR (5.1 HU ±1.6; 2.2±0.8) relative to FBP (4.8 HU ±1.7; 1.0±0.4) and HIR (4.8 HU ±1.7; 1.2±0.4) (p<0.01). The rate of increase in noise in 1mm thickness images was significantly lower with IMR (70.7% ± 32.6) compared to FBP (130.1% ± 31.9) and HIR (129.6% ± 35.2) (p<0.01). The visual scores in image contrast, image noise and overall image quality with knowledge-based-IMR were significantly higher than that with other reconstruction images (p<0.05).

CONCLUSION

IMR offers significant noise reduction, higher contrast and CNR in brain CT especially with thin slice images compared to FBP and HIR.

CLINICAL RELEVANCE/APPLICATION

IMR might offer higher image quality compared to FBP and hybrid-IR in brain CT especially for thin slice imaging.

Diagnostic Performance of Cone Beam Computed Tomography and MDCT in Diagnostic Imaging of the Midface: A Comparative Study on Phantoms and Cadaver Head Scans

Simon Veldhoen MD (Presenter): Nothing to Disclose, Maximillian Schollchen : Nothing to Disclose, Henning Hanken : Nothing to Disclose, Clarissa Precht : Nothing to Disclose, Frank Oliver Gerhard Henes MD : Nothing to Disclose, Gerhard Schon : Nothing to Disclose, Hans Dieter Nagel : Consultant, Koninklijke Philips NV, Max Helland MD : Nothing to Disclose, Gerhard B. Adam MD : Nothing to Disclose, Marc Regier : Nothing to Disclose

PURPOSE

As an overlap of cone beam computed tomography (CBCT) and MDCT use for imaging in midfacial trauma can be observed, purpose of the study is to compare a state-of-the-art CBCT device and a 256-MDCT for imaging of the midface.

METHOD AND MATERIALS

A CBCT device (3D Accuitomo, Morita) and a 256-MDCT (Brilliance iCT, Philips) were compared based on scans of 25 cadaver heads and phantoms. Scan protocols at three dose levels were generated (standard-dose, CTDIvol=4mGy; reduced-dose, CTDIvol=3mGy; low-dose, CTDIvol=4mGy). MDCT images were reconstructed using filtered back projection (FBP) and iterative reconstruction (IR) (iDose4™, Philips Healthcare). Spatial resolution was assessed using a phantom (Catphan™ 500, The Phantom Laboratory). Objective image noise (OIN) was measured and four readers evaluated the subjective quality of the blinded images separately.

RESULTS

Using low-dose settings, spatial resolution of CBCT and MDCT was equal (10 identifiable line pairs (lp) per cm). At reduced- and standard-dose, CBCT was superior with 11/13 lp/cm compared to 10/11 lp/cm in MDCT. Concerning cadaver head scans, OIN was higher in FBP-MDCT images when compared to CBCT (standard dose, 33 vs. 82HU; reduced dose, 47 vs. 135HU; low-dose, 71 vs. 196HU). Iterative reconstruction was able to lower the OIN of MDCT images but except standard-dose they remained higher than in CBCT (standard-dose, 40HU; reduced-dose, 93HU; low-dose, 132HU). Subjective image quality was comparable at standard-dose (CBCT 3.5 vs. MDCT 3.7). CBCT was superior at reduced- and low-dose settings (CBCT, 3.3/3.0 vs. MDCT 2.9/2.3). At low-dose settings, MDCT images were of limited diagnostic quality. Image acquisition and reconstruction times were markedly higher for the CBCT device.

CONCLUSION

CBCT imaging provided better objective and subjective image quality at low-dose settings, when compared to
MDCT whereas spatial resolution was equal. Similar performance was observed at higher exposure settings but CBCT then provided better spatial resolution. Modern CBCT devices seem to make use of noise-reduction techniques similar to IR as very low image noise and long reconstruction times were observed.

**CLINICAL RELEVANCE/APPLICATION**

Due to the high resolution, dental imaging is the specific strength of CBCT. Long image reconstruction times and the inferiority in soft-tissue assessment are main limitations of CBCT use in midfacial trauma. Therefore, MDCT should be preferred for this purpose.

**SST10-08**

**Spectral CT Imaging for the Differentiation between Primary Lymphoma and Meningiomas**

Qiang Ma (Presenter): Nothing to Disclose, Xiang Ren: Nothing to Disclose, Xuejun Ping: Nothing to Disclose, Najia Liu: Nothing to Disclose, Zhiyuan Zhang: Nothing to Disclose

**PURPOSE**

To evaluate the clinical value of dual energy spectral CT imaging in differentiating primary central nervous system lymphomas (PCNSL) from meningiomas.

**METHOD AND MATERIALS**

We retrospectively reviewed 23 patients with histologically proven primary intracranial solid tumors (16 meningiomas and 7 PCNSL) who underwent un-enhanced dual energy spectral CT scans. Patients were divided into 2 disease groups (meningiomas and lymphomas) and analyzed using GSI viewer software. Monochromatic images and material decomposition images with blood-fat as base material pairs were reconstructed. Spectral CT parameters such as the slope of spectral HU curve, effective-Z, and fat and blood concentrations were obtained for the tumors as well as normal brain tissues. Independent-samples t test was performed on these values between the two disease groups and matching tests were performed between tumors and normal brain tissues.

**RESULTS**

The slope and effective-Z values were (0.64±0.16, 7.99±0.09) for the meningiomas and (0.44±0.02, 7.81±0.04) for PCNSL. There was significant difference between them (p<0.001). The CT values at 40keV were 81.68±14.05HU and 56.39±6.26HU for meningiomas and PCNSL, respectively, with significant difference (p<0.001). The blood and fat concentrations (in mg/ml) for meningiomas (1227.94±85.35 and -180.35±85.38, respectively) were also significantly different from those for PCNSL (1077.93±21.97 and -26.41±26.68, respectively) (p<0.001). The matching t test indicated that there were significant differences for the blood and fat concentration values between the meningiomas and normal brain tissues, and between PCNSL and normal brain tissues (p<0.001).

**CONCLUSION**

Meningiomas and PCNSL had distinctively different characteristics in spectral CT imaging. Parameters obtained by spectral CT imaging, such as effective-Z and blood and fat concentrations, may provide additional and valuable information than conventional CT for the differential diagnosis between meningiomas and PCNSL.

**CLINICAL RELEVANCE/APPLICATION**

Dual energy spectral CT imaging may provide additional information than conventional CT for the differential diagnosis between primary lymphoma and meningiomas.

**SST10-09**

**The Value of Dual Energy Spectral CT in Differentiating Benign and Malignant Meningiomas**

Songhong Yue (Presenter): Nothing to Disclose, Junlin Zhou: Nothing to Disclose

**PURPOSE**

To evaluate the value of dual energy spectral CT (DEsCT) in differentiating benign and malignant meningiomas.

**METHOD AND MATERIALS**

Twenty-three patients with meningiomas underwent head CT scan with dual energy spectral mode (Discovery CT 750HD, GE healthcare), all cases were proved by pathological findings. The patients included 16 cases of grade I meningioma (benign group) and 7 cases of grade 2 or grade 3 (malignant group). For each patient, 40keV-140keV monochromatic images (interval of 10kev) and iodine/water based material decomposition images were reconstructed. The CT value, iodine and water concentration of meningiomas during both phases were measured. The slope K of spectral HU curve was calculated according to the formula: \( K = \frac{(CT_{40keV}-CT_{90keV})}{40-90} \), student T test was performed for data comparison.

**RESULTS**

**CONCLUSION**

The benign and the malignant meningiomas have distinct characteristics findings on dual energy spectral CT,
and the spectral HU curve can be used to differentiate the benign the malignant meningiomas.

**CLINICAL RELEVANCE/APPLICATION**

To evaluate the value of dual energy spectral CT (DEsCT) in differentiating benign and malignant meningiomas.

---

**SST11**

**Nuclear Medicine (Comparative Technologies and Modalities)**

- **Scientific Papers**
  - **NM**
  - **CT**
  - **AMA PRA Category 1 Credits ™:** 1.50
  - **ARRT Category A+ Credits:** 1.50
  - **Fri, Dec 5 10:30 AM - 12:00 PM   Location: SS05A**

**Participants**

- **Moderator**
  - Chadwick Lewis Wright MD, PhD : Nothing to Disclose
  - Akash Sharma MD : Nothing to Disclose

**Sub-Events**

**SST11-01 Abnormal CXR and Lung Ventilation and Perfusion Scan (V/Q)? The Role of SPECT/CT in the Evaluation of Pulmonary Embolism (PE) in Patients with Abnormal CXR**

- In S. Seo MD (Presenter): Nothing to Disclose, Won Jun Park MD : Nothing to Disclose, Kevin Tsai MD : Nothing to Disclose

**PURPOSE**

CT angiography (CTA) is the most frequently performed diagnostic tool for PE because of reduced invasiveness and greater availability. It has high specificity (SP) for PE while its sensitivity (SN) is limited and high radiation exposure limits its routine use, particularly on young women. V/Q has high SN for PE, but has low SP, particularly when CXR is abnormal. V/Q is performed when CTA is contraindicated, technically unsatisfactory or inconclusive. SPECT increases SN, but further decreases SP, whereas SPECT/CT improves SP significantly. CXR is important in determining which study should be performed - V/Q when CXR is normal and CTA when CXR is abnormal. The authors have tried to determine whether SPECT/CT has high diagnostic accuracy for PE, even among patients with abnormal CXRs.

**METHOD AND MATERIALS**

Between July 1, 2012 and December 31, 2013, 897 (348 men and 549 women, aged 20 - 101; median age 64.5 years old) patients had V/Q. 835 patients had V/Q as the initial study (Gp 1) while 62 patients had V/Q performed after a suboptimal or inconclusive CTA (Gp 2). SPECT/CT was performed in patients with high probability (HP) V/Q and abnormal CXR and in patients with intermediate probability (IP) or low probability (LP) V/Q with normal or abnormal CXR. SPECT/CT could not be performed in 145 patients because they were too wide, contracted, claustrophobic, or refusing the procedures.

**RESULTS**

In 104 of 107 (97.2%) patients with abnormal CXRs, SPECT/CT confirmed HP PE while 3 were downgraded to LP or VLP. In 8 of 12 patients with IP PE, SPECT/CT downgraded the findings to LP or very low probability (VLP). In 48 of 66 patients with LP PE, SPECT/CT downgraded the findings to VLP.

**CONCLUSION**

CXR findings are crucial, mainly for the HP V/Q. When CXR is normal, SPECT/CT is not needed. In our series, 46 of 62 (74.2%) patients in Gp 2 had normal CXRs, a situation in which V/Q could be the initial study of choice rather than CTA. When CXR is abnormal, SPECT/CT should be added, as supported by our study results.

**CLINICAL RELEVANCE/APPLICATION**

V/Q has no limitation for renal dysfunction and allergy to iodine and delivers less radiation to patients. When CXR is normal, V/Q should be used as the initial study for PE. When CXR is abnormal, the use of SPECT/CT increases both SN and SP for PE, improving the diagnostic accuracy. In any institute with SPECT/CT capability, V/Q could be used as the initial study for PE, even when CXR is abnormal.

---

**SST11-02**

**Novel penalized Likelihood Reconstruction of [18]F-FDG-PET Data Improves the Signal-to-Background Ratio of Colorectal Liver Metastases**

- James Franklin MA, MBBS (Presenter): Nothing to Disclose, Daniel Robin McGowan : Nothing to Disclose,
Iterative reconstruction algorithms are widely used for clinical PET reconstructions. Background signal in the liver reduces the sensitivity of PET for liver lesions, particularly for small lesions. We tested whether a novel iterative reconstruction technique using a penalized likelihood reconstruction would improve lesion signal-to-background ration (SBR) in patients with colorectal liver metastases.

A Bayesian penalized likelihood reconstruction algorithm (QClear, GE Healthcare, Milwaukee, USA) was used to retrospectively reconstruct sinogram PET data. The resulting images were compared to a clinical time of flight-ordered subsets expectation maximization (TOF-OSEM) reconstruction. A volume of interest was placed within normal liver parenchyma and lesions were segmented using automated thresholding. Lesion SUVmax and SUVpeak, and background SUVmax and standard deviation of SUV (noise) were recorded. SBR was defined as the ratio of lesion SUVmax to background SUVmax. Paired t-tests were used for intergroup comparisons.

16 patients with 28 histologically proven hepatic metastases from colorectal adenocarcinoma were included. The novel and clinical algorithm were successfully applied to all datasets. The average lesion SUVmax increased from 8.35 to 11.4 (p<0.001) with no significant difference in background noise. SBR increased from 2.95 to 3.88 (p<0.001).

This penalized likelihood reconstruction algorithm improved signal-to-background for focal liver lesions, principally by increasing the measured lesion SUVmax, without increasing image noise.

Novel penalized likelihood reconstruction algorithms can significantly improve signal-to-background for focal liver lesions, which may improve the diagnostic performance of clinical PET.
CLINICAL RELEVANCE/APPLICATION
Digital PET with photon counting detectors and time-of-flight capability has the potential to improve not only image quality but also diagnostic confidence and accuracy in oncologic diseases.

Registered Collimator Design for Direct-Conversion Gamma Cameras
Aleksandr Kivenson PhD (Presenter): Employee, Gamma Medica, Inc, Timothy Garcia PhD: Employee, Gamma Medica, Inc, Haris Kudrolli PhD: Employee, Gamma Medica, Inc

PURPOSE
Available scientific literature on collimator design for gamma cameras generally presupposes that the camera functions by means of scintillating crystals and photodetectors. However, recent advances in direct-conversion detectors using semiconductors like cadmium-zinc-telluride (CZT) have made it desirable to design collimators specifically for cameras built from such detectors. These detectors present new constraints on collimator design; specifically, they consist of fixed-size pixels in a square array.

Here we present algorithms for designing collimators registered to an array of pixels, the results of computer simulations of various collimator designs, and examples of real-world performance for registered collimators.

METHOD AND MATERIALS
Computer simulations were guided by first-order calculations and carried out using custom software as well as the GATE and Geant4 software packages. Collimators were fabricated from tungsten by electrical discharge machining and also by photochemical etching. Gamma cameras from a LumaGEM DC-MBI system were used for imaging experiments.

RESULTS
We have derived equations defining the set of optimal collimators given a pixel size and the collimator material. These collimators have the maximal sensitivity for their resolution while obeying the University of Chicago Penetration Criterion for septal thickness. A collimator has been designed and fabricated in accordance with these equations.

We have also investigated the effect of septal penetration on image quality in simulations and in experiments, in order to determine whether a collimator with thinner septa than those called for by the University of Chicago Penetration Criterion may be used in order to obtain improved sensitivity without a significant loss of image quality.

CONCLUSION
The collimator we have designed has resolution and sensitivity in agreement with our equations. We expect that it will be better than existing collimators for clinical applications. We have quantified septal penetration in this collimator and compared it to values predicted by simulations; future collimators with thinner septa may be possible.

CLINICAL RELEVANCE/APPLICATION
Imaging devices using pixellated direct-conversion gamma ray cameras are poorly served by conventional hexagonal collimators. Lower patient dose is possible with registered square-hole collimators.

Comparison of Breast Specific Gamma Imaging and Molecular Breast Tomosynthesis in Breast Cancer Detection: Evaluation in Phantoms
Zongyi Gong BS, PhD (Presenter): Institutional research agreement, Hologic, Inc, Tushita Patel BS: Institutional research agreement, Hologic, Inc, Andrew Polemi: Institutional research agreement, Hologic, Inc, Brigid McDonald: Institutional research agreement, Hologic, Inc, Heather Renee Peppard MD: Consultant, Siemens AG Research Grant, Hologic, Inc, Mark Bennett Williams PhD: Institutional research agreement, Hologic, Inc

PURPOSE
Breast specific gamma imaging (BSGI) obtains a single 2-dimensional image of Tc-99m sestamibi uptake in the breast. Molecular breast tomosynthesis (MBT) maps the tracer distribution in 3 dimensions by acquiring multiple projections over a limited angular range. Here we compare the performance of the two technologies in terms of spatial resolution, lesion contrast and signal difference to noise ratio (SDNR) in phantom studies under conditions of clinically relevant sestamibi dose and imaging time.

METHOD AND MATERIALS
The systems tested were a Dilon 6800 and a MBT prototype. Spatial resolution was measured using a phantom with evenly spaced point-like objects with varying heights. For lesion contrast and SDNR assessment, a box phantom containing spherical lesions at depths of 1.7 and 4.5 cm and diameters ranging from 4.9 to 9.8 mm was used. A single BSGI projection was acquired. Five MBT projections were acquired over ± 20 degrees. For both BSGI and MBT, the total scan count density was comparable to that in a typical 10 minute, 25 mCi human scan. The BSGI data were analyzed as both raw projections (noise-unregulated) and following Gaussian filtering.
RESULTS

Averaged over locations 1.5 cm to 7.5 cm below the top surface of the phantom the BSGI spatial resolution was 10.6 and 8.5 mm full width of half maximum (FWHM) with and without noise regulation respectively. The average resolution for MBT was 6.3 and 5.1 mm with and without regulation. Compared to BSGI, MBT improved lesion contrast by median factors of 2.1 and 1.7, and SDNR by median factors of 1.8 and 1.9 with and without regulation, respectively.

CONCLUSION

Under conditions of equal dose and imaging time, compared to BSGI MBT significantly improved lesion detection efficiency in terms of spatial resolution, contrast and SDNR.

CLINICAL RELEVANCE/APPLICATION

MBT could substantially improve image quality in molecular breast cancer imaging.

SST11-06

Improvements in Commercial CdZnTe Detector Quality and Their Impact on Molecular Breast Imaging


PURPOSE

Molecular Breast Imaging (MBI) systems fabricated using direct-conversion detectors have demonstrated very high sensitivity and specificity in detecting breast cancer in dense breasts. These systems are made possible by the development of Cadmium Zinc Telluride (CZT) detectors, which combined with high-end application specific integrated circuit electronics make superior gamma imaging detectors. The quality of the CZT modules directly impacts image quality and patient scan time. This work seeks to correlate the improvements in MBI image quality to the improvements in CZT detector properties.

METHOD AND MATERIALS

Performance data from CZT modules such as energy resolution, detector uniformity and photo-peak efficiency were analyzed. Energy calibration was performed by irradiating single CZT modules with 241Am and 57Co. Full gamma cameras were created by tiling the CZT modules into rectangular grids. The cameras were coupled to a registered tungsten collimator. Specialized phantoms designed to characterize image uniformity and lesion detectability were fabricated. The phantoms were filled with 99mTc (Sodium Pertechnetate) and data sets with event statistics representative of clinical data were acquired.

RESULTS

Data was analyzed for 1,500 CZT modules fabricated from 2009 to the present. Both the absolute value and the variance of the detector parameters improved. This means that the detectors are higher-quality and more uniform, perhaps due to a more tightly controlled fabrication process. Cameras that were fabricated with CZT modules that were more uniform in their properties showed a corresponding improvement in image uniformity and signal-to-noise ratio of the lesions in the phantoms.

CONCLUSION

This work has shown that an increase in CZT module performance directly corresponds to a higher-quality MBI image. In this presentation, we will present data from a number of cameras that shows the improvement over time and discuss the expected trend in future camera performance.

CLINICAL RELEVANCE/APPLICATION

Improving detector quality resulting in both an improved MBI image quality, as well as reduced patient dose.

SST11-07

Automated Computer-derived SUV and Metabolic Tumor Volume Measurements of Biopsy Proven Lesions: Comparison with Radiologist-derived PET-CT Imaging

Georgios Z. Papadakis MD (Presenter): Nothing to Disclose, Ulas Bagci PhD, MSc: Nothing to Disclose, Brent Foster: Nothing to Disclose, Ziyue Xu PhD: Nothing to Disclose, Awais Mansoor PhD: Nothing to Disclose, Nicholas John Patronas MD: Nothing to Disclose, Constantine Argyrios Stratakis MD, DSc: Nothing to Disclose, Daniel Joseph Mollura MD: Nothing to Disclose

PURPOSE

(1) To present an automated computational tool for accurate and fast image analysis of PET-CT scans, and (2) to compare computer-derived imaging markers of various biopsy proven lesions with radiologists' manual assessment.

METHOD AND MATERIALS
With IRB approval, we retrospectively analyzed PET-CT images of 15 patients who were diagnosed with granulomatous inflammation, cystadenomas, neurofibromas, neuroendocrine tumors, renal cell carcinomas, several types of lymphomas, and a case of breast carcinoma. All lesions were biopsy proven. Our proposed framework contains a PET image segmentation method which is based on the affinity propagation based clustering algorithm. Our optimal segmentation algorithm segments focal and multi-focal lesions within a few seconds in 3D image space. We compared the computer derived SUV-based statistics and metabolic tumor volumes with radiologists-derived measures to test the feasibility of using this software for PET image analysis for clinical practice.

RESULTS
We obtained a strong correlation (R > 0.91, p < 0.0001) between the SUVmax measurements derived automatically from our framework and the radiologist-derived measurements. We also observed that the radiologist-derived region of interest (ROI) for metabolic tumor volume assessment was significantly over-estimated, and did not show the correct boundary of the lesions. Furthermore, when radiologists used conventional thresholding based delineation algorithms, there were additional false positive removal steps necessary for proper lesion volume assessment. Figure 1 shows a sample view of the radiologist-derived elliptic ROI (left) as well as the true boundary and statistics of the computer-derived results (right).

CONCLUSION
The proposed automatic tool can be used to derive SUV-based measures as well as metabolic tumor volume in a more accurate and efficient manner. Our proposed framework is open-source, freely available, and will allow researchers to conduct PET quantification studies in routine clinics.

CLINICAL RELEVANCE/APPLICATION
Accurately assessing radiotracers uptake from PET and quantifying the metabolic tumor volume are important precursors in diagnostic decision mechanisms. The presented automatic method can be employed for a routine use.

SST11-08 Whole-Body FDG-PET/CT: How to Improve the Accuracy of Clinical Stage Assessment as Compared with Whole-body FDG-PET/MRI in Patients with Non-Small Cell Lung Cancer
Yoshisharu Ohno MD, PhD (Presenter): Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, DAICHI SANKYO Group Research Grant, Eisai Co, Ltd Research Grant, Terumo Corporation Research Grant, Fuji Yakuhin Co, Ltd Research Grant, FUIJIFILM Holdings Corporation Research Grant, Guerbet SA, Shinichiro Seki: Nothing to Disclose, Mizuho Nishio MD, PhD: Research Grant, Toshiba Corporation, Hisanobu Koyama MD, PhD: Nothing to Disclose, Kota Aoyagi: Employee, Toshiba Corporation, Hitoshi Yamagata PhD: Employee, Toshiba Corporation, Takeshi Yoshikawa MD: Research Grant, Toshiba Corporation, Sumiaki Matsumoto MD, PhD: Research Grant, Toshiba Corporation, Kazuhiro Kubo RT: Nothing to Disclose, Kazuro Sugimura MD, PhD: Research Grant, Toshiba Corporation Research Grant, Koninklijke Philips NV Research Grant, Bayer AG Research Grant, Eisai Co, Ltd Research Grant, DAICHI SANKYO Group

PURPOSE
To determine the utility of MR signal intensity assessment on whole-body FDG-PET/MRI for improving clinical stage assessment in non-small cell lung cancer (NSCLC) patients as compared with whole-body FDG-PET/CT with contrast-enhanced (CE-) brain MRI.

METHOD AND MATERIALS
140 consecutive pathologically diagnosed NSCLC patients (75 men, 65 women; mean age 72 years) prospectively underwent whole-body MRI at 3T system, integrated PET/CT, and conventional radiological examination as well as surgical, pathological and/or follow-up examinations. Final diagnoses of T,N and M factors and clinical stage in each patient were determined according to all examination results. All co-registered PET/MRIs were generated by means of our proprietary software, and evaluated with following two methods: 1) PET/MRI evaluated by not only anatomical and metabolic information, but also MR signal intensity assessment (PET/MRI type A) and 2) PET/MRI assessed by anatomical and metabolic information (PET/MRI type B). Then, every factor and clinical stage were visually assessed on both PET/MRIs and PET/CT with CE-brain MRI. Kappa statistics were used to determine agreements for assessment of all factors and clinical stage with final diagnoses, and McNemar’s test was used to compare the diagnostic accuracy of all methods.

RESULTS
On PET/MRI type A, agreements of every factor and clinical stage with final diagnoses were determined as almost perfect (0.85<κ<0.94). On the other hand, agreements of every factor and clinical stage on PET/MRI type B and PET/CT with final diagnoses were determined as substantial (others: 0.60<κ<0.69) except T factor (κ=0.89). Diagnostic accuracies of N and M factors and clinical stage on PET/MRI type A (N: 91.4 [128/140] %, M: 98.6 [138/140] %, clinical stage: 91.4 [128/140] %) were significantly higher than those on PET/MRI type B and PET/CT (N: 80.7 [113/140] %, p=0.0003; M: 90.7 [127/140] %, p=0.003; clinical stage: 80.0 [112/140] %, p=0.0002).

CONCLUSION
When MR signal intensity is evaluated as well as anatomical and metabolic information, PET/MRI can more accurately assess N and M factors and clinical stage than PET/CT with CE-brain MRI in NSCLC patients.

CLINICAL RELEVANCE/APPLICATION
When MR signal intensity is assessed as well as anatomical and metabolic information, PET/MRI can more accurately evaluate clinical stage than PET/CT in NSCLC patients.
Diffusion-weighted Magnetic Resonance Imaging for Pre-therapeutic Assessment and Staging of Lymphoma: A Prospective Study in 140 Patients

Marius Erik Mayerhoefer MD, PhD : Nothing to Disclose, Thomas Knogler MD (Presenter): Nothing to Disclose, Helmut Prosch MD : Nothing to Disclose, Georgios Karanikas MD : Nothing to Disclose, Kurt Kletter MD : Nothing to Disclose, Katja Pinker-Domenig MD : Nothing to Disclose, Dominik Berzaczy MD : Nothing to Disclose, Michael Weber : Nothing to Disclose, Ulrich Jaeger MD : Nothing to Disclose, Barbara Kiesewetter MD : Nothing to Disclose, Philipp Ubl MD : Nothing to Disclose, Markus Raderer MD : Nothing to Disclose

PURPOSE

To determine the value of diffusion-weighted MR imaging (DWI) for pre-therapeutic assessment and staging of patients with (1) fluorodeoxyglucose (FDG)-avid lymphoma (e.g., diffuse large B-cell lymphoma [DLBCL]), and (2) lymphoma with variable FDG-avidity (e.g., extranodal marginal zone B-cell lymphoma of the mucosa-associated lymphoid tissue [MALT]).

METHOD AND MATERIALS

Treatment-naïve lymphoma patients that were referred for pre-therapeutic whole-body staging were included in this prospective study. Group A included patients with FDG-avid lymphoma (e.g., Hodgkin, DLBCL, and follicular lymphoma), whereas Group B included patients with lymphoma of variable FDG-avidity (e.g., MALT lymphoma, small lymphocytic lymphoma). All patients underwent DWI-MRI and 18F-FDG-PET/CT (positron emission tomography/computed tomography) with a venous-phase contrast-enhanced (CE-)CT series. Region-based sensitivity and agreement with Ann Arbor staging, relative to the reference standard, were calculated for DWI-MRI, and, in Group B, also 18F-FDG-PET/CT and CE-CT.

RESULTS

In Group A (100 patients), DWI-MRI had a region-based sensitivity of 97%, and with regard to staging, agreed with the reference standard in 94/100 patients (kappa, 0.92). In Group B (40 patients; 38 MALT), DWI-MRI, 18F-FDG-PET/CT, and CE-CT had region-based sensitivities of 94.4%, 60.9%, and 70.7%, respectively. With regard to staging in Group B, DWI-MRI, 18F-FDG-PET/CT, and CE-CT agreed with the reference standard in 37/40, 26/40, and 24/40 patients, with kappa values of 0.89, 0.52, and 0.43, respectively.

CONCLUSION

In patients with FDG-avid lymphoma, DWI-MRI appears to be only slightly inferior to 18F-FDG-PET/CT, with regard to pre-therapeutic regional assessment and staging. In patients with lymphoma subtypes that show a variable FDG-avidity, particularly MALT lymphoma, DWI-MRI appears to be superior to both 18F-FDG-PET/CT and CE-CT.

CLINICAL RELEVANCE/APPLICATION

DWI-MRI may be a general alternative to 18F-FDG-PET/CT for pre-therapeutic lymphoma staging. In MALT lymphoma, DWI-MRI even appears to be superior not only to 18F-FDG-PET/CT, but also to CE-CT, which is the currently recommended imaging test in this type of lymphoma. This is particularly relevant for younger lymphoma patients, because, contrary to 18F-FDG-PET/CT or CE-CT, DWI-MRI is not associated with potentially harmful radiation, and may thus be better-suited for life-long follow-up.
(CSWS) in children with epilepsy, which is associated with poor neuro-cognitive outcome. We studied thalamic abnormalities in children with CSWS using FDG-PET imaging.

**METHOD AND MATERIALS**

Twenty patients (11 females; mean age: 8.6 years) with epilepsy and CSWS (excluding Landau-Kleffner syndrome), underwent FDG-PET. Thalamic glucose metabolism, represented by standardized uptake value normalized to whole brain (NSUV), and its asymmetry [absolute asymmetry index (AAI): |(Right-Left)|*200/(Right+Left)] was calculated. These values were compared with those from 10 normal healthy controls (5 females; mean age: 11.1 years).

**RESULTS**

Thalamic glucose metabolism was abnormal in 17 patients (85%). Significant thalamic asymmetry (AAI=5.5-31.5% (0.8-3.3% in controls); p=0.004) was seen in 9 children. 5/9 children had unilateral [increased (n=2) or decreased (n=3)] and 4/9 had bilateral [increased (n=1) or decreased (n=3)] thalamic abnormality. Thalamic NSUV was decreased (n=7) or increased (n=1) bilaterally in 8 children without any asymmetry. MRI was abnormal in two patients, showing unilateral thalamic atrophy, consistent with severely decreased glucose metabolism. Epilepsy surgery was performed in 6 patients with Engel class-I outcome seen in 3/4 patients with unilateral and 2/2 with bilateral decreased thalamic NSUV. Thalamic metabolism was found to be lower on the side of cortical resection in all children.

**CONCLUSION**

Thalamic abnormalities, both uni- and bilateral, are seen in patients with CSWS. FDG-PET is a sensitive and quantifiable modality to detect these changes compared to MRI which is mostly normal. Successful epilepsy surgery is possible in these cases.

**CLINICAL RELEVANCE/APPLICATION**

Our findings provide further insight into the pathogenetic mechanism behind continuous spike-wave during slow-wave-sleep (CSWS) in children with epilepsy.

---

**SST12-02**

**Relation to Cortical Blood Flow and Electrographic Activity in Childhood-onset Seizures: Correlation between MRI-SWI and EEG**


**PURPOSE**

To evaluate the relationship between cortical perfusion or venous flow and electrographic activity in the children with seizure using susceptibility weighted imaging (SWI) and electroencephalography (EEG).

**METHOD AND MATERIALS**

Children presenting with seizures who underwent MRI-SWI and EEG within 24 hours of seizure onset were retrospectively reviewed. The localized area of increased cortical venous flow (SWI+) was assessed using SWI while the abnormal activities such as slowing or epileptiform discharges (EEG+) were investigated on EEG recordings. We defined three groups of patients according to the correlation between MRI-SWI and EEG: (A) no increased venous flow and no abnormal discharges, (B) discordant finding between the SWI+ and EEG+ area, (C) concordant finding between the SWI+ and EEG+ area.

**RESULTS**

We identified 297 children (194 in group-A, 76 in group-B, and 27 in group-C). The mean age among the three groups was similar (group-A: 3.8±4.6, group-B: 5.0±4.5, group-C: 4.6±4.8 years). The greatest difference among these groups was in seizure frequency and underlying disease. Multiple seizures were revealed more frequently in group-C (12/27, 44.4%) than in group-A (47/194, 24.2%, p=0.026) or group-B (18/76, 23.7%, p=0.041). The incidence of newly-diagnosed epilepsy was significantly higher in group-C (14/27, 51.9%) than in group-A (59/194, 30.4%, p=0.026) or group-B (22/76, 28.9%, p=0.032). By contrast, there were no significant differences in the previous seizure history, seizure types or duration among the three groups.

**CONCLUSION**

Seizures with concordant findings between increased venous flow on MRI-SWI and abnormal electrographic activities are more likely to more frequent or real epileptic seizures.

**CLINICAL RELEVANCE/APPLICATION**

Susceptibility-Weighted image is well represented cortical venous flow in children with seizure and helpful to show the change of cortical blood flow in frequent seizure.

---

**SST12-03**

**Independent Contribution of Individual White Matter Pathways to Language Function in a Cohort of Pediatric Epilepsy Patients**

Johanna Monsalves MD (Presenter): Nothing to Disclose, Michael John Paldino MD : Nothing to Disclose, Wei Zhang PhD : Nothing to Disclose, Lynn Chapieski PhD : Nothing to Disclose
**PURPOSE**

Patients with epilepsy are at high risk for language and other cognitive impairment. Several white matter pathways have been implicated in such dysfunction. However, great potential exists to detect indirect associations between a proposed biomarker and a particular cognitive function, particularly in populations whose cerebral connectivity and brain function are both extensively abnormal. The goal of this study was to measure the independent contribution of well-described white matter pathways to language function in a cohort of pediatric patients with epilepsy.

**METHOD AND MATERIALS**

Patients were retrospectively identified from an existing database of pediatric epilepsy patients with the following inclusion criteria: 1. Diffusion tensor imaging acquired at 3 Tesla; 2. Language function measured by a neuropsychologist. The following tracts were analyzed: corpus callosum, corticospinal tracts (CSP), inferior longitudinal fasciculi (ILF), inferior fronto-occipital fasciculi (IFOF), uncinate fasciculi (UF), and arcuate fasciculi (AF). Mean diffusivity (ADC), axial diffusivity (e1), and fractional anisotropy (FA) were calculated for each tract. A machine learning algorithm (random forest) measured the independent contribution of metrics from each tract to the clinical phenotype. In other words, the importance of each tract was measured after adjusting for the contribution of all other tracts.

**RESULTS**

Twenty patients met criteria (age: 4-18 years). All tracts were identified in all patients except the AF, which was not identified on the right in 8 patients and not identified on the left in 1 subject. Metrics related only to the left UF, IFOF, and AF were independently associated with the clinical phenotype (Figure 1). In addition, the machine learning algorithm was highly accurate in predicting the individual patient language scores on the basis of tract metrics.

**CONCLUSION**

Quantitative metrics derived from the left uncinate, inferior fronto-occipital, and arcuate fasciculi were independently associated with language function.

**CLINICAL RELEVANCE/APPLICATION**

Our findings highlight the importance of these three association pathways in human language function.

---

**SST12-04**

**The Utility of MR Spectroscopy (MRS) for the Evaluation of Seizure in Pediatric Patients**

Marisa K. Blitstein MD (Presenter): Nothing to Disclose, Sandra Rincon MD: Nothing to Disclose, Paul Albert Caruso MD: Nothing to Disclose, Ramon Gilberto Gonzalez MD, PhD: Nothing to Disclose, Ronald Thibert: Nothing to Disclose, Eva-Maria Ratai PhD: Nothing to Disclose

**PURPOSE**

To determine the utility of MR Spectroscopy (MRS) for evaluation of seizure in the pediatric patient: does MRS add information to the MRI?

**METHOD AND MATERIALS**

A search was performed to identify patients <18 years old with both MRI and MRS for evaluation of seizure between 1/1/2011 and 12/31/2012. This search yielded 165 cases. 7 were discarded because the MRS was nondiagnostic, leaving 158 cases (146 patients). Chart review was performed to determine if the patient had a relevant diagnosis known at the time of imaging. We defined relevant diagnosis as a diagnosis related to seizure AND known to exhibit structural MRI features. MRI, MRS, and original radiology report were reviewed by 2 neuroradiologists and an MR physicist, to determine whether MRS was normal or abnormal, and whether MRS added information not provided by MRI.

**RESULTS**

MRS yielded additional information for 34% (53/158) of cases. In the largest subset, 10/53 cases, MRS was useful for distinguishing dysplasia from neoplasm. Of all cases, 46/158 had a known relevant diagnosis and 112/158 had no known relevant diagnosis at the time of imaging. Of cases with a known diagnosis, MRS yielded additional information in 54% (25/46), the largest number of which was for a diagnosis of hypoxic-ischemic injury (HII) (8/25) or perinatal infection (4/25). Of cases without known diagnosis, MRS yielded additional information in 25% (28/112); the largest number were for cases with a focal lesion where differentiation between neoplasm and dysplasia was helpful (7/28), and for cases where MRS abnormalities prompted a metabolic or genetic workup (6/28).

**CONCLUSION**

In our series, MRS provided additional information in 34% of pediatric patients with seizures, and was particularly helpful for distinguishing dysplasia from neoplasm. Furthermore, it was most helpful in patients with a known diagnosis vs patients without a diagnosis at the time of imaging. Of known diagnoses, it was most helpful for patients with HII or perinatal infection. For unknown diagnosis, it was most helpful differentiating dysplasia versus neoplasm, and was also helpful in prompting additional metabolic or genetic workup.

**CLINICAL RELEVANCE/APPLICATION**

In select pediatric patients evaluated for seizure, MRS can add information that is not provided by MRI.
**SST12-05**  
**Automated Processing of Dynamic Contrast Enhanced (DCE) T1 Permeability Perfusion: Advanced Pharmacokinetic Metrics in Pediatric Brain Tumors**

Sridhar Vajapeyam PhD (Presenter): Nothing to Disclose, Kelsey Ricci MA: Nothing to Disclose, Naira Muradyan PhD: Employee, iCAD, Inc, Mark Kieran: Nothing to Disclose, Tina Young Poussaint MD: Nothing to Disclose

**PURPOSE**

To study the efficacy and feasibility of automated dynamic contrast enhanced T1 permeability perfusion imaging and advanced imaging metrics in children with suspected pediatric brain tumors.

**METHOD AND MATERIALS**

T1 permeability imaging was performed using T1 mapping with flip angles of 2, 5, 10 and 15°, followed by DCE with 0.1 mmol/kg bw of Gd-based bolus. Data were processed prospectively using automated iCAD OmniLook software (iCAD Inc., Nashua, NH) to generate advanced pharmacokinetic parameters using the Tofts 2-compartment model, allowing voxel-wise calculation of Ktrans (transfer constant from the blood plasma into the extracellular extravascular space, EES), Kep (rate constant from EES back into blood plasma), ve (extravascular extracellular volume fraction), vp (fractional plasma volume) and T1 values.

**RESULTS**

There were 11 patients, ages 2.6-17 years, mean 10.3 years. New diagnoses included medulloblastoma (2), ependymoma (1), anaplastic ependymoma (1), sarcoma (1), atypical hemangioma (1), pilocytic astrocytoma (1), low grade glioma (2), tumeformative demyelination (initially thought to be tumor-1), and the followup case included recurrent pilocytic astrocytoma (1). 4 patients had supratentorial lesions and the remaining 7 were infratentorial. Pharmacokinetic parameters measured for the cohort were as follows: Ktrans = 2.306 ± 4.341 (1/min), Kep = 10.979 ± 14.292 (1/min), ve = 0.189 ± 0.082, vp = 0.047 ± 0.035 and T1 = 2.961 ± 0.693 sec., with higher permeability values for high grade tumors compared with low grade tumors.

**CONCLUSION**

Automated processing of DCE brain permeability perfusion data in children is feasible and provides valuable additional pharmacokinetic metrics useful for assessing tumor grade and ultimately response to therapy.

**CLINICAL RELEVANCE/APPLICATION**

Advanced DCE T1 perfusion pharmacokinetic metrics help in pediatric brain tumor characterization.

---

**SST12-06**  
**Resting State fMRI as a Predictor of Vision Loss in Patients with Neurofibromatosis Type 1 (NF1)-associated Optic Pathway Gliomas**

Noushin Yahyavi-Firouz-Abadi MD (Presenter): Nothing to Disclose, Jerrel Rutlin: Nothing to Disclose, James Hoekel: Nothing to Disclose, Robert C. McKinstry MD, PhD: Travel support, Siemens AG Speaker, Siemens AG, Joshua S. Shimony MD, PhD: Nothing to Disclose, David Gutmann MD, PhD: Nothing to Disclose

**PURPOSE**

Optic pathway Glioma (OPG) occurs in 15-20% of children with neurofibromatosis type 1 (NF1) and may result in vision loss in as many as 50% of patients. To date, no radiologic finding or other reliable factor has been identified to predict NF1-OPG vision loss or to determine which patients will require treatment. The purpose of this study was to investigate the utility of resting state fMRI (rsfMRI) as a potential marker for vision loss in a cohort of children with NF1-OPG.

**METHOD AND MATERIALS**

Ophthalmologic evaluations and concurrent rsfMRI measurements were performed in 26 patients with NF1-OPG (9 with progressive and 17 with stable disease), some of which underwent as many as 4 paired MRI-ophthalmology exams. The intra- and inter-connectivity of five resting state networks were evaluated in the following systems: default-mode network (DMN), dorsal attention network (DAN), control (CTL), salience (SAL) and sensory-motor network (SMN). Visual acuity was measured by the logarithm of the minimal angle of resolution (logMAR).

**RESULTS**

Evaluation of the rsfMRI demonstrates a correlation between increased intra-network connectivity of SAL (p

**CONCLUSION**

In a small cohort of patients with NF1-OPG, we demonstrated that functional connectivity measures derived from rsfMRI correlate with vision loss. A prospective study in a larger cohort with longer follow-up is needed to evaluate whether rsfMRI can be a used as a reliable predictor of vision loss and a marker for early treatment in this population.

**CLINICAL RELEVANCE/APPLICATION**

Our preliminary results indicate that functional connectivity as measured using rsfMRI may be useful as a marker of vision loss in children with NF1-OPG.
SST12-07  Retinoblastoma Nerve Optic Invasion: How Color Doppler Can Improve Diagnosis Better than MRI

Osmar Cassio Saito MD, PhD (Presenter): Nothing to Disclose, Maria Cristina Chammas MD: Nothing to Disclose, Maria Teresa Bonanomi PhD, MD: Nothing to Disclose, Giovanni Guido Cerri MD, PhD: Nothing to Disclose

PURPOSE
(1) We intend to review the retinoblastoma main findings by means of ultrasound and MRI; (2) to compare imaging findings (ultrasound and MRI) and anatomopathological findings after enucleation; (3) to evaluate which method can detect best the optical nerve invasion.

METHOD AND MATERIALS
(1) 18 monocular retinoblastoma tumors were evaluated by means of ultrasound with color Doppler and MRI at Clinicas Hospital of University of São Paulo (2) The mean age were 24 month year old (3) All patients underwent ultrasound examination with 16 MHz probe Toshiba applio 500 GE MRI 1,5 tesla (4) All patients underwent general anaesthesia before MRI and Ultrasound (5) Color Doppler evaluated the arterial systolic velocity and vein velocity inside optic nerve in the normal and tumor eye; (6) We also calculated IP and RI in the central retina artery and vein; (7) All tumors were evaluated by T1, T2 with gadolinium injection.

RESULTS
(1) All 18 patients had monocular retinoblastoma were enucleated and anatomopathological study were made in order to detect optic nerve invasion; (2) 11 patients had optic nerve invasion (61%); (3) 4 patients had optic nerve invasion detected by MRI (retrobulbar enhancement and optic nerve thickening (36 %); (4) 9 had increased velocity vein (81%); (5) Central retina arterial velocity and central retina vein velocity were higher in tumor than in normal eyes (p

CONCLUSION
(1) Retinoblastoma eyes have faster flow; (2) Lower PI is related to nerve optic invasion.

CLINICAL RELEVANCE/APPLICATION
Retinoblastoma is a highly malignant ocular neoplasm that shows a tendency to optic nerve invasion which implies in a poorer prognosis for the patient. The diagnosis of nerve invasion at presentation is important for prognostic and management. Retinoblastoma invasion of the optic nerve may not be detected by MRI. Due to the scant space inside lamina cribrosa to harbor artery, vein and tumor cells, it seems logical to study blood flow in retinoblastoma, aiming to detect nerve invasion.

SST12-08  MRI Characteristics of Ependymoblastoma: Results from 22 Centrally Reviewed Cases

Johannes Nowak MD (Presenter): Nothing to Disclose, Carolin Seidel: Nothing to Disclose, Frank Berg: Nothing to Disclose, Torsten Pietsch: Nothing to Disclose, Carsten Friedrich: Nothing to Disclose, Katja von Hoff: Nothing to Disclose, Stefan Rutkowski: Nothing to Disclose, Monika Warmuth-Metz: Nothing to Disclose

PURPOSE
Ependymoblastoma (EBL) is a malignant, embryonal central nervous system (CNS) tumor of early childhood with a dismal prognosis. Categorized by the WHO as a subgroup of CNS-PNET (primitive neuroectodermal tumor), EBL is histologically defined by "ependymoblastic rosettes". Due to its rarity, little is known about specific MRI characteristics of EBL. We first systematically analyze and discuss MRI features of EBL in a series of 22 consecutive patients.

METHOD AND MATERIALS
All 22 EBL cases within this study were centrally reviewed for histopathology, MRI findings, and multimodal therapy. Patients were diagnosed between 2002 and 2013. For systematic analysis of initial MRI scans at diagnosis, we evaluated 25 standardized criteria for reference image evaluation of pediatric brain tumors. Image reading was performed by two neuroradiologists in consensus.

RESULTS
EBL are large tumors with well-defined tumor margins and iso- to hyperintense signal on T2WI. The majority of EBL were located supratentorially (16/22 patients), whereas 4 tumors were found infratentorially and 2 tumors occurred in the brainstem. Tumors showed diffusion restriction in all cases where DWI was provided. Surrounding edema was present in 9%, and cysts could be found in 50% of the EBL cases. Contrast enhancement was variable, with a tendency to mild or moderate enhancement. Subarachnoid spread is common in EBL, but can be absent initially. There was a male preponderance (1.75:1 ratio) for EBL in our cohort. Mean age at diagnosis was 2.1 years.

CONCLUSION
Imaging appearance of EBL seems to share features with other pediatric embryonal CNS tumors. However, future studies are needed to systematically compare MRI findings of EBL with other CNS-PNET and ependymoma, in order to delineate imaging criteria that might help distinguish these pediatric brain tumor entities. Since there is still an ongoing debate about the exact histopathological definition of EBL among neuropathologists, we contribute to this discussion with the first systematic analysis of imaging characteristics of EBL.

CLINICAL RELEVANCE/APPLICATION
With this study, we add the largest case collection to the very limited published database of MRI findings in EBL, together with epidemiological data.
Organ Doses from Longitudinally Modulated Chest CT Scans in Commercial Software and Monte Carlo Simulations

Xochitl Lopez-Rendon MSc (Presenter): Nothing to Disclose, Guozhi Zhang: Nothing to Disclose, Raymond H. Oyen MD, PhD: Nothing to Disclose, Hilde Bosmans PhD: Co-founder, Qaelum NV Research Grant, Siemens AG, Federica Zanca PhD: Nothing to Disclose

PURPOSE
To estimate organ doses from longitudinally modulated chest CT scans with CT-Expo dosimetry software and full Monte Carlo (MC) simulations for normal size patients.

METHOD AND MATERIALS
Data from 9 patients (4 female, 5 male) with normal BMI (20.3-24.4), who underwent a chest scan on a Siemens Definition Flash scanner were collected. Examinations were performed with longitudinal TCM, 120 kV and 110 reference mAs. Patients organ doses (lungs for both gender and breasts only for female) were calculated using the new CT-Expo v. 2.2, which includes a dose correction for exams performed with tube current modulation. Specifically it uses two unique mAs profiles, one for male and one for female, which are modified based on the specific scan range by a set of correction factors for each z-position every cm. Dose to the same organs were also calculated with MC simulation (EGSnrc) for the ICRP phantoms, but this time using the patient specific tube current modulation profiles. The longitudinal TCM information from each patient was extracted from the images using an in-house tool. Percentage error between the dose calculated with the full MC simulation and the commercial software was assessed with respect to the MC simulations.

RESULTS
For all the patients, doses estimated with the full MC simulation were higher than with CT-Expo. For female patients, the percentage error for breasts ranged from 3.9 to 12.4%, while for the lungs from 10.8 to 21.2%. The percentage error for dose to the lungs for male patients ranged from 10.9 to 13.3%.

CONCLUSION
All included patients were similar in BMI to the stylized CT-Expo phantoms and to the ICRP anthropomorphic phantoms used for MC simulations. Observed organ dose differences are due to the stylized phantoms and the two single TCM profiles used in CT-Expo. TCM profile can vary considerably even across normal size patients due to different body habitus.

CLINICAL RELEVANCE/APPLICATION
To have accurate patient specific organs doses, even for normal patient sizes, MC simulations have to be preferred.
CTDvol can be stored as an optional attribute with tag (0018,9345) in the DICOM metadata on an image by image basis. This attribute is described in the DICOM literature as the average dose associated with that image. Although this description is not correct, this parameter can still be very useful for dose computations, even in the presence of current modulation.

**Discussion**

ImPACT is designed for the computation of dose with fixed scanning parameters and the start and end positions of the scan. However, CTDV_{vol}, by itself, accounts for tube current, rotation time, pitch and collimation. (In general, variations in tube potential and scanner model only weakly affect the dose distribution.) Linearity along with the scan region dependency of ImPACT allows for the computation of dose in the presence of current modulation. Tabulation of CTDV_{vol} as a function of position makes it unnecessary to know the collimation, tube current, rotation time and pitch in the computation of organ dose.

**Evaluation**

CTD_{vol} is obtained from the approximate spatial average of a 100 mm central portion of the single scan dose profile in the central plane of standard cylindrical phantoms. It is a function of collimation, pitch, tube potential, tube current, rotation time, and specific machine model. The reasoning in AAPM Task Group Report 111 along with published data shows that CTD_{vol} is directly proportional to the energy absorbed per rotation. Using ImPACT as a model and taking advantage of linearity, CTD_{vol} as a function of position can be used for the calculation of dose even in the presence of current modulation. Though ImPACT is limited to a standard, stylized patient, the principle should apply to any dose computation program where CTD_{vol} is computed.

---

**SST13-03**

**SSDE and Isocentre - A Weighty Relationship**

Dana M. Jackson RT (Presenter): Nothing to Disclose, Jacqui Hislop-Jambrich PhD: Employee, Toshiba Corporation

**CONCLUSION**

For SSDE to be an accurate and robust method for estimating individual patient dose, patients must be positioned at isocentre.

**Background**

Cardiac CTA (CCTA) utilization has increased steadily, and as such is contributing to an increasing medical ionizing radiation burden. The dose received by individuals however is affected by multiple factors including the unintended effects on dose modulation caused by operator mal-positioning. The AAPM has developed size specific dose estimates (SSDE) to use an individual’s size to more accurately estimate the dose delivered during a CT. The purpose of this research is to determine if significant differences exist between all SSDE’s from cardiac CTA’s using the dose metrics displayed by the scanner and corrected dose metrics accounting for improper positioning within the gantry.

**Discussion**

A total of 94% of patients were positioned greater than 1cm from isocentre resulting in significant dose increases for 75% of patients. Without applying corrections for mal-positioning, significant variations in SSDEs for the different calculation methods was apparent. In some instances the variation was in the order of 50%. Greatest variations occurred when comparing the SSDE calculated from the AP diameter and the lateral diameter in obese patients. Once corrections for mal-positioning were applied to the data, the majority of cases resulted in similar SSDEs for all calculation methods.

**Evaluation**

Under ethics approval 100 consecutive females undergoing routine CCTA were retrospectively evaluated. Using data obtained from anthropomorphic phantom studies, we determined the effects of mal-positioning within the gantry on dose and size assessments. Corrections were made to the dose and size metrics for all 100 patients.

---

**SST13-04**

**Dose to Partially Irradiated Organs as a Function of Z-Axis Over-Ranging and Scan Over-Prescription for Chest CT Examinations**

Kyle McMillan (Presenter): Institutional research agreement, Siemens AG Research support, Siemens AG, Maryam Bostani PhD: Research support, Siemens AG, Maria Zankl PhD: Nothing to Disclose, Christopher H. Cagnon PhD: Nothing to Disclose, John J. Demarco PhD: Nothing to Disclose, Michael F. McNitt-Gray PhD: Institutional research agreement, Siemens AG Research support, Siemens AG

**PURPOSE**

To evaluate the relationship between partially irradiated organ dose and z-axis over-ranging and over-prescription.

**METHOD AND MATERIALS**

Detailed Monte Carlo simulations of chest CT examinations were performed for one 64-slice multi-detector row CT scanner (Sensation 64, Siemens Healthcare) using a single voxelized patient model (GSF model “Irene”). Simulations were performed with a nominal collimation of 32 x 0.6 cm and a pitch of 1. As per the recommendations of the AAPM Routine Chest CT Protocol, an “ideal scan range” was set from the top through the bottom of the lungs. In order to model both z-axis over-ranging and scan over-prescription, scan start
(beam on) and stop (beam off) locations were independently increased in 1 cm increments until full coverage of the thyroid and liver occurred. For each scan range, dose to the thyroid, liver and red bone marrow (RBM) was tallied, and relationships between organ dose and z-axis over-ranging and scan over-prescription were derived.

**RESULTS**

For all organs, dose as a function of over-ranging and over-prescription follows a cubic function. Correlation coefficients for these relationships were 0.99. The difference between dose from an “ideal scan range” and a scan range that included 2 cm of over-ranging only was 62.4%, 34.1% and 15.6% for the thyroid, liver and RBM, respectively. The difference between dose from an “ideal scan range” and a scan range that included over-ranging and maximum over-prescription (i.e. full coverage of the thyroid and liver) was 89.3%, 164.4% and 52.8% for the thyroid, liver and RBM, respectively.

**CONCLUSION**

Z-axis over-ranging and scan over-prescription can have a significant impact on dose to partially irradiated organs. Strong correlations between partially irradiated organ dose and over-ranging and over-prescription can be used to predict dose to organs outside the image range.

**CLINICAL RELEVANCE/APPLICATION**

Results presented can be used to estimate the impact of over-ranging and over-prescription for dose to partially irradiated organs and help facilitate clinical decisions of scan range prescription.

**SST13-05 Individualized Organ Dose Calculations for Body CT Patients from Automatically Segmented Anatomy Coupled with Fast Monte Carlo Transport**

Choonsik Lee PhD (Presenter): Nothing to Disclose, Jiamin Liu PhD: Nothing to Disclose, Jianhua Yao PhD: Royalties, iCAD, Inc, Les Roger Folio DO, MPH: Nothing to Disclose, Ronald M. Summers MD, PhD: Royalties, iCAD, Inc Research funded, iCAD, Inc Stockholder, Johnson & Johnson Grant, Viatronix, Inc

**PURPOSE**

To establish the feasibility of individualized organ dose calculations in body computed tomography (CT) patients by using semi-automatic segmentation of major organs, scan parameters abstracted from DICOM header, CT scanner simulation model, and Monte Carlo transport in high-speed parallel computing system.

**METHOD AND MATERIALS**

We used the abdominal CT images (four male and five female) of patients, ranging in age from 19 to 46 years, sampled from our clinical PACS. First, we contoured 6 organs and tissues using threshold (body contour and skeleton) and Multi-Atlas Label Fusion (left and right kidneys, pancreas, spleen, and liver) techniques. Second, scan parameters (scanner model, average mAs, and tube potential) were automatically abstracted from DICOM headers by using an in-house script. Parameters and patient contours were coupled with a CT scanner simulation model within a Monte Carlo transport code, MCNPX2.7. Organ doses for kidneys, pancreas, spleen, and liver were estimated using a hi-speed 32-processor computing server.

**RESULTS**

The automatic segmentation, data abstraction, and Monte Carlo calculation took about an hour for each patient. All organs were completely included within the scan coverage. The coefficient of variations in organ volumes across the 9 patients were 20, 13, 34, and 26 % for liver, kidneys, spleen, and pancreas, respectively. When organ dose was normalized to mAs, the maximum dose (mGy/mAs) to each organ was from 1.2- (liver) up to 3.5-fold (spleen) greater than the minimum dose among the 9 patients. The dose discrepancy may be attributed to different locations/shapes of organs and body size. When patient-specific mAs was multiplied, the maximum dose to spleen was up to 3.5-fold greater than the minimum dose.

**CONCLUSION**

Our pilot study presented the feasibility to calculate patient-specific organ dose from segmented patient anatomy coupled with fast Monte Carlo calculation. The comparison of organ dose (normalized to mAs) revealed significant variation (over 2.5-fold) in all patients even though they were all adults and the organs were completely included into the scan coverage.

**CLINICAL RELEVANCE/APPLICATION**

We presented an important step towards estimating true patient dose. We are currently working to apply our method to help validate computational phantom-based organ dose in patient dose monitoring.

**SST13-06 The AAPM-ICRU CT Dose Phantom: A Robust and Versatile Tool for Dose Measurements Across CT Platforms**


**CONCLUSION**
Designed to incorporate the approaches described in TG111, the AAPM-ICRU phantom provides the means to standardize and unify dose measurements on a wide variety of CT scanners including diagnostic scanners with extended beams, cone beam and flat panel geometries.

Background

The phantom and measurement techniques used to obtain CTDI\textsubscript{vol} and DLP have limitations that can impose challenges in obtaining equivalent measurements on the growing number of cone beam and very wide fan beam CT machines. In accordance with the recommendations of AAPM Task Group 111 (TG111), TG200 has designed a phantom and tested procedures which are suitable over a broader range of machines than the current methodology. The phantom design and measurement methods lend themselves to a more unifying set of dose descriptors, especially when the concept of irradiated length is employed.

Evaluation

The phantom is 30 cm in diameter and is constructed of polyethylene; it is of sufficient length (60 cm) so that scatter reaching the central plane from the ends of the phantom is negligible. For scanners with a moving table, a small detector is placed within the central plane and a helical scan through the entire phantom is performed. The dose recorded by the chamber approaches \( D_{eq} \), the value that would be reached for an infinite scan. By recording the dose rate simultaneously, \( d(D(L))/dL \) can be determined, where \( D(L) \) is the dose as a function of the irradiated length \( L \). Integrating this gives us the approach to equilibrium function \( H(L) = D(L)/D_{eq} \). By employing the principle of irradiated length, these concepts can be extended to axial scans on stationary tables. These phantoms have been tested at a variety of locations either with the assistance of a member of TG200 or “cold” using written instructions only.

Discussion

\( H(L) \) is a robust function with only a weak dependence on tube potential, z-axis collimation and even scanner model. The phantom design is easily adaptable to the size specific dose estimates described by the report of AAPM Task Group 204 resulting in an index that remains simple but accounts for both girth and scan length. Correlations to air and small phantom measurements can be used for verification in the field.

RESULTS

New dose tables were generated for AP, PA and LAT localizer radiographs and added to the software tool. Localizer functionality was integrated into the software package ImpactDose2.1 (CT Imaging GmbH, Erlangen, Germany), which estimates organ and effective dose in CT depending on patient size, scan region and scan protocol. It is based on pre-tabulated dose values calculated by Monte Carlo (MC) simulations performed on the ORNL family of phantoms as well as on the ICRP110 standard adult male and female phantoms. The validity of the MC software used for table generation was evaluated by point-by-point comparison of MC dose results with measurements performed by using a set of thermoluminescent dosimeters (TLD) in a Rando-Alderson phantom. New dose tables were generated for AP, PA and LAT localizer radiographs and added to the software tool.

CONCLUSION

The optimal choice of the localizer direction (AP, PA, LAT) has a significant impact on dose and offers potential dose savings. Software based on MC pre-calculated tables provides within a few seconds accurate dose estimates for arbitrary CT examinations and localizer radiographs.

CLINICAL RELEVANCE/APPLICATION

Dose from localizer radiographs may contribute significantly to total effective dose. Software tools allow fast and accurate patient dose calculations taking localizer radiograph dose into account.
PURPOSE
To demonstrate the feasibility of estimating organ doses for patients undergoing tube current modulated (TCM) CT exams using a combination of: (a) a patient size metric derived from existing data in the CT localizer radiographs and (b) a scanner output metric based on the anatomical region of interest (CTDlvol-regional).

METHOD AND MATERIALS
For 20 patients who underwent clinically indicated TCM exams of the chest (n=10) or abdomen/pelvis (n=10), the CT localizer radiograph, image data and TCM data were obtained. The CT localizer radiograph (topogram) generated from most Siemens CT scanners contains a private DICOM field that stores an array of numbers describing AP and LAT attenuation-based measures of patient dimension. The square root of the product of the AP and LAT size data was used to calculate an estimate of water-equivalent diameter (WED-topo). For comparison, the image data was also used to calculate water-equivalent diameter (WED-image). Using a previously published approach, the average effective mAs over the anatomical region of interest was used to generate a regional descriptor of scanner output (CTDlvol-regional). Using previously described correlations between WED and organ doses normalized by CTDlvol-regional, estimates of organ dose (OD) were obtained using WED-topo and WED-image over the anatomical region of interest for the lung (chest scans) and liver (abd/pel scans). These estimated organ doses were then compared to estimates obtained with detailed Monte Carlo (MC) simulations that modeled individual patient anatomy and TCM data.

RESULTS
For abdomen/pelvis scans, the average difference between MC liver dose and OD(WED-image) and OD(WED-topo) was 6.06% and 7.43%, respectively. For chest scans, the average difference between MC lung dose and OD(WED-image) and OD(WED-topo) was 11.10% and 12.93%, respectively.

CONCLUSION
For both abdomen/pelvis and chest TCM CT examinations, organ dose estimated using WED derived from data in the DICOM header of the topogram was comparable to organ dose estimated using WED derived from image data. The topogram-based method has the advantage that WED data are readily available without additional post-processing of the image data.

CLINICAL RELEVANCE/APPLICATION
Accurate estimates of dose to patients undergoing TCM CT examinations can be obtained based on size data already available in some CT scan radiographs and a regional measure of scanner output.

SST13-09
Estimating the Role of Iodinated IV Contrast Media in Organ Radiation Dose: Effects of Vascular Phase and Tube Voltage in Multiphase Body CT

PURPOSE
To develop and apply a CT radiation dose estimation method accounting for IV iodinated contrast in computational phantom-based Monte Carlo simulations for more accurate scan and organ-specific radiation dose. We assessed the impact of time-dependent contrast phase and tube voltage (kVp) on organ radiation dose in multiphase body CT.

METHOD AND MATERIALS
An adult male computational phantom and CT scanner modeling within Monte Carlo n-particle extended (MCNPX2.6) code simulated x-ray photon interactions for a standard clinical Contrast-Enhanced body CT (CECT). Elemental composition of chest, abdominal and pelvic organs was adjusted to reflect the addition of iodinated contrast media (Isovue-300™) using predicted pharmacokinetic data of body contrast distribution. We modeled contrast phases (non-contrast, arterial, venous) at 120, 100 and 80 kVp; organ dose estimates were obtained with 2.6 million simulations on a supercomputer cluster.

RESULTS
Estimated organ dose showed greatest increase at the 120 kVp venous phase (absolute change: 1.9-10.3 mGy) in kidneys (361%), adrenals (379%), spleen (266%) and colon (228%) compared to non-contrast. Overall dose reduction was shown at lower kVp (100kVp: 37%, 80kVp: 73%) in all phases with largest magnitude of dose reduction in the same abdominal organs. Average dose increase was 15% from non-contrast to arterial and 84% continuing to venous. Lowering kVp reduced doses to near (100kVp) or below (80kVp) the non-contrast dose. Pelvic and thoracic organs received predicted radiation scatter.

CONCLUSION
Iodinated contrast increases organ radiation dose proportional to iodine accumulation and elapsed time, with the highest doses received by kidneys, adrenals, spleen and colon in the venous phase. Reducing organ doses by lowering kVp is effective in the presence of iodinated contrast media in all phases. Inclusion of iodinated contrast in radiation dose assessment is warranted.
Though clinical significance is currently unknown, increased x-ray absorption and energy deposition linked to tissue concentrations of iodinated contrast media increases non-uniform radiation dose distribution to organs during CT scanning. This can be accounted for by computational phantoms, allowing scan and patient-specific modeling which more closely approximates routine clinical CT scanning.

**Purpose**

Osteoporosis is characterized by changes to the trabecular bone micro-architecture in addition to reduction in bone mineral density (BMD). This study proposes using anisotropic Minkowski Functionals (AMF) for characterizing trabecular bone micro-architecture and evaluates their ability at predicting bone strength when analyzed with support vector regression (SVR).

**Method and Materials**

Axial images were acquired from 50 proximal femur specimens using 16-row MDCT scanner along with a calibration phantom. The specimens were then subject to biomechanical tests on the greater trochanter region and the failure load of each specimen was recorded. A spherical volume of interest (VOI) was fit into the femoral head region for further BMD value conversion and subsequent extraction of mean BMD and AMF-derived topological features. The computation of AMF feature vectors involved quantifying both the magnitude and direction of anisotropy in bone structure for all four Minkowski Functionals, i.e., volume, surface, mean breadth and Euler characteristic. All features were subsequently analyzed using multi-regression and support vector regression (SVR) to predict femoral failure load and prediction performance was evaluated with root-mean-square-error (RMSE). A Wilcoxon signed-rank test was used to compare RMSE distributions from different features and test for statistically significant differences in performance.

**Results**

The best prediction performance was achieved for the feature vector encoding the magnitude of anisotropy, as derived from AMF Euler Characteristic (RMSE = 1.01 ± 0.13). This was significantly better than MDCT-derived mean BMD (RMSE = 1.12 ± 0.16, p<0.05). Finally, we also noted that all AMF feature sets outperformed MDCT-derived mean BMD.

**Conclusion**

Our results demonstrate that high-dimensional AMF features, when used in combination with SVR, can significantly improve bone strength prediction in the proximal femur. The improved performance likely stems from inclusion of anisotropic properties in trabecular bone characterization which are not accounted for in conventional BMD measures.

**Clinical Relevance/Application**

Characterization of trabecular bone micro-architecture with anisotropic Minkowski Functionals for bone strength prediction can assist in osteoporosis diagnosis and monitoring of disease progression.
This study investigated techniques for fast segmentation and registration to facilitate visualization of treatment progress during the MRI-guided cryoablation procedure. Such visualization may aid in adaptive planning and improve treatment precision.

METHOD AND MATERIALS

Fast registration and segmentation techniques were applied to align the kidneys visualized across multiple acquisitions. A semi-automated segmentation was applied to identify the kidney that was robust to weak edges and low contrast. After segmentation, the phase correlation method was applied for rigid registration. The Hausdorff distance, a maximum edge-to-edge distance measure, and Dice Similarity coefficient, a measure of area overlap, were used to assess overall success of the techniques. Since the kidney is obscured by the iceball signal deficit during the freeze, the registration technique was tested for robustness to missing information.

RESULTS

A fast segmentation and registration scheme was developed which executed in under 2 minutes. During the freeze step of cryoablation, monitoring images are typically acquired every 3 minutes, therefore, this scheme executes within the clinically relevant time frame. The average HD before and after registration was 10.1mm and 3.21mm, respectively. The DSC of the segmentations before and after registration was increased from 46.6% to 82.6%, where a DSC of at least 70% may indicate a successful registration. The mean deformation observed in the kidney across all patients was 3.1mm. Because the rigid registration cannot account for these deformations, the average HD of 3.21mm was considered to indicate successful registration. The registration was robust while at least 25% of the kidney was visible in the freeze monitoring image. For final visualization, contours of the registered iceball were displayed onto the planning image along with damage likelihood contours.

CONCLUSION

Using a quick, semi-automated segmentation and registration scheme, the correct iceball location was reported as a contour on the planning image. The scheme executed within the clinically relevant time frame.

CLINICAL RELEVANCE/APPLICATION

In combination with a damage likelihood model, the visualization of the registered contours may be used to assess tumor coverage and aid in adaptive planning during the MRI-guided cryoablation procedure.

Performance Evaluation of Material Decomposition with Rapid kVp-switching Dual-energy CT and Implications for Assessing Bone Mineral Density


PURPOSE

To quantitatively investigate the accuracy and performance of material density images from the GE HD750 DECT scanner and evaluate its performance for assessing bone mineral density (BMD).

METHOD AND MATERIALS

Utilizing constituent basis pairs, the concentrations of various solutes in material decomposition images were measured for two-material syringe-phantoms under different experimental conditions together with SECT and DXA. The accuracy of the DECT concentration measurements in air was quantified by RMS error and linear regression was performed to compare measurements made in varying scanning conditions. Accuracy with concentric phantom (anthropomorphic) geometry was explored. The sensitivity of DECT and DXA to changes in BMD was evaluated. Correlations between DECT-derived areal bone mineral densities (aBMD) and DXA aBMD values were assessed for a variety of samples, including animal bones.

RESULTS

The RMS error of DECT concentration measurements in air ranged from 9-244%. Concentration measurements made off-isocenter or with a different DECT protocol were within 5% but measurement in scattering conditions resulted in a reduction of 8-27%; similar trends were observed in SECT data. In concentric phantoms, higher-attenuating material in the outer chamber increased measured values of the inner material for all measurement methods. DECT was found to be more sensitive than DXA to changes in BMD at 2 mg/ml K2HPO4. Measurements of aBMD using DECT were highly correlated (R2 = 0.983) with those from DXA.

CONCLUSION

DECT material density images were linear in response but showed poor accuracy. However, its high sensitivity and correlation with DXA aBMD suggests, perhaps with additional corrections, that DECT could be used clinically for monitoring relative changes to BMD.

CLINICAL RELEVANCE/APPLICATION

New commercial dual-energy CT scanners bring renewed interest in potential applications of the technology. One
such application is an accurate assessment of bone mineral density.

**SST14-04**

**Evaluation of a Novel Monoenergetic Postprocessing Algorithm with Newly Available Dual Energy Voltage Combinations of a 3rd Generation Dual Source CT in a Phantom Model and a Patient Study**

Christoph Schabel MD (Presenter): Speaker, Siemens AG, Malte Niklas Bongers: Nothing to Disclose, Stefanie Mangold MD: Nothing to Disclose, Bernhard Krauss PhD: Employee, Siemens AG, Konstantin Nikolaou MD: Speakers Bureau, Siemens AG, Speakers Bureau, Bracco Group, Speakers Bureau, Bayer AG, Christoph Karl Thomas MD: Speaker, Siemens AG, Ilias Tsiflikas MD: Nothing to Disclose, Ulrich Grosse MD: Nothing to Disclose

**PURPOSE**

To evaluate a novel monoenergetic postprocessing algorithm (MEI+) with newly available dual energy voltage combinations of a 3rd generation dual source CT (Somatom Definition Force, Siemens, Forchheim, Germany) in a phantom model and in patients with poor intrahepatic contrast enhancement.

**METHOD AND MATERIALS**

An anthropomorphic phantom which contained iodine of different dilutions, was scanned using a 3rd generation dual-source CT scanner with five different voltage combinations (70/150, 80/150, 90/150, 100/150, 80/140kV) with additional tin filter for 150kV and single energy at 120kV (SE). CTDI was kept constant throughout all scans. Optimal contrast images (OC), sole low kV (70, 80, 90, 100kV) images and traditional monoenergetic images (MEI) and MEI+ images (40keV to 190 keV) were calculated. MEI+ is a novel technique which combines the MEI algorithm with an advanced noise reduction algorithm. The contrast-to-noise ratio (CNR) between two different iodine dilutions were measured. Furthermore dual energy late-phase imaging of the liver which was acquired with a 2nd generation dual energy CT (Somatom Definition Flash, Siemens, Germany) was retrospectively evaluated in 25 patients with approval of local IRB and waiver of written informed consent. Measurements were used as a model for poor intrahepatic contrast enhancement.

**RESULTS**

MEI+ had highest CNR at 40keV (3.99-4.63 at 70/150kV) compared to MEI (2.34-3.89 at 60-70keV and 70/150kV), OC (3.02-4.35 at 70/150kV), sole low kV images (2.87-3.93 at 70kV) and SE (3.22). MEI, MEI+ (at low keV settings) and OC achieved highest CNR for 70/150kV scans but only MEI+ and OC were able to surpass sole 70kV images. In late phase imaging of the liver MEI+ increased CNR (2.1 ± 0.6 at 40keV) between liver veins and parenchyma significantly compared to MEI (1.0 ± 0.4 at 70keV) and sole 100 kV images (1.0 ± 0.3).

**CONCLUSION**

MEI+ overcomes noise limitations of MEI at low virtual keV levels and increases CNR by about 100% (72-100%) compared to SE at an equal radiation dose. Images acquired with 90/150kV and 100/150kV gain most CNR from MEI+ and are feasible in most patients due to power reserves of the scanning system.

**CLINICAL RELEVANCE/APPLICATION**

An increase in CNR can be used to reduce contrast dose or radiation dose in patients.

**SST14-05**

**Three-dimensional Super-resolution Technique Based on Self-similarity: Usefulness in Whole Heart Coronary Magnetic Resonance Angiography**

Ryohei Nakayama PhD (Presenter): Nothing to Disclose, Masaki Ishida MD, PhD: Nothing to Disclose, Yasutaka Ichikawa MD: Nothing to Disclose, Mio Uno MD: Nothing to Disclose, Yoshitaka Goto MD: Nothing to Disclose, Motonori Nagata MD, PhD: Nothing to Disclose, Kakuya Kitagawa MD, PhD: Nothing to Disclose, Hajime Sakuma MD: Research Grant, Siemens AG Research Grant, Koninklijke Philips NV Research Grant, General Electric Company Research Grant, Bayer AG Research Grant, Guerbet SA

**PURPOSE**

A recent study demonstrated that two-dimensional (2D) learning-based super-resolution (SR) technique can improve image resolution and signal-to-noise ratio (SNR) of whole heart coronary MRA (WHCMRA). However, 2D SR technique cannot increase the through-plane resolution. The purposes of this study were to develop a three-dimensional (3D) SR technique optimized for WHCMRA, and to investigate whether the 3D SR approach can provide high resolution images with improved fidelity and SNR as compared with 2D SR technique.

**METHOD AND MATERIALS**

Free-breathing WHCMRA images were obtained in 46 patients with known or suspected coronary artery disease by using a 1.5T MR system and 32-channel coils, with acquisition resolution of 1.2x1.2x1.5mm and reconstruction resolution of 0.6x0.6x0.75mm. A learning-based 3D SR processing consists of two steps including (1) generation of a 3D dictionary describing relationship between low-resolution (LR) patches and high-resolution (HR) patches, and (2) construction of SR WHCMRA images by embedding 3D patches optimally selected from the dictionary. For evaluating the advantages of the 3D SR processing, WHCMRA images with 0.6x0.6x0.75mm resolution were constructed from the down-sampled WHCMRA images (1.2x1.2x1.5mm) by using 3D-SR, 2D-SR and 3D bi-cubic interpolation (3D-BCI).

**RESULTS**

The root mean square error between 3D SR images generated from down-sampled WHCMRA and original WHCMRA was 2.75, showing a significant improvement when compared with 2D SR technique (3.28, P < .001)
and 3D-BCI (3.57, P < .001). The structural similarity index compared to original WHCMRA was also greater with 3D SR technique (0.982) than with 2D SR technique (0.981, P < .001) and 3D BCI (0.980, P < .001). Although 2D SR approach exhibited significantly improved SNR as compared with 3D-BCI (61.7 +/- 10.5 vs. 49.8 +/- 15.7, P < .001), the 3D SR approach proved further improvement in SNR (66.7 +/- 11.5, P = .041 compared with 2D SR).

CONCLUSION

The 3D SR technique developed in this study can provide high-resolution coronary images with improved fidelity and higher SNR when compared with the 2D SR technique and 3D BCI.

CLINICAL RELEVANCE/APPLICATION

Improved spatial resolution and higher SNR achieved by 3D SR may help to improve the detection of coronary artery stenoses with coronary MRA.

Automated Pancreas Segmentation Using a Multi-level Information Propagation Approach in Abdominal Computed Tomography

Amal Farag PhD (Presenter): Nothing to Disclose, Evrim Bengi Turkbey MD: Nothing to Disclose, Le Lu PhD: Nothing to Disclose, Jiamin Liu PhD: Nothing to Disclose, Ronald M. Summers MD, PhD: Royalties, iCAD, Inc Research funded, iCAD, Inc Stockholder, Johnson & Johnson Grant, Viatronix, Inc

PURPOSE

To develop an automated pancreas segmentation method using abdominal CT examinations.

METHOD AND MATERIALS

60 subjects (mean age= 47±16 yrs, 37 % women) who were either a healthy kidney donor candidate (n=17) or had no major abdominal abnormality in the consecutive retrospective search of PACS in a month (n=43) were included in this study. Images were acquired in the portal venous phase with a slice thickness of 1.5-2.5 mm on MDCT scanners. The computationally efficient method is based on a hierarchical, three-tiered information propagation by supervised training and classifying of image patches, superpixels and 3D connected components. First, over-segmentation is obtained by employing the Simple Linear Iterative Clustering (SLIC) method. Second, a multi-level, multi-process feature extraction and classification framework is implemented that allows superpixel label maps to be projected back into the 3D volumetric space to obtain 3D segmentation. Numerous statistical and texture information features are utilized to describe pancreas or not on a patch level (i.e. 25x25 pixels) and superpixels-level (i.e. SLIC). The multi-phase feature extraction is coupled with random forest classifiers that are trained once on the patch level and in a two-level cascade on the superpixels level. Experiments were conducted using six-fold cross-validation. The pancreas was manually segmented by a radiologist for the reference standard.

RESULTS

The mean pancreatic volume was 59.2±30.1 cm3 for the reference standard. The total automated segmented pancreas volume was 66.1±43.9 cm3 (Figure), of which an average 41.6±25.4 cm3 corresponds to the true pancreas tissue when compared to the reference standard. The correlation coefficient between the automated pancreas segmentation and reference standard was 0.83. Dice (similarity) coefficient of 64.9%±22.6 was obtained in comparison to the state-of-the-art results of 58.2% ±20.0.

CONCLUSION

The proposed method shows promising automated segmentation results on one of the most challenging and unsolved radiology image processing problems. The highest similarity index was obtained compared to prior studies.

CLINICAL RELEVANCE/APPLICATION

Automated pancreas segmentation is challenging due to high variation in pancreas anatomy and volume. An important potential clinical application is pancreatic volume measurement in diabetic patients.

Assessment of Microcirculatory Characteristics in Bladder Cancer Stalks Using Pharmacokinetic Mapped DCE-MRI

Huyen Thanh Nguyen PhD (Presenter): Nothing to Disclose, Kamal S. Pohar MD: Nothing to Disclose, Amir Mortazavi MD: Nothing to Disclose, Zarine Ketul Shah MD: Nothing to Disclose, Debra Zynger MD: Nothing to Disclose, Michael Vinzenz Knopp MD, PhD: Nothing to Disclose, Guang Jia PhD: Nothing to Disclose, Daniel James Clark MS: Nothing to Disclose, Xiangyu Yang PhD: Nothing to Disclose

PURPOSE

To evaluate the microcirculatory characteristics of papillary bladder cancer stalks detectable on MR images using pharmacokinetic parameters of dynamic contrast-enhanced (DCE) imaging.

METHOD AND MATERIALS
Fifty patients with cystoscopy-proven bladder cancer were included in this study. All patients were scanned on a 3T MRI system (Achieva, Philips Healthcare) using a 32-channel phased-array surface coil. T2-weighted (T2W) MRI was performed prior to DCE-MRI. DCE-MRI data were processed on in-house IDL-based software to estimate two pharmacokinetic parameters (Amp, amplitude of signal enhancement and kep, the exchange rate between plasma and interstitial space). With a pre-determined number of three clusters, k-means clustering of the two parameters was performed on the tumors with a stalk shown on either T2W or DCE images to quantitatively and visually assess the microcirculatory properties of bladder cancer stalks.

RESULTS

7 out of 50 patients had a bladder tumor with a pedicle shown at the base of the tumor on either T2W or DCE images. Compared to the rest of a tumor, the tumor’s stalk showed a delayed signal enhancement on DCE images (Figure 1). Using k-means clustering of the two pharmacokinetic parameters, a bladder tumor was segmented into three clusters with different microcirculatory characteristics: cluster 1 contained voxels of low Amp (low micro-vascularity) and low kep (low permeability); cluster 2 had voxels of high Amp and low kep; and cluster 3 consisted of high Amp and low kep voxels. On cluster color maps, the stalk at the base of a tumor was composed of a majority of tissues with low Amp and low kep. Quantitatively, the volume fraction of cluster 1 in a stalk were 89±8 (%) while that of clusters 2 and 3 were 6±5 (%), 5±5 (%).

CONCLUSION

Quantitative and visual assessment with DCE-MRI pharmacokinetic parameters showed that the stalk in a bladder tumor was mainly consisted of tissues with low micro-vascularity (low Amp) and low permeability (low kep).

CLINICAL RELEVANCE/APPLICATION

The visualization of bladder tumor's stalk has been shown to be critical to the determination of stage T1 or lower in bladder cancer, which remains a challenge in bladder cancer staging. This study provides insights into the imaging characteristics that will improve diagnostic readability.

SST15

Vascular/Interventional (IR: Gynecologic/Female Interventions)

Scientific Papers

**Characterization of Arterial and Venous Vasculature Using the Bolus Width Derived from the Scale Information of the Wavelet Transform in Cerebral Perfusion CT**

Lukas Havla (Presenter): Nothing to Disclose, Kolja Thierfelder MD, MSc: Nothing to Disclose, Sebastian Ekkehard Beyer: Nothing to Disclose, Maximilian F. Reiser MD: Nothing to Disclose, Wieland H. Sommer MD: Nothing to Disclose, Olaf Dietrich PhD: Nothing to Disclose

CONCLUSION

Wavelet analysis is a powerful means for displaying angiographic data derived from dynamic CT perfusion acquisitions and for separating arterial and venous flow patterns.

Background

Color-coded time-to-peak information of time-attenuation curves allows differentiating arterial feeders and normal veins (C.M. Strother et al. AJNR 2010). We propose the application of a time-domain wavelet transform on time-resolved cerebral CT perfusion data to differentiate arterial and venous vessels based on the scale information of the wavelet power spectrum (i.e., on the bolus dilation).

Evaluation

8 patients with suspected stroke were examined at multi-detector CT systems acquiring 32 dynamic phases (temporal resolution: 1.5s) of 99 slices (total slab thickness 99mm) at 80kV/350mAs. Typically, 35mL of iomeprol-350 were injected at a flow rate of 4.5mL/s. After initial rigid-body motion correction, the ("Paul order 4") wavelet power spectrum for each pixel was calculated and its maximum value was defined as angiographic intensity; the scale value $S_{max}$ where this maximum occurred (normalized to the value in the carotid arteries) was defined as marker for differentiating arterial and venous vessels. $S_{max}$ was quantitatively evaluated in cerebral arteries (N=9, internal carotid/basilar/M1 middle cerebral/P1 posterior cerebral/M2 middle cerebral) and sinuses (N=5, sagittal/transverse/sigmoid) and compared to the time-to-peak $T_{TTP}$ parameter derived from CT perfusion data (after subtracting the time until bolus arrival in the carotid arteries). Mean (±standard deviation) normalized scale values were $S_{max}$ arterial=1.00(±0.02) and $S_{max}$ venous=1.22(±0.15) differing significantly (Mann-Whitney test p<0.0001); $T_{TTP}$ arterial yielded 0.16(±0.54)s and $T_{TTP}$ venous 4.84(±2.43)s (p<0.0001).

Discussion

Our results show that bolus dilation during the passage through the vascular tree is sensitively mapped by the wavelet scale parameter; thus providing a new supplementary parameter for the separation of arteries and veins in addition to the time-to-peak information. This information might be used to improve the suppression of venous superposition in angiographic data or to color-code arterial and venous vessels.
**Purpose**

To evaluate the effect of the degree of necrosis in patients with adenomyosis after uterine artery embolization (UAE) on symptom recurrence at mid-term clinical follow-up.

**Method and Materials**

Fifty patients who underwent UAE for symptomatic adenomyosis were retrospectively analyzed. All patients underwent contrast-enhanced magnetic resonance imaging (MRI) at baseline and 3 months after UAE, and were followed up clinically for at least 18 months. The embolic agent contained non-spherical polyvinyl alcohol particles. The percentage of necrosis was measured at the 3-month follow-up MRI using Aquarius iNtuition® software. Patients were divided into 3 groups according to the percentage of necrosis: group A (90-100%, n = 35), group B (10-89%, n = 7), and group C (0-9%, n = 8). The clinical recurrence was compared among groups for up to 48 months. The cut-off percentage of necrosis to predict clinical recurrence was estimated.

**Results**

Among the 50 patients, 25 patients had focal adenomyosis and 25 patients had diffuse adenomyosis. The cumulative rates of symptom recurrence at 4 years were 14.3%, 14.3%, and 75% in groups A, B, and C, respectively. Group A had a significantly longer median recurrence-free time than group C (42.18 months vs. 12.88 months; p < 0.001). No significant difference in the recurrence-free time was noted between groups A and B (42.18 months vs. 41.50 months; p = 0.933). The hazard ratio for symptom recurrence between groups A and C was 16.7 (95% confidence interval [CI]: 4.24, 65.34; p >0.001). There was no significant difference in the hazard ratio for symptom recurrence between groups A and B (hazard ratio, 1.1; 95% CI: 0.13-9.37; p = 0.935). The cut-off point percentage of necrosis to predict symptom recurrence was estimated at 34.3% (sensitivity, 0.58 [95% CI: 0.28-0.85]; specificity, 0.87 [95% CI: 0.72-0.96]; area under the curve 0.721).

**Conclusion**

The percentage of necrosis in patients with adenomyosis after UAE may predict symptom recurrence at the mid-term follow-up. The cut-off percentage of necrosis to predict symptom recurrence was 34.3%, with 58.4% sensitivity and 86.8% specificity.

**Clinical Relevance/Application**

Necrosis of adenomyosis after UAE is mandatory for durability. The percentage of necrosis of adenomyosis may predict symptom recurrence at the mid-term follow-up.
RESULTS
Of the included 43 patients; post-embolization endometrial and myometrial ischemia was encountered in 29 patients (incidence = 67.44%). In all cases the ischemic region was seen as a newly developed irregular centrally located region of absent enhancement involving both the endometrium and myometrium. The mean volume of the ischemic region immediately after UAE was 29.29 ml +/- 19.15 (Range: 7.36 - 87.71 ml). At 3 month follow-up it was 0.35 ml +/- 0.95 (Range: 0 - 3.5 ml) with 25 (86%) patients showing complete resolution of the ischemia. The mean reduction in the volume of the ischemic region at 3 month follow-up was 98.24% +/- 5.72 (Range: 72 - 100%). A statistically significant reduction in the volume of the endometrial and myometrial ischemia was noted (p < 0.0001).

CONCLUSION
Endometrial and myometrial ischemic regions as a form of none target embolization following UAE might be encountered in up to two thirds of patients in the form of irregular centrally located regions of absent enhancement. These ischemic areas are significantly reduced at 3 month follow-up with up to 86% of cases showing completely reversibility of the ischemia.

CLINICAL RELEVANCE/APPLICATION
The post-embolization ischemia of the endometrium and myometrium is not a rare encounter following uterine artery embolization with excellent outcome and complete reversibility in up to 86% of cases.

SST15-03
Normalized Relative Contrast May Improve the Power of Contrast-Enhanced MRI to Predict the Prognosis of Uterine Leiomyoma Treated with Uterine Artery Embolization
Kejia Cai PhD (Presenter): Nothing to Disclose, Karen Xie DO: Nothing to Disclose, Jillian A. Karow MD: Nothing to Disclose, Lauren Green MD: Nothing to Disclose, Alison Palumbo MD: Nothing to Disclose, Xiaohong Joe Zhou PhD: Nothing to Disclose, Grace Knutinen: Nothing to Disclose

PURPOSE
Uterine artery embolization (UAE) has emerged to be an effective treatment option for women with symptomatic uterine leiomyomas. Factors to predict treatment outcome before UAE is critical for patient selection, procedure planning and postprocedural follow up. Previous studies using MRI have shown variable correlations between MRI predictors and the responses to UAE. Our study is to investigate whether tumor MR contrast normalized to surrounding normal myometrium, the relative contrast, may predict the fibroid response to UAE given that both MR contrast enhancement and UAE are related to tumor vascularization.

METHOD AND MATERIALS
The study was performed under an approved IRB protocol. Eight patients (cumulative tumor number n = 42) completed pre and 3-6 moths post treatment contrast-enhanced MRI of pelvis at 3T using a fat-suppressed 3D gradient-echo T1-weighted sequence pre and post administration of Gadolinium (0.01 mmol/kg). 100 -200 axial slices were acquired with a slice thickness of 5mm,TR/TE=5.2/2.5 ms, and in-plane resolution less than 1 x 1 mm2. Tumor relative contrast and contrast to noise ratio (CNR) were quantified. Two-tailed unpaired Student’s t tests were performed and a significance level was set at p<0.05.

RESULTS
After UAE treatment, 33/42 leiomyomas were found to be completely necrotic and considered to be fully responsive (group A). The remaining 9/42 leiomyomas showed partial or no necrosis, considered to be partial responsive or nonresponsive (group B). Group A exhibited significantly higher relative contrast than group B (1.6±0.4 vs. 1.0±0.4, *p<0.05). While, the conventional CNRs of these two groups were not significantly different (74.2±24.8 vs. 64.6±38.6, p=0.34). Using an optimum threshold of 1.3, pre-UAE tumor relative contrast correctly predicted 7/9 not-fully responsive tumors and 30/33 fully responsive tumors. On the other hand, tumor CNR correctly predicted 7/9 not-fully responsive tumors while only 22/33 fully responsive tumors at its optimum threshold of 70.

CONCLUSION
With a limited sample size, we demonstrated that pre-UAE highly enhanced leiomyomas were found more likely to have poor response to UAE presumably due to the presence of complex tumor vasculature, including existing collateral supplies in the poorly responsive tumors.

CLINICAL RELEVANCE/APPLICATION
Upon further validation, pre-UAE normalized relative contrast may help to predict UAE treatment outcome of leiomyomas.

SST15-04
MR-Imaging Immediately after Uterine Artery Embolization: Post-embolization Leiomyoma Enhancement Patterns and Their Effect on the Leiomyoma Volume Change at Follow-up
Nagy Naguib Naeem Naguib MD, MSc (Presenter): Nothing to Disclose, Nour-Eldin Abdelrehim Nour-Eldin MD, MSc: Nothing to Disclose, Tatjana Gruber-Rouh: Nothing to Disclose, Thomas Lehnert MD: Nothing to Disclose, Renate Maria Hammerstingl MD: Nothing to Disclose, Stefan Zangos MD: Nothing to Disclose, Thomas Josef Vogl MD, PhD: Nothing to Disclose

PURPOSE
To study the different post-embolization leiomyoma enhancement patterns on MRI and to test if the enhancement pattern correlates with the leiomyoma volume change at 3 month follow-up after successful uterine artery embolization (UAE), enabling its use as one of the parameters predicting embolization outcome.

**METHOD AND MATERIALS**

The study was retrospectively performed on 40 females (Age Range: 33-55 years, Mean: 45.6 +/- 4.48). MRI was performed immediately after UAE (within 6 hours) and the pattern of enhancement of the individual leiomyomas was identified. We identified 5 patterns of enhancement: total absence of enhancement (total devascularization), focal mural enhancement (subtotal devascularization), combined large areas of none enhancement and enhancement (partial devascularization), heterogeneous or mottled enhancement (inadequate devascularization) and homogenous enhancement (failed devascularization). Overall 116 leiomyomas were evaluated. The volume of each leiomyoma was calculated before and 3 months after UAE using contrast-enhanced MRI. Correlation was tested using Spearman Rank and analysis of variance (ANOVA) tests.

**RESULTS**

Before UAE the mean leiomyoma volume was 67.37 ml +/- 128.3 (Range: 1.33-987.34 ml). At 3 month follow-up the mean leiomyoma volume was 45.67 ml +/- 107.25 (Range: 0.15-875.05). The mean volume change percentage after 3 months was 50.81% [volume reduction] +/- 27.49 (Range: 40.05% [increase] - 96.97% [reduction]). Total devascularization was encountered in 73 leiomyomas and showed a mean volume reduction of 64.48%, subtotal devascularization (n=15) with 51.93% reduction, partial devascularization (n=8) with 31.95% reduction, inadequate devascularization (n=16) with 14.05% reduction and failed devascularization (n=4) with 18.12% volume increase. A statistically significant (p<0.0001) substantial correlation (rho= -0.7) between the post-embolization leiomyoma enhancement pattern and the percentage of volume change at 3 month follow-up was noted.

**CONCLUSION**

Five different patterns of leiomyoma enhancements can be encountered following UAE. A statistically significant substantial correlation was detected between the post-embolization leiomyoma enhancement pattern and the 3 month follow-up volume change.

**CLINICAL RELEVANCE/APPLICATION**

The post-embolization pattern of leiomyoma enhancement can predict the percentage of leiomyoma volume change at 3 month follow-up with total absent enhancement showing the most favorable results.

---

**SST15-05**

**Prediction of Early Response to Uterine Artery Embolization in Fibroids: Value of MR Signal Intensity Ratio**

Yoshifumi Noda MD : Nothing to Disclose, Satoshi Goshima MD, PhD : Nothing to Disclose, Akiko Kato MD (Presenter): Nothing to Disclose, Hiroshi Kawada MD : Nothing to Disclose, Nobuyuki Kawai MD : Nothing to Disclose, Yukichi Tanahashi MD : Nothing to Disclose, Masayuki Kanematsu MD : Nothing to Disclose

**PURPOSE**

To assess magnetic resonance (MR) imaging findings that help predict early post-therapeutic response in uterine fibroids following uterine artery embolization (UAE).

**METHOD AND MATERIALS**

This retrospective study was approved by our institutional review board and written informed consent was waived. Fifteen patients with a total of 52 symptomatic uterine fibroids underwent UAE. Pelvic MR imaging was performed 1 month before and 3 months after UAE. The signal intensity ratio (SIR) was calculated by dividing the mean signal intensity of uterine fibroids by that of the abdominal rectus muscle. Changes in volume of each fibroid pre- and post-UAE were computed. Fibroids were divided into the two groups: affected (post-UAE volume reduction rate > median of all fibroids) and unaffected (< median rate). The SIRs were compared between the two groups. Multiple regression analysis was performed for the imaging predictors associated with the volume reduction rate. ROC analysis was used to evaluate the predictive performance for differentiating the affected from unaffected lesions.

**RESULTS**

The SIRs of the affected group were significantly lower on T1-weighted images (P = 0.0001), but higher on the gadolinium-enhanced images (P = 0.0002) than those of the unaffected group. The sensitivity, specificity, and area under the ROC curve (AUC) in the prediction of the affected lesions were 92%, 50%, and 0.712 with SIR on T1-weighted images, and 85%, 62%, and 0.731 with SIR on gadolinium-enhanced images, respectively. No significant difference in sensitivity, specificity, or AUC was found between these two sequences.

**CONCLUSION**

The SIRs on T1-weighted images and gadolinium-enhanced images were useful for the prediction of the changes in size of uterine fibroids responding to UAE.

**CLINICAL RELEVANCE/APPLICATION**
Our study demonstrated the possibility of the prediction of the therapeutic response to UAE even with non-contrast MR imaging.

**SST15-06**

**Screening MRI-based Prediction Model for Therapeutic Response of MR-HIFU Ablation of Uterine Fibroids**

Young-Sun Kim MD (Presenter): Nothing to Disclose, Hyo Keun Lim MD: Nothing to Disclose, Hyunchul Rhim MD, PhD: Nothing to Disclose

**PURPOSE**

To generate screening MRI-based prediction model for therapeutic responses of MR-guided high-intensity focused ultrasound (MR-HIFU) ablation of uterine fibroids

**METHOD AND MATERIALS**

A total of 160 symptomatic uterine fibroids (diameter 8.3cm, range 3.1-15.0cm) in 112 women (age 43.3, range 25-55) who were treated with MR-HIFU ablation were retrospectively analyzed. The following three parameters of screening MRI were evaluated. 1) Subcutaneous fat was measured as a thickness of the most compressed point (mm) on prone position. 2) Relative peak enhancement (%) was calculated based on time-signal intensity curve analysis of fibroid in perfusion MRI (100 dynamics, 3s time resolution), in which 0% refers the same signal intensity as in precontrast image. 3) Signal intensity was assessed as a ratio of T2 signal intensity of uterine fibroids to that of skeletal muscle. Those parameters were used to generate prediction models with regards to ablation efficiency (i.e., non-perfused volume/treatment cell volume) and ablation quality (grade 1-5, from poor to excellent), respectively, using generalized estimating equation (GEE) analysis. Then, cut-off values for successful treatment (ablation efficiency >1.0; ablation quality grade 4 or 5) were determined based on receiver operating characteristic (ROC) curve analyses.

**RESULTS**

GEE analyses produced the models of 

\[ y_1 = 2.2637 - 0.0415x_1 - 0.0011x_2 - 0.0772x_3 \]  

and  

\[ y_2 = 6.8148 - 0.1070x_1 - 0.0050x_2 - 0.2163x_3 \]  

where  

\[ y_1 = \text{ablation efficiency}, \quad y_2 = \text{ablation quality}, \quad x_1 = \text{subcutaneous fat thickness}, \quad x_2 = \text{relative peak enhancement}, \quad x_3 = \text{T2 signal intensity ratio} \]  

(p-values for  

\[ x_1: 0.0068 < 0.0001; \quad x_2: 0.1952 \quad \text{and} \quad 0.0001; \quad x_3: <0.0001 \quad \text{and} \quad <0.0001, \text{respectively}.) \]

Cut-off values for successful treatments based on ROC curve analyses turned out to be 1.312 for of ablation efficiency (AUC, .7236; sensitivity, .6882; specificity, .6866) and 4.019 for ablation quality (AUC, .8794; sensitivity, .7156; specificity, .9020).

**CONCLUSION**

Simple equation models to predict therapeutic responses of MR- HIFU ablation of uterine fibroids in terms of ablation efficiency and quality were generated, which are easily applicable to screening MRI.

**CLINICAL RELEVANCE/APPLICATION**

With regards to MR- HIFU ablation of uterine fibroids, there have been no screening MR criteria that comprehensively consider multiple influencing factors. These prediction models would contribute to reducing the risk of unsuccessful, thus wasteful procedures.

**SST15-07**

**Postpartum Hemorrhage from Extravasation or Pseudoaneurysm: Efficacy of Transcatheter Arterial Embolization Using N-butyl-2-cyanoacrylate**

Kye Jin Park MD (Presenter): Nothing to Disclose, Ji Hoon Shin MD: Nothing to Disclose

**PURPOSE**

To evaluate the safety and effectiveness of transcatheter arterial embolization (TAE) using N-butyl-2-cyanoacrylate (NBCA) for the treatment of active postpartum hemorrhage (PPH).

**METHOD AND MATERIALS**

From January 2004 to August 2013, 26 patients underwent TAE using NBCA for PPH. All of these patients were in an active bleeding state and seven patients (26.9%) were in a coagulopathic condition. Two patients underwent a second session of TAE due to the failed first TAE using a gelatin sponge. Their angiograms and medical records were retrospectively reviewed in order to obtain the patients' baseline characteristics, technical/clinical success information, and follow-up data regarding menstruation and fertility.

**RESULTS**

Angiograms demonstrated pseudoaneurysm, extravasation or artery cut-off, and NBCA was used as the primary (n=24) or a complimentary (n=2) embolic material. The technical and clinical success rates were 100% and 92.3% (24/26), respectively. Two patients with persistent bleeding after TAE with NBCA (clinical failure) were among the three patients with an overt DIC condition. One of them recovered through conservative management, while another patient died due to multi-organ dysfunction. Two patients who underwent two sessions of TAE failed to regain their normal menstruation, while three patients experienced successful deliveries after TAE.

**CONCLUSION**
TAE using NBCA as the primary or a complimentary embolic agent is an effective method for treating PPH with extravasation and/or a pseudoaneurysm. Overt DIC and its corresponding clinical situations could not be compensated for with the use of NBCA. Repeated TAE with NBCA could result in uterine dysfunction and amenorrhea.

**CLINICAL RELEVANCE/APPLICATION**

Transarterial embolization using NBCA can be an effective method for treating postpartum hemorrhage and be recommended when a pseudoaneurysm or active extravasation is uncontrolled despite using conventional embolic material.

**SST15-08**

**Prophylactic Internal Iliac Balloon Placement prior to Caesarean Section In Patients with Placenta Accreta – Maternal & Foetal Outcomes**

Patrick Nicholson MBBCh (Presenter): Nothing to disclose, Karl James MBBCh, MRCS: Nothing to disclose, Jennifer Murphy MBBCh, MRCP: Nothing to disclose, John Gerard Buckley MD: Nothing to disclose, Liam Dominic Spence MBBCh: Nothing to disclose, David James Tuite MBBCh: Nothing to disclose

**PURPOSE**

The incidence of abnormal placental implantation has been increasing steadily over recent years. The most serious clinical consequence is massive obstetric haemorrhage. Hysterectomy is commonly required to control such bleeding. In our institution, we prophylactically place internal iliac balloons in these patients, before an elective caesarean section. Following delivery, these are then inflated if needed to allow the obstetrician to gain control of the hemorrhage. We sought to to retrospectively assess both maternal and foetal outcomes from this procedure in our unit.

**METHOD AND MATERIALS**

A retrospective chart review of all patients with abnormal placentaion who underwent prophylactic internal iliac balloon placement prior to elective caesarean section.

**RESULTS**

Over a 44-month period, 21 patients with placenta accreta or a variant thereof underwent caesarean section after first undergoing prophylactic placement of bilateral internal artery balloons. Technical success was achieved in 100%. The average gestational age was 37 weeks 6 days, and mean gravidity was 2.8. Mean number of previous caesarean sections was 2.4, while mean maternal age was 35 years. The mean intraoperative blood loss was 1.4 litres, and the mean number of blood units transfused was 2. Mean duration of surgery was 90 minutes, mean total length of hospital stay 7.5 days, while the mean duration of ICU/HDU stay was 1.2 days. The balloons were inflated in 80% of cases, and no patient underwent subsequent hysterectomy. There were no early or delayed maternal complications due to the procedure. A total of 23 live infants were delivered. Mean infant Apgar scores at 1 and 10 minutes were 8.9 and 9.6 respectively. There were umbilical cord pH values available in 11 of the cases - median cord pH was 7.27. None of the infants developed complications which could be attributed to maternal iliac balloon placement.

**CONCLUSION**

Prophylactic placement of arterial balloons prior to caesarean section in patients with placenta accreta is technically feasible, well tolerated and leads to satisfactory maternal and foetal outcomes with minimal complications.

**CLINICAL RELEVANCE/APPLICATION**

Prophylactic internal iliac balloon placement is a potentially life-saving, fertility preserving procedure which is safe for both mother and baby, and highlights the role of the interventional radiologist in the multidisciplinary management of these patients.

**SST15-09**

**Effectiveness of Intraoperative Ultrasound Guidance in Certain Gynecologic Procedures in High Risk Patients**

Duan Li MD (Presenter): Nothing to disclose, Debra M. Sarasohn MD: Nothing to disclose, Ariadne Maria Bach MD: Nothing to disclose

**PURPOSE**

This study evaluates the effectiveness of intraoperative ultrasound guidance in certain gynecologic procedures among high risk patients.

**METHOD AND MATERIALS**

A retrospective analysis of data collected from a tertiary cancer center was performed. A total of 101 consecutive patients who underwent gynecologic procedures with intraoperative ultrasound guidance from 1999 to 2013 were included. The procedures included D&C, polypectomy, cone biopsy, IUD retrieval, and placement of intracavitary brachytherapy seeds. All intraoperative ultrasound exams were correlated with surgical pathology results. The following information was assessed: successful access to the endometrial cavity, adequate tissue sampling, and complications including bleeding and perforation.

**RESULTS**

Of 101 patients who underwent gynecologic procedures in the operating room with intraoperative ultrasound guidance, 75 patients previously had unsuccessful procedures in clinic. The failure in clinic was due to
significant cervical stenosis caused by either trachelectomy for cervical cancer or pelvic radiation therapy for anal cancer. Among these 75 patients, 12 were diagnosed with endometrial polyps on imaging prior to the OR procedure. Of the 26 patients who went directly to the operating room, eight patients had GTD with increased HCG levels; six had partial or complete molar pregnancies; six required placement of intracavitary brachytherapy seeds; three had bicornuate uterus; two had IUDs in place for more than 40 years (in one of these two patients, the IUD device had deeply penetrated into the myometrium); and in one patient minimal cervical tissue remained after cone biopsy in clinic, making image-guided cervical tissue sampling essential to avoid perforation. In five of the 101 cases, intraoperative ultrasound guidance failed to provide access to the endometrial cavity. The overall success rate was thus 95%. In two cases, the peritoneal cavity was penetrated. However, in no cases was the uterus perforated.

**CONCLUSION**

The use of intraoperative ultrasound guidance for certain gynecologic procedures in high risk patients can increase the success rate of accessing the endometrial cavity and decrease complications.

**CLINICAL RELEVANCE/APPLICATION**

provide intraoperatively image guidance for gynecologic surgeon in high risk patients

---

**SST16**

**Vascular/Interventional (IR: GI and Hepatobiliary Interventions)**

**Scientific Papers**

IR VA GI

AMA PRA Category 1 Credits ™: 1.50

ARRT Category A+ Credits: 1.50

Fri, Dec 5 10:30 AM - 12:00 PM  Location: E352

**Participants**

Moderator
Albert A. Nemcek MD : Consultant, B. Braun Melsungen AG

Moderator
Wael E. A. Saad MBCh : Research Grant, Siemens AG Research Consultant, Siemens AG Consultant, Boston Scientific
Corporation Consultant, Getinge AB Consultant, Merit Medical Systems, Inc

**Sub-Events**

SST16-01  **When to Stent? Colonic Stenting – A Six Year Retrospective Review**

**Presenters**
Sarah Eljamel MBChB (Presenter): Nothing to Disclose, Derek AJ Smith MBChB : Nothing to Disclose, Domenyk Brown MBChB : Nothing to Disclose, Hugh M. Paterson : Nothing to Disclose

**PURPOSE**

- To determine the success rate of colonic stenting (CS) and describe positive/negative factors predictive of successful deployment.
- To determine the complication rate of colonic stenting and describe these encountered in the early and late phase.
- To define the average survival and stent patency/intervention free period in patients with inoperable metastatic disease (M1) and determine when palliative surgery may be preferable to CS.

**METHOD AND MATERIALS**

All patients undergoing CS between November 2007 and October 2013 were identified from the departmental radiology electronic database. Clinical data was obtained from retrospective casenote review.

**RESULTS**

178 colonic stents were deployed in 165 patients. 143 patients had primary colonic malignancy, 102 of these had M1 disease at presentation. 41 patients were considered unfit for surgery or refused surgical intervention. Technical success rate was 81.6%. Univariate factors predictive of success were: position of obstruction (left/right) (p-value <0.01), degree of obstruction (complete obstruction/stricture) (p-value 0.09) and presentation type (elective/emergency) (p-value 0.49). Early complications (within 7 days): perforation (1.8%), stent migration (1.2%) and technical failure (1.8%). Late complications (within follow-up period): perforation (5.6%) and stent migration (3.6%) 17 patients represented with obstruction secondary to tumour ingrowth (10.3%). 8 were managed by further stenting (100% technical success). 2 had laser therapy to unblock stent. 7 underwent surgery. Median primary stent patency (to first intervention) is 558 days by Kaplan-Meier survival analysis. In M1 and M1 chemotherapy, estimated median primary stent patency is 555 days and 315 days respectively with a median patient survival of 139 days and 224 days.

**CONCLUSION**

CS is proven to be a viable option in the relief of colorectal obstruction. Ideal candidates have metastatic colorectal disease with a left colonic stricture. In patients with inoperable metastatic colorectal cancer; stenting provides effective, minimally invasive, long-term management in the palliation of colonic obstruction, with stent patency rates often exceeding patient survival.
Technical and Clinical Outcomes of Colorectal Stenting in Large Bowel Obstruction

James Henry Briggs MBChB, FRCR: Nothing to Disclose, Thomas Oakley MBBS, MA (Presenter): Nothing to Disclose, Mark William Little MBBS, MSC: Nothing to Disclose, Joe Benson Woodhouse MBBS: Nothing to Disclose, Shaheen Dixon MBBS, FRCR: Nothing to Disclose, Raman Uberoi MBChB, FRCR: Nothing to Disclose

PURPOSE
The aims of this study are to determine anatomical and clinical factors which affect outcome following stenting for large bowel obstruction, allowing improved treatment selection for patients.

METHOD AND MATERIALS
Retrospective review of all colonic stents placed in our institution between February 2006 and December 2013 was undertaken. This yielded 271 stents placed in 249 patients. Radiological and medical records were examined and a wide range of data collected, including patient demographics, nature, location and length of stricture, duration of symptoms, technical and clinical success, complication and 30 day mortality.

RESULTS
Technical and clinical success were 80.1% and 68.3% respectively. Clinical success was significantly lower in strictures longer than 5cm (53.4% vs 71.3%, p=0.0216). Clinical success was also lower in lesions at anatomical flexures (59.6% vs 75.6%, p=0.0096). A longer duration of symptoms (more than one week) was associated with lower technical success (69.2% vs 85.4%, p=0.0086). Overall complication rate was 27.1% (17.2% perforations, 6.6% stent migration and re-occlusion in 3.3%) and in line with other series. Analysis of the cases with perforation showed that only half of the perforations were related to stent placement. There was a non statistically significant trend toward increased perforation rate in benign strictures over malignant (2.8% vs 11.1%, p=0.0802). No significant trends relating to patient age or 30 day mortality were shown. The length and site of stricture were not shown to be related to complication rate.

CONCLUSION
This study represents the largest published series of colonic stents to date. It has identified statistically significant trends in clinical success and lesion length and location, with lower technical success in patients with symptoms for longer than one week. These findings should be taken into account when choosing a treatment strategy for patients presenting with large bowel obstruction to optimise technical and clinical outcomes.

CLINICAL RELEVANCE/APPLICATION
Limited quality evidence exists around colonic stenting for bowel obstruction. The current study represents that largest single cohort of patients undergoing stenting for large bowel obstruction to date. We have identified patient, clinical and anatomical factors to stratify risk and predict outcomes. We present new evidence to refine decision making in relation to the management of colonic obstruction.

A Percutaneous Transhepatic Cholangiography Needle Prototype That Utilizes the Unique Electrical Conductivity of Bile to Alert the Operator That the Needle Tip Has Entered a Bile Duct

Hersh Desai: Nothing to Disclose, ravi mahadevan: Nothing to Disclose, Jackson Bruce Morton BS: Nothing to Disclose, Matt Nagle: Nothing to Disclose, Mark Palmeri MD, PhD: Nothing to Disclose, Paul Vincent Suhocki MD (Presenter): Nothing to Disclose

PURPOSE
Percutaneous cholangiography technique has changed little over the decades and is associated with prolonged fluoroscopy times. The purpose of this research was to develop a needle prototype that would reduce procedure time and, therefore, radiation exposure to the patient and operator.

METHOD AND MATERIALS
The needle prototype was created from an 18 gauge needle shaft and a 20 gauge stylet, separated by an insulating layer of non-conductive polyurethane and glue. Current travels from the tip of the 18 gauge needle shaft, across surrounding fluid and into the stylet tip. The needle functions as a leg of a Wheatstone Bridge, with the fluid at the needle tip acting as a variable resistor. It utilizes a BeagleBone Black microprocessor for its software computational needs. The BeagleBone Black stores a Python based code. Battery, circuit and microprocessor are housed inside a box equipped with USB and HDMI outputs for data display. The output is compatible with most medical display monitors and continuously updates output voltage values. The needle was tested in-vitro, using salt and deionized water solutions of differing electrical conductivities matching those of blood, bile and liver.

RESULTS
This needle prototype successfully transduced changes in relative electrical conductivity in fluids surrounding the needle tip. It accurately detected entry of the needle tip into a salt solution that has the same conductive properties as bile. In the range of biologically relevant conductivities, generally below 2 S/m, the response of the system allowed for differentiation between the electrical conductivities of bile, blood and liver tissue.

CONCLUSION
This percutaneous cholangiography needle prototype utilizes the unique electrical conductivity properties of bile to alert the operator that the needle tip has entered a bile duct. Further testing in animal models will be
necessary before determining its clinical utility for this and other applications.

**CLINICAL RELEVANCE/APPLICATION**

This needle prototype can reduce radiation exposure associated with percutaneous transhepatic cholangiography by eliminating the need for fluoroscopy during much of the procedure. This technology shows potential for use in other medical procedures as well, utilizing the unique electrical conductivities of body fluids not discussed here.

**SST16-04**

**Primary Hepatic Arterial Stenting in Patients after Liver Transplantation: 1 Year Patency Rates and Long Term Clinical Outcomes**

Ammar Sarwar MD (Presenter): Nothing to Disclose, Ian Martin Brennan MBChB, BMedSc: Nothing to Disclose, Olga Rachel Brook MD: Research Grant, Guerbet SA, Felipe Bircal Collares MD: Nothing to Disclose, Salitaao Faintuch MD: Nothing to Disclose, Barry A. Sacks MD: Nothing to Disclose, Muneeb Ahmed MD: Nothing to Disclose

**PURPOSE**

To determine clinical outcome in patients who underwent primary stent placement for hepatic artery (HA) stenosis after liver transplantation.

**METHOD AND MATERIALS**

A retrospective review of all adult liver transplant patients needing HA stent (2003-2013) was performed. All imaging studies and clinical outcomes were recorded. Primary clinical outcomes (mortality, graft dysfunction) were assessed. As a secondary endpoint, primary patency was assessed using available imaging at 1 month and 1 year.

**RESULTS**

20 pts (mean age: 54±11y, 10 male) fit inclusion criteria and had 26 HA stents, (mean 185±213 days (d)) after transplant. Overall, 20/26 stents in 16/20 patients were patent within the time period reviewed. Clinical follow-up was available in 18/20 patients (Mean 1173±1014d). Two patients were alive with no graft dysfunction but lost to follow-up at 1323 and 1742 days. Overall mortality was 77% (14/18). Graft dysfunction related mortality was 0%. Re-transplantation related to HA stenosis was needed in 1 patient who required 3 separate stents. In patients with at least 2 years (n=15) and 5 year clinical follow-up (n=4), none had HA-related graft dysfunction or HA-related mortality. Of the 5 patients with less than 2 year clinical follow-up, 1 required re-transplantation due to HA thrombosis and 2 died due to non-graft dysfunction related causes. At least 1 year imaging follow-up was available in 24/26 stents. Primary patency was 96% at 30 days and 75% at 1 year. Primary assisted patency was 79% at 1 year. In 3 patients with hepatic arterial occlusion on imaging, one needed re-transplantation (occlusion 14 days post-stenting) and two are doing well with no graft dysfunction (occlusion 44 days and 728 days post-stenting).

**CONCLUSION**

Primary stenting for HA stenosis has very good clinical outcomes and high primary patency rates. Late occlusions (>30d) do not necessarily lead to graft dysfunction.

**CLINICAL RELEVANCE/APPLICATION**

Hepatic arterial stenosis is an uncommon complication after liver transplantation. Successful percutaneous therapy with good long term outcomes may preclude need for surgical revision.

**SST16-05**

**Survival Benefit of TIPS in Patients with Refractory Ascites: A Single Institution Case-Control Analysis**

Ahmad Parvinian MD (Presenter): Nothing to Disclose, Leigh Casadaban BS: Research Grant, Guerbet SA, Jeet Minocha MD: Nothing to Disclose, Martha-Gracia Knuttinen MD, PhD: Nothing to Disclose, James Thuan Bui MD: Nothing to Disclose, Charles E. Ray MD, PhD: Nothing to Disclose, Ron Charles Gaba MD: Nothing to Disclose

**PURPOSE**

Ascites is a leading cause of morbidity and mortality among cirrhotic patients: it occurs in 50% within 10 years of diagnosis and becomes medically refractory in 5-10%, which entails a 1-year mortality rate of up to 50%. Transjugular intrahepatic portosystemic shunt (TIPS) is a safe and effective treatment for ascites secondary to portal hypertension. While the benefits of this procedure are well documented, data regarding the effect of TIPS on survival remain unproven. To that end, this study aims to quantify the impact of TIPS creation on survival in the setting of ascites.

**METHOD AND MATERIALS**

In this single-institution retrospective study, 79 patients who underwent TIPS for refractory ascites from 2001-2014 were compared with a cohort of 80 patients with refractory or recidivant ascites due to decompensated liver disease who underwent serial paracentesis procedures during the same period. Data pertaining to demographic and liver disease characteristics, Model for End Stage Liver Disease (MELD) scores, and survival outcomes were obtained from electronic medical record review and the social security death index. Survival outcomes were analyzed using Kaplan-Meier statistics with log-rank comparison.

**RESULTS**

The TIPS cohort comprised 56 men and 23 women (mean age 54 years, mean MELD 15); the no-TIPS cohort comprised 46 men and 34 women (mean age 54 years, mean MELD 22.5). Survival was enhanced with TIPS:
median survival was 1100±371 days in the TIPS cohort and 262±121 days in the no-TIPS cohort (P=0.021). Median survival among patients with MELD scores ≤18 was 1219±436 days versus 262±77 days (P=0.01) in the TIPS versus no-TIPS cohorts, respectively. Survival was similar in patients with MELD >18 (13.2% versus 12.5%, P=1.0) or 90 days (21.1% versus 28.8% P=0.58), indicating short-term procedure safety.

CONCLUSION

TIPS creation enhances long-term survival without significantly impacting short-term mortality in patients with ascites.

CLINICAL RELEVANCE/APPLICATION

TIPS imparts a quantifiable survival benefit on patients with ascites. A precise understanding of this benefit may aid in temporal optimization of TIPS allocation as a bridge to definitive therapy.

SST16-06

Migration of Retrievable, Expandable Metallic Stents Inserted for Malignant Esophageal Strictures: Incidence, Management, and Prognostic Factors in 332 Patients

Wei-Zhong Zhou (Presenter): Nothing to Disclose, Ho-Young Song MD : Nothing to Disclose, Jung-Hoon Park MS, RT : Nothing to Disclose, Ji Hoon Shin MD : Nothing to Disclose, Jin Hyoung Kim MD : Nothing to Disclose, Young Chul Cho BS : Nothing to Disclose, Jong Kun Jang : Nothing to Disclose, Eun Jung Jun PhD : Nothing to Disclose

PURPOSE

Focused on evaluating the factors that influence stent migration following placement of single design stent was not previously reported. The purpose of this study was to evaluate the incidence, prognostic factors, and secondary management of stent migration in patients with malignant esophageal strictures.

METHOD AND MATERIALS

A retrospective cohort study was performed in a single, tertiary-referral, university hospital to identify the incidence, management, and prognostic factors for stent migration in 332 consecutive patients with placement of a retrievable, expandable, metallic stent for malignant esophageal strictures. Stent migration was classified into four patterns as locations of a migrated stent when migrated stents were detected. A multivariate logistic regression model was used to identify the independent predictive factors associated with stent migration.

RESULTS

Stent migration occurred in 42 (12.6%) of 332 patients. Migration was partial (n=21) or complete (n=21), and nine, 12, 11, and 10 patients had patterns I, II, III, and IV, respectively. Multivariate analysis identified the following prognostic factors: esophagogastic junction strictures caused by cancer of the gastric cardia (OR, 3.330; 95% CI, 0.156-9.698; p = 0.004), patients who underwent anti-cancer treatment after stent placement (OR, 17.514; 95% CI, 7.094-43.235; p < 0.001), and patients with a longer survival time (OR, 2.994; 95% CI, 0.991-7.996; p < 0.001). Secondary management was needed for 33/42 (79%) patients. The strictures in the remaining nine patients improved throughout the follow-up.

CONCLUSION

Stent migration occurs most commonly in patients with cancer of the gastric cardia, longer survival time and who underwent anti-cancer treatment following stent placement. Stent migration is successfully managed by further intervention.

CLINICAL RELEVANCE/APPLICATION

Accurate knowledge of the pattern of stent migration is important for its successful management.

SST16-07

Approach of Image-Fusion from Pre-procedural Computed Tomography Angiography in an Interventional Vascular Procedure: The Portal Vein Puncture during Transjugular Intrahepatic Portosystemic Shunt (TIPS)

Karim Rouabah (Presenter): Nothing to Disclose, Jean-Marie Caporossi : Nothing to Disclose, Guillaume Louis MD : Nothing to Disclose, Alexis Jacquier MD : Research Grant, Groupe DANONE SA Research Grant, Merck & Co, Inc Consultant; General Electric Company Travel support, Siemens AG Travel support, Boston Scientific Corporation, Jean-Michel Bartoli MD : Nothing to Disclose, Vincent Vidal MD : Nothing to Disclose

PURPOSE

Evaluate the feasibility, accuracy and safety of Image-Fusion using 3D portography from pre-procedural Computed Tomography Angiography (CTA) with the fluoroscopy in portal vein puncture during TIPS.

METHOD AND MATERIALS

Eighteen patients underwent TIPS with Image-Fusion from pre-procedural CTA. The wedged iodinated sus hepatic vein portography was the conventional method used to visualize the portal vein. The study was performed by two groups of operators: one composed of radiologist with less than 3 years experience in TIPS procedure and the other more experienced. A direct portography was performed after succesful portal vein puncture to analyze the accuracy of the Image-Fusion. The subjective utility of the image fusion for the portal
puncture and the pre-procedural CTA post-processing time were analyzed. We also studied the total number of puncture attempts, the global radiation exposure as well as the specific radiation exposure correlated to the wedged sus-hepatic portography.

RESULTS
The TIPS procedure was successful in 17 patients (94.4%). The image fusion was useful in 13 patients (72.2%). The average post-processing time was 16.4 minutes. Image fusion was strictly superimposed with the direct portography in 10 patients (55.6%). The average gap was 0.69 cm in height and 0.28 cm laterally. The mean number of puncture was 4.6. Eight patients needed less than 3 portal vein puncture attempts. The wedged sus hepatic portography was interpretable in 8 patients (44.4 %), its mean radiation exposure was 421.2 dGy.cm² corresponding to an average surexposure of 19%. No complication was noticed.

CONCLUSION
Image fusion from pre-procedural CTA whit fluoroscopy in portal vein puncture during TIPS is a promising, feasible, safe and accurate technique.

CLINICAL RELEVANCE/APPLICATION
Long-term survival and post-procedures complications of TIPS are related to good initial positioning of the stent, depending on the precision of the portal puncture.

SST16-08
**Early, Unexpected, Liver Failure after TIPS Placement in Cirrhotic Patients with Relatively Preserved Liver Function (MELD ≤12): Incidence, Outcome and Prognostic Factors**

Angelo Luca MD : Nothing to Disclose, Roberto Miraglia MD : Nothing to Disclose, Luigi Maruzzelli MD (Presenter): Nothing to Disclose, Giovanni Vizzini : Nothing to Disclose, Mario D'Amico MS : Nothing to Disclose, Fabio Tuzzolino : Nothing to Disclose

PURPOSE
To evaluate incidence, outcome and prognostic factors of early liver failure (LF) after TIPS in cirrhotic patients with relatively preserved liver function.

METHOD AND MATERIALS
We retrospectively reviewed 217 consecutive cirrhotic patients with baseline MELD ≤12 who underwent TIPS for portal hypertensive complications. TIPS indications were recurrent variceal bleeding (47.9%), refractory/recurrent ascites (41.5%), other (10.6%). Early LF defined as presence of death, liver transplantation (LT) or MELD >18 within 3-months after TIPS was assessed. The Kaplan-Meier method and the Log-rank test were used to look for predictors of early LF. Independent predictors were assessed using a multivariate Cox proportional hazards model.

RESULTS
Twenty (9.2%) out of 217 patients developed early LF after TIPS (10 patients died, 1 patient required LT and 9 patients increased the MELD to more than 18). In the latter group, two patients died at 6 and 9,8 months, two underwent LT at 7.8 and 11.9 months, 4 patients decreased the MELD≤12 from 4.3 to 12 months after TIPS and one patient maintained a stable MELD. One patient had bi-segmental hepatic necrosis on computed tomography; no other procedure-related technical complications were associated with early LF. Early LF was associated with significantly lower transplant free survival 97% vs. 40% at 6-months (p< 0.05) and 88% vs. 24% at 12-months (p< 0.0001) compared with patients without LF. Multivariate analysis revealed that refractory ascites (OR 4.6; CI 1.37-15.5; p=0.01) and pre-TIPS MELD ≥11 (OR 3.2; CI 1.07-9.5; p=0.01) were independently associated with the risk of early LF. In the subgroup of 95 patients with refractory ascites early LF occurred in 15 patients (16%), multivariate analysis disclosed that platelets level (OR 0.9; CI 0.99-0.99; p=0.01) was an additional independent predictors of early LF.

CONCLUSION
Early LF is not uncommon in cirrhotic patients with MELD≤12 undergoing TIPS especially in patients with refractory ascites and those with MELD ≥11. In the subgroup of 95 patients with refractory ascites early LF was associated with significantly lower transplant free survival 97% vs. 40% at 6-months (p< 0.05) and 88% vs. 24% at 12-months (p< 0.0001) compared with patients without LF. Multivariate analysis revealed that refractory ascites (OR 4.6; CI 1.37-15.5; p=0.01) and pre-TIPS MELD ≥11 (OR 3.2; CI 1.07-9.5; p=0.01) were independently associated with the risk of early LF. In the subgroup of 95 patients with refractory ascites early LF occurred in 15 patients (16%), multivariate analysis disclosed that platelets level (OR 0.9; CI 0.99-0.99; p=0.01) was an additional independent predictors of early LF.

CLINICAL RELEVANCE/APPLICATION
Early LF is not uncommon in cirrhotic patients with MELD≤12 undergoing TIPS especially in patients with refractory ascites and those with MELD ≥11.

SST16-09
**Outcome Following a Negative CT Angiogram for Gastrointestinal Haemorrhage**

Victoria Chan MBChB (Presenter): Nothing to Disclose, Donald Man Lap Tse MRCP, FCR : Nothing to Disclose, Shaheen Dixon MBBS, FCR : Nothing to Disclose, Vivek Shrivastava MBBS : Nothing to Disclose, Charles Ross Tapping MBChB, FCR : Nothing to Disclose, Rafuiddin Patel MBChB, FCR : Nothing to Disclose, Mark Bratby MRCP, FCR : Nothing to Disclose, Suzie Anthony FRCR : Nothing to Disclose, Raman Uberoi MBChB, FCR : Nothing to Disclose

PURPOSE
To evaluate the role of a negative computed tomography angiogram (CTA) in patients who present with gastrointestinal (GI) haemorrhage.
METHOD AND MATERIALS

A review of all patients who had CTAs for GI hemorrhage over an eight-year period from January 2005 to December 2012 was performed. Data on patient demographics, location of hemorrhage, hemodynamic stability and details of angiograms and/or the embolization procedure were obtained from the CRIS/PACS database, interventional radiology database, secure electronic medical records and patient’s clinical notes.

RESULTS

202 CTAs were performed in 180 patients over the eight-year period. 87 CTAs were performed for upper GI hemorrhage (18 positive for active bleeding, 69 negative) and 115 for lower GI hemorrhage (37 positive for active bleeding, 78 negative). 58.7% (37/63) of patients with upper GI bleed and 77.4% (48/62) of patients with lower GI bleed who had an initial negative CTA did not rebleed without the need for radiological or surgical intervention. This difference was statistically significant (p = 0.04). The relative risk of rebleeding, following a negative CTA, in lower GI bleeding vs upper GI bleeding patients is 0.55 (95% confidence interval 0.32 - 0.95).

CONCLUSION

Patients with upper GI bleed who had negative CTAs usually require further intervention to stop the bleeding. In contrast, most patients presenting with lower GI hemorrhage who had a negative first CTA were less likely to rebleed.

CLINICAL RELEVANCE/APPLICATION

Negative CTA is a good indicator that patients with lower GI hemorrhage with a negative first CTA are much more likely to settle spontaneously without the need for intervention, compared with patients with upper GI hemorrhage.

SPFR61

Friday Imaging Symposium: A Guided Tour for Managing Incidental Findings: Adnexal, Thyroid, Pediatric, Adrenal and Chest

Special Courses

AMA PRA Category 1 Credits ™: 2.50
ARRT Category A+ Credits: 3.00
Fri, Dec 5 12:30 PM - 3:00 PM  Location: E253CD

Participants

Moderator
Lincoln L. Berland  MD : Consultant, Nuance Communications, Inc Stockholder, Nuance Communications, Inc

LEARNING OBJECTIVES

1) Appreciate the scope, variety and nature of the problem of incidental findings on imaging studies in multiple contexts and the special challenges each present. 2) Better apply a system for managing incidental adnexal lesions, including when to follow or further evaluate lesions based on their features, size and on patient factors. 3) Apply criteria for diagnosing and following incidental adrenal lesions, including when and how to reference information from an ACR White Paper addressing this topic. 4) Assess how new knowledge and techniques developed since publication of the Fleischner criteria in 2005 will lead to changes for managing incidental pulmonary lesions.

Sub-Events

SPFR61A  Chest
Reginald F. Munden  MD, DMD (Presenter):  Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

SPFR61B  Adnexal
Susan M. Ascher  MD (Presenter):  Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

SPFR61C  Adrenal
William W. Mayo-Smith  MD (Presenter):  Author with royalties, Reed Elsevier Author with royalties, Cambridge
LEARNING OBJECTIVES

View learning objectives under main course title.

**SPFR61D**

**Thyroid Nodules**

Edward G. Grant MD (Presenter): Research Grant, Bracco Group Research Grant, General Electric Company Medical Advisory Board, Nuance Communications, Inc

LEARNING OBJECTIVES

View learning objectives under main course title.

**SPFR61E**

**Pediatrics**

R. Paul Guillerman MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Recognize common or vexing incidental findings encountered in pediatric body imaging, such as lymphoid hyperplasia, brown fat, ectopic thymus, pulmonary nodules, small bowel intussusceptions, duodenal inversum, intraperitoneal free fluid, infantile ovarian cysts, urachal remnants, renal cysts, renal collecting system ectasia, neonatal adrenal masses, testicular microlithiasis, osteochondral irregularities, and hypercellular marrow. 2) Understand the clinical implications of these incidental findings to distinguish which of them can be dismissed and which of them warrant additional investigation or follow-up