

Program subject to change until 12/16/2019.



105<sup>TH</sup> Scientific Assembly and Annual Meeting December 1–6 | McCormick Place, Chicago







# VI002<u>-EB-X</u>

Comprehensive and Comparative Overview of Peripheral Artery Disease Imaging

All Day Room: VI Community, Learning Center Hardcopy Backboard

# Participants

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# **TEACHING POINTS**

1. Review components of the non-invasive vascular lab, emphasizing peripheral arterial examinations and ancillary modalities. 2. Discuss the different indications for, technique of, and a comparative overview for various peripheral arterial imaging methods including ultrasound, CTA, MRA, and conventional angiography.

# TABLE OF CONTENTS/OUTLINE

Peripheral arterial disease (PAD) is a prevalent ailment affecting over 8 million individuals in the U.S. according to the American Heart Association (AHA). The pathogenesis of PAD includes the development of occlusive atherosclerotic plaques, and clinical manifestations of the disease process range from intermittent claudication to critical limb ischemia. Vascular imaging studies have become increasingly instrumental in providing clinicians further insight into the diagnosis, localization, prognosis, and treatment planning of PAD. \*\*Background, Technique, Coding & Cost, Benefits/Limitations will be discussed for each modality listed below. Non-Invasive Vascular Lab Ankle-brachial index (ABI) Segmental Arterial Pressures Pulse Volume Recordings (PVRs) Ultrasound Cross-Sectional Imaging Single/Dual-Energy Computerized Tomography Angiography (SE/DE CTA) Magnetic Resonance Angiography (MRA) Conventional Angiography Digital Subtraction Angiography (DSA)







# VI003-EB-X

Contrast-Enhanced Ultrasound (CEUS) in the Assessment of Carotid Atherosclerotic Disease: A Seldom-used Technique to Understand Pathophysiology of Atherosclerotic Plaque Progression and Assess Risk of Thrombosis and Stroke

All Day Room: VI Community, Learning Center Hardcopy Backboard

FDA Discussions may include off-label uses.

#### Participants

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#### **TEACHING POINTS**

Contrast-enhanced ultrasound (CEUS) is a safe, radiation-free and minimally invasive imaging modality that takes advantage of the non-linear behavior of microbubble (MB) contrast agents to produce MB-only images allowing the assessment of the extracranial carotid arteries with a miniscule total dose of less than 1 ml. CEUS helps acquire images featuring all the characteristics of plaque instability - intraplaque hemorrhage, surface ulceration, low echogenicity, and plaque microvascularization.

# TABLE OF CONTENTS/OUTLINE

Contrast-enhanced ultrasound (CEUS) of the carotid arteries is of particular interest since this technique is a seldom used, but yet has a lot to offer when evaluating carotid atherosclerotic disease.CEUS of carotid vessels delineates the lumen/plaque interface to allow the direct measurement of percent area narrowing, a better estimate of blood flow, rather than velocity that is influenced by many unknown variables. It highlights erosions on the plaque surface and intraplaque changes due to angiogenesis and inflammation that are better indicators of vulnerable plaque, with molecular imaging capabilities on the horizon. It improves the assessment of the carotid lumen when plaques are calcified by enhancing the signal to noise ratio, and does not hinder the evaluation of velocities should they be desired.





#### VI100-ED-X

Diagnosis and Management of the Bile Duct Infarction: A Serious Complication of Transarterial Therapy of Liver Tumors

All Day Room: VI Community, Learning Center Digital Education Exhibit

#### Awards Identified for RadioGraphics

## Participants

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## **TEACHING POINTS**

To describe the etiology and histopathology of bile duct infarction after TACE and HAIC for hepatic malignancy. To visualize the typical imaging findings and clinical course of bile duct infarction after hepatic interventional therapy. To provide the clue to get early diagnosis of bile duct infarction during the repeated interventional treatment of liver tumors.

## TABLE OF CONTENTS/OUTLINE

Bile duct infarction might be one of the serious complications of transcatheter arterial chemoembolization (TACE) and hepatic arterial infusion chemotherapy (HAIC) for hepatic malignancy. The purpose of this presentation is to provide basic knowledge, imaging findings and clinical course of the bile duct infarction after hepatic interventional therapy. Fundamentals Anatomy of the intrahepatic bile duct Peribiliary vascular plexus (PBP), the supportive vessels of bile duct epithelium Pathological change of PBP in various liver condition Clinical findings CT findings of bile duct necrosis Differential diagnosis of bile duct necrosis with US and MRI Diagnostic application Early prediction of vascular damage after repeated HAIC for liver tumor Natural course of the bile duct necrosis after hepatic interventional treatment







Are We Competent to Diagnose Incompetence in Veins? The Plumbing Details Needed for Accurate Interpretation

All Day Room: VI Community, Learning Center Digital Education Exhibit

#### Awards Certificate of Merit

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#### **TEACHING POINTS**

List the indications for peripheral venous reflux examination. Describe the specifications and techniques of the examination including equipment requisites, scanning protocol and reporting. Review the anatomy and changes in nomenclature of veins. This is critical to keep the interpreting radiologist and the referring physician on the same page. Review the ultrasound findings in deep and superficial peripheral venous insufficiency. Address specifically the pitfalls and limitations of the exam.

# TABLE OF CONTENTS/OUTLINE

Introduction to peripheral venous insufficiency and review of Anatomy/Nomenclature Before the examination: a) Indications for ultrasound evaluation b) Physician responsibilities c) Equipment requisites The Examination: a) Scanning protocol b)Reporting Ultrasound findings in deep and superficial peripheral venous insufficiency Conclusions







# VI102-ED-X

# Transvenous Application of N-butyl Cyanoacrylate (NBCA) Glue

All Day Room: VI Community, Learning Center Digital Education Exhibit

#### Participants

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## **TEACHING POINTS**

To review indications for transvenous use of N-butyl cyanoacrylate (NBCA) To understand the behavior of NBCA in vein To get tips and tricks for the transvenous use of NBCA To learn adjunctive techniques to improve results and reduce complications such as pulmonary embolism.

# TABLE OF CONTENTS/OUTLINE

Characteristics of N-butyl-2-cyanoacrylate (NBCA) glue Intravenous behavior of NBCA (difference from intra-arterial use) Proper technique for transvenous NBCA embolization a. dilution of NBCA b. catheter system c. injection speed Adjunctive technique a. Balloon-occluded b in combination with vascular plug c. in combination with framing coils Review of transvenous applications/indications a. embolization of venous bleeding b. variceal embolization c. shunt embolization (portosystemic, arteriovenous) d. Embolization of portal venous access tract. etc Tips and Pearls NBCA is an inexpensive and highly therapeutic embolic material but has not been widely applied to transvenous embolization. If properly used, it is also a very effective embolic material in venous intervention. In this exhibit, we can learn about indications for transvenous NBCA, tips and tricks for transvenous NBCA, and adjunctive technique to improve results and reduce complications.







# VI103-ED-X

Optimizing Ultrasound Images, Diagnostic Accuracy and Confidence: A Primer for Residents, Practicing Radiologists, and Sonographers

All Day Room: VI Community, Learning Center Digital Education Exhibit

#### Participants

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#### **TEACHING POINTS**

We intend to discuss the optimization of sonographic grayscale, spectral and color Doppler acquisition parameters and associated artifacts and pitfalls. We will demonstrate how the different ultrasound parameters highlight different pathologies and when use is appropriate. Finally, we will outline a systematic approach for selection of ultrasound grayscale, color and spectral Doppler parameters that result in optimal acquisition of vascular diagnostic images with high diagnostic confidence.

#### **TABLE OF CONTENTS/OUTLINE**

I. Introduction II. General approach, common mistakes and fixes a. Greyscale i. Transducer selection ii. Depth iii. Penetration iv. Gain and Time gain compensation curves v. Harmonic imaging vi. Greyscale color maps vii. Accurate structure and vascular measurement b. Color Doppler i. Transducer selection ii. Steering for adequate angle iii. Color gain iv. Color scale v. Wall filter vi. Adjustments for low flow vii. Power Doppler viii. Microvascular Flow c. Spectral Doppler and M-mode i. Scale adjustment ii. Gain iii. How to deal with aliasing iv. Wall filter v. Accurate measurement vi. When to use M-mode III. Clinical Applications a. Vascular stenosis i. Aliasing ii. Parvus et tardus waveform iii. Spectral broadening iv. Approach to Renal artery stenosis b. Urinary calculi i. Twinkle artifact ii. Ureteral jets IV. Take home points





# VI104-ED-X

Subtraction CT Angiography of Peripheral Artery with Orbital Synchronized Helical Scanning Using Characteristic of Organ-Based Tube Current Modulation

All Day Room: VI Community, Learning Center Digital Education Exhibit

#### Awards Cum Laude

#### Participants

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# **TEACHING POINTS**

Severe calcification complicates the diagnosis of the blood vessel lumen in CT angiography of peripheral artery. Subtraction CT angiography (SCTA) with the use of orbital synchronized helical scanning is beneficial for the diagnosis of peripheral arteries with vessel wall calcifications. Using the organ-based tube current modulation (organ dose modulation: ODM, GE Healthcare) for SCTA easily makes the orbital synchronized helical scanning possible. In addition, using the ODM for SCTA can inhibit the mis-registration of the SCTA image and visualizes only the lumen of the peripheral artery with severe calcifications. In this exhibit, we will illustrate the background of the SCTA with ODM, scanning methods, and clinical applications.

# TABLE OF CONTENTS/OUTLINE

1. Technical points of the scanning method for the SCTA with ODM and the image processing, 2. Comparison of the image quality between the SCTA with ODM and SCTA without ODM. 3. Clinical images of SCTA with ODM, and comparison with digital subtraction angiography (DSA).







# VI105-ED-X

# CT-Guided Cryoablation for Lung Tumors: Basic and Advanced Techniques

All Day Room: VI Community, Learning Center Digital Education Exhibit

FDA Discussions may include off-label uses

#### Participants

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# **TEACHING POINTS**

1. Strategies for the indications of cryoablation for lung tumors 2. Learn how to perform the basic procedures of the CT-guided cryoablation 3. Discuss the tips on how to avoid critical complications.

# TABLE OF CONTENTS/OUTLINE

1. Strategies for the indications of cryoablation 2. Steps of cryoablation for lung tumors a. Equipments b. Procedure and workflow 3. Image findings during and after CT-guided cryoablation 4. Treatment outcomes 5. Critical complications a. Prevention b. Identification and evaluation c. First aid





# VI106-ED-X

Magnetic Resonance-Thoracic Ductography (MRTD): Importance of Thoracic Duct (TD) Configuration for Intervention (IR)

All Day Room: VI Community, Learning Center Digital Education Exhibit

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## **TEACHING POINTS**

1. To describe the principle of the depiction of the TDs using MRI 2. To review the embryology of the mediastinal lymphatic vessels 3. To analyze the anatomic variations of the TDs: i. Running course of the TDs in the mediastinum and supraclavicular region ii. Direction seen from the above the head of the TD flowing into the venous angle after the thoracic outlet 4. To recognize the pathology of the TDs: e.g. chylothorax, lymphedema 5. To understand TD-IR for the TD diseases

# TABLE OF CONTENTS/OUTLINE

1. Development of the mediastinal lymphatic vessels 2. Optimal MRTD protocol 3. Anatomic pathways of the TDs: Running course of the TDs Direction seen from the above the head of the TD flowing into the venous angle 4. Pathologic findings of TD diseases 5. TD-IR procedure 6. Important MR imaging information for TD-IR 7. Summary: In TD-IR, it is important to know the anatomic location of the TDs. MRTD is a feasible non-invasive technique to assess TD configuration. Our MRTD technique could provide useful imaging information for TD-IR, and is considered to positively contribute to safer performance of TD-IR.





# VI107-ED-X

# Evaluation of Peripheral Vascular Disease Using CT and MR Angiography

All Day Room: VI Community, Learning Center Digital Education Exhibit

## Participants

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### **TEACHING POINTS**

1. Review the imaging modalities for peripheral vascular disease 2. Describe the strengths and limitations of CT angiography, enhanced MR angiography and non-enhanced MR angiography 3. Demonstrate various CT and MR images of peripheral vascular disease

## **TABLE OF CONTENTS/OUTLINE**

1. Introduction - Disease entities of peripheral vascular disease - The use of CT and MR angiography - Needs of non-enhanced MR angiography 2. Imaging Modalities 1) CT angiography protocol 2) MR angiography protocol - Contrast enhanced MR angiography - Non-enhanced MR angiography (sequences such as REACT, TOF, ASL, BOLD) 3. Various Cases - Traumatic injury (for flap operation) - Critical limb ischemia including diabetes foot - Peripheral arteriovenous malformation





# VI108-ED-X

Seeing the Forest for the Trees: The New Systemic Options to Treat Hepatocellular Carcinoma

All Day Room: VI Community, Learning Center Digital Education Exhibit

FDA Discussions may include off-label uses.

#### **Participants**

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# **TEACHING POINTS**

Hepatocellular carcinoma (HCC) is the sixth leading cause of cancer mortality. The incidence of HCC is expected to rise until 2030 in the united states. For a decade, Sorafenib was the only systemic therapy in the treatment of HCC. However, since 2017, several new systemic therapies have been approved for the treatment of HCC and several others are along the pipeline. In this educational exhibit we will review: 1) Currently approved treatments of HCC 2) Trials with promising results 3) Upcoming strategies and the role of Interventional Oncology

#### **TABLE OF CONTENTS/OUTLINE**

1. Epidemiology and background of HCC 2. Staging and risk assessment 3. Review of treatment options 4. Review of recent trial results





# VI109-ED-X

Aortic Dissection and Acute Aortic Syndromes: Diagnostic Imaging Findings from Acute to Chronic Longitudinal Progression

All Day Room: VI Community, Learning Center Digital Education Exhibit

#### Awards Certificate of Merit Identified for RadioGraphics

#### Participants

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# **TEACHING POINTS**

1. Review the rationale for classification systems for aortic dissection (AoD), and the most commonly used classification. 2. Review the pathophysiology of AoD, acute aortic syndromes (AAS), and their imaging manifestations with emphasis on CT-angiography. 3. Identify common imaging findings in acute, sub-acute, and chronic AoD and AAS as well as the findings that define complicated AoD or AAS and their implications. 4. Become familiar with a systematic analysis and reporting process of salient imaging findings that impact management and follow-up of patients regardless of acuity or complexity of the AoD or AAS being considered.

#### TABLE OF CONTENTS/OUTLINE

Anatomy: Anatomic considerations, location of and type of aortic dissection or acute aortic lesion. Epidemiology and Pathology: Acute aortic syndromes with emphasis on aortic dissection. Pathophysiology: Imaging manifestations. Review imaging findings with sample cases of the continuum from acute, sub-acute, and chronic -Uncomplicated -Complicated. Future directions and evolving understanding to improve imaging diagnosis and management.





# VI110-ED-X

Case-based Learning during Anatomy Block as a Modality for Preclinical Interventional Radiology Education: Successes and Challenges

All Day Room: VI Community, Learning Center Digital Education Exhibit

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# **TEACHING POINTS**

-Describe case-based IR education model -Discuss challenges of model -Propose a vertically integrated model in the preclinical years to address the challenges of IR education in anatomy

# TABLE OF CONTENTS/OUTLINE

Current state of interventional radiology (IR) medical school education: -Radiology underrepresented in preclinical curriculum -Many students are unaware of the IR specialty -Lack of knowledge about the practice of IR translates into improper patient management (lack of referrals, incomplete review of diagnostic and treatment options with patients) Current preclinical IR education: -2% of medical schools offer preclinical IR courses Not consistently taught by radiology faculty (<50%) -Most-all IR education models take place exclusively in anatomy Case-based learning model: -During anatomy block -15 min-1 hour radiology lectures daily w/clinical correlates -1hr IR-specific lecture with cases on CT-guided interventions Challenges: -Student concerns: concepts clinically complex, unclear learning objectives -Limited time -Limited availability of radiology faculty Proposals: -Selection of IR cases that focus on medical school-level concepts -Vertically integrate IR throughout systems blocks (spread over years) -Use IR interest groups as auxiliary vehicle to engage students in advanced IR topics





# VI111-ED-X

Minimally-Invasive Endoscopic and Surgical Procedures in Management of Patients with Complicated Necrotizing Pancreatitis: What an Interventional Radiologist Needs to Know

All Day Room: VI Community, Learning Center Digital Education Exhibit

#### Participants

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#### **TEACHING POINTS**

The advent of the new clinically oriented learning pathways in Interventional Radiology (IR) requires cross-disciplinary education and awareness. The primary goal of this exhibit is to discuss the endoscopic and minimally invasive surgical management of necrotizing pancreatitis. Specifically, the indications, contraindications, basic technique, complications and relevance to IR will be highlighted.

# TABLE OF CONTENTS/OUTLINE

Overview of local complications of pancreatitis with indications and basic algorithm of drainage procedures. Role of Endoscopic drainage (ED) and Direct endoscopic necrosectomy (DEN). Approach and role of minimally invasive surgical techniques: Focus on video assisted retroperitoneal debridement (VARD) Relevance to Interventional Radiology - Role of percutaneous drainage and management of complications like bleeding Role of a Multi-disciplinary meeting in management of necrotizing pancreatitis.





# VI112<mark>-ED-</mark>X

# Imaging and Interventional Procedures of the Lymphatic System

All Day Room: VI Community, Learning Center Digital Education Exhibit

FDA Discussions may include off-label uses

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# **TEACHING POINTS**

• To become familiar with the normal anatomy of the lymphatic system and common pathologies. • To learn about imaging techniques of the lymphatic system and to recognize common imaging findings of different pathologies. • To understand imaging strategies used to examine the lymphatic system based on anatomy and physiology. • To know about therapeutic options and their differential indications in lymphatic pathologies (esp. lymphatic leakage like chylothorax). • To learn about possible radiological-interventional procedures and achievable outcomes in comparison to conservative and surgical options.

# TABLE OF CONTENTS/OUTLINE

1. Anatomy and function of the lymphatic system 2. Imaging methods and examination techniques and their indications a. Conventional lymphangiography (transpedal, intranodal) b. MR-lymphangiography (transpedal, intranodal) 3. Diseases of the lymphatic system a. Lymphedema b. Lymphatic leakages i. Chylothroax ii. Chylous ascites iii. Peripheral lymphatic leakage and lymphoceles c. Lymphatic flow pathologies (e.g. plastic bronchitis) 4. Interventional-radiological therapeutic approaches a. Conventional lymphangiography b. Endolymphatic transcatheter embolizations i. Transabdominal thoracic duct embolization ii. Alternative retrograde approaches c. Interstitial lymph node embolization





# VI113-ED-X

When Everything is NOT under Control: Aortic Endoleaks

All Day Room: VI Community, Learning Center Digital Education Exhibit

#### Awards Certificate of Merit

#### Participants

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#### **TEACHING POINTS**

The purpose of this exhibit is for the viewer to learn: -How to recognize the findings of Aortic Endoleaks after Endovascular Abdominal Aortic Aneurysm Repair: -Ultrasonographic findings -CT findings -Angiographic findings-How to distinguish which types of endoleaks require urgent catheter-based evaluation and treatment.-Comprehend the evaluation of Endoleaks and Post-EVAR followup algorithm.

## TABLE OF CONTENTS/OUTLINE

- Pathophysiology of aortic endoleaks- Aortic endoleak classification- Findings of aortic endoleaks: Ultrasonographic, CT and angiographic findings.- Endoleak treatment- Post-EVAR and endoleaks follow-up algorithm.- Sample cases - Future directionsWe will provide a case-based review of the main imaging features of Aortic Endoleaks





# VI114-ED-X

# Endovascular Management of Frostbite: Role of Intra-Arterial tPA

All Day Room: VI Community, Learning Center Digital Education Exhibit

FDA Discussions may include off-label uses

# Participants

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# **TEACHING POINTS**

Describe the pathophysiology of frostbite injury and its relation to the concepts of mangement. Discuss the management options of frostbite injury Explain the procedural technique and administration protocol of intra-arterial tPA for managing frostbite Review the literature describing the prognosis of frostbite cases treated with intra-arterial tPA

# TABLE OF CONTENTS/OUTLINE

- Different types of cold related local injuries - Pathophysiology of frostbite injury - Management protocol of frostbite injury - Selection criteria for intra-arterial tPA use in cases of frostbite injury - Technique and adminstration protocol of tPA in cases of frostbite injury - Prognosis of frostbite cases treated with tPA





# VI115-ED-X

Transradial Access: Review of Complications, Strategies to Minimize Risk, and Management of Complications

All Day Room: VI Community, Learning Center Digital Education Exhibit

#### Awards Certificate of Merit

#### **Participants**

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# **TEACHING POINTS**

Describe the complications associated with transradial access, including their incidences, proposed mechanisms, and risk factors. Describe strategies to minimize risk of transradial access complications. Describe management of transradial access complications.

# TABLE OF CONTENTS/OUTLINE

Major complications from transradial access (TRA) are significantly lower than with transfemoral access (TFA) and even more so compared to transbrachial access (TBA). Major complication rates range between 2-5% in TFA, 6-16% in TBA, and less than 1% in TRA. Of the potential transradial access complications, radial artery occlusion (RAO), radial artery spasm (RAS), and forearm hematoma are the most common, while the remaining complications are generally uncommon, but nonetheless important to understand due to sometimes grave outcomes. Rare complications include compartment syndrome, radial artery perforation/dissection, pseudoaneurysm formation, sterile granuloma formation, hand/digit ischemia, and neuralgia/complex regional pain. Our aim is to describe each of these potential complications, including the incidences, risk factors, and proposed mechanisms for their development. We will examine evidence-based strategies to minimize the occurrence of these complications, as well as approaches to management should they occur.







# VI116-ED-X

# Blunt Abdominal Trauma: A Primer for the Radiologist of Solid Organ Injuries

All Day Room: VI Community, Learning Center Digital Education Exhibit

#### Participants

Preston G. Hood, MD, Jacksonville, FL (*Presenter*) Nothing to Disclose Travis E. Meyer, MD, Jacksonville, FL (*Abstract Co-Author*) Founder, EQIP, Inc Stockholder, EQIP, Inc JoAnna Kee-Sampson, MD, Jacksonville, FL (*Abstract Co-Author*) Nothing to Disclose

# For information about this presentation, contact:

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#### **TEACHING POINTS**

Be able to describe the technical aspects behind multiphase CT in blunt abdominal trauma to maximize diagnostic sensitivity and quality.Be able to describe CT findings of blunt abdominal trauma in various organ systems.Be familiar with endovascular and non-endovascular interventions in the management of blunt abdominal solid organ, mesenteric, and bowel injuries

# TABLE OF CONTENTS/OUTLINE

Pathophysiology, Mechanisms and Physics of Blunt Abdominal Trauma• Rapid deceleration• Crush injuries• External compressionMultidetector CT in Trauma• Use of contrast• Multiphasic Imaging• Image ProcessingBlunt Abdominal Trauma of Specific Organ Systems and InterventionsSpleen, Liver, Kidney, Mesentery, Bowel • Contrast phases• AAST Injury scale• Imaging caveats• Delayed complications • Examples of interventions





# VI117-ED-X

# Chyle Leaks: All You Need to Know

All Day Room: VI Community, Learning Center Digital Education Exhibit

#### Awards Certificate of Merit

#### Participants

Aliaksei Salei, MD, Birmingham, AL (*Presenter*) Nothing to Disclose Ernesto G. Santos Martin, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Eric R. Bready, MD, Birmingham, AL (*Abstract Co-Author*) Nothing to Disclose Khalid H. Mahmoud, MBBS, Birmingham, AL (*Abstract Co-Author*) Nothing to Disclose Sarah M. Osman, Birmingham, AL (*Abstract Co-Author*) Nothing to Disclose Jay Martinez, BS, Albuquerque, NM (*Abstract Co-Author*) Nothing to Disclose Andrew J. Gunn, MD, Vestavia Hills, AL (*Abstract Co-Author*) Nothing to Disclose Andrew J. Gunn, MD, Vestavia Hills, AL (*Abstract Co-Author*) Consultant, BTG International Ltd; Speakers Bureau, BTG International Ltd; Research support, Penumbra Inc Ahmed K. Abdel Aal, MD,PhD, Birmingham, AL (*Abstract Co-Author*) Consultant, Abbott Laboratories; Consultant, Baxter International Inc; Consultant, C. R. Bard, Inc; Consultant, Boston Scientific Corporation; Consultant, W. L. Gore & Associates, Inc; Consultant, Sirtex Medical Ltd; Consultant, Guerbet SA

Rakesh K. Varma, MD, Vestavia Hills, AL (Abstract Co-Author) Nothing to Disclose

# **TEACHING POINTS**

Chyle leaks are uncommon conditions with highest incidence after thoracic surgery Chyle leaks can lead to extreme morbidity with up to 50% mortality following conservative management and up to 10% mortality rate following surgical repair Intranodal lymphangiography and thoracic duct interventions offer minimally invasive, safe and effective alternative

# TABLE OF CONTENTS/OUTLINE

Provide pictorial review of pertinent lymphatic anatomy Discuss etiology and pathophysiology of the chyle leaks Illustrate techniques for visualization of leak sites, including intranodal, direct transcervical, transvenous, and transhepatic lymphangiography Review techniques of thoracic duct embolization and disruption Review additional techniques of embolizing the chyle leaks including percutaneous glue injection and sclerotherapy Review outcomes of thoracic duct embolization





## VI118-ED-X

Anatomy and Pathologies of the Renal Arteries with Implications for Modern Endovascular Management

All Day Room: VI Community, Learning Center Digital Education Exhibit

#### Awards Identified for RadioGraphics

#### Participants

Richard D. White, MBChB, FRCR, Blairgowrie, United Kingdom (*Presenter*) Nothing to Disclose Ghali Salahia, MD, Cardiff, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Katherine S. Moore, MBChB, BSC, Cardiff, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Ian A. Zealley, MBChB, Perth, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Andrew C. Gordon, Cardiff, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Ian Williams, Cardiff, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Andrew Wood, MBBS, FRCR, Cardiff, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

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# **TEACHING POINTS**

1. Review the embryology, normal anatomy and anatomical variants of the renal arteries (RAs) with schematic diagrams and multimodality imaging (US, CT, MR, DSA) 2. Describe optimal imaging strategies for evaluating pathology related to the RAs 3. Illustrate the spectrum of pathologies involving the RAs on multimodality imaging emphasising clinical correlation and endovascular management where applicable, using cases from an extensive archive at two tertiary vascular centres

# TABLE OF CONTENTS/OUTLINE

1. Embryological development 2. Normal and variant anatomy of the RAs 3. Imaging strategies 4. Pathologies: a. Haemorrhage i. Iatrogenic ii. Trauma iii. Other b. Stenotic/occlusive disease i. Evidence for treatment c. Vasculitis d. Fibromuscular dysplasia e. Aneurysms f. Vascular malformations g. Angiomyolipoma i. Prophylactic vs emergent treatment h. Transplanted kidneys i. Considerations in endovascular aortic aneurysm repair i. Sacrifice ii. Fenestrated iii. Chimney j. Considerations in surgery i. Pre-operative embolisation ii. Renal transplant donor work-up iii. Hepatorenal bypass 5. Endovascular management: indications, tips and tricks







# VI119<u>-ED-X</u>

# Practical Applications of Lymphangiography and Lymphatic Interventions

All Day Room: VI Community, Learning Center Digital Education Exhibit

#### Participants

Joseph Procell, DO, Rochester, NY (*Presenter*) Nothing to Disclose Zachary M. Nuffer, MD, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose Andrew J. Cantos, MD, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose

#### **TEACHING POINTS**

A brief overview of lymphangiography and lymphatic interventions reinforced with case presentations. Define the various kinds of lymphangiography along with historical and current applications. Discussion of the anatomy of the lymphatic system and normal variants. A brief overview of chylous ascites and chylothorax with a discussion of etiology, diagnosis with imaging and laboratory testing, indications for treatment, and treatment methods. Brief overview of the technical aspects of lymphatic interventions and associated equipment. Example cases to reinforce the above learning objectives.

# TABLE OF CONTENTS/OUTLINE

Lymphangiography • Historical and current applications • Pedal • Intra-nodal o Inguinal o Mesenteric • Transhepatic • MR Review of lymphatic anatomy • Nodes / lymphatic vessels • Cisterna chyli / Thoracic duct anatomy and variants Applications / Indications • Chylous effusion / ascites • Lymphatic leaks • Traumatic / Iatrogenic / idiopathic Diagnosis / patient selection • Initial imaging • Laboratory tests Lymphatic Interventions • Coil and glue embolization • Sclerotherapy • Thoracic duct interruption Technical aspects (imaging modality, contrast, equipment) • Imaging modality • Equipment • Contrast agents • Embolic agents / coils Example cases





# VI120-ED-X

Immune Effector Cell Therapy for Solid Tumors: Opportunities for Interventional Radiology

All Day Room: VI Community, Learning Center Digital Education Exhibit

FDA Discussions may include off-label use

#### **Participants**

Felipe Matsunaga, MD, Cleveland, OH (*Presenter*) Nothing to Disclose Ayana Dambaeva, Cleveland Heights, OH (*Abstract Co-Author*) Nothing to Disclose Folashade Otegbeye, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose Sidhartha Tavri, MBBS, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose

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# **TEACHING POINTS**

Novel immunotherapies such as immune effector cell (IEC) therapies are revolutionizing cancer treatment. Herein, we provide an overview of the potential roles for interventional radiology in IEC therapies, with a particular emphasis on chimeric antigen receptor T-cell (CAR-T) immunotherapy for the treatment of solid tumors. Key teaching points include an overview of immunosurveillance and different classes of IEC therapies. Additional teaching points include the clinical limitations of IEC therapies in the treatment of solid tumors and the use of interventional radiology techniques in overcoming these limitations and possibly enhancing treatment efficacy.

# TABLE OF CONTENTS/OUTLINE

1. Molecular mechanisms underlying immunosurveillance and IEC immunotherapy 2. Overview of different IEC classes: T-cell and natural killer cell based therapies. 3. Clinical limitations associated with IEC therapies in the treatment of solid tumors. 4. Role of interventional radiology in overcoming barriers to IEC therapies for solid tumors. 5. Combinatorial approaches with existing interventional radiology techniques to enhance clinical efficacy.





#### VI121-ED-X

Novel Imaging Techniques and Algorithmic Approach to Diagnosis and Management of Vascular Anomalies

All Day Room: VI Community, Learning Center Digital Education Exhibit

#### Participants

Ankit Sangwan, MBBS, MD, New Delhi, India (*Presenter*) Nothing to Disclose Ankur Goyal, MBBS, MD, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose Atin Kumar, MD, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose Devasenathipathy Kandasamy, MD,FRCR, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose Raju Sharma, MD, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose Ashu S. Bhalla, MD, New Delhi , India (*Abstract Co-Author*) Nothing to Disclose Maneesh Singhal, New Delhi , India (*Abstract Co-Author*) Nothing to Disclose Rakesh Dawar, New Delhi , India (*Abstract Co-Author*) Nothing to Disclose Shashank Chauhan, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose Sudheer K. Arava, New Delhi , India (*Abstract Co-Author*) Nothing to Disclose Sujay Khandpur, New Delhi , India (*Abstract Co-Author*) Nothing to Disclose

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#### **TEACHING POINTS**

1. Present an algorithmic approach to characterize vascular anomalies using clinical and radiological features 2. Highlight the role of novel imaging techniques like contrast-enhanced ultrasound and time-resolved MR angiography in the diagnosis of vascular anomalies 3. Discuss the management options for common vascular anomalies

#### TABLE OF CONTENTS/OUTLINE

1. Classification of Vascular Anomalies: What's new in ISSVA 2018! 2. Typical clinical & imaging appearance of different types of vascular anomalies 3. Novel techniques like Contrast-enhanced Ultrasound and Time-Resolved MR Angiography in the evaluation of vascular anomalies 4. Step-by-step diagnostic algorithm to characterize these lesions appropriately 5. Uncommon vascular anomalies (Verrucous Hemangioma, Hobnail hemangioma, Angiokeratoma, Fibro-adipose Vascular Anomaly) 6. Mimics (Nerve Sheath tumors, ganglion cyst, tenosynovitis) and imaging pitfalls (microcystic lymphatic malformations may mimic solid neoplasms) 8. Treatment roadmap for common vascular anomalies and rationale behind different options







# VI122-ED-X

# Contrast-Enhanced Ultrasound for Challenging Abdominal Interventions

All Day Room: VI Community, Learning Center Digital Education Exhibit

FDA Discussions

## Awards Certificate of Merit

# Participants

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Perry J. Pickhardt, MD, Madison, WI (*Abstract Co-Author*) Stockholder, SHINE Medical Technologies, Inc; Stockholder, Elucent Medical; Advisor, Bracco Group;

Meghan G. Lubner, MD, Madison, WI (Abstract Co-Author) Grant, Koninklijke Philips NV; Grant, Johnson & Johnson;

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# **TEACHING POINTS**

1. Overview of microbubble ultrasound contrast 2. Role of contrast enhanced ultrasound in nonvascular abdominal interventions 3. Increasing yield of intervention or deferring intervention using contrast enhanced ultrasound

# TABLE OF CONTENTS/OUTLINE

1. Overview of microbubble ultrasound contrast 2. Technique 3. Contrast enhanced ultrasound abdominal interventions - Biopsy - Aspiration - Ablation - Confirming benignity to avoid intervention 4. Summary





# VI123-ED-X

The Bleeding Point: Manifestations of Hemorrhage and Related Pathologies - With Mimics and Pitfalls

All Day Room: VI Community, Learning Center Digital Education Exhibit

#### **Participants**

Ghali Salahia, MD, Cardiff, United Kingdom (*Presenter*) Nothing to Disclose Rhys W. Thomas, MBBCh,MRCS, Cardiff, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Adam Aboalkaz, Cardiff, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Ian A. Zealley, MBChB, Perth, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Andrew C. Gordon, Cardiff, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Andrew Wood, MBBS, FRCR, Cardiff, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Richard D. White, MBChB, FRCR, Blairgowrie, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

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# **TEACHING POINTS**

1.Describe optimal imaging strategies for evaluating active haemorrhage with schematic diagrams and multimodality imaging. 2.Review imaging appearances of haemorrhage and related pathologies, using cases drawn from an extensive archive at two tertiary interventional radiology centres. 3.Highlight important mimics of bleeding and interpretative pitfalls

# TABLE OF CONTENTS/OUTLINE

1. Imaging strategies a. CT i. Utility of different contrast phases b. DSA c. Nuclear medicine 2. Pathologies a. Active haemorrhage b. Pseudoaneurysm i. Differentiation from aneurysm c. Rupture d. Arterial fistula e. Transection / vascular injury f. Occult bleeding

g. Miscellaneous 3. Mimics and pitfalls





# VI124-ED-X

Comparison of Non-Contrast MR Angiography to CT Angiography to Evaluate the Access Route of Transfemoral Transcatheter Aortic Valve Replacement

All Day Room: VI Community, Learning Center Digital Education Exhibit

#### Participants

Naoki Hosoda, Tokyo, Japan (Presenter) Nothing to Disclose

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# **TEACHING POINTS**

1) To describe the assessment method for access route of transfemoral Transcatheter Aortic Valve Replacement (TAVR). 2) To describe the scan parameters of Non-contrast MR Angiography (NC-MRA). 3) To describe the usefulness of NC-MRA to evaluate the access route of transfemoral TAVR, using the data compared NC-MRA and CT Angiography (CTA).

#### TABLE OF CONTENTS/OUTLINE

Assessment points and images of access route of transfemoral TAVR: diameter, tortuousness, presence or absence of calcification, cross sectional images, volume rendering. Advantages and limitations of NC-MRA: non-contrast, respiratory gating, short time scan, signal void of calcification. It was suggested that the assessment of access route of transfemoral TAVR using NC-MRA is useful by comparison of measurement results (n=560). Since NC-MRA can be performed without using contrast media, it can be applied to patients with renal dysfunction or contrast allergy. This method uses respiratory gating and can be used for arrhythmia patients. The scan time is about 4 minutes, comparable to CTA. Since calcification is difficult to recognize in MRI, evaluation of calcification requires plain CT.







# Tips for Tips: A Resident's Survival Guide

All Day Room: VI Community, Learning Center Digital Education Exhibit

#### **Participants**

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#### **TEACHING POINTS**

- To describe the multimodality imaging diagnosis of Portal Hypertension (PHT) and its complications.- To understand the technique for Transjugular Intrahepatic Portosystemic Shunt (TIPS) placement.- To familiarize with potential complications of this procedure.- To learn about the post-procedure follow-up of these patients and management of dysfunctional stents.

### TABLE OF CONTENTS/OUTLINE

Portal hypertension (PHT) is a common clinical syndrome, defined by a pathologic increase in the portal venous pressure. Increased resistance to portal blood flow, the primary factor in the pathophysiology of portal hypertension, is in part due to morphological changes occurring in chronic liver diseases. Imaging plays an important role in both diagnosis and management of PHT. In particular, interventional procedures, such as TIPS, which are minimally invasive nonsurgical methods of achieving portal decompression, have become integral to the management of PHT-related complications. This review aims to provide tips for understanding the procedure, as well as for the imaging management of post-TIPS patients. Although a brief overview of PHT diagnosis is featured, the presentation focuses on learning about main clinical indications and contraindications for TIPS, the technique and management of dysfunctional stents.







Arterial and Venous Visceral Aneurysms and Pseudoaneurysms: A Pictorial Review

All Day Room: VI Community, Learning Center Digital Education Exhibit

#### **Participants**

Rakesh K. Varma, MD, Vestavia Hills, AL (*Abstract Co-Author*) Nothing to Disclose Khalid H. Mahmoud, MBBS, Birmingham, AL (*Abstract Co-Author*) Nothing to Disclose Eric Keasler, MD, Birmingham, AL (*Abstract Co-Author*) Nothing to Disclose Sarah M. Osman, Birmingham, AL (*Abstract Co-Author*) Nothing to Disclose Aliaksei Salei, MD, Birmingham, AL (*Presenter*) Nothing to Disclose Ahmed K. Abdel Aal, MD,PhD, Birmingham, AL (*Abstract Co-Author*) Consultant, Abbott Laboratories; Consultant, Baxter International Inc; Consultant, C. R. Bard, Inc; Consultant, Boston Scientific Corporation; Consultant, W. L. Gore & Associates, Inc; Consultant, Sirtex Medical Ltd; Consultant, Guerbet SA

# **TEACHING POINTS**

Visceral aneurysms and pseudoaneurysms are relatively uncommon but catastrophic condition with general incidence of 0.1%-2% in splanchnic circulation and 0.01%-0.09% in renal distribution. Surgical management used to be the gold standard which is now largely replaced by endovascular repair. This exhibit provides comprehensive pictorial review of interventional management of visceral aneurysms and pseudoaneurysms.

## TABLE OF CONTENTS/OUTLINE

1. Incidence and etiology of visceral aneurysms and pseudoaneurysms 2. Pictorial review of imaging features of visceral aneurysm and pseudoaneurysms 3. Indications for intervention 4. Pictorial review of various techniques of endovascular and percutaneous repair 5. Review of current literature on various treatment options and outcomes 6. Pearls for successful endovascular management of aneurysms and pseudonaeurysms





# VI130-ED-X

# Creating Low-cost Phantoms for IR Skills Training

All Day Room: VI Community, Learning Center Digital Education Exhibit

#### Awards Identified for RadioGraphics

#### Participants

Charles Nhan, MD, Montreal, QC (*Presenter*) Nothing to Disclose Louis-Martin N. Boucher, MD, PhD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose Jeffrey Chankowsky, MD, Montreal West, QC (*Abstract Co-Author*) Nothing to Disclose

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# **TEACHING POINTS**

1.Learn how to prepare a basic gelatin model and understand the effect of different additives on echotexture for the purpose of preparing a custom training model 2. Troubleshooting commonly-encountered problems creating gelatin models 3.Learn how to prepare gelatin and other materials for visibility under fluoroscopy 4. Learn how to create and design teaching models for specific skills for IR training

## TABLE OF CONTENTS/OUTLINE

1. Introduction/background2. How to prepare basic gelatine models3. Different gelatine additives and the ultrasound appearance of different compositions4. How to prepare gelatine and other objects for visibility under fluoroscopy5. Example and instructions on how to create models for: fluoroscopy needle orientation training, cone beam CT needle training, lumbar puncture training under fluoroscopy, ultrasound-guided vascular access, ultrasound-guided needle biopsy6. Our experience introducing phantoms for training





# VI131-ED-X

Depiction of Reachable Bronchi of Peripheral Lung Nodule for Transbronchial Approach by Ultra-High Resolution CT (UHRCT)

All Day Room: VI Community, Learning Center Digital Education Exhibit

#### Participants

Hiroshi Moriya, MD, Fukushima, Japan (*Presenter*) Advisor, Ziosoft, Inc; Research Grant, Canon Medical Systems Corporation; Research Grant, Fukushima Prefectural Labor Health Center Shun Muramatsu, RT, Fukushima, Japan (*Abstract Co-Author*) Nothing to Disclose Hiroshi Chiba I, Fukushima, Japan (*Abstract Co-Author*) Nothing to Disclose Kouji Hashimoto I, Fukushima, Japan (*Abstract Co-Author*) Nothing to Disclose Masahiro Suzuki, Chuo-Ku, Japan (*Abstract Co-Author*) Nothing to Disclose Shinsuke Tsukagoshi, PhD, Otawara, Japan (*Abstract Co-Author*) Employee, Canon Medical Systems Corporation Kingo Shichinohe, Bunkyo-ku, Japan (*Abstract Co-Author*) Employee, Amin Co Ltd

# **TEACHING POINTS**

1. Purpose of transbronchial approach: Transbronchial biopsy, marking for surgery, and interventional therapy. 2. Bronchial visualization of UHRCT: The bronchus has been able to be depicted to the 3-4 branch periphery compared with the conventional CT(CHRCT). 3. Depiction of the target bronchus of peripheral lung nodule by UHRCT.

# TABLE OF CONTENTS/OUTLINE

Bronchial imaging accuracy was examined in clinical practice and clinical value was considered. Peripheral lung nodules were examined with UHRCT and CHRCT for comparison of depiction. [Subjects] 16 cases / 24 nodules (Average diameter 13 mm ± 6 mm). GGO 7 / Part-solid 15 / Solid 2. [Methods] Identification of bronchi reaching peripheral pulmonary nodules on axial image. Comparison of visible bronchus orders in each image (UHRCT and CHRCT). [Results] Lobular bronchioles (1 mm diameter) and terminal bronchioles (0.5 mm diameter) were clearly depicted by UHRCT. There were more cases where the bronchus could be depicted continuously to the nodule as compared to CHRCT (25% vs. 83%). [Conclusion] UHRCT has the resolution that can depict the airway lumen continuously from the central bronchus to the intralobular bronchiole. It can be used to confirm the presence or absence of bronchial involvement in nodules and to improve the certainty of transbronchial guidance.





#### SSA24

# Vascular/Interventional (Liver Cancer Science)

Sunday, Dec. 1 10:45AM - 12:15PM Room: S404CD



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

#### Participants

Xiaoming Yang, MD, PhD, Mercer Island, WA (*Moderator*) Nothing to Disclose Resmi Charalel, MD, New York, NY (*Moderator*) Nothing to Disclose Amy C. Taylor, MD, Little Rock, AR (*Moderator*) Nothing to Disclose

#### Sub-Events

# SSA24-01 Safety of Shortened Observation Time Without Radiographic Follow-Up for Patients After CT-Guided Lung Biopsy

Sunday, Dec. 1 10:45AM - 10:55AM Room: S404CD

Participants Kenny Ah-Lan, MD, Brossard, QC (*Abstract Co-Author*) Nothing to Disclose Masoud Nakhaei, MD, Boston, MA (*Presenter*) Nothing to Disclose Andres Camacho, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Elisabeth Appel, MD, Dusseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose Olga R. Brook, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Bettina Siewert, MD, Boston, MA (*Abstract Co-Author*) Editor, Wolters Kluwer nv; Reviewer, Wolters Kluwer nv; Muneeb Ahmed, MD, Boston, MA (*Abstract Co-Author*) Research Grant, General Electric Company Stockholder, Agile Devices, Inc Scientific Advisory Board, Agile Devices, Inc

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## PURPOSE

To determine safety of shortened observation without follow up chest X-ray (CXR) after CT-guided lung biopsy in patients without immediate post-procedure pneumothorax (PTX).

#### **METHOD AND MATERIALS**

Consecutive patients that underwent CT-guided lung biopsies under moderate sedation between 01/05/2015 and 06/19/2017 in a tertiary academic center were included in this IRB-approved HIPAA-compliant study. "Immediate post-procedure PTX" was defined as one detected by CT at the end of the biopsy; "observation PTX" and "delayed PTX" defined as pneumothorax detected by CXR during and after the post-procedural monitoring period, respectively.

#### RESULTS

441 lung biopsies for 409 patients (average age  $68 \pm 11$ yrs, 231 (56%) female patients) were performed; 76 biopsies were excluded due to immediate post-procedure PTX, 6 due to insufficient documentation in the electronic medical records and 6 due to lack of follow up after biopsy. Average duration of monitoring for outpatients (n=293) was 2.01 ± 0.74 hrs . In 20/353 (5.7%) biopsies, the patient became symptomatic (chest pain, shortness of breath) during post-procedural observation with 1/20 (5%) developing PTX. In 313/333 biopsies, the asymptomatic patients did not undergo CXR after the procedure, with 7/309 of these patients (2.3%) developing delayed PTX 2-10 days after the procedure (average  $4.9 \pm 4.0$  days). In 24/333 biopsies (7.2%), the asymptomatic patients underwent CXR within 4 hours with no PTX detected and despite that 1/24 of these patients (4.2%) presented with delayed PTX 7 days after the procedure. When no immediate post procedural PTX was present, the rate of observation PTX and delayed PTX was 1/353 (0.3%) and 8/353 (2.3%), respectively.

#### CONCLUSION

Obtaining routine post-procedure CXRs in patients without immediate post-procedural PTX after CT-guided lung biopsies is not necessary given the low likelihood of PTX. Furthermore, shortening monitoring to 2 hour appears to be safe for these patients.

#### **CLINICAL RELEVANCE/APPLICATION**

A decrease in observation time for these subset of patients will allow improved utilization of hospital resources.

# SSA24-02 Transthoracic Ultrasound Guided Lung Biopsy: Accuracy and Safety

Sunday, Dec. 1 10:55AM - 11:05AM Room: S404CD

Participants Simon Lemieux, Quebec, QC (*Presenter*) Nothing to Disclose Taehoo Kim, MD, Moncton, NB (*Abstract Co-Author*) Nothing to Disclose Olivier Pothier-Piccinin, Quebec, QC (*Abstract Co-Author*) Nothing to Disclose Louis-Charles Racine, MD, Quebec, QC (*Abstract Co-Author*) Nothing to Disclose Faraz Firoozi, Quebec, QC (*Abstract Co-Author*) Nothing to Disclose Maxime Drolet, MD, Quebec, QC (*Abstract Co-Author*) Nothing to Disclose Kevin Kennedy, Kansas City, MO (*Abstract Co-Author*) Nothing to Disclose Sergio Pasian, MD, Quebec, QC (*Abstract Co-Author*) Nothing to Disclose Steve Provencher, Quebec, QC (*Abstract Co-Author*) Nothing to Disclose Paula Ugalde, Quebec, QC (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

Variables affecting performance of ultrasound-guided transthoracic needle biopsy (USG-TTNB) are not well established. The aim is to determine the clinical and imagery variables affecting sensitivity and rate of complications with USG-TTNB.

#### **METHOD AND MATERIALS**

From 2008 to 2017, a total of 542 consecutive USG-TTNB were reviewed. Mediastinal and chest wall lesions were excluded. 14 patients had incomplete data. Cubic splines were used to test the functional relationship between pleural contact length with sensitivity and complications. Multivariate logistic regression was used to account for possible confounding variables on that relationship.

#### RESULTS

Of the 528 biopsies, 312 diagnosis were obtained by USG-TTNB, including 285 malignant and 27 specific benign diagnosis, yielding a diagnostic accuracy of 59.2% (95%CI 54-62%) and sensitivity of 72.5% (95%CI 68-77%), respectively. Positive biopsies were associated with lesion size (p<0.001), pleural contact length (p<0.006), absence of pneumothorax (p=0.001), chest wall invasion (p=0.005) and core biopsy needle <=18G versus >18G (p=0.024). Graphical inspection of a cubic spline showed that the probability of positive biopsies rose sharply for increasing pleural contact length up to 30 mm, then a flattening of risk. A similar reverse relationship was observed for pneumothorax. After adjusting for lesion size, chest wall invasion, and core biopsy needle, there was a significant effect of increasing pleural contact length up to 30 mm predicting positive biopsy (HR 1.07 {1.02, 1.12}, p=.002 per 1mm) with a non-significant effect of pleural contact size past 30 mm. Pneumothorax occurred in 14.6% (95%CI 11.7-17.9%) and chest tube was placed in 1.7% (95%CI 0.8-3.2). Variables associated with pneumothorax were lesion size (p<0.001), pleural contact size past 30 mm. Neumothorax were lesion size (p<0.001), pleural contact length (p<0.002). On multivariate analysis, none of the above were significant a 5% level. No variables were associated with hemorrhagic complications, which occurred in 13.3% (95%CI 1.8-4.8).

#### CONCLUSION

Pleural contact length and target lesion size were the key variables predicting diagnostic accuracy and pneumothorax rate.

#### **CLINICAL RELEVANCE/APPLICATION**

Efficacy and safety outcomes are both affected by pleural contact length and lesion size. Therefore, choosing US-TTNB as a diagnostic procedure must consider these variables.

# SSA24-03 Ultrasound- versus CT-Guided Peripheral Lung Biopsies: A Comparison of Safety, Effectiveness, and Wait Times

Sunday, Dec. 1 11:05AM - 11:15AM Room: S404CD

Participants Mirek Mychajlowcyz, MD, Hamilton, ON (*Presenter*) Nothing to Disclose Oleg Mironov, MD, Hamilton, ON (*Abstract Co-Author*) Nothing to Disclose Abdullah Alabousi, MD, Burlington, ON (*Abstract Co-Author*) Nothing to Disclose

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## PURPOSE

To compare the safety, effectiveness and wait times of CT-guided percutaneous lung biopsies with ultrasound (US) guidance for peripheral lung lesions that abut or arise from the pleura.

#### **METHOD AND MATERIALS**

Consecutive CT- and US-guided biopsies performed at our institution between January 2017-January 2019 were retrospectively reviewed. Lesion size, the degree of pleural contact, wait time for the procedure, the number of needle passes, procedure duration, complications and final pathology diagnosis were recorded. Chi-square and Mann-Whitney U tests were used for statistical analysis. Research ethics board approval was obtained.

#### RESULTS

A total of 228 imaging-guided lung biopsies were performed by 5 interventional radiologists. Of these, 117 were for peripheral or pleural-based lesions. US guidance was used for 38 cases (20 men, 18 women, mean age 71.1). CT guidance was used for 70 cases (39 men, 40 women, mean age 69.9). Overall, the mean maximum axial diameter of pulmonary lesions sampled under US guidance was greater than for CT ( $4.8\pm2.5$  cm vs  $3.7\pm1.8$  cm, p = 0.007). Similarly, the length of pleural contact was also greater for US ( $4.1\pm2.4$  cm) than CT ( $2.6\pm1.7$  cm, p < 0.001). Procedure time was shorter for lesions localized with US than CT ( $2.8.7\pm16.9$  min vs  $36.6\pm20.2$  min, p = 0.017). In contrast, the mean number of needle passes per lesion was less for CT than US ( $3.1\pm0.9$  vs  $3.5\pm1.1$ , p = 0.019). The adequacy of biopsy samples was determined to be equivalent for both modalities (97.4% for US and 97.5% for CT). The wait time for both procedures was not significantly different ( $11.7\pm8.3$  days for US vs  $14.9\pm8.0$  days for CT, p = 0.059). Finally, the frequency of significant complications requiring chest tube insertion and/or hospital admission was similar between US and CT (2.6% vs 3.8%).

#### CONCLUSION

LIC auided peripheral lung higherias are safe and reliable with comparable results to CT auided higherias and similar wait times, but

os-guided peripheral lung piopsies are sare and reliable with comparable results to Cr-guided piopsies and similar wait times, but shorter procedure times.

#### **CLINICAL RELEVANCE/APPLICATION**

US is relatively low cost, does not require ionizing radiation and allows for real-time needle visualization, making it a viable alternative to CT guidance for biopsy of peripheral lung lesions.

# SSA24-04 CT-Guided Percutaneous Biopsy of Ever Smaller Lung Nodules: Diagnostic Yield and Complication Rate as a Function of Nodule Size

Sunday, Dec. 1 11:15AM - 11:25AM Room: S404CD

Participants

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### PURPOSE

The number of CT-guided percutaneous lung biopsies performed is rapidly growning, in part due to the advent of lung cancer screening CT. However, not only are we performing more lung biopsies, but we are biopsying ever smaller nodules. Given that subcentimeter nodules have not routinely been biopsied, the diagnostic yield and complication rates are not known. The purpose of this project was to evaluate the diagnostic yield and complication rate of percutaneous lung biopsy as a function of nodule size.

# METHOD AND MATERIALS

This IRB approved study involved retrospective review of 625 patients who underwent percutaneous, CT-guided lung biopsy. Patients were identified via search of our electronic medical records system (Montage). Biopsies were performed by one of fifteen attending radiologists specializing either in interventional radiology or body imaging. Data recorded included nodule size, distance from the pleura, needle type, number of passes peformed, pneumothorax rate, chest tube rate, hospital admission rate, diagnostic yield as well as history of smoking or prior malignancy.

#### RESULTS

Overall, a diagnostic specimen was obtained in 91.5% of patients (572/625). However, diagnotic yield for lesions <1 was 80% compared to 92.1% for nodules > 1 cm (p < 0.05). For every 1 cm increase in lesion size, the odds of achieving a diagnostic specimen increased 21% (p < 0.05). Pneumothorax complicated 11% of biopsies (69/625) and 5.6% of patients (35/625) required chest tube placement. However, 22.5% of procedures were complicated by pneumothorax when lesions were <1 cm, compared to 10.3% of procedures when the nodule was >1 cm (p < 0.05). For every 1 cm increase in nodule size, the odds of pneumothorax decreased 24% (p < 0.05). Although there was no statistically significant difference in patients requiring chest tubes in the two groups, the odds of requiring a chest tube decreased 21% for ever 1 cm increase in lesion size (p < 0.05).

# CONCLUSION

Percutaneous CT-guided lung biopsy is a safe and effective procedure, however the diagnsotic yield decreases and the complication rate increases as the size of the biopsy target decreases.

# **CLINICAL RELEVANCE/APPLICATION**

As the number of CT-guided lung biopsies increases across the country it is crucial that physicians and patients understand that diagnostic yield and complication rates are directly related to nodule size.

# SSA24-05 Efficacy of Thermal Ablation versus Stereotactic Radiotherapy for Stage I Lung Cancer: Subgroup Analyses Based on Tumor Histology

Sunday, Dec. 1 11:25AM - 11:35AM Room: S404CD

Participants

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## PURPOSE

To assess the effectiveness of thermal ablation (TA) versus stereotactic body radiotherapy (SBRT) for stage I lung cancer depending on histology.

# METHOD AND MATERIALS

The National Cancer Database was queried for patients with AJCC stage I lung cancer diagnosed from 2004-2015. Adenocarcinoma, squamous cell carcinoma (SCC), unspecified non-small cell lung cancer (NSCLC) und other histology (except carcinoid) were included. Treatment was stratified as TA (radiofrequency ablation, or grouped laser/cryo ablation) and SBRT (beam-based radiation of the lung). Patients age < 18yo, chemotherapy, and unknown survival /follow up were excluded. SBRT and TA patients were 5:1 propensity score matched to account for confounders, separately for each histology. Overall survival (OS) was compared in the matched cohort.

#### RESULTS

55,336 patients were included: n=68,693 receiving SBRT (97.3%) and n=1,836 receiving TA (2.7%). Histology was adenocarcinoma n=24,085 (35.1%), SCC n=20,736 (30.2%), NSCLC n=10,515 (15.3%), and other histology n=13,357 (19.4%). TA patients were more likely to be younger Caucasians with private insurance and more comorbidities and treated at academic centers in New England states for smaller adenocarcinomas.For each histology, a matched cohort was obtained with balanced distribution of confounders. TA and SBRT demonstrated comparable OS in all subgroups: adenocarcinoma (p=0.297; 1-year OS: 86 vs 86%; 3-year OS: 49 vs 52%), SCC (p=0.086; 1-year OS: 67 vs 67%; 3-year OS: 27 vs 30%), NSCLC (p=0.732; 1-year OS: 83 vs 83%; 3-year OS: 49 vs 47%), and other histologies (p=0.094; 1-year OS: 85 vs 83%; 3-year OS: 59 vs 50%).

# CONCLUSION

Utilization of thermal ablation techniques for stage 1 lung cancer varies with tumor and patient variables. For adenocarcinomas, squamous cell carcinomas and tumors classified as unspecified NSCLC, overall survival was comparable for TA and SBRT. Future studies should prospectively evaluate optimal patient selection criteria in stage I lung cancer to offer individualized treatment approaches.

## **CLINICAL RELEVANCE/APPLICATION**

Thermal ablation shows comparable OS to SBRT in stage I lung cancer and should be considered as an alternative treatment option, independent of histological subtype.

# SSA24-06 Percutaneous Cryoablation of Lung Metastasis:15 Year Experience of Feasibility, Safety and Recurrence Parameters

Sunday, Dec. 1 11:35AM - 11:45AM Room: S404CD

Participants

Hussein D. Aoun, MD, Dearborn, MI (*Abstract Co-Author*) Reviewer, Galil Medical Ltd Peter J. Littrup, MD, Rochester Hills, MI (*Abstract Co-Author*) Founder, CryoMedix, LLC Research Grant, Galil Medical Ltd Research Grant, Endo International plc Consultant, Delphinus Medical Technologies, Inc Hakob Kocharyan, MD, Detroit, MI (*Presenter*) Nothing to Disclose Barbara A. Adam, Detroit, MI (*Abstract Co-Author*) Nothing to Disclose Matthew Prus, BS, Detroit, MI (*Abstract Co-Author*) Nothing to Disclose Mark J. Krycia, MD, Detroit, MI (*Abstract Co-Author*) Nothing to Disclose

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# PURPOSE

To report our long-term experience with CT guided percutaneous cryoablation using intensive freeze parameters for lung metastasis, including factors affecting complications and local recurrence rates.

# METHOD AND MATERIALS

Following IRB approval under HIPAA compliance, 192 CT fluoroscopic-guided, percutaneous cryoablation procedures were performed for 262 masses in 107 outpatients. Primary sites of lung metastasis included colorectal (N=57), renal cell carcinoma (N=38), sarcoma (N=103), gynecologic (N=17), hepatobiliary (N=8) and other (N=24). Tumor size and location (central vs peripheral) with relationship to major vasculature. Hydrodissection and/or were utilized for protection of adjacent structures (ie: esophagus). All complications were graded according to standardized CTCAE criteria. Patients were followed by CT and/or MRI at 1, 3, 6, 12, 18, 24 months and yearly thereafter.

### RESULTS

Average tumor diameter of 2.0 cm was treated by average cryoprobe number of 3.1, which produced CT-visible ice ablation zone diameters averaging 4.1 cm. Grade >3 complications were 3.6% [N=7/192]. There were greater complications in tumors greater/less than 3 cm [9.8% (4/41) vs. 2.0%(3/151)], p<0.025). No deaths occurred in our series for ablation of metastatic lesions. Hydrodissection and/or warming catheter utilization was used in 7.8% (15/192). At a mean follow-up of 24 months, overall local tumor recurrence was 5.7%(15/262), but significantly greater for tumors above 3cm (i.e., 16% (7/44); p<0.005).

#### CONCLUSION

With appropriate pretreatment evaluation and PFT criteria, percutaneous lung cryoablation is safe and produces very low local recurrence rates, especially for tumors <3 cm.

#### **CLINICAL RELEVANCE/APPLICATION**

Appropriately delivered thoracic metastasis cryoablation is affected by tumor size yet still produces low recurrence and complication rates.

# SSA24-07 Innovative Technique for CT-Guided Presurgical Lung Nodule Marking: High Efficacy and Safety

Sunday, Dec. 1 11:45AM - 11:55AM Room: S404CD

Participants

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#### PURPOSE

To assess outcomes of CT-guided localization for preoperative lung nodule marking prior to video-assisted thoracoscopic surgery and robotic video-assisted thoracoscopic surgery.

#### METHOD AND MATERIALS

25 CT-guided lung nodule localization procedures were performed on 26 nodules in 25 patients prior to surgical resection. The procedures were performed by a fellowship trained radiologist 1 to 2 hours prior to scheduled surgery under local anesthesia. Approximately 4 to 6 ml of methylene blue/collagen solution was injected in a perinodular location under CT-guidance with a 19g trocar needle. Post procedure CT images with increased perinodular consolidation confirmed appropriate marking. Patients were then transferred back to surgery.

#### RESULTS

Accurate perinodular CT- guided needle trocar placement was achieved in all marking procedures. Increased perinodular consolidation was also demonstrated in all patients on the post procedural localized CT scans. One patient with moderate emphysema developed a small to moderate sized pneumothorax and a 8F thoracentesis catheter was placed under CT guidance prior to return to surgery. There was no noted bleeding or hemoptysis in any of the patients. Methylene blue/collagen solution was readily visible by the thoracic surgeon in association with all target nodules. One patient required conversion to open procedure due to advanced disease. Of the 26 identified nodules, pathology specimens confirmed adequacy of nodule resection in all cases.

#### CONCLUSION

Intraoperative identification of pulmonary nodules/ tumors, especially deep nodules and patients undergoing VATS or robotic surgery, may be challenging. Perinodular localization by CT guided methylene blue/ collagen solution injection offers a safe technique with high efficacy.

#### **CLINICAL RELEVANCE/APPLICATION**

CT-guided methylene blue/ collagen localization allows thoracic surgeons to readily identify nodules/tumors, improve outcomes and decrease morbidity in patients undergoing thoracic surgery.

## SSA24-08 Percutaneous CT-Guided Microwave Ablation of Non-Operable Pulmonary Metastases: Role of Apparent Diffusion Coefficient in Assessment Early Treatment Response

Sunday, Dec. 1 11:55AM - 12:05PM Room: S404CD

Participants

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#### PURPOSE

To determine retrospectively the early treatment response of MWA in patients with pulmonary metastases using Apparent diffusion coefficient(ADC) value.

#### **METHOD AND MATERIALS**

51 patients with 76 lung metastatic lesions were included &treated with MWA according to the guidelines. lesions were evaluated by diffusion weighted imaging (DWI) and ADC value before and 24 hours after MWA. DWI was obtained with b-values (50,400, 800:mm2/s) using 1.5& 3 tesla MRI. Postablation follow-up by chest CT and/or MRI with ADC value measurement was done after 24 hours, 3, 6 months, 1 year and every 6 months onwards to determine responsive and local progression cases with residual tumor activity.Immediate postablation changes in ADC values were compared to the net response based on CT and/or MRI follow-up

#### RESULTS

50 lesions(65.8%) showed complete response to treatment and 24 lesions(34.2%)with local progression.We reported statistical significance difference of ADC value measured 24 hours after ablation between the responding( $1.7 \pm 0.2x 10-3 \text{ mm2/s}$ ) and non-responding groups( $1.4 \pm 0.2x10 0-3 \text{ mm2/s}$ ) with significant relatively higher values at the former(P0.001); a cut-off ADC value (1.41) has been suggested as reference point to predict the response (66.65% Sensitivity, 84.22%Specificity, 66.72%PPV& 84.21%NPV). No significant difference of ADC value performed before the ablation as a prognostic factor for the response (P0.85). No significant difference in post- ablation ADC values of different types of pulmonary metastases (P 0.321)

#### CONCLUSION

ADC value calculated 24 hours post-treatment is a good quantitative measurement that may allow early prediction of the treatment efficacy of MWA of pulmonary metastases before changes in tumor size become detectable on Conventional CT or MRI.

#### **CLINICAL RELEVANCE/APPLICATION**

ADC can evaluate early MWA efficacy in treatment of pulmonary tumors and Can predict tumor recurrence after treatment.

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## SSA24-09 Palliative Role of Non-Selective Intra-Aortic Transarterial Chemoperfusion (TACP) in the Management of Inoperable Cases of Advanced Lung Cancer

Sunday, Dec. 1 12:05PM - 12:15PM Room: S404CD

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#### PURPOSE

To evaluate the initial tumor response, local control, and survival after the treatment of primary lung malignancies using nonselective intra-aortic transarterial chemoperfusion (TACP) in palliative intent.

## METHOD AND MATERIALS

Forty-two patients (mean:  $63\pm11$  years; 19 females and 23 males) with advanced unresectable lung cancer (stage III=8 & stage IV=34), underwent repetitive TACP, as third- or further-line therapy, between November 2006 and January 2016. The mean number of sessions was  $5.3\pm2.5$ . The treated pathologies were non-small cell lung cancer (n=29), small cell lung cancer (n=1) and 12 cases of bronchogenic carcinoma with unknown histology. Bilateral lung involvement was present in 61.9% of cases and the median number of lesions was four. Regional delivery was achieved by injecting the chemotherapeutic agents intra-aortic, as a bolus with maximum hand pressure, in close vicinity to the origins of the main tumor-supplying arteries. The treatment regimen included a combination of mitomycin C and Gemcitabine with (n=37) or without cisplatin (n= 3). Two patients received other combinations after their oncologists' recommendations. The treatment was performed in a palliative setting and patients who underwent subsequent ablation were excluded. The response was evaluated according to the revised RECIST criteria and local tumor progression and patient survival were analyzed using the Kaplan-Meier estimator.

#### RESULTS

Partial response (PR) was achieved in 4.8% (n=2), stable disease (SD) in 69% (n=29) and progressive disease (PD) in 26.2% (n=11). The estimated mean survival time (MST), median survival time and mean and median time to progression were  $20\pm5.5$ ,  $9.5\pm0.6$ ,  $10.7\pm1.8$  and  $6.7\pm2.2$  months, respectively. Technical success was achieved in all patients and no intervention-related complications were recorded.

## CONCLUSION

Transarterial chemoperfusion is a feasible and well-tolerated treatment in patients with advanced lung cancer who failed prior systemic chemotherapy and have the potential to improve local control and survival, when compared to the published results of other third - and further-line therapies.

## **CLINICAL RELEVANCE/APPLICATION**

TACP is a minimally invasive treatment option that can positively affect the local control and survival in patients with advanced lung cancer.





# SSA25

# Vascular/Interventional (Embolization)

Sunday, Dec. 1 10:45AM - 12:15PM Room: S405AB



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

#### Participants

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#### Sub-Events

## SSA25-01 Hepatic Pseudoaneurysm Formation after Blunt and Penetrating Traumatic Liver Injury: A Level 1 Trauma Centre Experience

Sunday, Dec. 1 10:45AM - 10:55AM Room: S405AB

Participants

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#### PURPOSE

At our institution, we have developed an imaging protocol for liver injury patients which involves repeat computed tomographic (CT) angiography of the liver at 48-72 hours to assess specifically for HPAs. The purpose of this study was to evaluate the utility of our imaging pathway in liver trauma with a focus on detection of hepatic pseudoaneurysms (HPAs).

#### **METHOD AND MATERIALS**

A retrospective analysis was performed on patients who were admitted to St Mary's Hospital, London over a four-year period found to have either blunt or penetrating liver injury on initial CT imagining. Data collection included initial and follow-up CT findings, mechanism of injury, injury severity score (ISS), American Association for the Surgery of Trauma (AAST) liver injury score and further intervention.

## RESULTS

Between January 2014 and January 2018, 149 major trauma patients were admitted with liver injuries (mean age 35.6 years; 72% male, 28% female). 72% patients suffered blunt (mean ISS=27.2; mean AAST=2.89) and 28% patients suffered penetrating injuries (mean ISS=26.9; mean AAST=2.88). Mean time to follow up CT was 46.05 hours. Follow-up CT identified 8 HPAs (62.5% blunt vs 37.5% penetrating injuries) and 1 (0.671%) arteriovenous malformation. 6 (4.03%) of these patients were treated with embolisation. ISS and AAST did not predict pseudoaneurysm formation according to logistic regression analysis. ISS (OR 1.06 [1.02, 1.09; p=0.002]) and AAST (OR 2.24, [1.31, 3.83; p=0.003]) were predictors of requirement for embolisation.

#### CONCLUSION

Our experience indicates a role for early detection of HPAs using a dedicated trauma imaging pathway. Interestingly, ISS and AAST are predictors for patients who will undergo interventional radiology procedures and could be used to stratify patients who should be planned for interventional procedures.

## **CLINICAL RELEVANCE/APPLICATION**

Hepatic pseudoaneurysm (HPA) is a rare but potentially life-threatening sequelae of blunt or penetrating liver trauma.

## SSA25-02 Performance of a Novel, Bioengineered, Retrievable Endovascular Gel Embolic in a Swine Model: Long Term Survival Data

Sunday, Dec. 1 10:55AM - 11:05AM Room: S405AB

Participants

Rahmi Oklu, MD, PhD, Phoenix, AZ (*Presenter*) Founder and Chief Medical Officer, Obsidio, Inc Jingjie Hu, Phoenix, AZ (*Abstract Co-Author*) Nothing to Disclose Izzet Altun, Scottsdale, AZ (*Abstract Co-Author*) Nothing to Disclose Zefu Zhang, MD, Pheonix, AZ (*Abstract Co-Author*) Nothing to Disclose Hassan Albadawi, MD, Phoenix, AZ (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

Coil embolization is used today to treat hemorrhage resulting from trauma, aneurysm rupture, or bleeding tumor. However, these coils are often ineffective in a state of anticoagulation. The purpose of this study was to study the long term effects of embolization using a bioengineered gel embolic material in a swine model.

#### **METHOD AND MATERIALS**

Yorkshire pigs weighing 50-60kg were used and anticoagulated with IV heparin (ACT 250-500). Briefly, via carotid artery access under US guidance, a catheter was delivered to the pelvic arteries or renal arteries. On one side, coil embolization was performed. On the other side, approximately 3 cc of the embolic material was injected. On day of sacrifice, Day 0, Day 7, Day 14 and Day 28, all animals underwent CTA using a Force CT scanner and embolized arteries were harvested and histology was performed. CBC, Chem-7, coagulation tests, cytokine arrays were performed pre and post embolization. Extensive image analysis was performed using standard CT scanner and a high resolution micro-CT scanner.

#### RESULTS

Arteries embolized with all types of coils demonstrated persistent flow. Arteries embolized with 3 cc of biomaterials achieved instant hemostasis and complete embolization regardless of anticoagulation state. Injection of 1-2 cc of biomaterial to the coiled arteries was able to rescue and achieve instant hemostasis. In addition, injected biomaterial could be successfully retrieved. Embolization with biomaterial was 40X faster than with coils (P<0.05). Histology of the embolized arteries demonstrated complete filling of the artery; however, there was progressive biodegradation of the biomaterial over time with its replacement with fibrotic tissue. CBC and chemistry labs as well as inflammatory markers were not significantly different pre and post embolization (P<0.05). Scanning electron microscope images, micro-CT and CT analysis of the embolized arteries showed absence of recanalization of the biomaterial.

#### CONCLUSION

Novel gel embolic outperforms coil technologies in every aspect tested. Biomaterials can also be retrieved suggesting that temporary embolization could be possible.

#### **CLINICAL RELEVANCE/APPLICATION**

We present data on >130 embolized swine arteries and demonstrate its superiority over coils and their efficacy. This biocompatible biomaterial is also easy to deliver and easy to use compared to coils.

## SSA25-03 Selective Bariatric Arterial Embolization with Calibrated 100-200 µm Radiopaque Microspheres Suppresses Weight Gain in Swine

Sunday, Dec. 1 11:05AM - 11:15AM Room: S405AB

Participants

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## PURPOSE

To assess whether calibrated radiopaque microspheres used for bariatric arterial embolization (BAE) enable fundal coverage assessment and weight gain suppression over an 8-week period in swine.

## METHOD AND MATERIALS

BAE was performed in 5 healthy swine ( $\sim$ 23kg) under X-ray guidance by selective infusion of calibrated 100-200 µm radiopaque microsphere (BTG) into the left gastroepiploic artery and right gastric artery. Control pigs (n=3) underwent a sham procedure. Weight was obtained at baseline and weekly until 8 weeks after embolization. Cone beam CT (CBCT) images of the stomachs were acquired immediately after embolization, at 8 weeks prior to sacrifice and postmortem to examine the persistence of embolic microspheres. Endoscopy was performed at 1-2 weeks after embolization to examine mucosal ulceration. Plasma ghrelin levels were assessed using a radioimmunoassay.

#### RESULTS

BAE with radiopaque microspheres was technically feasible in all embolized animals with the visualization of microspheres on both Xray and CBCT during the procedure and up to 8 weeks after embolization. Superficial mild mucosal ulcers restricted mainly to the stomach fundus and body were noted in all BAE pigs. One BAE animal had minimal embolics delivered in the fundus as assessed by CBCTs with concurrent normal weight gain as control pigs. Overall, a significant reduction of the percentage of weight gain was noted in embolized pigs as compared to controls ( $42.3\% \pm 5.7$  BAE vs.  $51.6\% \pm 2.9$  controls, p=0.04). Similarly, the plasma ghrelin levels of embolized animals were significantly lower than those of controls ( $1709 \pm 172$  BAE vs.  $4343 \pm 1555$  controls at 8 weeks, p<0.01).

## CONCLUSION

The radiopacity of the embolics enabled qualitative assessment of the fundal coverage. The significantly suppressed percentages of

weight gain and systemic plasma ghrelin levels suggests that the calibrated 100-200  $\mu$ m microspheres may be the optimal embolics for effective weight management via BAE.

## **CLINICAL RELEVANCE/APPLICATION**

Calibrated radiopaque microspheres could facilitate image-guided BAE for treating obesity.

## SSA25-04 Digital Subtraction Angiography versus Digital Variance Angiography for Image Guidance of Prostatic Artery Embolization (PAE)

Sunday, Dec. 1 11:15AM - 11:25AM Room: S405AB

Participants

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#### PURPOSE

Kinetic imaging is defined as a novel X-ray image processing method for the visualization of contrast motion. The algorithm produces so-called Digital Variance Angiography (DVA) images. The study objective was to compare the performance of DVA versus standard digital subtraction angiography (DSA) for vascular intervention in Prostatic Artery Embolization (PAE) of benign prostatic hyperplasia.

## METHOD AND MATERIALS

81 angiographic acquisitions of 26 patients (mean age 67.47, SD 9.76, range 42-82) undergoing PAE at our institution were evaluated. Signal-to-noise ratio (SNR) of DSA and DVA pairs was compared using regions of interest. Comparison of clinical image quality was performed by three experienced interventional radiologists in a randomized blinded trial comparing the DSA- and DVAvideos, using a 5-point-Likert-scale consisting of clinically relevant criteria (e.g. visibility of feeding- and collateral-branches, size of examinable arteries). Fleiss' kappa-test was used to determine interrater agreement.

#### RESULTS

DVA images provided 1.79 times higher SNR than DSA (median value, Q1-Q3 interval was 1.46-2- 32). The visual evaluation indicated that DVA-videos provided higher quality images than DSA-videos, since in 80.6% of comparisons evaluators preferred DVA over DSA. The interrater agreement was 83.8% and Fleiss's kappa was 0.38 (p<0.001).

#### CONCLUSION

In PAE setting, DVA-imaging enhances visualization of anatomical structures, compared to DSA- imaging, via significant SNR increase, thereby the new technology might improve the safety and efficacy of the intervention. As an additional advantage, the observed quality reserve of DVA might provide opportunity also for the reduction of radiation-dose and the amount of contrast agent, as an attempt to solve these major issues related to PAE procedures.

#### **CLINICAL RELEVANCE/APPLICATION**

DVA may improve safety and confidence during PAE interventions, by reducing image-noise and enhancing the visibility of small vascular structures, thus facilitating the reduction of radiation-dose and contrast agent, which is one of the major concerns for safety of PAE interventions.

## SSA25-06 Detection of Reperfused Pulmonary Arteriovenous Malformations on Dynamic Ultrafast Contrast Enhanced Magnetic-Resonance-Angiography (MRA) and High Resolution Static CE MRA

Sunday, Dec. 1 11:35AM - 11:45AM Room: S405AB

Participants

Guenther K. Schneider, MD, PhD, Homburg, Germany (*Presenter*) Research Grant, Siemens AG; Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Research Grant, Bracco Group;

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Nikolaus Fanderl, Homburg, Germany (Abstract Co-Author) Nothing to Disclose
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Arno Buecker, MD, Homburg, Germany (*Abstract Co-Author*) Consultant, Bracco Group Speaker, Bracco Group Consultant, Medtronic plc Speaker, Medtronic plc Research Grant, Novartis AG Research Grant, GlaxoSmithKline plc Research Grant, Biotest AG Research Grant, OncoGenex Pharmaceuticals, Inc Research Grant, Bristol-Myers Squibb Company Research Grant, Eli Lilly & Company Research Grant, Pfizer Inc Research Grant, F. Hoffmann-La Roche Ltd Research Grant, sanofi-aventis Group Research Grant, Merrimack Pharmaceuticals, Inc Research Grant, Sirtex Medical Ltd Research Grant, Concordia Healthcare Corp Research Grant, AbbVie Inc Research Grant, Takeda Pharmaceutical Company Limited Research Grant, Merck & Co, Inc Research Grant, Affimed NV Research Grant, Bayer AG Research Grant, Johnson & Johnson Research Grant, Seattle Genetics, Inc Research Grant, Onyx Pharmaceuticals, Inc Research Grant, Synta Pharmaceuticals Corp Research Grant, Siemens AG Research Grant, iSYMED GmbH Research Grant, Abbott Laboratories Co-founder, Aachen Resonance GmbH

Paul S. Raczeck, MD, Homburg, Germany (Abstract Co-Author) Nothing to Disclose

Tobias Woerner, MD, Homburg, Germany (Abstract Co-Author) Nothing to Disclose

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#### PURPOSE

The recommended treatment of pulmonary AV-Malformations in patients with HHT (Osler disease) is catheter embolization using platinum coils or vascular plugs. However, in up to 30 percent of patients, reperfusion may occur due to opening of collateral vessels or reopening of the treated vessel itself. The aim of our study was to investigate patients post treatment of pulmonary

AVM's for possible reperfusion using dynamic and high resolution CE MRA.

## METHOD AND MATERIALS

72 patients with previous treatment of PAVMs by either coil embolization or implantation of Amplatzer vascular plugs underwent follow-up studies for detection of reperfused PAVM by contrast enhanced MRA. A time-resolved MRA-study was performed with injection of a small contrast medium bolus (0.025 mmol/kg BW MultiHance, Bracco). The temporal resolution of the sequence was < 3 sec/dataset with a total number of 72 slices. Thereafter a high resolution CE MRA (0.075 mmol/kg BW MultiHance) was performed. Images were evaluated regarding enhancement of the AVM and if detected, time of enhancement of the draining vein was further evaluated.

#### RESULTS

In 22 pts 33 reperfused PAVM were diagnosed based on both time-resolved and high-resolution MRA. If findings were unclear on high resolution images, evaluation of the enhancement kinetics of the draining vein was helpful to distinguish between retrograde filling, filling of the still dilated draining vein via normal lung tissue and reperfusion by reopening of shunt vessels or new collateral supply. All reperfused PAVM were confirmed by DSA and underwent reembolization. The mean diameter of reperfused vessels was 4.5 mm (SD 1.4). Reperfusion was detected both after coil embolization and implantation of Amplatzer vascular plug 4. Interestingly reperfusion may even occur after longer time intervals of completely occluded vessels.

#### CONCLUSION

Contrast-enhanced MR-Angiography can reliably depict reperfusion / recanalization of treated PAVM. Reperfusion might even occur after longer time intervals after initial complete occlusion, thus regular follow-up studies are mandatory.

# **CLINICAL RELEVANCE/APPLICATION**

Reperfusion of PAVM can occur in up to 30 percent of cases and early detection is mandatory to avoidcomplications. Dynamic CE MRA directly depicts early enhancement of the draining vein as a sign of reperfusion and thus can give important additional information not gained in conventional acquisitions or CT.

## SSA25-07 Quantitative 2D DSA: A Novel Method for Determining Treatment Endpoints during Transarterial Embolization

Sunday, Dec. 1 11:45AM - 11:55AM Room: S405AB

#### Participants

Carson Hoffman, Madison, WI (*Presenter*) Nothing to Disclose Sarvesh Periyasamy, MS, Madison, WI (*Abstract Co-Author*) Nothing to Disclose Yijing Wu, Madison, WI (*Abstract Co-Author*) Nothing to Disclose Michael Speidel, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose Paul F. Laeseke, MD, PhD, Madison, WI (*Abstract Co-Author*) Consultant, NeuWave Medical, Inc ; Shareholder, Elucent Medical ; Consultant, Elucent Medical ; Shareholder, HistoSonics, Inc; Consultant, HistoSonics, Inc; Shareholder, McGinley Orthopaedic Innovations, LLC; Grant, Siemens AG

#### PURPOSE

Treatment endpoints during transarterial embolization (TAE) are subjective and rely on visual recognition of contrast stasis postembolization. 2D DSA provides the necessary spatial resolution and dynamic contrast information to visualize the hepatic vasculature during liver-directed therapies. This study sought to evaluate temporal 2D DSA velocity variations and contrast stasis post injection as quantitative endpoints during TAE.

## METHOD AND MATERIALS

A left hepatic TAE was performed to complete stasis on an ~50kg female domestic swine using 100-300  $\mu$ m microspheres. 2D DSA velocity and pulsatility persistence values (n=3 each per time point) were evaluated on two projection angles before (time point 1), sequentially during (time points 2 & 3) and after TAE (time point 4). For the 2D DSA acquisitions, iodinated contrast medium was injected at 2.5 mL/s for 15 mL with respiration suspended. Velocity was derived from a shifted least-square method that relies on the pulsatility of opacified blood from an intra-arterial iodine injection. Pulsatility persistence (contrast stasis metric) was defined as the time interval between the final left hepatic (LH) contrast peak (50% greater than baseline) and the time of common hepatic artery (CHA) contrast clearance.

#### RESULTS

Sequential 2D DSA velocity measurements during TAE (time points 2 & 3) decreased on both projection angles. The average variation of velocity was 3.1% for the first 3 time points and 20.4% for the final time point. Velocity was not accurately quantified on the final time point when stasis was achieved due to reflux disturbing the baseline pulsatility. The average contrast clearance time calculated for the CHA was  $10.0 \pm 0.2$  sec. Pulsatility persistence was zero for the first 2 time points, increased on the 3rd time point and was highest on the 4th time point when stasis was reached.

#### CONCLUSION

2D DSA can provide quantitative measurements of velocity and pulsatility persistence in vivo. A combination of these metrics could help define more objective endpoints during TAE.

## **CLINICAL RELEVANCE/APPLICATION**

2D DSA velocity, when combined with pulsatility persistence post contrast injection, may facilitate development of quantitative endpoints for transarterial embolization.

## SSA25-08 Emergency Endovascular Treatments for Delayed Hemorrhage after Pancreaticobiliary Surgery: Indications, Outcomes and Follow-Up of a Retrospective Cohort

Riccardo Muglia, MD, Pieve Emanuele , Italy (*Abstract Co-Author*) Nothing to Disclose Ezio Lanza, MD, Rozzano, Italy (*Presenter*) Nothing to Disclose Dario Poretti, MD, Rozzano, Italy (*Abstract Co-Author*) Nothing to Disclose Felice D'Antuono, MD, Rocchetta Sant'Antonio, Italy (*Abstract Co-Author*) Nothing to Disclose Nicolo Gennaro, MD, Trento, Italy (*Abstract Co-Author*) Nothing to Disclose Francesca Gavazzi, Rozzano , Italy (*Abstract Co-Author*) Nothing to Disclose Alessandro Zerbi, Rozzano, Italy (*Abstract Co-Author*) Nothing to Disclose Arturo Chiti, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose Vittorio Pedicini, Napoli, Italy (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To evaluate the outcomes of emergency endovascular treatments for delayed bleeding after pancreaticobiliary surgery.

## **METHOD AND MATERIALS**

We retrospectively evaluated 21 patients (M:F=13:8, median age=64 years) undergoing 23 endovascular treatments, performed from 2010 to 2017 in a single center. Data collected were: patient characteristics; surgery; pathology; incidence of postoperative pancreatic fistulas (POPF); bleeding signs on CT and angiography; damaged artery; endovascular tools used; technical and clinical success; intervals between surgery, endovascular treatment and discharge; survival rates. Sixteen patients had pancreatoduodenectomy, three hepaticojejunostomy, two distal pancreatectomy. Indications to surgery were mainly biliary (33%), pancreatic (19%) or duodenal (10%) malignancies.

#### RESULTS

Seventeen patients had 'grade C' POPF, three suffered a biliary leak, one had no POPF. Active bleeding was present in 17/23 CTs and in 22/23 angiographies, mostly from hepatic (43%), gastroduodenal (22%) and splenic (13%) arteries. Embolizations were performed with coils (26%), glue (22%), stent-graft or vascular prostheses (22%) and their combinations (30%). Sixteen patients had a single endovascular treatment, one underwent a second embolization, three had surgery, one had repeat embolization followed by surgery. Relaparotomy rate was 19%. Median hospital stay was 37 days (range 12-75); median intervals among pancreaticobiliary surgery, endovascular treatment and discharge were 21 (2-36) and 12 (8-47) days, respectively. We observed 4/21 intrahospital deaths (median: 31 days from endovascular treatment, 4-53); one-year survival rate of discharged patients was 71%.

#### CONCLUSION

In our experience, endovascular treatment using embolization and/or stent-graft placement is a useful first-line intervention to halt postoperative hemorrhage after pancreaticobiliary surgery.

#### **CLINICAL RELEVANCE/APPLICATION**

Avoiding hazardous relaparotomy, the endovascular treatment should be considered the first-line intervention for patients suffering from delayed hemorrhage after pancreaticobiliary surgery.

# SSA25-09 4D-Cone Beam Computed Tomography(4D-CBCT) for Image Guidance during Prostatic Artery Embolization (PAE): Feasibility and Comparison to Magnetic Resonance Angiography (MRA)

Sunday, Dec. 1 12:05PM - 12:15PM Room: S405AB

Participants Leona Alizadeh, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose Thomas J. Vogl, MD, PhD, Frankfurt, Germany (*Presenter*) Nothing to Disclose Nagy N. Naguib, MD, MSc, Frankurt, Germany (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To evaluate pelvic 4-Dimensional-ConeBeamComputedTomography (4D-CBCT)-DigitalSubtractionAngiography (DSA) for intraprocedural application of prostatic artery embolization (PAE). Our aim was to test this novel techniques performance against established preinterventional MagneticResonanceAngiography(MRA).

#### **METHOD AND MATERIALS**

21 patients(age range: 47-81years; mean: 66years) undergoing PAE at our institution were included. 4D-CBCT volumes were reconstructed from a single contrast-injection 5-second-conebeamCT run, which was using the altered locoregional distribution of contrast-agent between the volumes' single images, to calculate visualization of real-time temporal-resolution DSA. Image-quality of 4D-CBCT was compared by three independent readers to established prostatic MR-angiography in terms of visualization of prostatic vessels, collaterals to neighboring organs, reproducibility of image-quality(IQ) and general, or contralateral, prostatic parenchymal enhancement prior to embolization.

#### RESULTS

Success rates of MRA-acquisitions in identifying feeding vessels were 17 of 21 versus 28 of 29 4D-CBCT-acquisitions. In 12 patients 4D-CBCT provided additional information compared to MRA, which influenced the treatment decision in 9 cases of 21 patients, by dynamically visualizing crossflow, anatomical variants of prostatic arteries, preventing potential nontarget embolization. Variants in blood-supply were found in 6 patients, multiple feeding prostatic arteries in in 4 patients and contralateral perfusion in 2 patients. Prostatic perfusion was confirmed before embolization for all patients. Spatial resolution of 4D-CBCT was 0.1mm compared to 0.9mm for the MRA.

## CONCLUSION

Time-resolved 4D-CBCT is a feasible method to create vascular volumes with exceeding image-quality for PAE-procedures, compared to common MRA and DSA alone. The 4D-CBCTs maximum-intensity-projections' spatial- and temporal-resolution surpasses that of MRA-acquisitions especially with small vessels, such as the prostatic arteries, also with a higher contrast compared to conventional DSA.

#### **CLINICAL RELEVANCE/APPLICATION**

4D-CBCT is a novel approach for intraprocedural image guidance during prostatic artery embolization, that generates additional information and safety, compared to MRA and DSA alone.







# VIS-SUA

# Vascular Interventional Sunday Poster Discussions

Sunday, Dec. 1 12:30PM - 1:00PM Room: VI Community, Learning Center



FDA Discussions may include off-label uses.

## Participants

Seetharam C. Chadalavada, MD, MS, Cincinnati, OH (Moderator) Nothing to Disclose

## Sub-Events

#### VI200-SD-SUA1 Assessment of Semiquantitative Parameters of Dynamic Contrast-Enhanced Perfusion MR Imaging in Predicting the Nonperfused Volume Ratio of at Least 80%: High-Intensity Focused Ultrasound Ablation of Uterine Fibroids

Station #1

Participants

Bilgin Keserci, PhD, Kota Bharu, Malaysia (*Abstract Co-Author*) Nothing to Disclose Nguyen Minh Duc, MD, Ho Chi Minh, Vietnam (*Presenter*) Nothing to Disclose

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## PURPOSE

To investigate the role of semiquantitative T1 perfusion parameters in predicting the uterine fibroid treatment outcome of magnetic resonance-guided high-intensity focused ultrasound (MRgHIFU) ablation with an immediate nonperfused volume (NPV) ratio of at least 80%.

## METHOD AND MATERIALS

This study protocol was designed as a prospective study. 90 women (mean age,  $39.9\pm5.5$  years with a range of 22-53 years) underwent volumetric MRgHIFU ablation during a period of 15 months beginning June 2015 were divided into two groups: group 1 (n = 56, NPV ratio of at least 80%) and group 2 (n = 34, NPV ratio less than 80%). The software automatically generated time-SI curves and then calculated the semiquantitative perfusion parameters of each region of interest of uterine fibroids on perfusion axial MR imaging data. The receiver operating characteristic (ROC) curve was further analyzed to determine the area under the curve (AUC) of each semiquantitative parameter.

#### RESULTS

The mean NPV ratio for groups I and II was  $96.1\% \pm 5.8$  (80-100%) and  $50.7\% \pm 26.9$  (4.3-79.7%), respectively. The semiquantitative perfusion parameters were significantly different in both groups. The ROC curve analyses revealed that the AUC for relative enhancement, maximum enhancement, maximum relative enhancement, time to peak, wash-in rate and the area under the time-signal intensity curve of uterine fibroids for predicting the immediate NPV ratio of at least 80% was 0.746, 0.851, 0.777, 0.204, 0.911 and 0.720, respectively.

## CONCLUSION

Our findings revealed that semi-quantitative perfusion parameters were effective factors in predicting the NPV ratio of at least 80%. Wash-in rate parameter was the highest AUC in predicting the treatment success defined as NPV ratio of at least 80%.

## **CLINICAL RELEVANCE/APPLICATION**

MRgHIFU ablation for uterine fibroids is a noninvasive therapeutic treatment to preserve the uterus. The achievement of NPV ratio of at least 80% in HIFU treatment of uterine fibroids based on significant semi-quantitative perfusion parameters as a measure of technical success appears to be clinically possible without sacrificing the safety.

# VI202-SD- Magnetic Resonance Angiography Derived Predictors of Aortic Root Dilation in Marfan Syndrome SUA3

## Station #3

Participants Julius M. Weinrich, Hamburg, Germany (*Presenter*) Nothing to Disclose Cyrus Behzadi, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose Gerhard Schon, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose Bjoern Schoennagel, MD, Hamburg, Germany (*Abstract Co-Author*) Co-founder and Stakeholder, Northh-Medical GmbH Isabel Molwitz, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose Alexander Lenz, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose Gerhard B. Adam, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose Frank Oliver G. Henes, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose Yskert von Kodolitsch, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose Peter Bannas, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To identify predictors of aortic root dilation derived from magnetic resonance angiography (MR-angiography) in patients with Marfan syndrome.

## METHOD AND MATERIALS

Material and Methods: We retrospectively included 160 Marfan patients (average age:  $33 \pm 17$  years; 64 male) with a total of 496 MR-angiographies who underwent a median of four MR-angiographies (range: 2-11) in annual intervals. Based on the absolute diameter, age and body surface we calculated Z-scores for each patient. Aortic root morphology was subdivided into three different types: 1: no dilatation, 2: localized anulo-aortic dilatation, 3: generalized aortic root dilatation. Aortic root morphology, age, as well as baseline diameter and Z-score were tested for prediction of aortic root dilatation using a random-coefficient model.

#### RESULTS

40/160 patients (25%) had normal aortic root diameters, 75/160 patients (47%) had a localized anulo-aortic dilatation, and 45/160 patients (28%) had a generalized aortic root dilatation. Average growth of the aortic root for all patients was  $0.6 \pm 0.3$  mm/y (Z-score:  $0.06 \pm 0.01/y$ ). Both baseline diameter and Z-score were predictors for rapid growth: a higher diameter or Z-score indicated a faster growth of the aortic root (both p<0.001). Age was a predictor for the increase of absolute aortic root diameters: younger patients showed a faster diameter growth than older patients (p<0.001). However, age was no significant predictor with regard to Z-scores (p=0.2), taking into account ongoing body growth in younger patients. Different aortic root morphologies (normal vs. localized vs. generalized dilatation) did not predict growth of the aortic root (diameter: p=0.8; Z-score: p=0.5).

## CONCLUSION

Age and type of aortic root morphology do not predict aortic growth, while a larger baseline aortic root diameter predicts progressive aortic root dilatation in Marfan patients.

#### **CLINICAL RELEVANCE/APPLICATION**

Aortic root diameter is a predictor for rapid growth and may allow to improve the risk stratification in Marfan patients: patients with smaller aortic diameters could be screened less frequently.

# VI238-SD- Percutaneous Laser Ablation under Ultrasound-Guidance of Normal Thyroid Gland in a Swine Model SUA4

Station #4

Participants Fourat Ridouani, MD, New York, NY (*Presenter*) Nothing to Disclose Michael R. Tuttle, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Fuad Nurili, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Richard J. Wong, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Sebastien Monette, New York, NY (*Abstract Co-Author*) Nothing to Disclose Duan Li, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Stephen B. Solomon, MD, New York, NY (*Abstract Co-Author*) Consultant, BTG International Ltd ; Consultant, Johnson & Johnson; Consultant, XACT Robotics; Consultant, Endoways; Consultant, Aperture Medical Technology; Researcher, General Electric Company; Researcher, Johnson & Johnson; Researcher, AngioDynamics, Inc; Stockholder, Aspire Bariatrics; Stockholder, Johnson & Johnson; Stockholder, Immunomedics, Inc; Stockholder, Strongbridge; Stockholder, Progenics Pharmaceuticals, Inc; Stockholder, Aperture Medical Technology; Stockholder, Innoblative; Stockholder, Surefire Medical, Inc Juan C. Camacho, MD, Charleston, SC (*Abstract Co-Author*) Research Grant, El.en.

## PURPOSE

The aim of this study was to evaluate the safety and feasibility of percutaneous ultrasound-guided ablation using a laser source applicator, as well as to provide insights about the correlation between energy parameters and ablation margin of normal thyroid tissue of a swine model

#### **METHOD AND MATERIALS**

An interstitial thyroid laser application (Echolaser X4, Nd: YAG 1064nm) was performed on 8 pigs under ultrasound guidance (US). Computed tomography (CT) was used before and after procedure to assess the ablation zone and any adverse events. Hydrodissection with saline was performed before the procedure to protect the trachea and the surrounding vascular structures.Under US guidance, a 21-gauge needle was inserted into the thyroid gland. The distal tip of the fiber was then placed in the middle of the gland. For 4 animals, ablation was applied at 3 W and 1400 J and for the other 4 at 3 W and 1800 J. Histological evaluation was obtained after the procedure on necroscopy tissue.

#### RESULTS

There were no technical limitations to the performance of the procedure and no major complications were recorded. The mean volume of the thyroid gland was  $3\pm 2$  mL. The mean volume of ablation tissue measured on gross pathologic images was  $0.58\pm0.05$  mL at a laser power of 3 W and 1400 J and closely matched measurements from CT. Thermal damage on collagen was observed in all animals on histological examination. Results are still pending for the second group whose ablation energy was 3 W and 1800 J.

# CONCLUSION

PLA of thyroid gland is safe and feasible in a swine model. Moreover, PLA induces well-defined tissue ablation correlated with energy parameters in normal thyroid tissue.

## **CLINICAL RELEVANCE/APPLICATION**

Patients with Papillary Thyroid Microcarcinoma (PTMC) opting for therapeutic intervention rather than active surveillance can be considered for PLA. Given the small size of these tumors (<= 10 mm), a balance between the optimal ablation margins and the risks of thermal damage to the thyroid and surrounding structures is important. Therefore, this animal study provides insights on correlation between the energy parameters and the ablation zone.

#### VI239-SD-SUA5 Hepatic Pseudoaneurysm Formation After Blunt and Penetrating Traumatic Liver Injury: A Level 1 Trauma Center Experience

#### Station #5 Participants

Neeral R. Patel, MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose Dermot Mallon, MBChB, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Amandeep Sandhu, MBBS, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Aia S. Mehdi, MBBS, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Elizabeth A. Dick, MD, FRCR, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Nicola Batrick, MBBS, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Elika Kashef, FRCR, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

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## PURPOSE

At our institution, we have developed an imaging protocol for liver injury patients which involves repeat computed tomographic (CT) angiography of the liver at 48-72 hours to assess specifically for HPAs. The purpose of this study was to evaluate the utility of our imaging pathway in liver trauma with a focus on detection of hepatic pseudoaneurysms (HPAs).

#### **METHOD AND MATERIALS**

A retrospective analysis was performed on patients who were admitted to St Mary's Hospital, London over a four-year period found to have either blunt or penetrating liver injury on initial CT imagining. Data collection included initial and follow-up CT findings, mechanism of injury, injury severity score (ISS), American Association for the Surgery of Trauma (AAST) liver injury score and further intervention.

#### RESULTS

Between January 2014 and January 2018, 149 major trauma patients were admitted with liver injuries (mean age 35.6 years; 72% male, 28% female). 72% patients suffered blunt (mean ISS=27.2; mean AAST=2.89) and 28% patients suffered penetrating injuries (mean ISS=26.9; mean AAST=2.88). Mean time to follow up CT was 46.05 hours. Follow-up CT identified 8 HPAs (62.5% blunt vs 37.5% penetrating injuries) and 1 (0.671%) arteriovenous malformation. 6 (4.03%) of these patients were treated with embolisation. ISS and AAST did not predict pseudoaneurysm formation according to logistic regression analysis. ISS (OR 1.06 [1.02, 1.09; p=0.002]) and AAST (OR 2.24, [1.31, 3.83; p=0.003]) were predictors of requirement for embolisation.

## CONCLUSION

Our experience indicates a role for early detection of HPAs using a dedicated trauma imaging pathway. Interestingly, ISS and AAST are predictors for patients who will undergo interventional radiology procedures and could be used to stratify patients who should be planned for interventional procedures.

#### **CLINICAL RELEVANCE/APPLICATION**

Hepatic pseudoaneurysm (HPA) is a rare but potentially life-threatening sequelae of blunt or penetrating liver trauma.

#### VI240-SD-SUA6 Ablation Therapy of Non-Colorectal Cancer Lung Metastases: Retrospective Analysis of Tumor Response Post-Radiofrequency Ablation (RFA) and Microwave Ablation (MWA)

Station #6

Participants Nour-eldin A. Nour-Eldin, MD,PhD, Frankfurt am Main, Germany (*Presenter*) Nothing to Disclose Nagy N. Naguib, MD, MSc, Frankurt, Germany (*Abstract Co-Author*) Nothing to Disclose Elsayed M. Elhawash, BMedSc,MS, Frankfurt am Main, Germany (*Abstract Co-Author*) Nothing to Disclose Emad H. Emara, Kafr El-Shikh, Egypt (*Abstract Co-Author*) Nothing to Disclose Thomas J. Vogl, MD, PhD, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

To retrospectively compare the local tumour response and survival rates in patients with non-colorectal cancer lung metastases post-ablation using radiofrequency ablation (RFA) and microwave ablation (MWA).

## METHOD AND MATERIALS

Retrospective analysis of 153 computed tomography (CT)-guided ablation sessions performed on 92 patients (38 males and 54 females, mean age: 56.6 years). 29 patients with 49 lesions underwent RFA (tumour size: 0.8-4.5?cm) and 63 patients with 104 lesions underwent MWA treatment (tumour size: 0.6-5?cm). CT scans were performed 24-h post-therapy and on follow-up at 3, 6, 12, 18 and 24 months.

#### RESULTS

The overall-survival rates at 1-, 2-, 3- and 4-year were 81.5, 50.0, 45.5 and 24.2% for patients treated with RFA and 97.6, 79.9, 62.3 and 45.4% for patients treated with MWA, respectively. The mean survival time was 34.14 months for MWA and 34.79 months for RFA. In paired comparison, a significant difference could be detected between MWA versus RFA (p?=?0.032). The progression-free survival showed a median of 23.49?±?0.62 months for MWA and 16.66?±?0.66 months for RFA (p?=?0.048). The lowest recurrence rate was detected in lesions ablated with MWA (7.7%; 8 of 104 lesions) followed by RFA (20.4%; 10 of 49 lesions) p value of 0.012. Pneumothorax was detected in 22.16% of MWA ablations and 14.23% of RFA ablations.

#### CONCLUSION

RFA and MWA may provide an effective therapeutic option for non-colorectal cancer lung metastases with an advantage for MWA regarding local tumour control and progression-free survival rate.

#### **CLINICAL RELEVANCE/APPLICATION**

RFA and MWA have a therapeutic potential for local tumor control and progression free surival rates in patients with lung metastases.

# VI128-ED- US-Guided Localization and Removal of Soft-Tissue Foreign Bodies: How We Do It

Station #7

#### Awards Identified for RadioGraphics

#### Participants

Itziar Aza, MD, Bilbao , Spain (*Presenter*) Nothing to Disclose Udane Oiartzabal, MD , Bilbao, Spain (*Abstract Co-Author*) Nothing to Disclose Igone Korta Gomez, MD, Amurrio, Spain (*Abstract Co-Author*) Nothing to Disclose Rosa Zabala, MD, Bilbao, Spain (*Abstract Co-Author*) Nothing to Disclose Marta Sarabia, MD, Bilbao, Spain (*Abstract Co-Author*) Nothing to Disclose Garazi Elizundia Lopez, MD, Bilbao, Spain (*Abstract Co-Author*) Nothing to Disclose Marta Legorburu Tona, MD, Berango, Spain (*Abstract Co-Author*) Nothing to Disclose Paula Diez Fores, Balmaseda, Spain (*Abstract Co-Author*) Nothing to Disclose Martin Saenz, MBBS, Bilbao, Spain (*Abstract Co-Author*) Nothing to Disclose Estibaliz Onis, Bilbao, Spain (*Abstract Co-Author*) Nothing to Disclose Jose Luis del Cura, MD, PhD, Bilbao , Spain (*Abstract Co-Author*) Nothing to Disclose Spain (*Abstract Co-Author*) Nothing to Disclose

## **TEACHING POINTS**

Describe the sonographic findings of different soft-tissue foreign bodies (FB). Describe the technique for US-guided removal. Report a case series of different kind of FB removed with US-guidance.

## TABLE OF CONTENTS/OUTLINE

Soft-tissue foreign bodies (FB) are a common reason for medical consultation. Since they can cause acute or late complications such as infection, allergic or inflammatory reaction, detection and removal of FB are necessary. US helps identifying FB regardless of their composition. FB are echogenic independently of their composition, therefore always visible on US. Signs like surrounding hypoecoic rim, posterior acoustic shadowing and reverberation also help in the localization of the FB. Surgical extraction is challenging and frequently fails. It can be helped by US-guided placement of a metallic harpoon to facilitate location of the FB. FB can be also successfully removed using US-guidance. Removal is performed with local anesthesia, making a small incision in the skin through which surgical forceps are inserted and US-guided untill the FB. US-guided FB removal has lower risk of complications, it is inexpensive and it does not rule out surgical removal in case of failure. FB removed up untill now include contraceptive implants, glass, metal and wooden splinters, catheter tips, fishbones, needles and wires.

# VI129-ED- When There is No Rectum: CT-Guided Targeted and Sextant Prostate Biopsy SUA8

# Station #8

Participants

Neel Patel, MD , Portland, OR (Presenter) Nothing to Disclose

Evan R. Narasimhan, MD, Portland, OR (Abstract Co-Author) Nothing to Disclose

Kyle K. Jensen, MD, Portland, OR (Abstract Co-Author) Nothing to Disclose

Fergus V. Coakley, MD, Portland, OR (Abstract Co-Author) Founder, OmnEcoil Instruments, Inc; Shareholder, OmnEcoil Instruments, Inc

Bryan R. Foster, MD, Portland, OR (Abstract Co-Author) Consultant , BotImage Inc

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## **TEACHING POINTS**

Elevated PSA occurs not infrequently in men who have had proctocolectomy and poses a diagnostic challenge. Radiologists, experts in image-guided biopsy, are well equipped to perform this minimally invasive procedure on men without rectal access to the prostate.

## TABLE OF CONTENTS/OUTLINE

Existing data/frequency of the problem Description of the CT prostate sextant biopsy technique (bilateral vs.unilateral approach) How to target a lesion seen on multiparametric prostate MRI Brief review of our own institutional data Selected case-based presentation to highlight biopsy concepts, pathology results.





# VIS-SUB

# Vascular Interventional Sunday Poster Discussions

Sunday, Dec. 1 1:00PM - 1:30PM Room: VI Community, Learning Center

VA

AMA PRA Category 1 Credit ™: .50

## Participants

Seetharam C. Chadalavada, MD, MS, Cincinnati, OH (Moderator) Nothing to Disclose

#### Sub-Events

# VI203-SD- Evaluation of Outcomes Following Pulmonary Artery Stenting in Fibrosing Mediastinitis

Station #1

Participants John Welby, BS, Rochester, MN (*Presenter*) Nothing to Disclose Erin A. Fender, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose Tobias Peikert, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose David R. Holmes JR, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose Haraldur Bjarnason, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose Erica Knavel, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose

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## PURPOSE

Fibrosing mediastinitis (FM) is a rare disease characterized by fibrosis of mediastinal structures with subsequent constriction of the bronchi and pulmonary vessels leading to potential respiratory compromise and death. Presently there is no effective treatment mitigating this response. Thus, treatment has focused on reducing symptomology caused by compression of structures including percutaneous placement of pulmonary artery stents. Previous studies examining the use of arterial stents in FM are largely limited to case reports and no aggregated study of outcomes has occurred in nearly a decade. Given this knowledge gap, we assessed outcomes of pulmonary artery stenting in FM using multiple radiologic modalities.

# METHOD AND MATERIALS

FM patients with pulmonary artery stents were identified through operative reports. At the time of analysis, 9 patients were included in this study (6 females, 3 males; mean age 44.17 years, range 13-68; total 13 stents) from 2005-2018. Results from CT, VQ, and echocardiography studies were collected to assess patency and physiologic response.

## RESULTS

All patients had dyspnea on presentation. 7 patients had pre-stenting VQ studies demonstrating diffusion impairment. 100% of patients received initial stenting in the right pulmonary artery. Mean pulmonary artery diameter was 54% of normal lumen prior to stenting. Stenting improved mean systolic pressure differential across the stenosis (pre-stent: 12.00 mmHg, range 5-20; post-stent: 2.29 mmHg, range 0-10; p < 0.005). At first CT follow-up (mean 3.58 months, SD 0.52), stents demonstrated improved mean patency (pre-stent: 54.5%, post-stent: 70%). Mean primary patency measured by CT was 69% at average of 1.95 years (range 0.39-7.74). Right ventricular systolic pressures showed a mean 13mmHg reduction. Symptomatically, 89% reported improvement in dyspnea in the initial post-stenting period. There were no mortalities. No significant complications were noted beyond transient chest pain in 2 patients. 2/13 stents were re-intervened upon at 276 and 497 days.

## CONCLUSION

Combined , this study demonstrates pulmonary artery stents remain widely patent and provide symptomatic improvement with minimal risk in cases of FM .

## **CLINICAL RELEVANCE/APPLICATION**

This study demonstrates the efficacy, safety, and durability of pulmonary artery stenting and the importance of ongoing imaging follow-up in assessing outcomes in attempts to reduce FM symptoms.

#### VI204-SD- The Initial Experience of 2D-Perfusion Angiography-Guided Balloon Pulmonary Angioplasty SUB2

Station #2

Participants Teruhito Hayashi, Osaka, Japan (*Presenter*) Nothing to Disclose Shohei Doi, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose Yoshiro Hori, Osaka, Japan (*Abstract Co-Author*) Nothing to Disclose Satoshi Higuchi, Sendai, Japan (*Abstract Co-Author*) Nothing to Disclose Tatsuya Nishii, MD, PhD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose Atsushi K. Kono, MD, PhD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose Yasutoshi Ohta, MD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose Emi Tateishi, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose Keisuke Kiso, MD, Suita, Japan (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

The usefulness of balloon pulmonary angioplasty (BPA) has been shown in the treatment of chronic thromboembolic pulmonary hypertension (CTEPH). However, there are no indicators for BPA's target vessel and endpoint definitions, which depend on the operator's experience and the angiography's visual evaluation. In this study, we conducted 2D-perfusion angiography (2D-PA) during BPA to investigate whether it could be an indicator to select BPA's target vessel and endpoint definitions.

## METHOD AND MATERIALS

Thirteen patients with twenty-nine treated pulmonary artery segments were included in this study. Those with chronic total occlusion vessels were excluded. To quantify changes in pulmonary blood flow, 2D-PA applications were used. A target ROI in the lung parenchyma was placed in corresponding areas on DSA both pre- and post-BPA. Time to peak (TTP), wash-in rate (WIR), peak density (PD), area under the curve (AUC), and mean transit time (MTT) were assessed. The correlations between the pulmonary-flow grade score (PFG) and these parameters and between changes in PFG and changes in these parameters were evaluated. Using the parameter with the highest correlation, the cutoff values of grade 3 and others were examined using receiver operating characteristic (ROC) curves.

#### RESULTS

The spearman correlations between PFG and each parameter were as follows: TTP, -0.335, p = 0.0102; WIR, 0.539, p = 0.0000127; PD, 0.448, p = 0.000426; AUC, 0.436, p = 0.000624; and MTT, -0.367, p = 0.00458. The correlations between the changes in PFG and the improvement rate of each parameter were as follows: TTP, -0.481, p = 0.00832; WIR, 0.726, p = 0.00000826; PD, 0.666, p = 0.000079; AUC, 0.694, p = 0.0000293; and MTT, -0.373, p = 0.0462. Using the WIR as an index, the ROC curves of the definition of PFG 3 and others were drawn. The area under the ROC curves was 0.802 (95% confidence interval, 0.683 - 0.921). When the cutoff value was at 91.4, a diagnostic ability with a sensitivity of 0.760 and a specificity of 0.758 was obtained.

#### CONCLUSION

The WIR is the most sensitive and correlated marker of PFG. By setting the WIR cutoff value to 91.4, it became an index to determine the endpoint of BPA.

#### **CLINICAL RELEVANCE/APPLICATION**

This study shows the possibility of predicting the endpoint of BPA for CTEPH using 2D-PA.

#### VI205-SD-SUB3 Transperineal Laser Ablation (TPLA) for the Treatment of Lower Urinary Symptoms in Benign Prostatic Hyperplasia (BPH)

Station #3

Participants

Guglielmo Manenti, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Tommaso Perretta, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Salvatore Marsico, Naples, Italy (*Presenter*) Nothing to Disclose Dejanira D'Amato, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Colleen P. Ryan, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Andrea Turbanti, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Giuseppe Vespasiani, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Enrico Finazzi Agro, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Roberto Floris, MD, Roma, Italy (*Abstract Co-Author*) Nothing to Disclose

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## PURPOSE

This is a pilot study aimed to assess safety and efficacy of transperineal laser ablation (TPLA) for treating benign prostatic hyperplasia (BPH).

#### METHOD AND MATERIALS

Sixteen patients (age 73.4  $\pm$  8.4 years) with LUTS underwent TPLA under local anesthesia. Under US guidance, up to four 21G applicators were inserted in the prostatic tissue. Primary endpoint was absence of relevant complications intra and early (15 days) post-op. Secondary endpoints included operation time, ablation time, energy deployed, observation time, catheterization time, IPSS, Quality of Life (QoL), peak urinary flow rate (Q max), post-void residual (PVR), and prostatic morphology and volume, evaluated with 3T multiparametric MRI at 3 months.

#### RESULTS

No intra or early post-op complications occurred. Mean ablation time was 33.3 minutes (range 25.3 min -max 42.4 ), mean energy deployed 12,137 J (range 7204.4 - max 14,3483 J), mean hospital stay 113 minutes, and mean catheterization time 7.1 days (range 1.1- max 9.3 days). At 3 months, mean IPSS improved from 22.3 to 7.4 (P < 0.001), mean QoL from 3.4 to 1.7 (P < 0.001), mean Q max from 5.1 to 12.5 mL/s, mean PVR from 148.3 to 87.1, and mean prostate volume from 54.9 to 42,3 mL.

#### CONCLUSION

TPLA is feasible and safe in the treatment of BPH. Our preliminary data show significant clinical results at 6 months with an excellent performance of 3T multiparametric MRI to detect morphological and functional changes after the procedure.

#### **CLINICAL RELEVANCE/APPLICATION**

Transperineal laser ablation therapy is a safe and feasible treatment method for lower urinary tract symptoms in benign prostatic hyperplasia

#### VI242-SD-SUB5 Microwave Ablation of Lung Tumors: Early Radiological Parameters Determining the Treatment Outcome

#### Station #5 Participants

Elsayed M. Elhawash, BMedSc,MS, Frankfurt am Main , Germany (*Presenter*) Nothing to Disclose Thomas Vogl, PhD, Muenster, Germany (*Abstract Co-Author*) Nothing to Disclose Emad H. Emara, Kafr El-Shikh, Egypt (*Abstract Co-Author*) Nothing to Disclose Nagy N. Naguib, MD, MSc, Frankurt, Germany (*Abstract Co-Author*) Nothing to Disclose Amr Abdel-Kerim I, PhD,MSc, Alexandria, Egypt (*Abstract Co-Author*) Nothing to Disclose Sherif E. Hegab, MD, Alexandria, Egypt (*Abstract Co-Author*) Nothing to Disclose Sherif E. Hegab, Alexandria, Egypt (*Abstract Co-Author*) Nothing to Disclose Hossam Mansour, Zagazig, Egypt (*Abstract Co-Author*) Nothing to Disclose Nour-eldin A. Nour-Eldin, MD,PhD, Frankfurt am Main, Germany (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

To evaluate the impact of microwave ablation (MWA) in the management of inoperable lung tumors on a long-term follow up and the potentiality to retrospectively evaluate the early prognostic radiological parameters to predict the treatment response.

#### **METHOD AND MATERIALS**

50 patients (average age 64.1 +/- 14.8 years,23 males and 27 females) with 68 inoperable pulmonary lesions (8 primary, 60 metastatic); tumor board decision was to perform CT-guided MWA. Initial CT and/or MRI performed with assessment of the size, outlines, position and relation to the vascular and bronchial structures followed by CT-guided MWA. Contrast enhanced MRI and CT was performed 24 hours after the procedure thereafter CT and/or MRI performed at 3 months interval for one year. Certain parameters including the pre-and postablation size, ADC value 24 hours after the procedurearre precisely evaluated and correlated with the follow up images and longterm treatment responce.

#### RESULTS

44 lesions (64.7%) showed complete response with no residual activity on successive follow up while the rest (35.3%) showed incomplete response. Certain factors have been found and suggested as early predictors for the response including the maximum diameter of the lesion as well as its volume and the ADC value 24 hours after the procedure. The location of the lesion as well as its relation the significant vessel or bronchus in the current study didn't seem to affect the net response.

#### CONCLUSION

MWA of inoperable lung tumors provide an alternative therapeutic way with relatively high success rate, preoperative radiological assessment of the lesion namely the maximum diameter and volume as well as immediate 24 hour MRI assessment with DWI mapping may provide early predictors for the net response.

#### **CLINICAL RELEVANCE/APPLICATION**

Microwave ablation of pulmonary tumors is a valuable therapeutic tool and performing MRI evaluation within 24 hours following the ablation may predict the responce proving the potentiality for improving treatment efficacy.





Peripheral Artery Disease: CTA and MRA (Interactive Session)

Sunday, Dec. 1 2:00PM - 3:30PM Room: S404CD



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

# Participants

Constantino S. Pena, MD, Key Biscayne, FL (*Moderator*) Speakers Bureau, Cook Group Incorporated; Speakers Bureau, Medtronic plc; Speakers Bureau, W. L. Gore & Associates, Inc; Speakers Bureau, Penumbra, Inc; Speakers Bureau, Terumo Corporation; Speakers Bureau, Merit Medical Systems, Inc; Advisory Board, C. R. Bard, Inc; Advisory Board, Boston Scientific Corporation; Stephan Clasen, MD, Tuebingen, Germany (*Moderator*) Nothing to Disclose

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stephan.clasen@med.uni-tuebingen.de

## **Special Information**

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

## LEARNING OBJECTIVES

1) Describe techniques for acquisition, reconstruction, and image interpretation of peripheral CTA and MRA. 2) Discuss available data and evidence-based results for peripheral CTA and MRA, and expected impact on patient care. 3) Compare advantages and drawbacks of lower extremity CTA and MRA.

#### Sub-Events

## RC112A Interventional Procedure Planning: Role for CTA and MRA

#### Participants

Constantino S. Pena, MD, Key Biscayne, FL (*Presenter*) Speakers Bureau, Cook Group Incorporated; Speakers Bureau, Medtronic plc ; Speakers Bureau, W. L. Gore & Associates, Inc; Speakers Bureau, Penumbra, Inc; Speakers Bureau, Terumo Corporation; Speakers Bureau, Merit Medical Systems, Inc; Advisory Board, C. R. Bard, Inc; Advisory Board, Boston Scientific Corporation;

## LEARNING OBJECTIVES

1) Understand the value of peripheral CTA and MRA. 2) Discuss the benefits of CTA in comparison to MRA in the treatment of PAD. 3) Comprehend the importance of MRA sequences to highlight particular details in peripheral MRA. 4) Understand the importance of image reconstruction for peripheral CTA and MRA.

# RC112B Peripheral CTA

Participants Stephan Clasen, MD, Tuebingen, Germany (Presenter) Nothing to Disclose

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## LEARNING OBJECTIVES

1) Describe techniques for acquisition, reconstruction, and image interpretation of peripheral CTA. 2) Discuss available data and evidence-based results for peripheral CTA, and expected impact on patient care. 3) Compare advantages and drawbacks of lower extremity CTA in comparison to other imaging modalities and diagnostic tools for arterial occlusive disease.

#### ABSTRACT

Peripheral arterial disease (PAD) is a common cause of morbidity and mortality in developed countries. Traditionally, imaging for risk stratification and therapeutic planning involved catheter angiography. In recent years, cross-sectional imaging by CTA and MRA has proven a robust technique for non-invasive PAD assessment. Given ubiquity of CT scanning technology, CTA is widely available. High resolution datasets can be acquired rapidly, which facilitates assessment of clinically labile or trauma patients. To be optimally effective, CTA techniques require particular attention to contrast medium and scan protocol. With appropriate protocol design, data acquisition requires limited operator dependence. The acquired 3D dataset is rich with information, but requires careful scrutiny by the interpreting physician. Volumetric review of these datasets produces the most accurate results. Extensive small vessel calcification remains a potential barrier to full assessment of pedal vessels by CTA. Recent published data validates the clinical effectiveness of CTA for diagnosis of PAD and for the direction of treatment planning. Ongoing research aims to exploit the newest generation of CT scanners to acquire additional information, including dual energy data, time-resolved information, and radiation dose savings.

Participants

James C. Carr, MD, Chicago, IL (*Presenter*) Research Grant, Siemens AG; Advisory Board, Siemens AG; Travel support, Siemens AG; Advisory Board, General Electric Company; Speaker, General Electric Company; Research Grant, Bayer AG; Advisory Board, Bayer AG; Travel support, Bayer AG; Speaker, Bayer AG; Research Grant, Guerbet SA; Advisory Board, Guerbet SA; Travel support, Guerbet SA; Consultant, Circle; Speaker, Circle

# RC112D Interventional Complications: Role for CTA and MRA

Participants

Charles Y. Kim, MD, Raleigh, NC (Presenter) Consultant, Medtronic plc; Consultant, Humacyte; Consultant, Galvani

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#### LEARNING OBJECTIVES

1) Understand decision making for assessment of stent patency with CTA versus MRA. 2) Describe endovascular aneurysm repair with endografts as well as types of endoleaks and associated implications. 3) Discuss current methods for optimal detection endoleaks with CTA and MRA, with understanding of advantages and disadvantages.

## ABSTRACT

Stents are used ubiquitously for the management of atherosclerotic lesions in peripheral arterial disease. While symptomology is an important metric, noninvasive imaging is also a crucial tool for more detailed assessment. Both CTA and MRA have been validated for the assessment of stent patency, although there are nuances for both modalities, and in certain circumstances, one may outperform the other. Imaging of endoleaks has evolved over the past two decades, to include a multitude of techniques with CTA and MRA. While national guidelines for post-EVAR surveillance are relatively unidimensional, it is important for the practicing radiologist to understand the spectrum of available CT and MR techniques for detection of endoleaks, along with the advantages and disadvantages to each approach.





# **Peripheral and Visceral Occlusive Disease**

Sunday, Dec. 1 2:00PM - 3:30PM Room: S103AB



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

# Participants

Bulent Arslan, MD, Oak Brook, IL (*Moderator*) Advisory Board, Medtronic plc; Advisory Board, Guerbet SA; Speakers Bureau, Biocompatibles International plc; Speakers Bureau, C. R. Bard, Inc; Advisory Board and Speakers Bureau, Boston Scientific Corporation; Speakers Bureau, Penumbra, Inc

Minhaj S. Khaja, MD, MBA, Ann Arbor, MI (Moderator) Consultant, Penumbra, Inc; Speaker, Penumbra, Inc

## LEARNING OBJECTIVES

1) Describe pros and cons of intervention for median arcuate ligament compression on the celiac axis. 2) Review clinical presentation and endovascular treatment options for acute and subacute portal vein thrombus. 3) Outline three recommendations for endovascular treatment of peripheral vascular disease. 4) Describe how and when to intervene in patients with mesenteric ischemia. 5) Describe two vascular compression syndromes.

#### Sub-Events

## RC114A Compressive Arterial Syndromes

Participants

Minhaj S. Khaja, MD, MBA, Ann Arbor, MI (Presenter) Consultant, Penumbra, Inc; Speaker, Penumbra, Inc

#### LEARNING OBJECTIVES

1) Describe compressive arterial syndromes. 2) Understand role of diagnostic or therapeutic interventions in patients with these syndromes.

## RC114B Treatment of Visceral Aneurysms

Participants

Jordan C. Tasse, MD, Chicago, IL (Presenter) Nothing to Disclose

## LEARNING OBJECTIVES

1) Review the clinical presentation and diagnosis of visceral aneurysms. 2) Describe endovascular and surgical approaches to the management of visceral aneurysms. 3) Illustrate case based examples of their endovascular treatment.

# RC114C Advanced Arterial Revascularization

Participants

Sreekumar Madassery, MD, Chicago, IL (*Presenter*) Speakers Bureau, Cook Group Incorporated Speakers Bureau, Penumbra, Inc Speakers Bureau, Abbott Laboratories Consultant, C. R. Bard, Inc

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#### LEARNING OBJECTIVES

1) Understand current changes and management of femoropopliteal disease interventions in light of drug coated/drug eluting device issues. 2) Describe advanced tibopedal interventions for critical limb ischemia patients. 3) Comprehend new endovascular options for 'no-option' patients.

# RC114D Below-the-Knee Interventions

Participants Ryan C. Schenning, MD, Portland, OR (*Presenter*) Nothing to Disclose

# RC114E Renovascular Occlusive Disease: Current Paradigm

Participants

Bulent Arslan, MD, Oak Brook, IL (*Presenter*) Advisory Board, Medtronic plc; Advisory Board, Guerbet SA; Speakers Bureau, Biocompatibles International plc; Speakers Bureau, C. R. Bard, Inc; Advisory Board and Speakers Bureau, Boston Scientific Corporation; Speakers Bureau, Penumbra, Inc







# **Emergency Cardiothoracic CT Angiography**

Monday, Dec. 2 8:30AM - 10:00AM Room: E450B



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

# Participants

Douglas S. Katz, MD, Mineola, NY (Moderator) Nothing to Disclose

# Sub-Events

# RC208A Imaging of Venous Thromboembolism in Obesity: Pitfalls and Pearls

Participants Douglas S. Katz, MD, Mineola, NY (*Presenter*) Nothing to Disclose

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# LEARNING OBJECTIVES

1) To provide some 'pearls' for accurate interpretation of CT pulmonary angiography performed for suspected pulmonary embolism. 2) To review some potential 'pitfalls' in the interpretation of CT pulmonary angiography for suspected pulmonary embolism, using examples from clinical practice, and to discuss strategies for avoiding falling into these potential pitfalls. 3) To briefly review the relevant imaging literature.

# RC208B CT Angiography of Acute Aortic Syndrome

Participants

Constantine A. Raptis, MD, Saint Louis, MO (Presenter) Nothing to Disclose

## LEARNING OBJECTIVES

1) Review the imaging findings of patients presenting with the acute aortic syndrome. 2) Identify imaging findings in patients with the acute aortic syndrome that can affect prognosis or management. 3) Discuss mimics and confounding imaging findings in cases of suspected acute aortic syndrome.

## RC208C Emergency Coronary CT Angiography

Participants Jeffrey M. Levsky, MD, PhD, Bronx, NY (*Presenter*) Nothing to Disclose

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## LEARNING OBJECTIVES

1) Identify the landmark studies that form the evidence base for ED coronary CTA. 2) Contrast the levels of evidence supporting CTA use in different settings. 3) Differentiate between proven and speculative benefits and drawbacks of CTA. 4) Assess the appropriateness of development of ED coronary CTA programs.





# Body Imaging Expert Panel: CTA or MRA?

Monday, Dec. 2 8:30AM - 10:00AM Room: S104A



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

#### Participants

Martin R. Prince, MD,PhD, New York, NY (*Moderator*) Patent agreement, General Electric Company; Patent agreement, Hitachi, Ltd; Patent agreement, Siemens AG; Patent agreement, Koninklijke Philips NV; Patent agreement, Nemoto Kyorindo Co, Ltd; Patent agreement, Bayer AG; Patent agreement, Lantheus Medical Imaging, Inc; Patent agreement, Bracco Group; Patent agreement, Mallinckrodt plc; Patent agreement, Guerbet SA; Patent agreement, Toshiba Corporation

#### Sub-Events

## RC212A MRA

Participants J. Paul Finn, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose Scott B. Reeder, MD,PhD, Madison, WI (*Presenter*) Nothing to Disclose Robert R. Edelman, MD, Evanston, IL (*Presenter*) Research support, Siemens AG; Royalties, Siemens AG

## LEARNING OBJECTIVES

1) Discuss CTA and MRA methods and techniques for optimized vascular imaging in clinical practice. 2) Debate the advantages and disadvantages of CTA and MRA in clinical practice. 3) Recommend the application of CTA or MRA for common challenging clinical scenarios.

# RC212B CTA

Participants

Elliot K. Fishman, MD, Owings Mills, MD (*Presenter*) Institutional Grant support, Siemens AG; Institutional Grant support, General Electric Company; Co-founder, HipGraphics, Inc

W. Dennis Foley, MD, Milwaukee, WI (Presenter) Nothing to Disclose

Geoffrey D. Rubin, MD, Durham, NC (*Presenter*) Consultant, Fovia, Inc; Advisor, HeartFlow, Inc; Consultant, General Electric Company; Advisor, Boehringer Ingelheim GmbH; Advisor, Siemens AG;

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## LEARNING OBJECTIVES

1) Discuss CTA and MRA methods and techniques for optimised vascular imaging in clinical practice. 2) Debate the advantages and disadvantages of CTA and MRA in clinical practice. 3) Recommend the application of CTA or MRA for common challenging clinical scenarios.







# SSC15

# Vascular/Interventional (Spine and Pain Intervention)

Monday, Dec. 2 10:30AM - 12:00PM Room: E263



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

#### Participants

Rex M. Pillai, MD, Sacramento, CA (*Moderator*) Nothing to Disclose Karunakaravel Karuppasamy, MD, FRCR, Westlake, OH (*Moderator*) Nothing to Disclose

#### Sub-Events

# SSC15-01 Risk of Acute Vertebral Fractures Post-Vertebroplasty Depends on the Distance and Location Relative to the Initial Treatment Level

Monday, Dec. 2 10:30AM - 10:40AM Room: E263

Participants

James Moroney, Grand Rapids, MI (*Presenter*) Nothing to Disclose Aaron Clark, Grand Rapids, MI (*Abstract Co-Author*) Nothing to Disclose Albert D. Jiao, BS, Grand Rapids, MI (*Abstract Co-Author*) Nothing to Disclose Nicholaus Monsma, BS, Grand Rapids, MI (*Abstract Co-Author*) Nothing to Disclose Charlene B. Ofosu, MD, Grand Rapids, MI (*Abstract Co-Author*) Nothing to Disclose Jordan Castle, MD, Belmont, MI (*Abstract Co-Author*) Nothing to Disclose James J. Morrison, MD, Grand Rapids, MI (*Abstract Co-Author*) Nothing to Disclose

## For information about this presentation, contact:

moroneyjamesb@gmail.com

## PURPOSE

The risk of developing an acute vertebral fracture following a percutaneous vertebroplasty (PVP) remains unclear in the literature. Some studies suggest an increased risk is placed on adjacent vertebrae while other studies report no additional risk whatsoever.

## METHOD AND MATERIALS

Between 2002 and 2017, 1796 patients (mean age 78.9; 70.1% female) received a PVP secondary to an acute vertebral fracture. Medical records were reviewed for new onset vertebral fractures within one-year post-PVP and for evidence of additional PVP. Fractures were categorized as osteoporotic, traumatic and pathologic. New fractures were evaluated for relative location to the initial PVP level. Risk factors including age, gender, chronic steroid use and body mass index were evaluated. Analysis of post-PVP vertebral fractures stratified fracture risk as a measure of distance from the initial treatment level, evaluated specific fracture risk locations (above or below PVP) and identified risk factors for repeat PVP.

#### RESULTS

Distribution of initial fractures was 56.35% osteoporotic, 41.65% traumatic and 2.00% pathologic. Thoracolumbar junction fractures (T12 or L1) accounted for 34.65% of total initial PVP. 403 patients (22.44%) developed a new fracture with a mean time of 76 days post-PVP. The highest frequency of post-PVP vertebral fractures occurred at adjacent vertebrae (34.2%) with 53.3% of total new fractures occurring within two vertebral levels from the initial PVP. Fractures at adjacent vertebrae were 15.1% more likely than fractures two vertebrae removed. Adjacent fractures located above the PVP level were 1.83 times more likely to occur than adjacent fractures below the PVP level (p=0.0256). Chronic steroid users were 1.33 times more likely to develop multi-level fractures (p=0.034) and 1.65 times more likely to require multiple PVP compared to non-steroid users (p<0.01).

## CONCLUSION

Acute vertebral fractures post-PVP occur with greatest frequency at adjacent vertebrae above the PVP level. Chronic steroid use was the most predictive risk factor for multi-level fractures and repeated PVP.

## **CLINICAL RELEVANCE/APPLICATION**

This is the first report to assess post-vertebroplasty fracture risk as a measure of distance and relative location (above or below) to the previously treated vertebral level.

## SSC15-02 Clinical Follow-Up of Low-Dose CT Guided Lumbar Foraminal Nerve Blocks: Differential Visual Analogue Scale Score for Pain At 3 Months Can Predict the Need for Spine Surgery

Monday, Dec. 2 10:40AM - 10:50AM Room: E263

Participants Bharath B. Das, MD, MBBS, Bangalore, India (*Presenter*) Nothing to Disclose Sankar Neelakantan, MD, Bangalore, India (*Abstract Co-Author*) Nothing to Disclose Prashanth Reddy, MBBS,MD, Bangalore, India (*Abstract Co-Author*) Nothing to Disclose Suman T. Prabhakar, MBBS,MD, Bangalore, India (*Abstract Co-Author*) Nothing to Disclose Puneeth K. K N, MD, Mumbai, India (*Abstract Co-Author*) Nothing to Disclose Jainesh V. Dodia, MBBS,MD, Bangalore, India (*Abstract Co-Author*) Nothing to Disclose Bhavana Nagabhushana Reddy, MBBS, MD, Bengaluru, India (*Abstract Co-Author*) Nothing to Disclose Sanjaya Viswamitra, MD, Bangalore, India (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

To assess the utility of differential VAS in predicting need for surgery at 3months follow up in patients undergoing low dose CT guided lumbar foraminal nerve blocks (LD CTGNB) for radiculopathy. To ascertain cut off differential VAS score to dichotomise patients into groups who will not need surgery.

#### METHOD AND MATERIALS

A total of 34 patients with lumbar radiculopathy were taken for LD CTGNB. All patients had prior MR LS spine for disc level. Procedure was done in low dose presets in 128 slice CT scanner. Pre procedure VAS score was considered baseline. Differential score obtained from subtracting follow up VAS from pre-VAS, these were obtained immediately after procedure, follow up 1-week and at 3-months. Dixon test for performed to identify outliers. ROC curve and one tailed test was used to find cut off differential VAS score, p Value and accuracy predicting for no surgery.

## RESULTS

In 34 patients, 2 outliers were excluded. Average duration of follow up is 5months. With ROC curve analysis and one tailed test, a differential VAC score of 4 was identified to have highest sensitivity and specificity. This cut off was used for accuracy prediction for surgery free group. Thus, with differential VAC 4 or above, in immediate post procedure, we could predict that patient does not need surgery with 81% accuracy, similarly at 1 week with 92% accuracy and at 3 months with 96% accuracy. These were statistically significant with p value <0.001

#### CONCLUSION

Differential VAC score obtained from follow up showed progressively increasing accuracy in determining surgery free cohort. A differential pain score of 4, at >3 months of follow up (median number of months) would mean that the patient does not have to go into surgery, 97% of the times. This can be said with 95% confidence.

#### **CLINICAL RELEVANCE/APPLICATION**

In reference to this study, after CT GNB, if pain is alleviated by differential VAC score of 4 immediately post procedure, patient is likely to have same degree of alleviation of pain for next 3 months and 97% of times he may not need spine surgery. This could be used for patient counselling and follow up.

## SSC15-03 The Potential Role of Intervertebral Lumbar Disc FA (Fractional Anisotropy) Map in Diffusion Tensor Imaging (DTI) to Select Patients Suffering from Low Back Pain and Who May Benefit from Intradiscal Oxygen-Ozone Injection

Monday, Dec. 2 10:50AM - 11:00AM Room: E263

Participants

Marco Varrassi, L'Aquila, Italy (*Presenter*) Nothing to Disclose Marco Perri, MD, Laquila, Italy (*Abstract Co-Author*) Nothing to Disclose Alessandra di Sibio, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose Emanuele Tommasino, MD,MSc, Laquila, Italy (*Abstract Co-Author*) Nothing to Disclose Giampaolo Bianchi, MD, Laquila, Italy (*Abstract Co-Author*) Nothing to Disclose Pierpaolo Palumbo, MD, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose Alessandra Splendiani, MD, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose Antonio Barile, MD, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose Ernesto E. Di Cesare, MD, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose Carlo Masciocchi, MD, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

To assess annular fibers anisotropy through the use of intervertebral disc FA map to select patients suffering from low back pain of lumbar disc origin and who may benefit from intradiscal oxygen-ozone injection.

## METHOD AND MATERIALS

A total of 75 patients suffering from back pain were selected for prospective non-randomized blinded trial approved by the Medical Ethical Committee of our Institution. Before treatment they underwent MRI 3 Tesla exams performed with conventional sequences (T2-FSE-WI, T2 fat-sat and T1 FSE-WI) and additional DTI sequence, respectively for assessing lumbar disc pathology according to the nomenclature and Fractional Anisotropy (FA) map of the involved intervertebral disc. Discography was obtained before treatments under CT guidance of the involved discs in order to confirm MRI reports. Patients were randomly assigned to two groups; control Group (20 men, 16 women; median age 45 years old) underwent intraforaminal injection of steroid and anesthetic. The remaining 39 patients (Study Group composed by 18 men, 21 women; median age 46 years old) underwent the same treatment with the addiction of intradiscal oxygen-ozone (O2-O3) injection. Oswestry Low Back Pain Disability (ODI) Questionnaire was administered before treatment and at intervals, the last at 6-month follow-up. Results were compared with X2, t test and regression analysis.

In cases of annular fissures without herniation or extrusion disc, O2-O3 intradiscal injection therapy was successful in 16 (41%) study group patients compared with 10 control group patients (27,5%) (P < 0.01). ODI questionnaire showed significant improvement of symptoms in both Groups (P < 0.01). Similar results were observed in the remaining cases of both groups when the disc was involved with associated radicular pain (P < 0.01).

#### CONCLUSION

An FA disc map congruous with a rupture of annular fibers could be considered as a predictive sign of response to oxygen-ozone lumbar intradiscal injection treatment so it could be added to the routine MR exam.

## **CLINICAL RELEVANCE/APPLICATION**

Preliminary MRI evaluation before Oxygen-Ozone treatment with FA map of lumbar degenerated discs may be helpful in distinguishing annular tear from herniation and ,therefore, planning which patients may benefit of O2-O3 chemiodiscolysis.

#### SSC15-05 Efficacy of MR-Guided Focused Ultrasound Surgery in Facetal arthropathy: A Study of 21 Patients

Monday, Dec. 2 11:10AM - 11:20AM Room: E263

Participants Ritu M. Kakkar, MBBS, DMRD, Mumbai, India (*Abstract Co-Author*) Nothing to Disclose Chandresh O. Karnavat, Mumbai, India (*Abstract Co-Author*) Nothing to Disclose Shrinivas B. Desai, MD, Mumbai, India (*Presenter*) Nothing to Disclose

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## PURPOSE

To evaluate efficacy of MR guided Focused Ultraound Surgery(MRgFUS) in treatment of low backache due to facetal arthropathy by assessing symptomatic improvement in terms of decrease in Numerical rate score (NRS) and Oswestry Disability Index(ODI)

#### **METHOD AND MATERIALS**

126 facet joints (L3-4 to L5-S1)in 21 patients in the age group 40 to 80 yrs were selected for study after approval from ethics committee. The inclusion criteria were LBP due to facetal arthropathy without significant Radiculopathy, Facet joint arthropathy without significant spinal canal or neural foraminal stenosis ,Diagnostic facet jt. injection with local anesthetic & steroid causing significant pain reduction (done in 10 patients ). All included patients had a NRS of >5 and ODI >50% Treatment was performed on GE 1.5 TESLA HDXT with EXBLATE 2000 in supine position under mild conscious sedation Immediate post treatment evaluation was done by identifying Post Contrast enhancement at the posterior margin of the facets joints.1 week, 1 month, 3 and 6 months follow up of all the patients was done by plotting of Numerical rate scale (NRS)scores, Oswestry Disability (ODI)scores .

## RESULTS

Average pre treatment NRS was 9 ,which reduced to 4, 1 month following treatment and to 2 ,6 months following treatment The reduction in NRS score after 1 and 6 months is statistically significant (p=0.00001) Average pre treatment ODS 70% ,with reduction to 35% and 22% following 1 and 6 months respectively .By chi square test ,reduction in ODS was significant with p value of 0.0248 after 1 month and 0.0020 after 6 months .

#### CONCLUSION

MRgFUS is a safe and effective procedure in treatment of facetal arhropathy related pain in selected patients with no adverse effects or complications and can be performed on out patient basis .

#### **CLINICAL RELEVANCE/APPLICATION**

MRgFUS is a non invasive modality providing good pain relief in facetal arthropathy ,with results comparable to other more invasive procedures like radiofrequency ablation

## SSC15-06 3T- MRI Analysis of Alcohol Distribution and Side Effects after Sympathetic Blocks and Sympathicolysis: Is 1ml Enough for Harm Avoidance?

Monday, Dec. 2 11:20AM - 11:30AM Room: E263

Participants

Benjamin Reichardt, Essen, Germany (*Presenter*) Nothing to Disclose Lale Umutlu, MD, Essen, Germany (*Abstract Co-Author*) Consultant, Bayer AG Michael Forsting, MD, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose Sam Sedaghat, MD, Bochum, Germany (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

Sympathicolyses are optional third line treatments in patient with complex regional pain syndrome (CRPS) and peripheral occlusive disease, whose vascular status does not permit reconstructive surgery. To avoid structure damage CT needle guidance is the most often used procedure when performing an alcohol sympathicolysis. There are reports that alcohol can cause minor and major complications such as ureter strictures, retroperitoneal bleeding and irritation of peripheral nerves. However, the frequency, mechanism, spread and atypical dilution of injected alcohol is unknown. This is the first 3T-MRI based study for visualization the distribution and diffusion behavior of alcohol at the area of injection and affection of the neighboring tissue.

#### RESULTS

In all cases alcohol demonstrated an effective sympathicolysis and patients reported pain relief. One Patient reported a peripheral

paresthesia caused by a nerve irritation. One Patient had a retroperitoneal bleeding. No-one had detected erythrocytes in urine as a sign of ureter strictures. Despite small volume injection of 1,5ml alcohol and even when needle placement was performed correctly, MRI showed high signal changes caused by edema in soft tissues and vessel- and ureter walls in all patients. Neurolytic sympathetic ganglia showed an increase of size and proton signal in MRI in 4 patients.

#### CONCLUSION

In all cases the interventions lead to an effective sympathicolysis and pain relief. In most cases all detected changes and injuries had no clinical consequences. A prediction of distribution of applicated alcohol and its performance is not possible or seems to be ambiguous and may be accompanied with an intermediate risk for the patient. Therefor after alcohol sympathicolysis patients must be clinical monitored and with present of clinical signs an MRI should be performed. For risk avoidance throughout alcohol injections we suggest radiofrequency ablations of sympathetic ganglia.

#### **METHODS**

14 patients with either CRPS (n=8) or PAOD (n=6) were treated with a diagnostic sympathetic block with an anesthetic at the Level L3 or L4. With positive response a CT guided alcohol sympathicolysis with 1,5ml were performed. Independently all patient received 3 MRI Neurography of the lumbar sympathetic chain prior and after block and following the alcohol injections. MRI-Neurography protocol included T1 sequences in all direction for visualization of the anatomy, an edema and fluid sensitive sequences for detection of tissue changes and structure damage. We calculated fluid volumes and distribution around the injection area anterior to the vertebra, dorsal of Aorta/IVC and around the psoas muscle. Diffuse edema in muscle, fat, nerves and organs were analyzed for each single CT and MRI and were correlated between the different time points.

# SSC15-07 Intraarticular Facet Joint Steroid Injection versus Medial Branch Block: Which One Represents the Best Therapeutic Option in the Management of Lumbar Facet Joint Pain?

Monday, Dec. 2 11:30AM - 11:40AM Room: E263

Participants

Antonio Izzo, Laquila, Italy (*Presenter*) Nothing to Disclose Giampaolo Bianchi, MD, Laquila , Italy (*Abstract Co-Author*) Nothing to Disclose Maria Valeria Marcella Micelli, Laquila , Italy (*Abstract Co-Author*) Nothing to Disclose Pierpaolo Palumbo, MD, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose Luca Panebianco, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Marco Varrassi, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose Sergio Carducci, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose Aldo Victor Giordano, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose Carlo Masciocchi, MD, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

The aim of our study is to compare the clinical outcome of two different techniques used in the management of lumbar facet joint (LFJ) back pain: intraarticular (IA) steroid injection and medial branch block (MBB).

#### **METHOD AND MATERIALS**

76 patients with LFJ back pain were selected on the basis of clinical evaluation and MR-findings and randomly assigned to one of two groups: 36 patients (Group A) underwent intraarticular LFJ steroid injection while 40 patients (Group B) carried out MBB. Both procedures were performed under CT-guidance. We injected each patient with 1.5mL of Ropivacaine in addition to 2mL of Triamcinolone. We evaluated the clinical-outcome by means of VAS score and Rolland-Morris Questionnaire (RMQ) for respectively evaluating the level of pain and disability, before treatment and after 1, 3 and 6 months of treatment. Clinical effectiveness was determined as a >50% reduction to the pre-treatment VAS value and a value <9 in the RMQ Score.

#### RESULTS

Mean values of VAS and RMQ before treatment in Group A were 8.1 and 14.6 respectively. The treatment was effective (VAS reduction >50%, RMQ score <9) in 86.1% of patients after 1month, 72.2% after 3months, 61.1% after 6months. Mean values of VAS and RMQ before treatment in Group B were 7.8 and 14.1. The treatment was effective in 85% of the patients after 1month, 67.5% after 3months and 47.5% after 6months.

#### CONCLUSION

In our study both IA steroid injection and MBB showed similar effectiveness in the treatment of LFJ back pain at 1 and 3 months after procedure. However IA steroid injection has proved a greater clinical efficacy at 6 months (61.1% vs. 47.5%). Although there are not important differences in pain reduction between the two groups of patients, it seems that patients in Group A show slightly better results. On the basis of our results, both IA steroid injection and MBB are effective and interchangeable techniques in the treatment of LFJ back pain with good results in the short and medium term and moderate results in the long term. Both the techniques can be repeated indefinitely over time, considering that there are roughly no side effects.

## **CLINICAL RELEVANCE/APPLICATION**

Intraarticular steroid injection and medial branch block are valid treatment options in the management of lumbar facet joint pain with positive clinical effects for almost six months.

## SSC15-08 Utilization and Outcomes for Vertebral Augmentation in Cancer Patients

Monday, Dec. 2 11:40AM - 11:50AM Room: E263

Participants William Borror, MD, Houston, TX (*Presenter*) Nothing to Disclose Joshua D. Kuban, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose Stephen Lee, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

The spine is the most common site of bone metastasis, and metastasis often lead to pathological vertebral compression fractures. Vertebral augmentation is commonly used for mitigation of pain associated with these pathological fractures. The purpose of this study was to perform a population health analysis of the time course, demographics, and outcomes following spine augmentation procedures in cancer patients.

#### METHOD AND MATERIALS

Using administrative data from all inpatient and outpatient hospital encounters in California (2005 - 2011) and Florida (2005 - 2014), we identified patients a cancer diagnosis based on the relevant ICD-9 diagnostic codes. Patients who underwent spine augmentation procedure (vertebroplasty or kyphoplasty) were then identified based on the appropriate CPT procedure codes. The influence of spine augmentation on overall survival was determined using Kaplan-Meier statistics

#### RESULTS

We identified 5,757 cancer patients who underwent 7,105 spine augmentation procedures; this population comprised our study cohort. The median age was 76 years, and 58.7% of the cohort was female. Comorbidities included renal insufficiency (19.2%), heart failure (1.6%), chronic obstructive pulmonary disease (27%), diabetes (11.6%), hypertension (36.5%), and osteoporosis (21.3%). Lung, breast, and prostate cancer were the most common histologies. There was a 2.9-fold increase in the utilization of spine augmentation procedures for cancer patients between 2005 - 2014. The mean annual hospital volume for spine augmentation in cancer patients was 1.9, with a range from 1 to 26.9. When compared to a cohort of patients with bone metastases who did not undergo spine augmentation, patients who underwent spine augmentation were noted to have a significant improvement in overall survival (P = 0.02).

#### CONCLUSION

The utilization of spine augmentation in cancer patients is increasing. In addition to its palliative role, spine augmentation may play an important role in patient survival outcomes.

#### **CLINICAL RELEVANCE/APPLICATION**

Understanding the outcomes following spine augmentation can better help with treatment and management of patients with spinal metastasis.

## SSC15-09 Lobster Project®: A New Method for the Percutaneous Treatment of Lumbar Central Canal and Foraminal Stenosis. Preliminary Experience in 40 Patients

Monday, Dec. 2 11:50AM - 12:00PM Room: E263

Participants

Matteo Bellini, MD, Siena, Italy (*Presenter*) Consultant, Stryker Corporation Giulia Sadotti, MD, Siena, Italy (*Abstract Co-Author*) Nothing to Disclose Dario Notaro, MD, Siena, Italy (*Abstract Co-Author*) Nothing to Disclose Chiara Zini, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Lucia Monti, MD, Siena, Italy (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

To evaluate the effectiveness and to describe the technique of Lobster® device in a cohort of 40 patients with lumbar central canal and foraminal stenosis (LSS).

#### **METHOD AND MATERIALS**

From May 2018 to March 2019, 40 patients (male = age range: 45-92 years, mean: 72,7) with elettromigraphically confirmed for neurogenic intermittent claudication (NIC), related to mono (N=37) or bi-segmental (N=3) LSS, were enrolled in the present study. We treated 43 levels (n.32 L4-L5, n.8 L3-L4, n.3 L5-S1).Magnetic Resonance (MR), physical exam and VAS scale were performed before the procedure and 3 months later. Technical success was defined as correct placement of Lobser® device demonstrated with computer tomography (CT), performed immediately after treatment. All treatments were performed under fluoroscopic guidance (Innova 3131iq, General Electric Healthcare, CT, USA), using mild sedation plus local anesthesia with standard anti-infectious therapy.

## RESULTS

All Lobster® device have been placed with 100% of technical success and in 3 cases the device has been placed at L5-S1 level; in 3 patients the treatment was performed in 2 levels at the same time. No major complications occurred; in our population we did not experience any cases of infection, nerve damage, nor bleeding. Most patients (N=36) showed great improvement in symptoms with relevant post-operative VAS scale reduction (p < 0,001) and remain stable at 3-month follow-up.

#### CONCLUSION

Lobster® is feasible and safe minimally-invasive decompression method for LSS in selected patients with NIC, despite the age.Further studies on same topic would be highly desirable to investigate the long term effectiveness.

#### **CLINICAL RELEVANCE/APPLICATION**

Lobster® is implanted under local anesthesia using a small skin incision limiting blood loss and muscle trauma preserving anatomical structures; the device could be removed percutanously, if necessary.







# VIS-MOA

# Vascular Interventional Monday Poster Discussions

Monday, Dec. 2 12:15PM - 12:45PM Room: VI Community, Learning Center



AMA PRA Category 1 Credit ™: .50

**FDA** Discussions may include off-label uses.

## Participants

Gloria M. Salazar, MD, Boston, MA (Moderator) Consultant, Medtronic plc

## Sub-Events

#### VI206-SD-MOA1 The Efficacy and Safety of Magnetic Resonance-Guided High-Intensity Focused Ultrasound Ablation of Pedunculated Subserosal Leiomyoma

Station #1 Participants

Nguyen Minh Duc, MD, Ho Chi Minh, Vietnam (*Presenter*) Nothing to Disclose Rajiv Chopra, PhD, Dallas, TX (*Abstract Co-Author*) Stockholder, Profound Medical Corporation; Stockholder, Solenic Medical Inc Bilgin Keserci, PhD, Kota Bharu, Malaysia (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

To evaluate the efficacy and safety of magnetic resonance-guided high-intensity focused ultrasound (MRgHIFU) ablation as an alternatively noninvasive therapy for patients with pedunculated subserosal leiomyoma.

#### **METHOD AND MATERIALS**

This prospective study was approved by institutional review board. Over 3 years (from July 2015 to December 2018), 148 women with symptomatic leiomyoma underwent MRgHIFU at two centers. Of these women, 12 patients mean age 40 years (32-48y) had a single pedunculated subserosal fibroid. During treatment, these pedunculated fibroids were targeted, while sparing the stalk connection between the fibroid and the uterus. Contrast-enhanced T1-weighted MR images were obtained immediately after the treatment to measure the nonperfused volume ratio (NPVr) and to check stalk viability. Changes in tumor volume, diameter of the stalk, patient symptoms and adverse events were evaluated 6 months after treatment.

#### RESULTS

The mean volume of uterine fibroids was 142mL (82-222) and the mean NPV ratio was 82% (60-94). MR imaging follow-up at 6 months presented a 42% (18-60) reduction in the volume of the treated fibroids (P<0.05). All pedunculated subserosal fibroids remained connected to the uterus at 12-month post-treatment. The mean diameter of the stalk reduced from 2.8cm to 2.1cm with a mean 25% reduction ratio (p<0.05). The transformed symptom severity score improvement ratio at 6-month and 12-month post-treatment was 79% and 91%, respectively. There were no severe adverse events during the 12 months of follow-up.

## CONCLUSION

The results in this study suggest that MRgHIFU could be an alternatively safe and efficacious method for pedunculated subserosal fibroids alternative to conventional surgeries. Further larger population studies with longer follow-up should be carried out to validate these results.

## **CLINICAL RELEVANCE/APPLICATION**

MRgHIFU should be considered as an alternatively noninvasive treatment for patients with pedunculated subserosal fibroids without significant adverse events.

# VI225-SD- MRI Markers of Disease Activity and Predictors of Progressive Arterial Disease in Takayasu Arteritis

Station #2

Participants Angela Napolitano, MD, Milano, Italy (*Presenter*) Nothing to Disclose Gabriele Ironi, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose Enrico Tombetti, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose Maurizio Papa, MD, Segrate, Italy (*Abstract Co-Author*) Nothing to Disclose Marta Campolongo, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose Angelo Manfredi, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose Alessandro Del Maschio, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose Francesco A. De Cobelli, MD, Bergamo, Italy (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

The aim of our study is to clarify the capability of MRI to assess disease activity in Takayasu arteritis (TA); moreover, to identify MRI features of disease vascular progression.

#### **METHOD AND MATERIALS**

In this longitudinal prospective study, we enrolled 75 TA patients who underwent an MRI examination yearly on a clinical 1.5 T MR scanner. We studied the supra-aortic trunks, the aorta and the visceral vessels with a standardized protocol, including PD black blood sequences, 3D high resolution T1-weighted sequences before and 10 minutes after contrast administration, and a first pass MRA. We measured arteritic lesions by wall thickness, lenght, percentage of stenosis or dilation; we further calculated differences in SNR and CNR measured for each lesion on pre and post contrast sequences. 222 MRI examination for a total number of 1506 lesions were analyzed by two indipendent radiologists, blinded to the patient's clinical status. Clinical and laboratory data were also collected.

#### RESULTS

In a *per lesion* analysis, lesion thickness correlated with several activity measures, as thicker lesions were present in patients with active disease according to NIH (p<0.001) and PGA of activity (p<0.001), in patients with higher CRP (p<0.001) and ESR (p<0.002). Similarly, higher arterial wall enhancement, assessed by  $\Delta$ CNR, correlated with clinical activity scores, as well as with CRP (p<0.001). Both wall thickness and  $\Delta$ CNR were higher in patients with active disease. Percentage of stenosis or dilation failed to correlate with clinical activity score or CRP levels, while correleted with damage score (p<0.017), thus reflecting the vascular extension of the disease. Moreover, lesions undergoing progression in the MRI follow-up were less frequent in patients undergoing steroid theraphy (p<0.003) and were long, thick, causing severe stenosis or dilation (p<0.001); higher  $\Delta$ CNR at baseline MRI was predictive of vascular progression (p<0.011).

#### CONCLUSION

MRI is able to assess TA disease activity, demonstrating boh the luminal remodelling and the global vascular extension of TA; moreover arterial wall tickeness and enhancement can be used as imaging predictors of vascular progression during the MRI followup.

#### **CLINICAL RELEVANCE/APPLICATION**

MRI is useful tool for the evaluation of TA and should be integrated in the follow-up, for a better management of the patient.

## VI226-SD- Accuracy and Performance Evaluation of a Smartphone-Based Augmented Reality Needle Guidance MOA3 Platform

Station #3 Participants

Ming Li, PhD, Bethesda, MD (Presenter) Nothing to Disclose

Rachel Hecht, Bethesda, MD (Abstract Co-Author) Nothing to Disclose

Sheng Xu, PhD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose

Venkatesh Krishnasamy, MD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose

William F. Pritchard JR, MD, PhD, Chevy Chase, MD (*Abstract Co-Author*) Research collaboration, Koninklijke Philips NV; Research collaboration, Biocompatibles International plc; Research collaboration, BTG International Ltd; Research collaboration, Siemens AG; Research collaboration, XACT Robotics; Research collaboration, W. L. Gore & Associates, Inc; Research collaboration, Celsion Corporation

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#### PURPOSE

To assess the accuracy and performance of a smartphone-based Augmented Reality (AR) guidance platform to facilitate CT-guided percutaneous needle placement.

## METHOD AND MATERIALS

A needle guidance AR smartphone application was developed using Unity and Vuforia SDK platforms to display a planned needle trajectory on an iphone7 in real-time. An acrylamide-based phantom was utilized and containing multiple 2mm target beads embedded at 16cm depths. A 3D reference marker attached on the phantom is used to orient and track the phantom's preprocedural CT image with the smartphone. Two experienced interventional radiologists (IR) performed 3 needle insertions in the phantom via CT-guided cognitive freehand (FH) and 3 insertions via AR guidance. Success was defined as a needle inserted within 5mm of a target bead. Needle placement was adjusted until success was achieved for each target. Each IR was allowed to take and view CT scans similar to their practice with human subjects. Total time and the number of CT scans required to achieve success were recorded, and results from both guidance methods were statistically compared.

#### RESULTS

For IR 1, the average time per successful needle placement using CT-guided FH compared to AR guidance was 16.8±8 min and 5.3±0.8 min (p<0.05), respectively. The average number of CT scans required to achieve success was 2.7±0.6 via CT guidance and 0±0 via AR guidance (p<0.01). For IR 2, the average adjusted time per successful needle placement using CT-guided FH compared to AR guidance was 9.4±2.2 min and 6.7±1.5 min (p<0.05), respectively. The average number of CT scans required was 1.3±0.6 using CT guidance and 0±0 using AR guidance (p<0.05). For each navigation task using AR guidance both operators required only a single insertion attempt to successfully navigate a needle tip to within 5mm of its intended target.

These data suggest that using this novel AR guidance platform in procedures requiring cognitive CT-guided freehand could reduce the number of intermittent CT scans and expedite procedural times.

## **CLINICAL RELEVANCE/APPLICATION**

The AR application can effectively facilitate needle guidance in percutaneous procedures when real time imaging is not available, such as lung intervention. It may shorten operational time and reduce radiation dosages to patients and physicians.

# VI233-SD- Quantitative Inflammatory and Imaging Biomarkers for the Prediction of Tumor Response to DEB-MOA4 TACE in HCC

#### Station #4 Participants

Isabel T. Schobert, BS, New Haven, CT (*Presenter*) Nothing to Disclose Julius Chapiro, MD, New Haven, CT (*Abstract Co-Author*) Research Grant, Guerbet SA; Consultant, Guerbet SA; Research Grant, Koninklijke Philips NV; Consultant, Koninklijke Philips NV; Research Grant, Boston Scientific Corporation; Khaled Bousabarah, MSc, Duesseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose Evan Chen, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose Fabian Laage-Gaupp, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose Nariman Nezami, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose Ming de Lin, PhD, North Haven, CT (*Abstract Co-Author*) Employee, Visage Imaging, Inc; Former Employee, Koninklijke Philips NV Todd Schlachter, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose Lynn J. Savic, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

To investigate the prognostic value of quantifiable laboratory and imaging features for tumor response in hepatocellular carcinoma (HCC) treated with drug-eluting beads transarterial chemoembolization (DEB-TACE).

#### **METHOD AND MATERIALS**

This IRB-approved retrospective study included 51 patients with treatment-naïve HCC (m/f 41/10) who received DEB-TACE (2012-2018). All patients underwent a laboratory work-up prior to treatment, including complete and differential blood count, liver function tests, and alpha-fetoprotein levels. Neutrophil-to-Lymphocyte-Ratio (NLR) and Platelet-to-Lymphocyte-Ratio (PLR) were calculated based on the differential blood count. Additionally, contrast-enhanced magnetic resonance imaging (MRI) was obtained prior to and 1 month after treatment. On T1-weighted triphasic MRI, PyRadiomics-based feature extraction was performed to quantify morphologic tumor characteristics such as sphericity indicating invasive tumor growth, and enhancement dynamics. Tumor response was assessed according to 3D quantitative European Association for the Study of the Liver (qEASL) criteria and correlated with baseline imaging and laboratory markers. Statistics included Pearson correlation and linear regression with alpha level adjusted to multiple testing.

#### RESULTS

Baseline laboratory values and immunologic scores were predictive of tumor response to DEB-TACE. Specifically, patients with increased NLR, PLR, or alkaline phosphatase levels were less likely to respond to therapy (p=0.016, p=0.005, p<0.001, respectively). As opposed to laboratory markers, quantitative radiomic imaging features at baseline did not predict tumor response. However, baseline tumor sphericity correlated with the systemic inflammatory status before treatment. Specifically, increased NLR and PLR were found in patients with less spherical and more invasively growing tumors (p=0.009, p=0.003, respectively).

#### CONCLUSION

This study demonstrates the prognostic value of quantitative laboratory (AP) and particularly immunologic biomarkers (NLR, PLR) at baseline to predict tumor response to DEB-TACE. Additionally, those inflammatory markers were also associated with imaging features indicative of tumor invasiveness before treatment.

#### **CLINICAL RELEVANCE/APPLICATION**

Readily available inflammatory biomarkers can be applied to achieve a quantifiable characterization of the tumor and systemic immune response and thus, personalize patient selection for DEB-TACE in HCC.

#### VI230-SD-MOA5 The Feasibility of Adaptive Statistical Iterative Reconstruction-V for Reducing Radiation Dose and Contrast Agent in CT Portal Venography with 'Three-Low' Technique

Station #5

Participants Zhanli Ren, Xianyang, China (*Presenter*) Nothing to Disclose He Taiping, MMed, Xianyang, China (*Abstract Co-Author*) Nothing to Disclose Yun Shen, PhD, Beijing, China (*Abstract Co-Author*) Employee, General Electric Company Researcher, General Electric Company Jun Gu Sr, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Yong Yu, Xianyang City, China (*Abstract Co-Author*) Nothing to Disclose Nan Yu, MD, Xianyang, China (*Abstract Co-Author*) Nothing to Disclose Yongjun Jia, MMed, Xianyang, China (*Abstract Co-Author*) Nothing to Disclose Xirong Zhang, Xianyang, China (*Abstract Co-Author*) Nothing to Disclose Haifeng Duan, Xianyang, China (*Abstract Co-Author*) Nothing to Disclose Zhang Yanzi, Xianyang City, China (*Abstract Co-Author*) Nothing to Disclose Yanging Yu, Shaanxi, China (*Abstract Co-Author*) Nothing to Disclose Yifan Cheng, Xianyang, China (*Abstract Co-Author*) Nothing to Disclose Yue Wang, Xianyang, China (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

To explore the feasibility of adaptive statistical iterative reconstruction-V(ASIR-V) for reducing radiation dose and contrast agent in CT portal venography(CTPV) with 'Three-Low' technique.

#### **METHOD AND MATERIALS**

Sixty patients with Revolution CT portal venography were randomly divided into group A and group B.Patients in group A were examined with conventional scanning, pre-setted ASIR-V ratio 0%,tube voltage 120kV,contrast agent dose 450mgI/kg,and were reconstructed with filtered back projection(FBP).Patients in group B were scanned with 'three low' technique,pre-setted ASIR-V ratio 40%,tube voltage 100kv,contrast agent dose 350mgI/Kg,and were reconstructed with 0%ASIR-V(FBP) to 100%ASIR-V with interval 10%ASIR-V.The CT values and standard deviation of the main branch of portal vein(MPV),left branch of portal vein(LPV),right branch of portal vein(RPV) were respectively measured to calculate the signal to noise ratio(SNR) and contrast to noise ratio(CNR).The subjective scores of image quality were obtained by two radiologists blindly with a 5-point system.

#### RESULTS

The general data showed no statistical difference between two groups(P>0.05). The effective radiation dose( $2.36\pm0.57mSv$ ) and contrast agent( $21.47\pm3.67g$ ) of group B were reduced by 38.9% and 19.13% than those in group A( $3.86\pm1.80mSv$  and  $26.55\pm2.91g$ )(P<0.05). There was no significant difference in the CT values among 12 groups images(P > 0.05)(Table 1). The SD values in group B decreased gradually while SNR and CNR increased gradually with the increase of ASIR-V ratio(P <0.05). The SD values of group B with 40% -100% ASIR-V were lower while the SNR and CNR values were significantly higher than those in group A (P <0.05)(Table 1 and Table 2). The subjective scores with 50%-100% ASIR-V in group B were higher than those in group A (P <0.05), among which the 80% ASIR-V reconstruction images obtained the highest score(P <0.05)(Table 3).

## CONCLUSION

In CTPV with 'Three-Low' technique,50%-100%ASIR-V reconstruction can significantly reduce image noise and improve image quality, among which the 80%ASIR-V reconstruction can obtain the best portal venography, while the radiation dose and contrast agent reduce by 38.9% and 19.13% respectively than conventional scanning.

## **CLINICAL RELEVANCE/APPLICATION**

In CTPV with 'Three-Low' technique, ASIR-V reconstruction can reduce radiation dose and contrast agent while 50%-100% ASIR-V reconstruction can maintain the image quality that meet clinical diagnosis.

#### VI132-ED-MOA8 All About and How We Do Prostate Artery Embolization (PAE): Indication, Optimal Preparation, Technique, Imaging Analyses, and Complications

Station #8

## Identified for RadioGraphics

Participants

Awards

Ubenicio S. Dias Jr, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose Natally Horvat, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose Mauricio R. Moura SR, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose Publio C. Viana, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose Andre M. Assis, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose Antonio S. Marcelino, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose Airton M. Moreira, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose Claudia D. Leite, MD, PhD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose Giovanni G. Cerri, MD, PhD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose Francisco C. Carnevale, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose

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## **TEACHING POINTS**

1. Management of benign prostatic hyperplasia (BPH) 2. Indications for PAE 3. Pre procedure relevant clinical and imaging features 4. Vascular anatomy and its variations: MRI and Digital Subtraction Angiography (DSA) 5. PAE technique: common difficulties and how to overcome them 6. Post PAE imaging features and pitfalls 7. Early and late complications 8. Innovations and future directions

## TABLE OF CONTENTS/OUTLINE

MANAGEMENT OF BPH - Epidemiology, clinical concepts, guidelines and treatment KEY CONCEPTS - Vascular anatomy and glandular aspects: illustrations with imaging correlation. IMAGING ANALYSIS: WHAT EVERYONE NEED TO KNOW - Advantages and disadvantages of each modality - Preparation. - Imaging protocols and how to optimize it - Difficulties and how to overcome them - Systematic approach to evaluate ultrasound, MRI and CT - Suggestion of a template reporting system PAE TECHNIQUE - Preparation. - The PErFecTED Technique - Difficulties and how to overcome them PAE FOLLOW-UP - Success Criteria and Clinical follow up - Suggestion of a standard follow up POST PAE - Expected imaging features and pitfalls - Early and late complications CASE-BASED DIDACTICS - Challenging cases FUTURE DIRECTIONS - What's on the horizon

# VI001-EB- Identification of Forearm Muscles with Dynamic Ultrasound Imaging for Botulinum Toxin Injection MOA and Image Guided Botox Injections

Hardcopy Backboard

Participants Gokhan Kuyumcu, MD, Tucson, AZ (*Presenter*) Nothing to Disclose Charles T. Hennemeyer, MD, Topanga, CA (*Abstract Co-Author*) Nothing to Disclose Gregory J. Woodhead, MD, PhD, Tucson, AZ (*Abstract Co-Author*) Nothing to Disclose

#### For information about this presentation, contact:

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#### **TEACHING POINTS**

1. Utilization of Botox in stroke patietns with upper extremity spasticity. 2. Utilization of botox in interventional radiology setting.

## TABLE OF CONTENTS/OUTLINE

Botulinum toxin (BoNT) is a neurotoxic protein produced by the Clostridium botulinum. It prevents the release of the neurotransmitter acetylcholine from axon endings at the neuromuscular junction and thus causes flaccid paralysis. Specifically in medicine, injection of botulinum toxin for muscle spasticity has been described in cases of multiple sclerosis, cervical myelopathy and, stroke. Injections in other muscle dystonias like belly dancer dystonia and chronic pelvic pain has also been reported. Ultrasound guided Botox injection has been previously described in the literature and several advantages reported over blind injection including decreased pain and decreased dose. In this exhibit we will describe dynamic ultrasound imaging of forearm muscle groups for accurate localization and maximum efficiency. We will allso summarize our interventional radiology clinic experience with BoNT. TOC: 1.Botox, mode of action, dosages and current utilization 2. Image guided Botox injection in various dystonias including stroke related upper extremity. 3. Dynamic US imaging of forearm to differentiate between profundus and superficialis muscle groups. 4. Example of usage in other dystonias.







# VIS-MOB

# Vascular Interventional Monday Poster Discussions

Monday, Dec. 2 12:45PM - 1:15PM Room: VI Community, Learning Center



AMA PRA Category 1 Credit ™: .50

**FDA** Discussions may include off-label uses.

## Participants

Gloria M. Salazar, MD, Boston, MA (Moderator) Consultant, Medtronic plc

## Sub-Events

#### VI224-SD-MOB1 Transperineal US-Guided Focal Laser Ablation (TPLA) in Treatment of Low and Intermediate Risk Prostate Cancer: Feasibility Multicentric Study at 6- and 12-Month Follow-Up

Station #1 Participants

Guglielmo Manenti, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Tommaso Perretta, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Colleen P. Ryan, Rome, Italy (*Presenter*) Nothing to Disclose Salvatore Marsico, Naples, Italy (*Abstract Co-Author*) Nothing to Disclose Andrea Turbanti, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Martina M. Favre, Geneva, Switzerland (*Abstract Co-Author*) Nothing to Disclose Stefano Regusci, Geneva, Switzerland (*Abstract Co-Author*) Nothing to Disclose Enrico Finazzi Agro, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Giuseppe Vespasiani, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Roberto Floris, MD, Roma, Italy (*Abstract Co-Author*) Nothing to Disclose

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## PURPOSE

The purpose of this study is to evaluate therapy success, complications and technical feasibility and safety of transperineal USguided focal laser ablation as primary treatment for focal unilateral prostate cancer.

# METHOD AND MATERIALS

Fifteen patients with newly diagnosed, histopathologically proven unilateral prostate cancer were treated with US-guided transperineal focal laser ablation as primary treatment. Inclusion criteria were no previous prostate treatment, a prostate specific antigen (PSA) level <=20, Gleason Score (GS) <=7, Lesion <= T2b N0M0 and a MRI-visible cancer lesion (PIRADS >= 4). All US-guided focal laser ablation procedures were performed under local transperineal anesthesia. A needle guide 21G was inserted and guided into the tumor lesion and after correct alignment, the laser fiber (Elesta EchoLaser, Calenzano Florence, Italy) was inserted. Procedure was considered complete when 1800J was reached for each laser fiber. Directly after the ablation a mpMRI of the prostate was acquired. Follow-up consisted of PSA-level measurement and multiparametric prostate MR examination at 1,3,6,12 months with US/MRI Fusion-guided biopsy at 6 and 12 months.

#### RESULTS

Fifteen patients were successfully treated with transperineal US-guided focal laser ablation. No complications occurred. All patients were dismissed on the same day of treatment. The IPSS and SHIM did not significantly change after treatment. Mean operation time was 38.2 minutes (range 32.6-42.5), mean ablation time was 21.7 minutes (range 18.3-26.8), mean energy deployed 3606J (range 3212-3804), mean hospital stay 113 minutes (range 55-178) and mean catheterization time 261 minutes (range 95-412). At the 6- and 12-month follow-up, prostate mpMRI and US/MRI Fusion-guided biopsy showed neither evidence of local residual disease nor recurrence.

## CONCLUSION

Transperineal US-guided focal laser ablation has shown encouraging results, however further follow-up is necessary to confirm oncological long term control.

## **CLINICAL RELEVANCE/APPLICATION**

Transperineal Laser Ablation can treat focal cancerous prostate lesions effectively without short-term complications.

#### VI207-SD-MOB2 The Role of Magnetic Resonance Imaging in Predicting the Outcome of High-Intensity Focused Ultrasound Treatment of Adenomyosis

Station #2 Participants

Nguyen Minh Duc, MD, Ho Chi Minh, Vietnam (*Presenter*) Nothing to Disclose Chandran Nadarajan, MD, Kota Bharu, Malaysia (*Abstract Co-Author*) Nothing to Disclose Huynh Q. Huy Sr, MD, PhD, Ho Chi Minh, Vietnam (*Abstract Co-Author*) Nothing to Disclose Rajiv Chopra, PhD, Dallas, TX (*Abstract Co-Author*) Stockholder, Profound Medical Corporation; Stockholder, Solenic Medical Inc Bilgin Keserci, PhD, Kota Bharu, Malaysia (*Abstract Co-Author*) Nothing to Disclose

## For information about this presentation, contact:

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#### PURPOSE

To investigate the role of magnetic resonance imaging (MRI) in predicting the treatment outcome of high-intensity focused ultrasound (HIFU) ablation of adenomyosis defined as the immediate non-perfused volume (NPV) ratio.

#### **METHOD AND MATERIALS**

A total of 50 women ( $40.3 \pm 6.0$  years with a range of 30-56 years) with symptomatic adenomyosis underwent MRI-guided HIFU ablation. Multivariate linear regression analyses were carried out on multiple pre-treatment MRI parameters including (i) baseline anatomical features, (ii) T2 signal intensity (SI) and (iii) semiquantitative perfusion analysis. The ability of these parameters to predict the final NPV ratio was investigated. Generalized estimating equation (GEE) of all the significant screening MRI parameters acquired from the multivariate analyses were used to predict the immediate NPV ratio.

#### RESULTS

The results of multivariate analyses revealed that there were four statistically significant predictors (p < 0.05): abdominal subcutaneous fat thickness, T2 SI ratio of adenomyosis to myometrium, relative enhancement ratio of adenomyosis to myometrium, time to peak enhancement ratio of adenomyosis to myometrium were significant factors affecting NPV ratio. GEE analysis generated linear equation for predicting the immediate NPV ratio with four statistically significant predictors derived from multivariate analyses : y = 165.952 + 0.119x1 - 10.514x2 - 56.177x3 - 39.812x4, where x1 = abdominal subcutaneous fat thickness, x2 = T2 SI ratio of adenomyosis to myometrium, x3 = relative enhancement ratio of adenomyosis to myometrium, x4 = time to peak ratio of adenomyosis to myometrium. The Pearson test revealed strong correlation between the GEE predicted value with NPV ratio (rho = 0.783, p < 0.001)

#### CONCLUSION

The study suggests that the prediction of MRI-guided HIFU treatment of adenomyosis based on multivariate analyses and prediction model appears to be clinically possible.

#### CLINICAL RELEVANCE/APPLICATION

Based on the prediction model introduced, the role of each significant MRI parameter in the screening phase must be considered to predict the treatment outcome of HIFU ablation of adenomyosis.

#### VI208-SD- Value of 3D Rotational Epidurography on Percutaneous Epidural Adhesiolysis MOB3

Station #3

Participants Yi-Chih Hsu, MD, Taipei, Taiwan (*Presenter*) Nothing to Disclose Chi-Tun Tang, Taipei, Taiwan (*Abstract Co-Author*) Nothing to Disclose Fu-Chi Yang, Taipei, Taiwan (*Abstract Co-Author*) Nothing to Disclose Guo-Shu Huang, MD, Taipei, Taiwan (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

We aimed to evaluate the association between the outcome of percutaneous epidural adhesiolysis (PEA) and 3D-rotational epidurography (3D-RE).

## METHOD AND MATERIALS

After ethics board approval and written informed consent were obtained, we performed 30 PEA in 26 patients, and evaluated their post-PEA image findings. Two independent clinicians categorized and recorded the occurrence of contrast at extra-foraminal and ventral regions on conventional epidurography (CE); and contrast at dorsal canal (DC), ventral canal (VC), dorsal foramen (DF), and ventral foramen (VF) on 3D-RE. Reproducibility was assessed using the intra-class correlation coefficient (ICC). The symptom relief after one month for the patients receiving PEA and the contrast distribution patterns of CE and 3D-RE and were determined.

#### RESULTS

The rate of patients with symptoms relief > 50% after PEA was 63.3%. The inter-reader agreement was higher on 3D-RE (ICC = 0.955) than CE (ICC = 0.793) among different operators (p<0.05). The presence of contrast at DF and VC adjacent to the irritated root on 3D-RE was a predictor for successful response (p=0.015).

#### CONCLUSION

The contrast distribution patterns on 3D-RE may be associated with better outcomes after PEA.

## **CLINICAL RELEVANCE/APPLICATION**

3D-rotational epidurography could provide more accurate information of epidural contrast distribution than conventional epidurography and be used to determine the outcomes after percutaneous epidural adhesiolysis.

#### VI237-SD-MOB4 Comparison between Percutaneous Balloon Vesselplasty and Percutaneous Vertebroplasty in Chronic Painful Compression Fractures of Dorsolumbar Spine

Station #4

Participants Akhil Monga, MD, MBBS, New Delhi, India (*Presenter*) Nothing to Disclose Madhusudhan KS, MBBS, MD, New Delhi , India (*Abstract Co-Author*) Nothing to Disclose Chandan J. Das, MD, MBBS, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose Ankur Goyal, MBBS, MD, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose Deepnarayan Srivastava, Delhi, India (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

To evaluate the efficacy and safety of percutaneous vesselplasty in non-traumatic vertebral fractures of the thoracolumbar spine and compare it with percutaneous vertebroplasty.

## METHOD AND MATERIALS

A total of 50 patients with chronic vertebral compression fracture with duration of more than 12 weeks, severe pain (VAS: more than or equal to 7) and disability attributable to the vertebral fracture were included. They underwent vertebral augmentation procedure out of which 27 patients underwent vertebroplasty and remaining 23, vesselplasty. Clinical and imaging follow up was done for both the groups and they were evaluated for pain, disability scores, increase in anterior vertebral body height and volume of cement injected. Rate of complications was also compared in the study

#### RESULTS

The mean decrease in pain score was 4.27 in the vertebroplasty group and 4.45 in the vesselplasty group (p=0.448). The mean increase in the physical functionality scores was 27.4 in the vertebroplasty group and 35.9 in the other group which was statistically significant (p=0.005). The mean amount of cement injected was 3.84 ml in the vertebroplasty group and 4.68 ml in the other group which was significantly higher (p=0.008). The mean change in anterior vertebral height was 0.63 mm in the vertebroplasty group and 2.47 mm in the vesselplasty group which was significant (p<0.001). There were cement leaks seen in 34% patients in the vertebroplasty group which were minor and mainly involved the paravertebral and intradiscal regions, whereas in the other group, no cement leaks were seen

#### CONCLUSION

Vesselplasty is superior to vertebroplasty in terms of improvement in disability scores, increase in anterior vertebral body height and volume of cement injected, with extremely low complication rate.

#### **CLINICAL RELEVANCE/APPLICATION**

Vertebroplasty has been done for pain alleviation but can rarely cause spinal cord compression if there is epidural leakage of PMMA. Vesselplasty promises to eliminate this catastrophic complication,

#### VI236-SD-Mognetic Resonance Imaging for Tracking Tumor Progression and Identifying Optimal Timepoint for Intervention with Embolization Treatment

#### Station #5

Participants

El-Sayed H. Ibrahim, PhD, Milwaukee, WI (Presenter) Nothing to Disclose

Venkateswara R. Gogineni, PhD, Milwaukee, WI (*Abstract Co-Author*) Research support, Instylla; Research support, Guerbet SA; Research support, InSightec Ltd

Dilip R. Maddirela, MD, Milwaukee, WI (Abstract Co-Author) Research support, Instylla

Sarah B. White, MD, Milwaukee, WI (*Abstract Co-Author*) Research support, Guerbet SA; Research support, Siemens AG; Research support, InSightec Ltd; Consultant, Guerbet SA; Consultant, BTG International Ltd; Consultant, Cook Group Incorporated; Consultant, Strategies MD

#### PURPOSE

Hepatocellular carcinoma is the most common form of primary liver cancer, and globally it is the sixth most common cancer. In patients with unresectable hepatocellular carcinoma, trans-arterial embolization or chemoembolization procedures can be conducted, which require specific targeting of tumors. In this study, we show MRI capability for tracking pre-procedure tumor progression to identify optimal treatment timepoint and allow for accurate tumor targeting.

#### **METHOD AND MATERIALS**

New Zealand white rabbits (males=5, females=4) underwent tumor fragment (3-4 mm3) implantation in the liver under ultrasound guidance. The rabbits were imaged at different timepoints post implantation (10 days (n=4), 21 days (n=8), and 35 days (n=2)) to track solid tumor growth and identify optimal timepoint for the treatment procedure based on tumor size and location. Anesthetized rabbits were scanned on a 3T GE MRI scanner using a 18-channel knee coil and fast spin-echo sequence to generate T2 maps. Axial and coronal stacks of parallel images covering the liver were acquired. As we are imaging a relatively small animal (weight  $\sim$ 3kg) on a human MRI scanner, imaging parameters were optimized to improve resolution and SNR while minimize motion artifacts. Signal intensities from the acquired echoes were fitted to mono-exponential decaying curves to generate T2 maps.

#### RESULTS

The T2 maps showed tumor growth at different timepoints post implantation. After careful setup of the colormap, tumors can be clearly identified on the T2 maps. T2 value was  $67\pm12$  ms and  $32\pm2$  ms in the tumor and normal liver tissue, respectively. Tumor grew in size from  $4.5\pm0.7$  mm to  $8.9\pm1.4$  mm to  $10.7\pm0.7$  mm at 10, 21, and 35 days post implantation, respectively. Based on these results, the 21-days timepoint was identified as the optimal time for intervention with treatment, which allows for accurate tumor targeting.

#### CONCLUSION

This study showed the capability of noninvasive, non-contrast MRI T2 mapping for tracking tumor progression in the liver for selection of optimal treatment timepoint and accurate identification of the tumor location and size for proper treatment planning and optimal outcome.

The developed technique allows for non-invasive tracking of tumor growth and accurate identification of its location and size for proper trans-arterial chemoembolization planning and optimal outcome.

#### VI234-SD-MOB6 Qualitative Study of Patients with Low-Flow Venous Malformation: Symptom Experiences and Content Validity of Patient-Reported Outcome Measures

Station #6

Participants Ryan W. England, MD, Baltimore, MD (*Presenter*) Nothing to Disclose Christopher Bailey, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose Mark H. Meissner, MD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose Melvin Rosenblatt, MD, Fairfield, CT (*Abstract Co-Author*) Nothing to Disclose Anne M. Skalicky, MPH, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose Heather L. Gelhorn, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose Milena D. Anatchkova, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose Clifford R. Weiss, MD, Baltimore, MD (*Abstract Co-Author*) Research Grant, Siemens AG Research Grant, Merit Medical Systems, Inc Research Grant, BTG International Ltd Medical Advisory Board, Clear Guide Medical LLC Founder, Avasys, LLC Officer, Avasys, LLC

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#### PURPOSE

No standard set of patient-reported outcome (PRO) measures or clear method for evaluating symptom or functional improvement after venous malformation (VM) treatment has been established. The purpose of this study is to determine important symptoms and functional effects of VMs and to assess content validity of commonly used patient-reported outcome (PRO) measures for use with VM patients.

#### **METHOD AND MATERIALS**

This cross-sectional, qualitative study involved cognitive interviews with participants with VM aged >=14 years. From February to June 2016, 11 participants (8 female) with a mean (± standard deviation) age of  $31 \pm 15$  years were recruited from 3 clinical sites. The following subgroups were evaluated: 5 adults (aged >=18) with trunk/extremity VMs; 3 adolescents (aged 14-17) with trunk/extremity VMs; and 3 adults with head/neck VMs. We evaluated the content validity of the Worst Pain Numeric Rating Scale (NRS), Patient-Reported Outcomes Measurement Information System (PROMIS) Pain Interference 8-item short form, and PROMIS Physical Function 8-item short form.

#### RESULTS

The most common participant-reported VM symptoms were swelling (n=10), skin discoloration (n=8), acute episodic pain (n=8), chronic pain (n=7), numbness (n=7), and tingling/burning (n=6). Participants reported that VMs affected their physical function (n=10), appearance (n=10), relationships/social activities (n=7), and emotional health (n=3). The Worst Pain NRS and PROMIS Pain Interference measures were relevant to all participants' VM experience. All adults with head/neck VMs found the PROMIS Physical Function measure to be irrelevant. The assessed PRO measures did not address several symptoms commonly reported by VM patients (swelling, skin discoloration, numbness, appearance).

#### CONCLUSION

These results suggest that several VM symptoms are not assessed fully by commonly used PRO measures, and that the relevance of functional limitation questions may vary by VM location.

## **CLINICAL RELEVANCE/APPLICATION**

As VMs vary widely in clinical presentation and response to treatment, these findings can inform future development of locationspecific and comprehensive PROs for VM patients.

#### VI235-SD- Impact of an Electromagnetic Navigation System on Dose Radiation Exposure: A Comparative MOB7 Retrospective Study

Station #7

Participants

Christophe Teriitehau, Saint Denis, France (Presenter) Nothing to Disclose

#### PURPOSE

To assess the impact of a navigation station (CT-Navigation system by IMACTIS) on radiation doses delivered to patients during percutaneous vertebroplasty.

#### **METHOD AND MATERIALS**

In this retrospective comparative trial, 38 patients requiring percutaneous vertebroplasty were included. All procedures were conducted at CCN (Centre Cardiologique du Nord, Saint-Denis, France), by the same radiologist and using the same model and CT scan with identical parameters. The Dose length product (DLP), representing the absorbed dose by the length of explored organs, was acquired in 15 consecutive patients who underwent a conventional procedure (CT group), and in 23 patients who underwent a vertebroplasty assisted by a navigation system (Nav group). The difference in DLP between the two groups was evaluated using Student T-test.This study was approved by CCN's ethical committee; all patients provided informed consent.

#### RESULTS

The mean of DLP dose for the NAV group was 365.1 mGy.cm; this represents a 62.86% reduction compared with that of the CT group (mean 983 mGy.cm; p< 0.001).

#### CONCLUSION

The use of a navigation system reduced the radiation dose compared to conventional vertebroplasty method.

## **CLINICAL RELEVANCE/APPLICATION**

#### lower dose to vertebroplasty under CT

#### VI134-ED-MOB8 Radiofrequency Ablation Guided by Ultrasonography: Tips and Tools to Improve Results in Benign Thyroid Nodules

Station #8

#### Awards Certificate of Merit

#### Participants

Jose Miguel Escudero-Fernandez, MD, Barcelona, Spain (*Presenter*) Nothing to Disclose Alba Anton-Jimenez, MD, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose Ema Andra Moraru, MD, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose Adriana Carolina Montealegre, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose Gabriel Obiols Alfonso, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose Angel Ortiz Zuniga, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose Guillem Quatrecases Cambra, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose Gloria Aranda, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose Xavier Serres Creixams, PhD, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose

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#### **TEACHING POINTS**

Radiofrequency ablation (RFA) guided by US is a safe and effective alternative to surgery with an increasing number of therapeutic indications, including hyperfunctionating ormalignant thyroid nodules. Objectives: - To provide a comprehensive review of anatomical landmarks of cervical region - To highlight technical tips to improve results of RFA - To evaluate usefulness of contrastenhanced ultrasonography (CEUS) during RFA - To evaluate usefulness of elastography in management of nodules - To evaluate effects of RFA on immunitary system - To evaluate usefulness of RFA in hyperfunctionating thyroid nodules

## TABLE OF CONTENTS/OUTLINE

99 patients treated with RFA, women (81%) with clinically benign thyroid nodules. Evaluation of vocal cord movement was performed by US. Elastography performed before and after RFA to define possibility of success. Trans-isthmic approach to better define cervical landmarks. Initial position of the needle depends on length of the active-tip. Moving-shot to create a conus-shape cylinder of ablation. CEUS defines untreated areas. Volume reduction of 61% at 6 months, with significant reduction of symptomatic scores. Similar results were observed in hyperfunctionating nodules (10%) with normalization of hormone levels. There were no changes in anti-TG and anti-TPO IgG after RFA.

#### VI133-ED-MOB9 Algorithmic Approach to Assess Pulmonary Embolism on Dual-Energy Spectral Detector Computed Tomography (SDCT): Overcoming the Pitfalls of Conventional CT

Station #9

Participants Amit Gupta, MBBS, Cleveland, OH (*Presenter*) Nothing to Disclose Kai Roman Laukamp, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose Ramandeep Singh, MBBS, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Elias Kikano, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose Kevin R. Kalisz, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose Dhiraj Baruah, MD, Troy, MI (*Abstract Co-Author*) Educator, Boehringer Ingelheim GmbH Sachin S. Saboo, MD, FRCR, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose

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## **TEACHING POINTS**

Understand the basic physics and reconstructions available from SDCT. Learn the implementation of spectral reconstructions to better assess pulmonary embolism and its hemodynamic significance. Explore the various conditions that mimic pulmonary embolism on iodine density maps Discuss various pitfalls of conventional CT and how to eliminate them using SDCT.

#### TABLE OF CONTENTS/OUTLINE

Basic physics Basic concepts of dual energy CT Various approaches to dual energy CT. Physics behind the spectral reconstructions, with special emphasis on VMIlow images and Iodine density maps. An algorithmic approach to pulmonary embolism studies using spectral CT, using clinical examples. VMIlow for salvaging non diagnostic exams and better detection of pulmonary emboli. Iodine density maps/overlay images for finding occult emboli and improving diagnostic confidence. Iodine density maps/overlay images for predicting the hemodynamic significance of the embolism. Various conditions mimicking pulmonary embolism on iodine density maps. Pitfalls and limitations of conventional CT and how these can be eliminated by SDCT reconstructions: Inherent limitations of conventional CT False positive pulmonary embolism on conventional CT False negative pulmonary embolism on conventional CT






Enhancing Patient Care in CTEPH through Imaging Innovation: Presented by Bayer and Siemens Healthineers

Monday, Dec. 2 2:00PM - 3:30PM Room: S105D

#### **Participants**

Deepa Gopalan, MRCP, FRCR, Cambridge, United Kingdom (*Presenter*) Nothing to Disclose Narinder S. Paul, MD, Toronto, ON (*Presenter*) Research Grant, Canon Medical Systems Corporation; Research Grant, Carestream Health, Inc

Martine J. Remy-Jardin, MD, PhD, Lille, France (Presenter) Research Grant, Siemens AG; Speaker, Siemens AG

## **PROGRAM INFORMATION**

Through the use of case examples, we will walk through imaging techniques currently used by radiologists to identify and diagnose CTEPH, so that the radiological signs seen in respective modalities are not missed. We will explore the role of AI in CTEPH diagnosis and how it will benefit radiologists and patients in the near future.

#### СМЕ

This course does not offer CME credit.





# SSE17

# Nuclear Medicine (Cardiovascular PET)

Monday, Dec. 2 3:00PM - 4:00PM Room: S403A



AMA PRA Category 1 Credit ™: 1.00 ARRT Category A+ Credit: 1.00

**FDA** Discussions may include off-label uses.

## Participants

Peter S. Conti, MD, PhD, Los Angeles, CA (*Moderator*) Consultant, Canon Medical Systems Corporation; Consultant, Bayer AG; Consultant, Lantheus Medical Imaging, Inc;

Don C. Yoo, MD, Lexington, MA (Moderator) Consultant, inviCRO, LLC

#### Sub-Events

# SSE17-01 To Evaluate the Role of 18F-FDG PET/CT in Prosthetic Vascular Graft Infection

Monday, Dec. 2 3:00PM - 3:10PM Room: S403A

Participants

Sikandar M. Shaikh, DMRD, Hyderabad, India (Presenter) Nothing to Disclose

## PURPOSE

Graft infection after prosthetic vascular reconstruction is an uncommon nowadays due to utmost psot surgical care however severe complication. The clinical presentation is often subtle and nonspecific and may occur long after surgery. Although defining a prosthetic vascular graft infection can be difficult, early diagnosis and treatment are important because of the relatively high rates of amputation and death. The present study assessed the role of PET/CT using 18F-FDG for the diagnosis of vascular graft infections

#### METHOD AND MATERIALS

Nineteen patients (15 men and 4 women; age range, 44-71 y) with suspected vascular graft infection underwent 18F-FDG PET/CT. The performance of PET/CT for the diagnosis of an infectious process and its localization to the graft or soft tissues was assessed. The final diagnosis was based on histopathologic findings and microbiologic assays obtained at surgery or on clinical and imaging follow-up.

#### RESULTS

PET/CT detected foci of increased 18F-FDG uptake suspected as infection in 14 patients and localized these findings to the graft in 8 patients. Vascular graft infection was confirmed in 7 of these patients (88%). PET/CT excluded graft involvement in 5 patients, and in 5 (91%) of these 5, long-term follow-up further confirmed that the infectious process was limited to surrounding soft tissues only. No abnormal 18F-FDG uptake was found in any of the 6 patients with no further evidence of infection. PET/CT had a sensitivity of 93%, specificity of 91%, positive predictive value of 88%, and negative predictive value of 96% for the diagnosis of vascular graft infection.

#### CONCLUSION

18F-FDG PET/CT is a reliable noninvasive imaging modality for the diagnosis of vascular graft-related infection. The precise anatomic localization of increased 18F-FDG uptake provided by PET/CT enables accurate differentiation between graft and soft-tissue infection.

## **CLINICAL RELEVANCE/APPLICATION**

Thus 18F-FDG PET/CT is a reliable noninvasive imaging modality for the diagnosis of vascular graft-related infection

## SSE17-02 Usefulness of <sup>11</sup>C-PiB PET/CT for Diagnosing Cardiac Amyloidosis

Monday, Dec. 2 3:10PM - 3:20PM Room: S403A

Participants

Takashi Norikane, Kita-gun, Japan (*Presenter*) Nothing to Disclose Yuka Yamamoto, MD, PhD, Kita-Gun, Japan (*Abstract Co-Author*) Nothing to Disclose Yasukage Takami, Mikicho, Japan (*Abstract Co-Author*) Nothing to Disclose Katsuya Mitamura, Kita, Japan (*Abstract Co-Author*) Nothing to Disclose Yukito Maeda, Kita-gun, Japan (*Abstract Co-Author*) Nothing to Disclose Nobuyuki Kudomi, Kagawa, Japan (*Abstract Co-Author*) Nothing to Disclose Takahisa Noma, Kita, Japan (*Abstract Co-Author*) Nothing to Disclose Yoshihiro Nishiyama, MD, Kagawa, Japan (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

11C-Pittsburgh compound B (PiB) has been promising PET tracer for evaluating amyloid deposition in myocardium. The purpose of this study was to investigate the usefulness of PiB PET/CT for the detection of cardiac amyloidosis using retention index (RI)

images and standardized uptake value (SUV) images.

#### **METHOD AND MATERIALS**

PiB PET/CT studies were performed in 12 patients with cardiac amyloidosis (ATTR: 5, AL: 5, AA: 1 and unknown: 1) and 6 patients without cardiac amyloidosis. A 30-min dynamic emission scan of the heart was obtained immediately after bolus injection of PiB. The RI was calculated as the mean PiB radioactivity concentration between 15 and 25 min after injection divided by the integral of the arterial time-activity curve between 0 and 20 min after injection. The SUV images (at 10-20 min and 20-30 min) were reconstructed. RI and SUV images were visually evaluated. SUV images were also semiquantitatively evaluated using myocardium-to-blood pool ratio (MBR).

#### RESULTS

PiB uptake was visually evident in all 12 patients with cardiac amyloidosis on RI image, in 11/12 patients on 10-20min SUV image and in 7/12 patients on 20-30min SUV image. Myocardial PiB uptake was not observed in all 6 patients without cardiac amyloidosis on both SUV and RI images. The mean ( $\pm$ SD) value of MBR in cardiac amyloidosis on SUV images at 10-20 min and 20-30 min was significantly higher (2.01 $\pm$ 0.78 and 1.70 $\pm$ 0.75, respectively) than that of patients without cardiac amyloidosis (1.07 $\pm$ 0.13 and 0.92 $\pm$ 0.14, respectively) (p=0.010 and 0.024). With a cutoff MBR of 1.5 on 10-20min SUV image, the sensitivity and specificity were 100% and 92%, respectively. The mean ( $\pm$ SD) value of MBR in AL type cardiac amyloidosis patients on SUV images at 10-20 min and 20-30 min was higher (2.36 $\pm$ 1.12 and 1.98 $\pm$ 1.10, respectively) than that of ATTR type cardiac amyloidosis patients (1.88 $\pm$ 0.18 and 1.65 $\pm$ 0.20, respectively), however, there were no significant differences between two types of cardiac amyloidosis.

#### CONCLUSION

These preliminary results indicate that PiB PET/CT using RI images and SUV images were likely to be a useful imaging modality for cardiac amyloidosis.

## **CLINICAL RELEVANCE/APPLICATION**

PiB PET/CT using RI images and SUV images were likely to be a useful imaging modality for diagnosing cardiac amyloidosis.

## SSE17-03 Varying Correlation between Inflammation and Microvascularization in Carotid Atherosclerotic Plaques with Hybrid 18^F-FDG PET/MR

Monday, Dec. 2 3:20PM - 3:30PM Room: S403A

Participants

Yue Zhang, MD, Beijing, China (*Presenter*) Nothing to Disclose Jie Lu, MD, PhD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Hongwei Yang, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Jie Ma, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Haiqing Song, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Qingfeng Ma, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

Hallmarks of vulnerable atherosclerotic plaques are inflammation that can be quantitatively assessed with 18F-fluorodeoxyglucose positron emission tomography (18F-FDG-PET), and increased neovascularization that can be evaluated by dynamic contrastenhanced magnetic resonance imaging (DCE-MRI). It remains unclear whether these parameters are correlated or represent independent imaging parameters. This study determines to investigate the correlation between inflammation and neovascularization in atherosclerotic carotid plaques by performing hybrid 18F-FDG PET/MR.

## METHOD AND MATERIALS

Twenty-five patients with transient ischemic attack or minor stroke in the carotid territory and ipsilateral carotid artery stenosis of 30% to 69% were included. All patients underwent hybrid PET/MR a median of 180 min after injection of 18F-FDG. 18F-FDG standard uptake values with target/background ratio (TBR) were determined. Neovascularization was quantified by transfer constant (Ktrans). Spearman rank correlation coefficients between TBR and Ktrans were calculated.

#### RESULTS

Results: The correlation between TBR and Ktrans was only marginal in the whole study sample (r=0.25, p=0.043). The two variables correlated with each other in the symptomatic plaques (r=0.71, p=0.013), but were independent in the asymptomatic plaques (r=0.03, p=0.473). Neither TBR nor Ktrans was significantly higher in the symptomatic plaques, but both showed inverse relationships with time since last cerebrovascular ischemic event (r=-0.92 and -0.74 for TBR and Ktrans, respectively).

## CONCLUSION

The correlation between inflammation and microvascularization in carotid atherosclerotic plaques with hybrid 18F-FDG PET/MR varied with clinical conditions, pointing to a complex interplay between macrophages and neovessels under different pathophysiological conditions. The moderate correlation shown only in symptomatic plaques indicates the presence of acute plaque inflammation with increased metabolic activity and cytokine production by inflammatory cells. Hybrid 18F-FDG PET/MR systems can help to evaluate the correlation between inflammation and microvascularization in carotid atherosclerotic plaques.

#### **CLINICAL RELEVANCE/APPLICATION**

Hybrid 18F-FDG PET/MR systems can help to evaluate the correlation between inflammation and microvascularization in carotid atherosclerotic plaques and this exam is recommended when the underlying cause of such a lesion is unclear.

# SSE17-04 Brown Fat Activation Demonstrated on FDG PET/CT Predicts Favorable Lipid Profile and Reduced Risk of Diabetes

Participants Sonya Y. Park, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

## PURPOSE

Brown adipose tissue (BAT) plays a key role in energy homeostasis, conferring protection against diet-induced obesity, and has even been suggested as a potential target for the treatment of obesity and metabolic syndrome. The purpose of this study was to compare the metabolic outcomes (lipid profile and diabetes) of patients with and without BAT activity on FDG PET/CT.

#### **METHOD AND MATERIALS**

PET/CT exams from 1834 breast cancer patients were retrospectively reviewed for bilateral symmetric elongated FDG activity in the neck and chest, typical of BAT activation. To account for temperature changes in the environment, patients with BAT activity and those who underwent PET/CT exams on the same day (but without BAT activity) were included in the study. Blood glucose, lipid profile and presence of diabetes at baseline and last clinical follow-up (mean follow-up of 57 months) were recorded. Comparison of the groups with and without BAT activity was done using Mann Wwhithney U-test. Development of diabetes was analyzed with respect to the other clinical variables using Cox proportional hazard model.

#### RESULTS

1.1% (20/1834) of the patients who underwent PET/CT demonstrated BAT activation, and 119 patients were analyzed for comparison as the group without BAT activity. The group with BAT activity showed significantly lower age (mean 41.8 vs. 53.7, p<0.001), BMI (mean 22.0 vs. 23.6, p=0.049), blood glucose (mean 90.3 vs. 109.3, p=0.029) and total cholesterol (mean 169.4 vs. 190.4, p=0.029) than the group without. At last clinical follow-up, the group with BAT activity showed little change in terms of triglyceride and total cholesterol levels, but increased HDL (mean 45.5 to 60.8) and decreased LDL (mean 115.5 to 85.6). Presence of BAT activity was the only statistically significant predictor for diabetes on Cox regression (p=0.014), with a hazard ratio of - 9.007.

## CONCLUSION

Patients with BAT activity demonstrated the characteristic traits of lower age, BMI, blood glucose and total cholesterol at baseline, and showed a favorable change in lipid profiled on follow-up. The hazard for this group was also lower than for the group without BAT activity in terms of diabetes, further suggesting the role of brown fat in lipoprotein metabolism.

#### **CLINICAL RELEVANCE/APPLICATION**

Mention of brown adipose tissue activity is recommended when visualized on FDG PET/CT, due to the added information it offers regarding lipoprotein metabolism.

# SSE17-05 Assessment of Aortic Involvement in Takayasu Arteritis with FDG PET during the Immunosuppressive Therapy

Monday, Dec. 2 3:40PM - 3:50PM Room: S403A

Participants

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#### PURPOSE

F-18 fluorodeoxyglucose (FDG) positron emission tomography (PET) is a promising technique for the diagnosis of Takayasu arteritis (TAK). The severity of FDG uptake in the aortic wall is often evaluated by the comparison with liver uptake; whereas, the FDG uptake in the liver has been discussed to be affected by prednisone (PSL) and tocilizumab (TCZ), which are the common treatment of TAK. Moreover, the optimal evaluation of aortic involvement with FDG PET in TAK during the immunosuppressive therapy (IST) has not been established enough. The aim of this study was to elucidate the influence of PSL and TCZ on liver FDG uptake and to find out the appropriate assessment of FDG uptake in the aortic wall in TAK patients during IST.

#### **METHOD AND MATERIALS**

Twenty-five consecutive TAK patients during IST were examined with FDG PET. We excluded 6 patients with a history of total arch replacement. Of 19 patients, 11 patients were treated with only PSL (PSL group) and 8 patients received TCZ with/without PSL (TCZ group). First, the maximum standardized uptake value (SUVmax) of the aortic wall, liver, and lumen blood pool was calculated. Next, the aortic wall to liver FDG uptake ratio [target-to-liver uptake ratio (TLR)] and the aortic wall to lumen ratio [target-to-background ratio (TBR)] were determined. Furthermore, TLR and TBR were compared between the patients remaining symptoms (Active, n=12) and the patients with no clinical complaint (Inactive, n=7).

#### RESULTS

First, SUVmax in the liver was significantly lower in TCZ group than PSL group  $(2.36\pm0.15 \text{ vs. } 3.08\pm0.13, p<0.01)$ . Secondly, there was no significant difference in TLR between Active and Inactive; on the other hand, TBR was significantly higher in Active than Inactive  $(1.45\pm0.07 \text{ vs. } 1.14\pm0.09, p=0.01)$ . Based on ROC curve analysis, the optimal TBR cut-off value for detecting active inflammation in the aortic wall was 1.35 with the sensitivity of 72% and specificity of 100%.

#### CONCLUSION

Since liver FDG uptake was susceptible to IST, the comparison with the liver uptake might not be recommended for the assessment of persistence or recurrence of aortic involvement with FDG PET. TBR is more appropriate to evaluate the aortic involvement in TAK during IST.

#### **CLINICAL RELEVANCE/APPLICATION**

IST for TAK affects the FDG distribution in the liver. For the assessment of aortic involvement in TAK during IST, it is more appropriate to compare the FDG uptake in the aortic wall with the lumen blood pool.

# SSE17-06 Vulnerable Plaque Features Can Be Detected in Carotid Plaques with Hybrid 18<sup>F-FDG PET/MR</sup> Imaging

Monday, Dec. 2 3:50PM - 4:00PM Room: S403A

Participants

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#### PURPOSE

To investigate morphological and biological features of vulnerable carotid atherosclerotic plaques in patients with known increased risk of atherosclerosis with hybrid 18F-FDG PET/MR imaging.

## METHOD AND MATERIALS

Sixteen patients with known increased risk of atherosclerosis underwent hybrid PET/MR of the carotid arteries after injection of 18F-FDG. PET/MR was performed a median of 180 min after injection. American Heart Association (AHA) lesion type and plaque composition were determined on consecutive MRI axial sections in both carotid arteries. 18F-FDG uptake in carotid arteries was quantified using maximum standardized uptake values (SUVmax) and tissue to background ratio (TBR) on corresponding PET sections.

## RESULTS

The prevalence of complicated atherosclerotic plaques (AHA lesion type VI) detected with high-resolution MRI was significantly higher in the carotid artery ipsilateral to the ischemic stroke as compared to the contralateral side (31 vs 0 %; p=0.006). Atherosclerotic plaques classified as vulnerable with MRI (AHA lesion type VI) were associated with higher 18F-FDG uptake in comparison with other AHA lesions (SUVmax=3.31±1.13 vs 1.61±0.68 and 0.91±0.37; TBR=3.21±1.04 vs 1.56±0.53 and 0.88±0.26, respectively; p<0.001).

## CONCLUSION

Morphological and biological features of vulnerable plaques can be detected with 18F-FDG PET/MR in patients with known increased risk of atherosclerosis. Hybrid 18F-FDG PET/MR systems might help in the evaluation of patients with vulnerable carotid atherosclerotic plaques.

#### **CLINICAL RELEVANCE/APPLICATION**

Hybrid 18F-FDG PET/MRI systems can help in the evaluation of patients with vulnerable carotid atherosclerotic plaques.





## SSE26

# Vascular/Interventional (Education and Safety)

Monday, Dec. 2 3:00PM - 4:00PM Room: E260



AMA PRA Category 1 Credit ™: 1.00 ARRT Category A+ Credit: 1.00

# Participants

Lisa H. Kang, MD, Sacramento, CA (*Moderator*) Nothing to Disclose Gloria M. Salazar, MD, Boston, MA (*Moderator*) Consultant, Medtronic plc

# Sub-Events

# SSE26-01 Endovascular Simulation Training: A Tool to Increase Enthusiasm for Interventional Radiology Among Medical Students

Monday, Dec. 2 3:00PM - 3:10PM Room: E260

Participants

Roman Kloeckner, MD, Mainz, Germany (*Presenter*) Advisory Board, Guerbet SA; Advisory Board, Bristol-Myers Squibb Company; Advisory Board, Sirtex Medical Ltd; Speaker, Guerbet SA; Speaker, Sirtex Medical Ltd; Speaker, BTG International Ltd Fabian D. Stohr, Mainz, Germany (*Abstract Co-Author*) Nothing to Disclose Sebastian Schotten, MD, Mainz, Germany (*Abstract Co-Author*) Nothing to Disclose Christoph Dueber, MD, Mainz, Germany (*Abstract Co-Author*) Nothing to Disclose Michael B. Pitton, MD, Mainz, Germany (*Abstract Co-Author*) Nothing to Disclose Franziska Schmidt, Mainz, Germany (*Abstract Co-Author*) Nothing to Disclose Daniel Pinto dos Santos, MD, Mainz, Germany (*Abstract Co-Author*) Nothing to Disclose

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## PURPOSE

Interventional radiology (IR) is a growing field. However, in most medical schools it is underrepresented in the curriculum. Therefore, we aimed to test whether endovascular simulator training improves the attitude towards IR among medical students.

## METHOD AND MATERIALS

This prospective study is conducted at two university medical centers. In both, a dedicated 90-minute course on IR is given to 4th year medical students; in center A in two weeks in February 2019 on a daily basis, in center B once per week between March and May 2019. The course is split into two halves: One theoretical 45-minute part about IR and one practical 45-minute part using endovascular simulators. Questionnaires are completed before the course, after the theoretical part, and after the practical part using smartphones/tablets. Students are asked to rate their knowledge of IR, their interest in IR, the attractiveness of IR, and their willingness to potentially work in IR in the future on a 7-point Likert scale. To prevent position effect-bias, the study was conducted in a crossover design, i.e. 50% of the students heard the theoretical part first followed by the practical training, the other 50% vice versa.

## RESULTS

As of the abstract deadline, 211 students completed all three questionnaires. Seminar and simulator led to an increase in knowledge about IR (pretest: 2.7 vs. post-seminar/post-simulator: 5.11/5.36), interest in IR (5.16 vs. 5.54/5.69), attractiveness of IR (4.55 vs. 4.76/4.85), and the likelihood to choose IR in the future (3.33 vs. 3.75/3.9) (all p<0.05). Although both parts led a significant improvement, the effect was significantly stronger for the simulator part compared to the theoretical part regarding all items (all p<0.05).

# CONCLUSION

Endovascular simulator training in medical school significantly increases the knowledge about IR and the willingness to potentially choose IR in the future. In May 2019 the second part will be completed in center B, hopefully confirming these initially positive results.

## **CLINICAL RELEVANCE/APPLICATION**

Implementing dedicated IR-courses in medical school can help to fight recruitment problems in IR; a practical simulator training further increases students' motivation.

# SSE26-02 Burnout and Moral Injury Among Interventional Radiologists

Monday, Dec. 2 3:10PM - 3:20PM Room: E260

Participants Jacob J. Bundy, MD, MPH, Ann Arbor, MI (*Presenter*) Nothing to Disclose Anthony N. Hage, MD, Ada, MI (*Abstract Co-Author*) Nothing to Disclose Ravi N. Srinivasa, MD, Agoura Hills, CA (*Abstract Co-Author*) Nothing to Disclose Joseph J. Gemmete, MD, Northville, MI (*Abstract Co-Author*) Consultant, Terumo Corporation; Stockholder, Ablative Solutions, Inc; Stockholder, Innovative Cardiovascular Solutions; Stockholder, InNeuro; Stockholder, FlexDex, Inc; Stockholder, Kalypso LP Eunjee Lee, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose Jonathan Gross, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Travis L. Healey, MD, Indianapolis, IN (*Abstract Co-Author*) Nothing to Disclose Agnieszka O. Solberg, MD, Bismarck, ND (*Abstract Co-Author*) Owner, SunMountain Medical Consulting LLC; Spouse, Owner, SunMountain Medical Consulting LLC Jeffrey F. Chick, MD, MPH, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

To characterize burnout among Interventional Radiologists.

#### METHOD AND MATERIALS

An anonymous, Institutional Review Board-exempt, 34-question online survey was distributed to practicing Interventional Radiologists through the Society of Interventional Radiology Open Forum, Twitter, Facebook, and LinkedIn. The survey consisted of demographic and practice environment questions, and the 22-item Maslach Burnout Inventory (MBI). Interventional radiologists with high scores on EE (>= 27) or DP (>= 10) MBI subscales were considered to have at least one manifestation of physician burnout. STROBE reporting guidelines were followed.

## RESULTS

339 surveys were completed over ten days starting on January 7, 2019. 263 (77.6%) respondents identified as men, 75 (22.1%) as women, and 1 (0.3%) as trans-male. The respondents were Interventional Radiologists practicing at academic (136; 40.1%), private (145; 42.8%), and hybrid (58; 17.1%) centers. Respondents worked an estimated >40 hours (15; 4.4%), 40-60 hours (225; 66.4%), 60-80 hours (81; 23.9%), and >80 hours (18; 5.3%) per week. 307 (90.6%) reported taking call, with most respondents taking 1-5 (116; 34.2%) or 6-10 (158; 46.6%) calls per month. Mean MBI scores for EE, DP, and personal achievement were 29.7  $\pm$  12.9, 10.7  $\pm$  7.0, and 39.7  $\pm$  6.8. Burnout among respondents was 72.0% (244 Interventional Radiologists). Identifying as a woman was significantly associated with burnout (odds ratio 2.4; P=0.009). Compared to respondents who worked <80 hours per week, working >80 hours per week was significantly associated with burnout (odd ratio 7.0; P=0.030). Practice level (P=0.553), practice setting (P=0.557), diagnostic radiology duties (P=0.588), practice size (P=0.232), years' post-graduate (P=0.373), age (P=0.856), and amount of call taken (P=0.110) were not significantly associated with burnout.

## CONCLUSION

Burnout is prevalent among Interventional Radiologists. Identifying as a woman and working more than 80 hours per week were strongly associated with burnout. Strategies to reduce burnout within interventional radiology should consider improving gender equity and work hours among Interventional Radiologists.

#### **CLINICAL RELEVANCE/APPLICATION**

Strategies to reduce burnout within interventional radiology should consider improving gender equity and work hours among Interventional Radiologists.

## SSE26-03 Hand Motion Analysis of Radiologists Performing Simulated Radial Arterial Access: Discerning Differences in Operator Experience Using Kinematic Analysis

Monday, Dec. 2 3:20PM - 3:30PM Room: E260

Participants

Jeffrey Weinstein, MD, Wellesley, MA (*Presenter*) Nothing to Disclose Fady El-Gabalawy, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Ammar Sarwar, MD, Boston, MA (*Abstract Co-Author*) Stockholder, Agile Devices, Inc; Scientific Advisory Board, Agile Devices, Inc; Grant Support, Sirtex Medical Inc Olga R. Brook, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Salomao Faintuch, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Michael Hsu, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Seth J. Berkowitz, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Matthew R. Palmer, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Muneeb Ahmed, MD, Boston, MA (*Abstract Co-Author*) Research Grant, General Electric Company Stockholder, Agile Devices, Inc Scientific Advisory Board, Agile Devices, Inc

#### PURPOSE

To perform a pilot evaluation of the ability of electromagnetic hand motion sensor technology to determine differences in the kinematic profile of operators based on their practice experience with radial artery access.

## **METHOD AND MATERIALS**

Six fellowship-trained, right-handed attending interventional radiologists with 1-13 years of experience performed simulated arterial access on a commercial phantom. Two of the attendings reported limited radial arterial access experience (<50 cases), two reported significant experience obtaining palpatory radial artery access (>100 cases), and two had experience with radial artery access under ultrasound (US) guidance (>100 cases). The task involved placing a 21-gauge needle into the phantom radial artery and threading a wire into the artery. The phantom had tubing with red fluid and a squeeze-bulb to simulate a radial artery with blood and arterial pulsations. Each operator performed the task 5 times with an electromagnetic sensor affixed to the dorsum of each hand between the second and third metacarpals. Total time and total distance the sensors traveled (path length) were measured. Statistical analysis was performed using paired T-tests.

#### RESULTS

The radiologists with significant palpatory radial artery access experience had both a shorter time to complete the task and path

length compared to those who had limited radial artery experience  $(91 \pm 13 \text{ s} \text{ vs. } 143 \pm 32 \text{ s}, \text{ p} < 0.01 \text{ and } 141 \pm 18 \text{ cm vs. } 239 \pm 100 \text{ cm}, \text{ p} = 0.012)$ . Those with ultrasound experience had a shorter time to complete the task than those with limited radial access experience  $(105\pm11 \text{ s} \text{ vs. } 143\pm32 \text{ s}, \text{ p} = 0.012)$  but their path length was not significantly shorter  $(168\pm35 \text{ cm vs. } 239\pm100 \text{ cm}, \text{ p} = 0.063)$ . When comparing only the palpatory and US groups, the time to complete the task was not significantly different  $(91\pm13 \text{ s} \text{ vs. } 105\pm11 \text{ s}, \text{ p} = 0.079)$  but the path length was shorter for the palpatory group  $(141\pm18 \text{ cm vs } 168\pm35 \text{ cm}, \text{ p} = 0.042)$ .

## CONCLUSION

Kinematic analysis of hand motion using electromagnetic motion tracking was successful in distinguishing variability of operator experience with radial artery access. Further exploration of this technology may determine if the kinematic profile correlates with proficiency in completing a procedural task.

#### **CLINICAL RELEVANCE/APPLICATION**

Electromagnetic motion sensor technology can determine subtle differences in experience between trained operators for a given manual task and help determine areas for further development.

# SSE26-04 Comparison of a New Material-Specific Contrast-to-Noise Ratio-Based Exposure Control with a Regular-Dose Dependent Exposure Control in a Clinical Angiographic System

Monday, Dec. 2 3:30PM - 3:40PM Room: E260

Participants

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#### PURPOSE

The purpose of this phantom study was to evaluate the skin-dose reduction potential of a material specific contrast-to-noise ratio based exposure control (CEC) in comparison to a regular detector based exposure control (DEC) in a clinical angiographic system.

#### **METHOD AND MATERIALS**

A standardized 3D-printed phantom with an iron, tantalum and platinum foil and cavities for contrast material (iodine, barium, carbon dioxide) was developed in order to investigate the dependency of a spatial frequency dependent CNR on image acquisition settings. This phantom was placed into a stack of polymethylmethacrylate and aluminum plates, simulating a patient equivalent thickness (PET) of 2.5cm-40cm. Fluoroscopic (FL) and diagnostic radiograph (DR) images were acquired using a clinical angiographic system with material-specific CEC (iron, tantalum, platinum, carbon dioxide, iodine barium) and regular DEC protocols implemented. The CNR of the CEC protocols were adjusted to the CNR of the DEC protocols in order to allow for a comparison. The possible skin radiation dose reduction for material specific CEC protocols compared to DEC protocols was estimated while the CNR was maintained.

#### RESULTS

Material specific CEC demonstrated a substantial skin dose reduction potential compared to DEC protocols. For platinum and tantalum the possible mean skin radiation dose reduction while maintaining CNR was 59 ±21% (max. 91% at 30cm) and 65 ±18% (max. 92% at 30cm) for DR and 58 ± 23% (max. 84% at 30cm) and 58 ± 23% (max. 87% at 27.5cm) for FL, respectively. For carbon dioxide imaging the possible mean skin radiation dose reduction was 52 ± 19% (max. 87% at 30cm). For barium, iodine and iron the mean skin radiation dose reduction while maintaining CNR was 32 ±19%, 33 ±17%, 34 ±17% for DR and 18 ±12%, 19 ±18% and 18 ±11% for FL. For these materials highest skin dose reduction of approx. 40% for FL and 50% for DR at 27.5-30cm.

#### CONCLUSION

The use of a material specific contrast-to-noise ratio based exposure control bears a substantial skin dose reduction potential compared to the regular detector dose dependent exposure control.

#### **CLINICAL RELEVANCE/APPLICATION**

Material specific CEC allows for a substantial radiation dose reduction without loss of image quality as compared to DEC. In particular, the dedicated imaging of tantalum and platinum might help to considerable reduce the radiation exposure of the patient and staff.

## SSE26-05 Demonstration of a Real-Time Scattered Radiation Display for Staff Dose Management during Fluoroscopic Interventional Procedures

Monday, Dec. 2 3:40PM - 3:50PM Room: E260

Participants

Jonathan L. Troville, MS,BS, Buffalo, NY (*Presenter*) Research support, Canon Medical Systems Corporation Chao Guo, MS, Amherst, NY (*Abstract Co-Author*) Research support, Canon Medical Systems Corporation Stephen Rudin, PhD, Buffalo, NY (*Abstract Co-Author*) Research Grant, Canon Medical Systems Corporation Daniel Bednarek, PhD, Buffalo, NY (*Abstract Co-Author*) Research Grant, Canon Medical Systems Corporation

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#### PURPOSE

To facilitate staff dose management during long fluoroscopic interventional procedures, our group has developed a real-time, virtual reality (VR) scattered radiation display system (SDS). A demonstration of how the SDS works using data from clinical procedures is presented.

The SDS provides a VR representation of a patient graphic, the c-arm gantry, patient table, and a color-coded overlay that displays the spatial distribution of scattered radiation in the room as well as the scatter dose rate at a staff member's location using a circular indicator. Update of the staff indicator position occurs in real-time via body tracking using a Microsoft Kinect V2 depth camera. To demonstrate its use, cardiovascular interventional cases were retrospectively analyzed under IRB approval using log files of all exposure events obtained from Canon's Dose Tracking System (DTS). The log file data for each clinical case was read into the SDS for selection of the appropriate pre-calculated scatter distributions during playback for each procedure. The real-time SDS has been developed in Matlab using the Python controller area network (CAN) interface module to facilitate inflow of geometric and exposure messages from a Canon Biplane Angiography system. A virtual CAN bus using the Python interface was utilized to play back the clinical log files for this demonstration.

## RESULTS

For each cardiovascular case, VR scatter distribution displays were generated showing variations with changes in each of the geometric and exposure parameters read in from the system. A staff member indicator was placed on-screen to display the changing dose-rates during the intervention. The magnitude of the change in scatter is shown as the procedures progressed. Simultaneously, patient skin dose distributions and entrance dose rates were displayed with the DTS.

#### CONCLUSION

A real-time scattered radiation display can enable staff members to make informed decisions throughout the procedure on where to stand in the room and thus maintain staff dose as low as reasonably achievable. The SDS can be implemented in the procedure room with the DTS for a comprehensive approach to radiation safety and dose reduction.

## **CLINICAL RELEVANCE/APPLICATION**

A real-time scattered radiation display system can facilitate staff dose management and with Canon's real-time patient skin dose mapping system would offer a comprehensive approach to dose reduction.

## SSE26-06 A Systematic Review of 639 Patients with Biopsy-Confirmed Nephrogenic Systemic Fibrosis

Monday, Dec. 2 3:50PM - 4:00PM Room: E260

#### Participants

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## PURPOSE

To perform a systematic review of nephrogenic systemic fibrosis (NSF).

## METHOD AND MATERIALS

PubMed database was searched using 'nephrogenic systemic fibrosis' from January 2000 to February 2019 for studies in which patients with biopsy-confirmed NSF were reported. Data were pooled and authors were contacted for clarification. We used GraphPad software for statistical analysis of the data.

#### RESULTS

639 biopsy-confirmed patients with NSF from 173 articles are included. Among 542 with data 292 were female and 250 were male. Age at symptom onset was available for 174 patients [mean=49, (range=6-87)] with no reports in neonates or toddlers and few reports (n=7) in the very old (>80 years). 532 patients had documented exposure to GBCA including Group I (gadodiamide=315, gadopentetate dimeglumine=49, gadoversetamide=6), Group II (gadobutrol=1, gadobenate dimeglumine=1), multiple (n=49) and unknown (n=111). All but 3 patients with GBCA exposure, received gadolinium prior to 2008. 14 patients had no prior GBCA exposure in spite of searching. For 413 patients with clinical severity data, different degrees of motion limitation were present in 291/413(70%) indicating a more severe form of the disease in contrast to 122/413(30%) with only dermatological manifestations. Having a more severe debilitating disease was significantly correlated with being on dialysis at the time of GBCA exposure (P=0.005), chronic renal failure (P=0.04), and receiving a higher cumulative GBCA dose (P=0.0004). NSF was also associated with pro-inflammatory conditions, hyperphosphatemia, beta blockers and epoetin. 48%(70/146) of patients with autoimmune data, had autoimmune disease. Face was always spared except for 3 patients. For 341 patients with follow-up, 12 were cured and 72 partially improved including one during pregnancy. In 34 of these patients, improvement of symptoms occurred following renal function restoration. 4 deaths were attributed to NSF.

#### CONCLUSION

Although 639 patients with biopsy-confirmed NSF were reported, only 3 followed GBCA exposure after 2008 indicating that regulatory actions and practice changes have been effective preventive measures. Improvement and sometimes cure with renal function restoration is now possible.

## CLINICAL RELEVANCE/APPLICATION

This systematic review shows that NSF has been nearly eliminated, is no longer incurable and supports the preference for group II GBCAs in at risk patients.







# SPDL30

Houston, We Have a Problem (Case-based Competition)

Tuesday, Dec. 3 7:15AM - 8:15AM Room: E451B



AMA PRA Category 1 Credit ™: 1.00 ARRT Category A+ Credit: 0

# Participants

Adam E. Flanders, MD, Narberth, PA (*Presenter*) Nothing to Disclose Sandeep P. Deshmukh, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose Christopher G. Roth, MD,MS, Philadelphia, PA (*Presenter*) Nothing to Disclose Vishal Desai, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose

# For information about this presentation, contact:

adam.flanders@jefferson.edu

# **Special Information**

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

## **LEARNING OBJECTIVES**

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





# RC312

# Body MR Angiography: 2019 Update

Tuesday, Dec. 3 8:30AM - 10:00AM Room: N229



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

**FDA** Discussions may include off-label uses.

## Participants

Maureen N. Hood, PhD,RN, Bethesda, MD (*Moderator*) In-kind support, General Electric Company Scott B. Reeder, MD,PhD, Madison, WI (*Moderator*) Nothing to Disclose

## Sub-Events

## RC312A MRA Techniques

Participants Scott B. Reeder, MD,PhD, Madison, WI (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) Understand the fundamental principles of contrast enhanced MRA. 2) Understand the fundamental principles of non-contrast enhanced MRA. 3) Understand the fundamental principles of phase velocity MRA.

# RC312B Thoracic MRA: Clinical Applications

Participants

Robert A. Liotta, MD, Kensington, MD (Presenter) Nothing to Disclose

For information about this presentation, contact:

robert.liotta@usuhs.edu

## LEARNING OBJECTIVES

1) Identify common clinical applications for thoracic MRA. 2) Describe the role for non-contrast versus contrast-enhanced thoracic MRA.

# RC312C Abdominal/Pelvic MRA: Clinical Applications

Participants Pamela J. Lombardi, MD, Chicago, IL (*Presenter*) Nothing to Disclose

## LEARNING OBJECTIVES

1) Describe current contrast enhanced and non contrast MR angiography techniques. 2) Present clinical applications of MR angiography. 3) Introduce future perspectives for MRA.

## RC312D MR Safety Concerns in Cardiovascular Patients

Participants Maureen N. Hood, PhD,RN, Bethesda, MD (*Presenter*) In-kind support, General Electric Company

For information about this presentation, contact:

maureen.hood@usuhs.edu

## LEARNING OBJECTIVES

1) Discuss the importance of an MR Safety Program in your institution. 2) Describe safety concerns related passive and active cardiovascular devices. 3) Explain the evaluation MR safety procedures for electronic devices. 4) Discuss contrast agent concerns and safety recommendations in MRA.

## ABSTRACT

MR safety is a team effort. Cardiovascular patients often need special care and the use of contrast agents. MRI settings that perform cardiac MR and MRA regularly should have advanced education in MR safety. Staff should be trained annually on MR safety, especially with the growth in the number of patients with implanted active cardiovascular devices. Training and proper selection of staff are required for certain active devices. The off-label use of contrast agent use, both gadolinium and iron will be presented along with adverse events the MR team needs to be prepared for. Teamwork is critical for optimal patient care.

## Active Handout: Maureen Nanette Hood

http://abstract.rsna.org/uploads/2019/18002591/RC312D Hood MR Safety Concerns 2019\_Handout.pdf







## RC314

## **Interventional Series: Venous Disease**

Tuesday, Dec. 3 8:30AM - 12:00PM Room: E352



AMA PRA Category 1 Credits ™: 3.25 ARRT Category A+ Credits: 3.75

FDA Discussions may include off-label uses.

#### Participants

Sanjeeva P. Kalva, MD, Boston, MA (*Moderator*) Consultant, General Electric Company; Royalties, Reed Elsevier; Royalties, Springer Nature; Investor, Althea Health, CA; Consultant, C. F. Koo Foundation; Consultant, Medtronic plc; Research Grant, AngioDynamics, Inc; Consultant, US Vascular LLC; Consultant, Dova Pharmaceuticals

Kari J. Nelson, MD, North Tustin, CA (*Moderator*) Research support, SillaJen, Inc; Research collaboration, Koninklijke Philips NV; Research collaboration, Teclison Cheery Pharma;

#### For information about this presentation, contact:

skalva@partners.org

#### LEARNING OBJECTIVES

1) Describe current management of pulmonary embolism, including interventional techniques. 2) List rationale for venous thrombolysis. 3) Describe the current state of practice surrounding inferior vena cava filters. 4) Learn about techniques for endovascular management of chronic venous occlusions

## ABSTRACT

n/a

#### Sub-Events

## RC314-01 New Endovascular Devices for PE

Tuesday, Dec. 3 8:30AM - 8:45AM Room: E352

Participants

Akhilesh K. Sista, MD, New York, NY (*Presenter*) Research Grant, Penumbra, Inc; Scientific Advisory Board, Thrombolex; Scientific Advisory Board, Vascular Medicure

## LEARNING OBJECTIVES

1) Describe the different mechanical options for thrombus maceration and/or removal. 2) Describe the risks and benefits of these devices. 3) Identify which patients may benefit the most from these devices. 4) Describe the state of the data for these mechanical devices.

#### ABSTRACT

n/a

## RC314-02 PE Treatment Options and Pulmonary Embolism Response Team

Tuesday, Dec. 3 8:45AM - 9:00AM Room: E352

Participants

Ketan Y. Shah, MD, Chicago, IL (Presenter) Nothing to Disclose

## RC314-03 Safety and Feasibility of Pulmonary Artery Mechanical Thrombectomy Using the FlowTriever System: Real World Experience with a New Device

Tuesday, Dec. 3 9:00AM - 9:10AM Room: E352

Participants

Nariman Nezami, MD, New Haven, CT (*Presenter*) Nothing to Disclose Jeffrey S. Pollak, MD, Woodbridge, CT (*Abstract Co-Author*) Nothing to Disclose Igor Latich, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose Juan Carlos Perez Lozada, MD, Fairfield, CT (*Abstract Co-Author*) Nothing to Disclose Angelo G. Marino, DO, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose Todd Schlachter, MD, New Haven, CT (*Abstract Co-Author*) Research Grant, Guerbet SA Hamid R. Mojibian, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Catheter-directed and assisted therapies have revolutionized the management of higher-risk pulmonary embolism (PE) by means of chemical dissolution or mechanical disruption of clots. This is the first study reporting the safety, feasibility, and early outcome of

the FDA approved pulmonary artery mechanical thrombectomy (MT) device, the Inari FlowTriever System.

## METHOD AND MATERIALS

This was a retrospective analysis of 14 consecutive patients with acute massive or submassive PE, who underwent MT with the Inari FlowTriever System from Dec 2018 to Feb 2019. One patient underwent repeated MT 2 days after the initial one. The patient's demographic data, imaging findings, procedural details, outcomes, and complications were analyzed. Successful placement of the system and initiation of MT was considered technical success. Stabilization of hemodynamic parameters was defined clinical success. Outcome of the procedure, complications, and survival till hospital discharge was assessed for 30 days.

#### RESULTS

The procedure was technically and clinically successful in all 13 patients. One patient was excluded as she had no pre or post imaging assessment. Tachycardia, dyspnea, and dizziness were resolved in all patients. Systemic and diastolic blood pressures, and need for oxygen were corrected in all patients. Troponin trended down in all patients. The main pulmonary pressure was decreased 30% after MT (pre vs. post). 30 days survival was 100% and no procedure related complication occurred.

#### CONCLUSION

The Inari FlowTriever System is safe and feasible for mechanical thrombectomy of pulmonary artery in patients with acute massive or submassive PE.

### **CLINICAL RELEVANCE/APPLICATION**

The Inari FlowTriever System can be safely used for mechanical thrombectomy of pulmonary arteries in patients with acute massive or submassive PE.

## RC314-04 Chronic Venous Recanalization

Tuesday, Dec. 3 9:10AM - 9:25AM Room: E352

Participants

Kari J. Nelson, MD, North Tustin, CA (*Presenter*) Research support, SillaJen, Inc; Research collaboration, Koninklijke Philips NV; Research collaboration, Teclison Cheery Pharma;

### LEARNING OBJECTIVES

1) Describe indications for chronic venous recanalization. 2) Define patient work-up and follow-up. 3) Explain procedural tools and techniques. 4) Review outcomes of chronic venous recanalization.

## RC314-05 Gianturco Z-Stent Placement for the Treatment of Chronic Central Venous Occlusive Disease: Implantation of 208 Stents in 137 Symptomatic Patients

Tuesday, Dec. 3 9:25AM - 9:35AM Room: E352

Participants

Jacob J. Bundy, MD, MPH, Ann Arbor, MI (*Presenter*) Nothing to Disclose Joseph McDevitt, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose Daryl T. Goldman, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose Anthony N. Hage, MD, Ada, MI (*Abstract Co-Author*) Nothing to Disclose Joseph J. Gemmete, MD, Northville, MI (*Abstract Co-Author*) Consultant, Terumo Corporation; Stockholder, Ablative Solutions, Inc; Stockholder, Innovative Cardiovascular Solutions; Stockholder, InNeuro; Stockholder, FlexDex, Inc; Stockholder, Kalypso LP Ravi N. Srinivasa, MD, Agoura Hills, CA (*Abstract Co-Author*) Nothing to Disclose Jeffrey F. Chick, MD, MPH, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

jaketke992@gmail.com

#### PURPOSE

To report the technical success, adverse events, and long-term stent patencies of Gianturco Z-Stent placement for management of chronic central venous occlusive disease.

## METHOD AND MATERIALS

137 patients, with mean age  $49 \pm 16$  years (range: 16-89 years), underwent placement of Gianturco Z-Stents for chronic central venous occlusion. Presenting symptoms included: lower extremity edema (n=66; 48%), superior vena cava syndrome (n=30; 22%), unilateral upper extremity swelling (n=20; 15%), hemodialysis fistula or catheter dysfunction (n=11; 8.0%), ascites (n=8; 5.8%), and both ascites and lower extremity edema (n=2; 1.5%). Most common etiologies of central venous occlusion were: prior central venous access placement (n=58; 42%), extrinsic compression (n=29; 21%), and post-surgical anastomotic stenosis (n=27; 20%). Number of stents placed, stent implantation location, stent sizes, technical success, adverse events, need for re-intervention, follow-up evaluation, stent patencies, and mortality were recorded. Technical success was defined as recanalization and stent reconstruction with restoration of in-line venous flow. Primary and primary-assisted stent patencies were analyzed using Kaplan-Meier analysis.

## RESULTS

208 total Z-Stents were placed. The three most common placement sites were the inferior vena cava (n=124; 60%), superior vena cava (n=44; 21%), and brachiocephalic veins (n=27; 13%). Technical success was achieved in 133 (97%) patients. There were two (1.5%) severe adverse events (two cases of stent migration to the right atrium), one (0.7%) moderate adverse event, and one (0.7%) mild adverse event. Mean follow-up was 44 months. Estimated 1-, 3-, and 5-year primary stent patency was 84%, 84%, and 82%, respectively. Estimated 1-, 3-, and 5-year primary-assisted patency was 92%, 89%, and 89%, respectively. 30- and 60- day mortality rates were 2.9% (n=4) and 5.1% (n=7), none of which were directly attributable to Z-Stent placement.

#### CONCLUSION

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I his study, which is the largest to date and with the longest follow-up evaluation, demonstrates the efficacy and safety of Gianturco Z-Stent placement for the treatment for chronic central venous occlusive disease.

#### **CLINICAL RELEVANCE/APPLICATION**

Gianturco Z-Stent placement is safe and effective for the treatment for chronic central venous occlusive disease with durable short- and long-term patencies.

# RC314-06 Short-Term Outcomes and Predictive Factors of Primary Patency of Stent Placement for Central Venous Occlusion Disease (CVOD) in Hemodialysis Patients

Tuesday, Dec. 3 9:35AM - 9:45AM Room: E352

Participants

Bin Chen, Guangzhou, China (*Presenter*) Nothing to Disclose Yonghui Huang, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose Run Lin, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose

#### For information about this presentation, contact:

cir.huangyonghui@vip.163.com

## PURPOSE

To determine the outcomes and the predictive factors of primary patency of endoprothesis for central venous occlusive disease (CVOD) in hemodialysis patients.

#### **METHOD AND MATERIALS**

This study was approved by the institutional ethics committee. Data of consecutive 110 CVOD patients who underwent endovascular treatment in our department, include all clinical evaluation: demographic, clinical, and multi-slice spiral computed tomography venography(MSCTV) characteristics, from January 2012 to December 2017 were recorded and analyzed. The primary patency of stenting patients and the correlative factors were investigated. The data of patients who were treated with stents and followed up successfully was analyzed in the study.

#### RESULTS

Percutaneous recanalization was technically successful in 93 of the 102 patients (91%). Seventy-eight of the 93 patients (84%) were treated with stent placement. 71 case successful followed up were enrolled in the study. Procedure-related adverse events occurred in 17 patients (21.8%), and 4 events (5.1%) required medical intervention. No life-threaten complications occurred. The median primary patency was  $16\pm2.2$  month. The cumulative 3-, 6-, 9- and 12- month primary patency rates of stents were 93%, 72%, 55%, and 51%, respectively. Independent positive predictive factors of primary patency included vessel diameter >12mm, covered stents and non-calcification. Median primary patency of covered stents group was 21 months, significant better than that of bare stent group, which was 10 months (P<0.001). The primary patency rates of 1-, 3-, 6-, and 12-month in the covered stents group were 100%, 86.4%, 77.3% and 59.1%, respectively. In the bare stents group, the primary patency rates were 100%, 93.9%, 67.3% and 44.9%, respectively.

## CONCLUSION

According to primary patency, percutaneous stent placement is promising treatment in Chinese CVOD patients. Characteristics of occlusive lesions including vessel diameter stent type and calcification are key factors of the primary patency. Covered stents demonstrated as a factor to improve the outcoming of CVOD treatment.

## **CLINICAL RELEVANCE/APPLICATION**

These results can be useful to help us to select optimal intervention as the first choice to treat CVOD in hemodialysis patients.

## RC314-07 Biology of Pulmonary Embolism

Tuesday, Dec. 3 9:45AM - 10:00AM Room: E352

Participants

Akhilesh K. Sista, MD, New York, NY (*Presenter*) Research Grant, Penumbra, Inc; Scientific Advisory Board, Thrombolex; Scientific Advisory Board, Vascular Medicure

#### LEARNING OBJECTIVES

1) Define the post-PE syndrome. 2) Identify gaps in knowledge of the pathophysiology of PE. 3) Identify future areas of research for interventional and non-interventional management of PE. 4) Describe the pathophysiology of massive and submassive PE.

#### ABSTRACT

#### n/a

#### RC314-08 Compressive Venous Syndromes

Tuesday, Dec. 3 10:15AM - 10:30AM Room: E352

Participants

Sanjeeva P. Kalva, MD, Boston, MA (*Presenter*) Consultant, General Electric Company; Royalties, Reed Elsevier; Royalties, Springer Nature; Investor, Althea Health, CA; Consultant, C. F. Koo Foundation; Consultant, Medtronic plc; Research Grant, AngioDynamics, Inc; Consultant, US Vascular LLC; Consultant, Dova Pharmaceuticals

For information about this presentation, contact:

skalva@partners.org

1) To review the pathophysiology, clinical symptoms and imaging diagnosis of common venous compression syndromes including May Thurner, Paget Schrotter, Nut cracker and popliteal venous compression syndromes. 2) To discuss the current role of endovascular therapy, endovascular treatment options and their results.

## RC314-09 MR-Venography in the Diagnosis of Post-Thrombotic Iliac Vein Obstruction and Extravascular Compression

Tuesday, Dec. 3 10:30AM - 10:40AM Room: E352

Participants

Vladimir Shebryakov, PhD, Moscow, Russia (*Presenter*) Nothing to Disclose Oleg Karpov, Moscow, Russia (*Abstract Co-Author*) Nothing to Disclose Yuriy Stoyko, Moscow, Russia (*Abstract Co-Author*) Nothing to Disclose Oleg Bronov, Moscow, Russia (*Abstract Co-Author*) Nothing to Disclose Maxim Yashkin, Moscow, Russia (*Abstract Co-Author*) Nothing to Disclose Danata Lutarevich, Moscow, Russia (*Abstract Co-Author*) Nothing to Disclose

## For information about this presentation, contact:

vshebryakov@mail.ru

## PURPOSE

Evaluate value of non-contrast MRI in the diagnosis of post-thrombotic iliac vein obstruction and extravascular compression.

#### METHOD AND MATERIALS

The study included 168 patients with CVD (clinical class C3-C6 according to the CEAP classification), including 80 males and 98 females. The average age of the patients was 43.6±11.6 years. All patients underwent ultrasound angioscanning veins of the lower extremities and MRI of the iliac veins and inferior vena cava. Studies were performed on MRI using a special protocol non-contrast sequences: 1. BH TRUFI/FIESTA 3D using Valsalva maneuver; 2. INHANCE 3D using free breathing technique, with subsequent 3D reconstruction.

#### RESULTS

87 patients have been diagnosed with stenosis of the left common iliac vein due to compression of the right common iliac artery (May-Thurner syndrome). 55 patients underwent stenting of left common iliac vein with the May-Turner syndrome. Two patients underwent stenting of the left external and common iliac veins with post-thrombotic obstruction. 30 post-thrombotic deep vein changes have been revealed.

#### CONCLUSION

MR-venography is the most optimal method in the diagnosis of the causes of extra and intravenous pathology of the IVC and its basin. There is no radiation exposure, no use of contrast agent and short time relation. 3D-reconstruction of the IVC and iliac veins can be used for planning corrective treatment and reconstructive operations.

#### **CLINICAL RELEVANCE/APPLICATION**

MR-venography is equal to contrast angiographic methods in detecting extravasal compression and is recommended in the initial evaluation of suspected May-Thurner syndrome and post-thrombotic iliac vein obstructions.

## RC314-10 IVC Filters: Evidence and Ongoing Trials

Tuesday, Dec. 3 10:40AM - 10:55AM Room: E352

Participants

Nima Kokabi, MD, Atlanta, GA (Presenter) Research support, Sirtex Medical Ltd

# LEARNING OBJECTIVES

1. Learn the most up-to-date guidelines for placment of IVC filters. 2. Learn the highest level of evidence regarding IVC filter efficacy for various indications. 3. Learn highest level of evidence regarding IVC filter retrieval.

## RC314-11 DVT Lysis: An Update

Tuesday, Dec. 3 10:55AM - 11:10AM Room: E352

Participants

Kush R. Desai, MD, Chicago, IL (*Presenter*) Speakers Bureau, Cook Group Incorporated; Consultant, Cook Group Incorporated; Consultant, Koninklijke Philips NV; Consultant, The Spectranetics Corporation; Consultant, AngioDynamics, Inc; Consultant, Boston Scientific Corporation; Consultant, W. L. Gore & Associates, Inc

## For information about this presentation, contact:

kdesai007@northwestern.edu

#### LEARNING OBJECTIVES

1) To review the data governing thrombolysis of lower extremity DVT, with an emphasis on patient selection and procedural outcomes. 2) To review current technologies available for endovascular DVT treatment.

## RC314-12 IVC Filters: Past, Present, and Future

Tuesday, Dec. 3 11:10AM - 11:25AM Room: E352

## RC314-13 In-Vitro Comparison of the Clot Capturing Efficiency of Commercially Available Retrievable Inferior Vena Cava Filters

Tuesday, Dec. 3 11:25AM - 11:35AM Room: E352

Participants

He Zhao, Beijing, China (*Presenter*) Nothing to Disclose Jiaywei Tsauo, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose Xiao Li, PhD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

simonlixiao@gmail.com

## PURPOSE

To compare the clot capturing efficiency (CCE) of commercially available retrievable inferior vena cava (IVC) filters.

## **METHOD AND MATERIALS**

Aliquots of blood were collected from domestic pigs and was coagulated for 30 minutes at room temperature and matured for 24 hours at 4?. The thrombi were cut into different sized cylindrical fragments ranging from 2.5×10mm to 7×20mm, and a venous flow simulator apparatus was used to test the CCE of four commercially available retrievable IVC filters [i.e. Denali (Bard, AZ), Option (Argon, TX), Celect (Cook, IN) and Optease (Cordis, NJ)].

## RESULTS

The CCE of the Denali, Option, Celect, and Optease filter for sized  $2.5 \times 10$ mm,  $3 \times 10$ mm, and  $>= 4 \times 10$ mm thrombi was 70%, 85%, and 100%, 80%, 95%, and 100%, 95%, 100%, and 100%, and 100%, 100%, and 100%, respectively. The CCE of all four filters for  $>= 4 \times 10$ mm sized thrombi were not significantly different (P > 0.99). The CCE of the Denali filter for sized  $2.5 \times 10$ mm thrombi was significantly lower than the Optease filter (P < 0.05) and the Option filter (P < 0.05). The CCE of the Denali filter for sized  $3 \times 10$ mm thrombi was significantly lower than the Optease filter (P < 0.05).

#### CONCLUSION

The CCE of commercially available retrievable IVC filters for large and medium sized thrombi is similar. However, the Denali filter showed inferior CCE to the Optease and Option filter for small sized thrombi.

#### **CLINICAL RELEVANCE/APPLICATION**

The CCE of commercially available retrievable IVC filters for large and medium sized thrombi is similar, however, the Denali filter showed inferior CCE to the Optease and Option filter for small sized thrombi.

## RC314-14 Single-Center 10-Year Clinical Experience with SVC Filters in the Era of Retrievable Filters

#### Tuesday, Dec. 3 11:35AM - 11:45AM Room: E352

#### Participants

Jorge E. Lopera, MD, San Antonio, TX (*Presenter*) Shareholder, Tecnostent SA; Advisor, Boston Scientific Corporation ; Proctor, Teleflex Incorporated

## For information about this presentation, contact:

Lopera@uthscsa.edu

## PURPOSE

To report a 10 -year clinical experience with SVC filters with emphasis in complications and filter retrieval rates.

## METHOD AND MATERIALS

A retrospective review of the images and electronic medical records of patients with Superior Vena Cava (SVC) filters was performed between 2008 and 2018 in a single tertiary medical center. Patient demographics, indications for filter placement, type of filter placed and clinical evolution were recorded. Complications during placement and retrieval were also determined. Contrast enhanced computed tomography images after the procedure were reviewed if available, to study filter migration and leg penetration

#### RESULTS

Fifty patients with ages ranging from 17 to 89 years (average 54) underwent SVC retrievable filter placement. Main indication for SVC filter placement was deep venous thrombosis (DVT) of the major upper extremity and/or neck veins with contraindications to anticoagulation. Twenty -one patients had major neurological conditions, 16 had advanced cancers and 13 patients had other severe life- threatening comorbidities. Complications during placement included: filter malposition into the right brachycephalic vein in two patients, another patient had a leg of the filter entrapped in the tip of a hemodialysis catheter that required filter reposition and line exchange. Twelve patients had attempted filter removal. Eleven filters were successfully removed 3 - 14 months after placement (mean 5.8 m) with one technical failure . During removal one filter had a leg retained that required additional retrieval. Follow- up CT scans of the chest were available in 15 patients 1- 1920 days after filter placement (mean 493 days). Leg penetration into the mediastinum was seen in three patients , in one patient as early as 10 days after placement, no symptoms were oberved in these patients. No pericardial or pleural related to filter perforation was noted.

#### CONCLUSION

The use of retrievable SVC filters in patients with upper extremity DVT although highly controversial is safe with minimal complications. Most filters can be safely retrieved. Retrieval rates are modest.

#### **CLINICAL RELEVANCE/APPLICATION**

The use of retrievable SVC filters in patients with upper extremity DVT is safe with minimal complications . The majority of filters

can be safely retrieved. The mortalty in this group of patients is very high and the use of SVC filters is highly controversial .

# RC314-15 Advanced Filter Retrieval Techniques

Tuesday, Dec. 3 11:45AM - 12:00PM Room: E352

Participants Thuong G. van Ha, MD, Chicago, IL (*Presenter*) Nothing to Disclose

# LEARNING OBJECTIVES

1) Advanced techniques for difficult filter retrieval will be discussed in details.





# RC331

# **Percutaneous Thoracic Interventions**

Tuesday, Dec. 3 8:30AM - 10:00AM Room: S403A



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

# Participants

Christopher Lee, MD, Los Angeles, CA (Moderator) Nothing to Disclose

# For information about this presentation, contact:

christopher.lee.1@med.usc.edu

# LEARNING OBJECTIVES

1) Evaluate the role of percutaneous lung biopsy in the molecular profiling era. 2) Utilize various techniques during percutaneous lung biopsy to maximize the chances of success and limit complications. 3) Apply strategies to prevent and manage a post-biopsy pneumothorax.

#### Sub-Events

# RC331A Percutaneous Lung Biopsy

Participants

Christopher Lee, MD, Los Angeles, CA (Presenter) Nothing to Disclose

#### For information about this presentation, contact:

christopher.lee.1@med.usc.edu

## LEARNING OBJECTIVES

1) Evaluate the role of percutaneous lung biopsy in the molecular profiling era. 2) Utilize various techniques during percutaneous lung biopsy to maximize the chances of success and limit complications. 3) Apply strategies to prevent and manage a post-biopsy pneumothorax.

## RC331B Percutaneous Lung Nodule Localization

Participants Amita Sharma, MD, MBBS, Boston, MA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

#### asharma2@mgh.harvard.edu

## LEARNING OBJECTIVES

1) Explain how percutaneous localization aids nodule resection during minimally invasive surgery. 2) Compare different techniques used for percutaneous nodule localization. 3) Identify complications that may occur during percutaneous nodule localization.

## RC331C Percutaneous Lung Ablation

Participants

Fereidoun G. Abtin, MD, Los Angeles, CA (*Presenter*) Speaker, Johnson & Johnson; Speaker, HealthTronics, Inc; Consultant, BTG International Ltd

## For information about this presentation, contact:

fabtin@mednet.ucla.edu

## LEARNING OBJECTIVES

1) Describe the current indications for lung ablation and compare the ablation results with competing modalities. 2) Review the criteria affecting the choice of various ablative modalities in particular RFA, Microwave and cryoablation. 3) Technical considerations to optimize the ablation results and to avoid or reduce complication. 4) Brief outline of Interventional Oncology out patient clinic and post ablation follow up recommendations.





#### SSG03

# Science Session with Keynote: Chest (Pulmonary Vasculature and Angiography/Dual Energy CT)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: S404CD

# AI CH CT VA

AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

**FDA** Discussions may include off-label uses.

#### Participants

Ioannis Vlahos, MRCP, FRCR, Houston, TX (*Moderator*) Director, Grayscale Ltd; Co-owner, Grayscale Ltd Carole A. Ridge, MD, London, United Kingdom (*Moderator*) Nothing to Disclose

#### Sub-Events

## SSG03-01 Chest Keynote Speaker: Issues and Techniques in Imaging of Pulmonary Vasculature

Tuesday, Dec. 3 10:30AM - 10:40AM Room: S404CD

Participants

Ioannis Vlahos, MRCP, FRCR, Houston, TX (Presenter) Director, Grayscale Ltd; Co-owner, Grayscale Ltd

## SSG03-02 CT Pulmonary Angiography in Pregnancy Specific Conversion Factors to Estimate Effective Radiation Dose from Dose-Length Product

Tuesday, Dec. 3 10:40AM - 10:50AM Room: S404CD

Participants

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# PURPOSE

Effective dose (ED) is used to understand radiation related malignancy risk of CT scans. Currently, ED for computed tomography pulmonary angiography (CTPA) in pregnancy is estimated by multiplying the CT reported dose length product (DLP) by a DLP-to-ED conversion factor (k-factor) for general chest CT. The purpose of this study is to determine the specific k-factor for CTPA in pregnant patients and its predictive factors.

## **METHOD AND MATERIALS**

This retrospective study evaluates consecutive CTPA in pregnant women across a large health system from January 2012 to April 2017. Patient and CT-related data were obtained from the radiology information system, the picture archiving and communication system, and a radiation dose index monitoring system. Each patient's ED (mSv) was determined by patient specific Monte-Carlo simulation using Cristy phantoms and divided by study DLP to determine k-factor. K-factor was compared to the standard k factor for chest CT of 0.014 with one sample t-test. Patient size was determined by the CT scanner in water equivalent diameter. Bivariate and multivariable analysis were performed for k-factor based on patient and CT factors.

#### RESULTS

534 patients were included in this study. The mean k-factor for all patients was 0.0249 (mSv·mGy-1·cm-1), 78% greater than 0.014 (p<0.001). Multivariable analysis demonstrated lower k-factor was observed with decreasing pitch (p=0.0002), patient size (p<0.001), and scan length (p<0.0001). 120 kVp (p< 0.001) and 140 kVp (p=0.0028) studies showed a larger k-factor than 80 and 100 kVp studies combined.

## CONCLUSION

The k-factor for CPTA for pregnant patients higher than the previously used value for chest CT, which statically increased with decreasing pitch, patient size, and scan length, and was higher for larger kVp values.

## **CLINICAL RELEVANCE/APPLICATION**

The specific k-factor for CTPA in pregnancy should be used to estimate effective radiation dose in that population.

# SSG03-03 Patterns of Failure of an AI-Based Software: A Report on False Positive Findings of an Algorithm Detecting Pulmonary Embolism on CT Pulmonary Angiograms

## Participants

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#### PURPOSE

To detect patterns of false positive (FP) findings of an algorithm trained for the detection of pulmonary embolism (PE) in CT pulmonary angiograms (CTPAs) and derive future directions for software development.

## METHOD AND MATERIALS

We identified all CTPAs with the clinical question of PE performed at our institution in 2017 (n=1465). The 1-mm slices in soft-tissue kernel were processed by an AI-based software for the detection of PE trained on more than 28,000 CTPAs from other institutions. It was based on a deep convolutional neural network with a residual neural network architecture. Findings suspected of presenting a pulmonary embolus were marked by an arrow on the output series. Findings were reviewed by two radiologists and classified as true positive or FP. Frequency and reasons of FP findings were noted. Ratio of FP findings per case was calculated.

#### RESULTS

In total, we found 178 FP findings (0.12 FP/case). The six most frequent causes of FP findings were contrast agent related flow artifacts in the pulmonary arteries (n=46), detection of pulmonary veins (n=32), lymph nodes (n=29), pulmonary infiltrates, (n=20), beam hardening artifacts (n=12) and pulmonary metastases (n=10). For all but three FP findings, there was an anatomical correlate (175 of 178; 98.3%). Most FP findings were caused by structures outside the pulmonary tree (120 of 178; 67.4%). A large portion of FP findings was due to non-tubular structures (79 of 178; 44.4%).

## CONCLUSION

Most FP findings can be attributed to a limited number of categories comprising clearly visually definable structures. These are often located outside the pulmonary artery tree and/or non-tubular. Therefore, both segmentation of the artery tree and the integration of algorithms detecting nodular structures may be measures to further reduce FP findings.

## **CLINICAL RELEVANCE/APPLICATION**

Irrespective of the performance level of an AI-based algorithm, it is recommended to identify patterns underlying failure to further improve accuracy.

## SSG03-04 Machine Learning Assisted Risk Stratification of Acute Pulmonary Embolism on Computer Tomography Pulmonary Angiography Images

Tuesday, Dec. 3 11:00AM - 11:10AM Room: S404CD

#### Participants

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### PURPOSE

This study aims to investigate the value of a machine-learning prediction model based on radiomics features derived from computer tomography pulmonary angiography (CTPA) images in risk stratification of acute pulmonary embolism (APE) patients.

## METHOD AND MATERIALS

30 APE patients confirmed by CTPA were divided into high-risk (n = 15) and non-high-risk (n = 15) groups according to 2014 European Society of Cardiology guidelines. Radiomics features were extracted from the manually segmented region of interest (ROI), and independent t test and least absolute shrinkage and selection operator (LASSO) were used for feature selection. A stepforward Multiple Linear Regression was used to build a risk stratification model with the selected features.

#### RESULTS

Among 1746 radiomics features, 7 features were eventually selected as the most discriminative features, including 0 short low gray level, 5-7 Correlation, 2Gauss Area, Hist Area, Convenx Hull Volume, Energy and Skewness. In the step-forward-linear-regression, only 5-7 Correlation, Convenx Hull Volume and Energy were included, R square of the equation is 0.899.

## CONCLUSION

The radiomics-based machine learning is useful strategy of risk stratification of CTPA images of APE patients.

## **CLINICAL RELEVANCE/APPLICATION**

The radiomics-based machine learning provides a useful strategy of risk stratification of CTPA images of APE patients.

## SSG03-05 Comparison of a New Deep Learning-Based Image Reconstruction (DLIR) with Conventional Image Reconstruction for CT Pulmonary Angiography (CTPA)

Tuesday, Dec. 3 11:10AM - 11:20AM Room: S404CD

Participants

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## PURPOSE

A recently introduced deep learning based image reconstruction (DLIR) algorithm (TrueFidelityTM, GE Healthcare) aims to emulate very high dose FBP image texture, with low noise and high-resolution by employing deep CNN-based models, including millions of trained parameters. This study aims to compare image quality of the DLIR algorithm with standard image reconstruction in CTPA.

## METHOD AND MATERIALS

52 CTPA studies scanned during routine clinical use (Revolution CT Apex edition, GE Healthcare) were retrospectively reconstructed at 1.25mm slice thickness using FBP, ASIRv50, and 3 levels of a prototype DLIR (low (L), medium (M), and high(H)). Quantitative measurements of noise (standard deviation), signal to noise ratio (SNR) and contrast to noise ratio (CNR vs. liver parenchyma) in Main PA were obtained for all recons. Two radiologists independently rated subjective image noise, nose texture, artifacts, and diagnostic quality of the ASIRv50 and DLIR-M on a 1-5 scale.

#### RESULTS

The noise (std dev) was 40.55, 29.32, 25.34, 20.42, 15.22 HU, the SNR was 9.81, 13.58, 15.82, 19.81, 27.44, and the CNR was 10.39, 16.22, 16.51, 21.06, and 30.39 in the FBP, ASIRv50, DLIR-L, DLIR-M, and DLIR-H images respectively. All comparisons were significant (p<0.001) except for CNR between ASIRv50 and DLIR-L (p=0.175). Qualitative scores for ASIRv50 and DLIR-M were 3.86 +/- 0.26 and 4.89 +/- 0.25 (mean +/- std dev) respectively for image noise (p<0.001), 3.24 +/- 0.27 and 4.26 +/- 0.27 respectively for noise texture (p < 0.001), 3.92 +/- 0.25 and 3.93 +/- 0.25 for artifacts (p=0.322), and 4.94 +/- 0.31 and 3.94 +/- 0.31 for diagnostic image quality (p = n.s.).

## CONCLUSION

DLIR shows decreased image noise with increased CNR and SNR compared to FBP and ASIRv. DLIR medium strength show decreased image noise with improved image texture qualitatively as compared to ASIRv50. There was no significant difference in subjective assessment of diagnostic quality or artifacts.

#### **CLINICAL RELEVANCE/APPLICATION**

The use of AI based image recon to lower noise and improve image texture is an emerging technology. Further study is needed to evaluate translation into dose savings or clinical performance in CT.

## SSG03-06 Vascular and Parenchymal Enhancement Assessment by Dual-Phase Dual Energy CT in the Diagnostic Investigation of Pulmonary Hypertension

Tuesday, Dec. 3 11:20AM - 11:30AM Room: S404CD

#### Participants

Jenny L. Bacon, MRCP, East Molesey, United Kingdom (*Presenter*) Research support, Actelion Ltd; Brendan P. Madden, MBBCh, MD, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Conor Gissane, Twickenham, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Charlie Sayer, MBBS, FRCR, Brighton, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Sarah L. Sheard, MBBS, FRCR, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Ioannis Vlahos, MRCP,FRCR, Houston, TX (*Abstract Co-Author*) Director, Grayscale Ltd; Co-owner, Grayscale Ltd

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#### PURPOSE

To prospectively evaluate the non-invasive identification of pulmonary hypertension (PH) by dual-phase dual-energy CT pulmonary angiography (DE-CTPA) vascular enhancement and perfused pulmonary blood volume quantification (PBV) to assess mean pulmonary artery pressure (mPAP) and pulmonary vascular resistance (PVR), corroborated by right heart catheterization (RHC).

#### **METHOD AND MATERIALS**

102 patients were recruited to undergo RHC and standard DE-CTPA protocol (series 1) with a second 10 cm central DE-CTPA acquisition after 7 second delay (series 2). In both series, enhancement in the main pulmonary artery (PAenh) and descending aorta (DAenh) were calculated from DE-CTPA iodine images, and volumetric enhancement of each whole lung (WLenh) was analysed using PBV.

#### RESULTS

65 patients had PH defined by mPAP>=25 mmHg and 51 patients PH defined by PVR >3WU. In series 1, PH patients had significantly higher PAenh/WLenh ratio and lower WLenh and DAenh compared to no PH. By series 2, PH patients had significantly higher PAenh and WLenh than no PH. Change in WLenh (series 1 to 2) offered the best diagnostic accuracy to define disease by mPAP (AUC 0.78) and PVR (AUC 0.79) and the best correlation with mPAP (r=0.62). PAenh series 2 correlated best with PVR (r=0.49). Metrics incorporating series 2 were superior in multivariate linear regression analysis (mPAP, r=0.62; PVR, r=0.56). Utilizing DE-CTPA metrics improved the correlation achieved by conventional CT metrics (mPAP, r=0.61 to r=0.71; PVR, r=0.53 to r=0.64). The presence of

moderate or markedly prominent bronchial collaterals was not more common in patients with increasing WLenh in series 2 compared to those with decreasing WLenh in series 2 (p=0.71).

## CONCLUSION

This large prospective RHC corroborated study determined that dual-phase DE-CTPA vascular and parenchymal enhancement assessment appear complimentary to conventional CT metrics and improve the ability to predict mPAP and PVR. This is predominantly by the incorporation of change in whole lung enhancement over time to diagnose PH and by the use of this parameter and delayed pulmonary arterial enhancement to characterize disease severity.

#### **CLINICAL RELEVANCE/APPLICATION**

This study has identified a reader independent method to improve the non-invasive diagnosis of PH. These novel techniques have the potential to monitor disease severity and to help identify PH patients where early identification improves poor prognosis.

## SSG03-07 Dual Energy Derived Pulmonary Blood Volume Histogram Parameters as Biomarkers of Pulmonary Dysfunction in Acute and Chronic Pulmonary Thromboembolic Disease

Tuesday, Dec. 3 11:30AM - 11:40AM Room: S404CD

Participants Partha Hota, DO, Philadelphia, PA (*Presenter*) Nothing to Disclose Farbod N. Rahaghi, Durham, NC (*Abstract Co-Author*) Nothing to Disclose Raul San Jose Estepar, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Mark M. Hammer, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose Aaron B. Waxman, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Andetta R. Hunsaker, MD, Sudbury, MA (*Abstract Co-Author*) Nothing to Disclose

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## PURPOSE

To use dual energy computed tomography (DECT) histogram parameters as biomarkers to characterize the degree of pulmonary dysfunction in patients with acute and chronic pulmonary embolism (PE).

#### **METHOD AND MATERIALS**

Retrospective analysis of 95 DECT pulmonary angiography scans was performed from 2015-2019 for patients with suspected acute or chronic PE. 0.8mm thick whole lung PBV maps were reconstructed using material decomposition analysis and normalized with a 1cm2 circular region of interest within the main pulmonary artery. 0.8mm thick axial CT images were used to generate a lung mask to limit the PBV map analysis area. Histograms were generated from voxels falling within the label map and fitted with parametric models to generate parameters for analysis.

## RESULTS

Of 95 patients, 36 were identified with acute PE, 30 with chronic PE (18 with chronic thromboembolic pulmonary hypertension (CTEPH); 12 with chronic thromboembolic disease without pulmonary hypertension (CTED)), and 29 normal patients without PE. Ages ranged from 21-95 years (average of 61 years). 49 patients were female and 46 were male. Mean voxel values were 109±33 in normal patients, 99±63 in acute PE patients, 83±24 in CTED patients, and 80±31 in CTEPH patients. Statistically significant differences (p<0.05) were observed in patients with CTED and CTEPH compared to normal patients. Statistically significant differences (p<0.05) were observed when comparing the kurtosis (curve pointedness) and skewness (curve symmetry) in acute PE, CTED, and CTEPH patients to normal patients. Right heart catheterization (RHC) data within 1 month of the DECT were available for review in 11/18 CTEPH patients. RHC-derived mean pulmonary artery pressure (mPAP) and pulmonary vascular resistance (PVR) correlated with mean voxel values with linear regression coefficients of determination (R2) of 0.64 and 0.74 respectively.

## CONCLUSION

Preliminary data suggests DECT histogram parameters can characterize pulmonary dysfunction in patients with acute and chronic PE. Mean voxel value is a potential imaging biomarker for quantifying RHC-derived mPAP and PVR.

#### **CLINICAL RELEVANCE/APPLICATION**

DECT histogram parameters are a promising surrogate biomarker for pulmonary hemodynamic assessment. Additional studies are warranted to define the role of DECT in evaluating acute and chronic PE and the potential to supplant invasive RHC and echocardiography as the surveillance imaging modality of choice.

## SSG03-08 Comparison of Lung Volumes and Perfusion Defects on DECT-Perfusion Blood Volume Images with Clinical Outcomes for Patients with Pulmonary Embolism

Tuesday, Dec. 3 11:40AM - 11:50AM Room: S404CD

Participants

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#### PURPOSE

To determine whether presence and/or extent of perfusion defects on dual energy CT pulmonary angiogram (DECT-PA) of patients with pulmonary embolism (PE) affected their clinical outcomes in terms of morbidity and mortality.

## METHOD AND MATERIALS

With IRB Approval, we identified 164 adult patients (86 males, 78 females, mean age- 62±17 years) from the institutional pulmonary embolism response team (PERT) registry. All patients underwent DECT-PA for suspected PE on 384-slice, dual-source CT (SOMATOM Force, Siemens). Deidentified DICOM images were processed with a Lung Lobe Segmentation prototype (eXamine, Siemens). The prototype performed automated lobar segmentation and provided lung volumes, and several perfusion parameters for each lung and each lobe. Two radiologists assessed all DECT-PA for presence/absence of PE, location, occlusive/non-occlusive, and presence and location of pulmonary infarcts and perfusion defects (matched and mismatched). The medical records were reviewed to record any adverse clinical outcome within 3 days of DECT-PA (need for ventilation/mechanical respiration, uncontrolled hypertension, or death). Data were analyzed with multivariable analysis of variance (MANOVA) with SPSS statistical software.

#### RESULTS

Of the 164 patients, 139 had PE and 25 had no PE. Of the 20 patients (group 1: 20/139 PE+) with adverse clinical outcomes, 60% had perfusion defects on DECT-PA (12/20) as opposed to 29% rate of perfusion defects in patients with stable or improved clinical outcomes (group 2: 35/119 PE+). All quantitative perfusion parameters (iodine concentration, uptake, skewness, kurtosis) in group 1 patients were significantly different from group 2 patients (p=0.0001). There was a higher frequency of central and multiple PE in patients with adverse clinical outcomes compared to those with stable or favorable outcomes. The right, left, and whole lung volumes between group 1 (mean  $1701\pm674$ ,  $1487\pm620$ ,  $3181\pm1202$  ml) and group 2 (mean  $1954\pm885$ ,  $1506\pm697$ ,  $3461\pm1553$  ml) were significantly different as well (p<0.008).

### CONCLUSION

Qualitative and quantitative perfusion abnormalities, and lung volumes are independent prognostic predictors of adverse clinical outcome in patients with pulmonary embolism on DECT-PA.

#### **CLINICAL RELEVANCE/APPLICATION**

Patients with perfusion defects and decreased quantitative perfusion on DECT-PA have high incidence of adverse clinical outcomes.

## SSG03-09 The Deep Learning Model in Evaluation of Acute Pulmonary Embolism on Computed Tomographic Pulmonary Angiography

Tuesday, Dec. 3 11:50AM - 12:00PM Room: S404CD

Participants

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#### PURPOSE

Our goal is to use the deep learning method to calculate clot volume of acute PE on computed tomographic pulmonary angiography (CTPA) and explore its relationship with other imaging parameters.

## METHOD AND MATERIALS

The method is on a fully convolutional network called U-Net model to segment acute PE. Two datasets were used to train the deep learning(DL) model. Dataset 1 contains 230 samples of acute PE on CTPA labeled by radiologists and Dataset 2 consists of 65 samples without PE on CTPA. We set the values to 0.1, 0.3, 0.5, 0.7 and 0.99 for the measurement of the clot volume. The test dataset included 144 patients with suspected acute PE admitted to our hospital from Jan 2016 to Oct 2018. The images of CTPA in the test dataset were transferred to the trained model to detect the clot while the clot volume of acute PE were automatically calculated. We evaluated diagnosing time, accuracy, sensitivity and specificity of the proposed model in detecting clot. Meanwhile, clot burden of acute PE patients were assessed with obstruction scores and other imaging parameters by the radiologists.

#### RESULTS

The test dataset included 51 patients without PE and 93 patients with clinically confirmed acute PE. The average measurement time of DL model was  $12.9\pm3.8$  seconds approximately, while the second-year residents needed  $10\pm4$  minutes. When the critical value of the model is set as 0.1, the sensitivity and specificity are the highest, 94.6% and 76.5% respectively, and the consistency between measurements two was 100%. The AUC was 0.926 (95% CI:0.884-0.968), which indicates good discriminative power. Clot burden measured with DL model at setting value of 0.1 was significantly correlated with Qanadli score (r=0.819, p<0.001) and Mastora score (r=0.874, P<0.001). And it is moderately correlated with parameters related to function of right heart.

#### CONCLUSION

Detection of acute DE with DL model could amostly improve the diagnosing officiancy and reduce the workload of the radialogists

Detection of acute PE with DL model could greatly improve the diagnosing enciency and reduce the workload of the radiologists. The DL model had high degree of sensitivity and reproducibility. The clot volume was highly correlated with obstruction scores, while it is moderately correlated with parameters related to function of the right heart.

# **CLINICAL RELEVANCE/APPLICATION**

The deep learning model has high degree of sensitivity and reproducibility in the detection of clot, which is recommended for the detection of clot in patients with pulmonary embolism.





## SSG16

# Vascular/Interventional (Liver Cancer)

Tuesday, Dec. 3 10:30AM - 12:00PM Room: E260



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

#### Participants

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#### Sub-Events

## SSG16-01 Ultrasound-Guided Percutaneous Brachytherapy for the Treatment of Hepatocellular Carcinoma with Portal Vein Branch Tumor Thrombus

Tuesday, Dec. 3 10:30AM - 10:40AM Room: E260

Participants Hong Duo, Shenyang, China (*Presenter*) Nothing to Disclose Haibo Shao, MD, Shenyang, China (*Abstract Co-Author*) Nothing to Disclose

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## PURPOSE

To evaluate the safety and efficacy of ultrasound guided iodine-125 implantation for the treatment of hepatocellular carcinoma with portal vein branch tumor thrombus (PVBTT).

## **METHOD AND MATERIALS**

From June 2013 to August 2018, a total of 69 HCC patients complicated with PVBTT were included in this single-center retrospective study. 34 patients underwent iodine-125 seeds implantation combined with transarterial chemoembolization (TACE), while 35 patients underwent TACE alone. Outcomes were measured in terms of tumor response, overall survival (OS), progress free survival (PFS) and adverse events.

#### RESULTS

The technique was successfully performed in all patients. No complications grade 3 or higher according to Common Terminology Criteria for Adverse Events (CTCAE) version 3.0 occurred. In the analysis for PVTT response 1 month after treatment, TACE-Iodine125 group, 5 patients (14.7%) achieved CR, 15 patients (44.1%) achieved PR. Whereas in the TACE group, no patient achieved CR, 2 patients (5.7%) achieved PR. Patients receiving TACE-Iodine125 had a median OS and PFS of 11 months (95% CI: 8.5, 13.5) and 9 (95% CI: 6.0, 12.0), compared with 7 months (95% CI: 5.9, 8.1) and 3 months (95% CI: 1.7, 4.3) for those who receiving TACE only. Treatment strategy, type of PVTT were significant predictors of OS.

#### CONCLUSION

Ultrasound guided iodine-125 seed implantation is a safe and effective treatment for HCC patients with PVBTT.

## **CLINICAL RELEVANCE/APPLICATION**

This study provide a convenient and efficient method in addition to Sorafenib and radiotherapy for unresectable HCC with PVBTT.

## SSG16-03 Predictors of Successful Bridging to Liver Transplantation in Patients with Hepatocellular Carcinoma Undergoing Yttrium-90 Radioembolization Therapy

Tuesday, Dec. 3 10:50AM - 11:00AM Room: E260

Participants

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## PURPOSE

To identify key clinical and imaging predictors of successful bridging to liver transplantation (LT) in patients undergoing Yttrium-90

radioembolization (Y90 RE) therapy for hepatocellular carcinoma (HCC).

## **METHOD AND MATERIALS**

A retrospective analysis was conducted in patients with HCC who were deemed by a multidisciplinary tumor board as candidates or potential candidates for LT by Milan Criteria (MC) and underwent Y90 RE as bridging therapy. Patients were divided into favorable and unfavorable Y90 RE response groups based on changes to their MC eligibility, with maintained or achieved eligibility defined as favorable, and unchanged or lost eligibility defined as unfavorable. Pre Y90 baseline prognostic factors were compared between favorable and unfavorable responders using chi-square, Fisher's exact test, and student's t-test analysis.

#### RESULTS

Between 2014 and 2018, 144 patients were deemed candidates or potential candidates for LT by MC and underwent Y90 RE bridging. Out of the 56 (39%) patients within MC, eligibility was maintained in 45 (80%) and lost in 6 (11%) patients. Out of the 88 (61%) patients outside MC, eligibility was achieved in 40 (45%) patients and remained unchanged in 45 (51%) patients. Among the 85 (59%) patients who experienced a favorable therapy response, 22 (26%) patients went on to receive LT. Comparison analysis between the favorable and unfavorable response groups suggested that younger age (p=0.0461), female gender (p=0.0095), unilobar distribution (p=0.0238), <=4 viable tumors (p=0.0058), smaller dominant lesion diameter (p=0.0058), lower tumor burden (p=<0.0001), lower Barcelona Clinic Liver Criteria (BCLC) stage (p=<0.0001), lower alkaline phosphatase (p=0.0456) and higher sodium blood levels (p=0.0084) were all associated with successful bridging to liver transplantation.

## CONCLUSION

Certain favorable clinical and imaging characteristics in patients with HCC appear to be positive prognostic factors for the successful bridging to liver transplantation using Y-90 Radioembolization.

#### CLINICAL RELEVANCE/APPLICATION

Positive prognostic factors in patients with HCC can provide clinicians with opportunities to personalize Y-90 radioembolization treatments for potential liver transplant patients in need of maintaining or achieving transplantability status.

## SSG16-04 Long-Term Outcomes of Combined Radiofrequency Ablation and Multipronged Ethanol Ablation for the Treatment of Unfavorable Hepatocellular Carcinoma

Tuesday, Dec. 3 11:00AM - 11:10AM Room: E260

Participants

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## PURPOSE

To evaluate the local efficacy, safety and long-term outcomes of combining radiofrequency ablation (RFA) and multipronged ethanol ablation (EA) in the treatment of unfavourable hepatocellular carcinoma (HCC) and determine the prognostic factors for survival.

## **METHOD AND MATERIALS**

Between August 2009 and December 2017, 98 patients with 110 unfavourable HCC nodules who underwent combining RFA and multipronged EA were enrolled retrospectively in this study. Unfavourable HCC is defined as medium (3.1-5.0 cm) or large (5.1-7.0 cm) HCC, tumour located at a high-risk site or perivascular tumour. Treatment response, overall survival (OS) and recurrence-free survival (RFS) were analysed. The Kaplan-Meier method and Cox proportional hazards regression model were used to evaluate the prognostic factors.

#### RESULTS

Complete ablation (CA) was obtained in 80.9% (89/110) of the tumours after initial treatment. Major complications were observed in 3 (3.1%) patients. The cumulative incidence of local tumour progression (LTP) was 23.5% at 5 years, and no variable was found to be an independent predict factor for LTP. The five-year OS and RFS rates were 41.9% and 18.6%, respectively. Multivariate analysis showed that the serum alpha-fetoprotein (AFP) level and number of tumours were significant prognostic factors for OS (P= 0.017 and P< 0.001, respectively) and RFS (P= 0.014 and P= 0.001, respectively). Perivascular tumour was not an independent factor predicting OS or RFS.

#### CONCLUSION

Combining RFA and multipronged EA is a safe and effective treatment for unfavourable HCC, especially for perivascular tumours. A high serum AFP level and multiple tumours had significant negative effects on OS and RFS.

## **CLINICAL RELEVANCE/APPLICATION**

Combined RFA and multipronged EA is a safe and effective modality for unfavorable HCC. Combined RFA and multipronged EA expand the indication of thermal ablation to tumors in diameter of 5cm. High serum AFP level and multiple tumours had a significant negative effect on OS and RFS.

## SSG16-05 Ultrasound-Guided Percutaneous RFA in 287 Patients with Isolated Recurrent Hepatocellular Carcinoma: 10-Year Survival Rates and Prognostic Analysis - The Effect of Primary Treatment Modalities on Outcomes

Tuesday, Dec. 3 11:10AM - 11:20AM Room: E260

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#### PURPOSE

The therapeutic outcomes of RFA for recurrent hepatocellular carcinoma (RHCC) after different primary treatment modalities have not been compared. The aim of this study was to assess the long-term outcome of RFA in RHCC and evaluate the effect of primary treatment modalities on outcomes.

#### **METHOD AND MATERIALS**

This retrospective study was approved by the institutional review board. Between January 2005 to December 2016, 287 patients who underwent ultrasound guided percutaneous RFA for single RHCC (mean diameter 2.9 cm) were enrolled. Of these 287 patients, 134 patients had RHCC from previous hepatectomy, 128 patients from TACE and the other 25 patients from local ablation therapy. There were 235 males and 52 females with mean age of 60.5 years.

## RESULTS

For 287 patients, 336 sessions of RFA were performed. Major complications were observed in 5 patients (2.0%). The technical success was achieved in 95.1% of lesions. Local tumor progression was detected in 42 lesions (14.6%). Local tumor progression rate in RHCC with previous local ablation was significant higher than that in RHCC with previous hepatic resection (28.0% vs 11.9%, P=0.036). The estimated 1-, 3-, 5-, and 10-year OS for RHCC patients after RFA were 92.3%, 73.1%, 58.8%, and 39.6%, respectively. There was no significant difference in OS among the three different primary treatment groups (P=0.777). Based on multivariate analysis, tumor size (P=0.017), Child-Pugh class (P=0.045), portal vein hypertension (P=0.036), and serum alpha fetoprotein level (P=0.018) were associated with OS.

#### CONCLUSION

RFA is a safe and effective modality with an overall 10-year survival rate of 39.6 % in patients with single RHCC. The primary treatment modality had significant effect on the local tumor progression and OS (only for patient with RHCC > 3cm).

#### **CLINICAL RELEVANCE/APPLICATION**

The RHCC patients accounted for more than one of third of RFA cases in our center, most of them received one of the three main treatments, including hepatectomy, TACE or local ablation. So far, few studies reported 10-year survival rates of RFA for RHCC treatment. Also, it is not clear if the primary treatment modalities would impact the long-term outcomes. In our study, the primary objective was to analyze the long-term survival and prognostic factors of RFA in RHCC, and the second objective was to compare the difference in outcome after RFA among different primary treatments.

# SSG16-06 Impact of Post-Therapy Prophylaxis on Radiation-Induced Liver Disease

Tuesday, Dec. 3 11:20AM - 11:30AM Room: E260

Participants

Matthias P. Fabritius, MD, Munich, Germany (*Presenter*) Nothing to Disclose Max Seidensticker, Munich, Germany (*Abstract Co-Author*) Grant, Sirtex Medical Ltd Grant, Bayer AG Grant, Siemens AG Speaker, Sirtex Medical Ltd Speaker, Bayer AG Speaker, Siemens AG Ricarda Seidensticker, Magdeburg, Germany (*Abstract Co-Author*) Nothing to Disclose MacIej Pech, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose MacIej Powerski, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose Holger Amthauer, MD, Magdeburg, Germany (*Abstract Co-Author*) Research Grant, Siemens AG Jens Ricke, MD,PhD, Berlin, Germany (*Abstract Co-Author*) Research Grant, Sirtex Medical Ltd Research Grant, Bayer AG

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## PURPOSE

Radioembolization (RE) with yttrium-90 (90Y) resin microspheres is an effective treatment in patients with primary or secondary liver cancer. Radiation-induced liver disease (RILD) is a potentially life-threatening complication with higher prevalence in cirrhotics or patients exposed to previous chemotherapies. This study aimed to evaluate the impact of post-therapeutic RILD-prophylaxis in a relatively homogeneous cohort of liver metastatic breast cancer patients.

#### **METHOD AND MATERIALS**

Ninety-three patients with liver metastases of breast cancer received RE between 2007 and 2016. Patients received RILD prophylaxis for 8 weeks post-RE. From January 2014, RILD prophylaxis was changed from ursodeoxycholic acid (UDCA) and prednisolone (standard prophylaxis [SP]; n=59) to pentoxifylline (PTX), UDCA and low-dose low molecular weight heparin (LMWH) (intensified prophylaxis [IP]; n=34). The primary endpoint was toxicity including symptoms of RILD, secondary endpoints included overall survival (OS).

## RESULTS

Median OS (95% CI) after RE was 8.0 (6.2-9.8) months. IP (HR 0.47; p=0.033;) and pre-RE alkaline phosphatase >=2  $\mu$ mol/s.L (HR 2.01; p=0.013) were independent predictors of survival. Subclinical RILD events (bilirubin >=21  $\mu$ mol/L [but < 30  $\mu$ mol/L] or ascites) or treatment discontinuations were observed more frequently in the SP group, albeit without significance (5 vs. 1; p=0.397). Symptomatic RILD (bilirubin >=30  $\mu$ mol/L and ascites) occurred in the SP group only (n=2; p>0.1).

#### CONCLUSION

Intensified post-therapeutic RILD prophylaxis with PTX, UDCA and LMWH has an independent positive impact on OS in patients with metastatic breast cancer and may reduce RILD frequency and severity.

## **CLINICAL RELEVANCE/APPLICATION**

Radioembolization is an effective treatment in patients with chemotherapy-resistant liver metastases of different primary tumours

as well as primary liver cancer. However, radioembolization may cause injury to the healthy tissues of the liver leading to radiationinduced liver disease (RILD); a potentially life-threatening complication which pathophysiologically resembles venous occlusive disease. Intensive prophylactic (preventative) treatment, with a combination of ursodeoxycholic acid (UDCA) pentoxifylline (PTX), and low-dose low molecular weight heparin (LMWH), has a positive impact on patients' survival and might reduce RILD frequency and severity.

## SSG16-07 Local Tumor Control and Survival Rates in Unresectable or Recurrent Hepatic Cholangiocarcinoma (CCC): Transarterial Chemoembolization (TACE) versus Combined TACE and Microwave Ablation (MWA)

Tuesday, Dec. 3 11:30AM - 11:40AM Room: E260

Participants

Thomas J. Vogl, MD, PhD, Frankfurt, Germany (*Presenter*) Nothing to Disclose Elsayed M. Elhawash, BMedSc,MS, Frankfurt am Main, Germany (*Abstract Co-Author*) Nothing to Disclose Nagy N. Naguib, MD, MSc, Frankurt, Germany (*Abstract Co-Author*) Nothing to Disclose Nour-eldin A. Nour-Eldin, MD,PhD, Frankfurt am Main, Germany (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

To evaluate the effect of local targeted liver therapy using transarterial chemoembolization (TACE) with or without microwave ablation (MWA) in patients with unresectable or recurrent cholangiocarcinoma (CCC) regarding overall survival and local tumor control.

#### **METHOD AND MATERIALS**

In this retrospective study from January 2007 to December 2017 152 patients (69 males/83 females; mean 58.7 years; range 25-86) with CCC with either unresectable (123/152=80.2%) or recurrent (29/152=19.8%) lesions were treated with at least three sessions (range 3-26) of TACE. Patients were subclassified into non-metastatic (86/152=56.5%), nodal metastatic (39/152=25.7%), systemic metastatic (18/152=11.8%) and both nodal and systemic metastatic (9/152=5.9%). 30 patients received combined TACE and MWA. Follow-up was performed using MRI and CT to evaluate local tumor control according to the modified RECIST criteria and survival was evaluated using the Kaplan-Meier method.

#### RESULTS

Mean survival for all patients was 28.7 months (CI 21.8-35.7). The survival for patients with non-metastatic, nodal, systemic metastatic and combined metastases was 37, 23.4, 17.5 and 12.4 months, respectively (p value = 0.006). Tumor response after three cycles of TACE was either stable (35.5%), partial response (41.4%) or progressive (23%) and the response at the last follow up was 25.7%, 15.2%, 59.2% and 3.5%, respectively. Patients who received additional MWA showed significantly longer survival vs those with only TACE (median 28 momths and 18 months, respectively, p<0.007). Significant prognostic factors for local tumor control and survival were nodal and/or systemic metastases, pre-therapeutic tumor size, initial local tumor response and additional application of MWA. However, no significant correlation was found between recurrent and unresectable tumors.

## CONCLUSION

Local targeted liver therapy of unresectable or recurrent hepatic CCC using TACE or combined TACE and MWA provides an adequate therapeutic option for loca tumor control and improves patient survival

## **CLINICAL RELEVANCE/APPLICATION**

TACE with additional MWA is a promising therapeutic tool in patients with advanced CCC involvement.

## SSG16-08 Automated Pattern-Based and Voxelwise Analysis of Lipiodol Deposits on Computed Tomography after Conventional Transarterial Chemoembolization and their Effect on Tumor Response

Tuesday, Dec. 3 11:40AM - 11:50AM Room: E260

Participants

Sophie Stark, Freiburg, Germany (*Presenter*) Nothing to Disclose Clinton Wang, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose Lynn J. Savic, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose Brian S. Letzen, MD, Orange, CT (*Abstract Co-Author*) Nothing to Disclose Isabel T. Schobert, BS, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose Milena A. Miszczuk, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose Nikitha Murali, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose Paula Marie Oestmann, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose Ming de Lin, PhD, North Haven, CT (*Abstract Co-Author*) Nothing to Disclose Ming de Lin, PhD, North Haven, CT (*Abstract Co-Author*) Employee, Visage Imaging, Inc; Former Employee, Koninklijke Philips NV Todd Schlachter, MD, New Haven, CT (*Abstract Co-Author*) Research Grant, Guerbet SA Julius Chapiro, MD, New Haven, CT (*Abstract Co-Author*) Research Grant, Guerbet SA; Consultant, Guerbet SA; Research Grant, Koninklijke Philips NV; Consultant, Koninklijke Philips NV; Research Grant, Boston Scientific Corporation;

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## PURPOSE

To establish Lipiodol as a theranostic imaging biomarker for therapeutic efficiency of conventional transarterial chemoembolization (cTACE) using automated quantitative and pattern-based image analysis techniques on 24h post cTACE computed tomography (CT).

This was a retrospective review of prospectively collected clinical trial data including 42 primary and secondary liver cancer patients with 65 tumors treated using cTACE (2012-2018). Hounsfield Unit (HU) thresholds were used to automatically characterize the presence and density of Lipiodol on 24h post cTACE CT scans. Additionally, Lipiodol deposition patterns within a volumetric tumor mask were automatically assessed with regards to homogeneity, sparsity, rim, and peripheral deposition of Lipiodol. Following 3D image registration of baseline (BL) and 1-month follow-up (F/U) MRI to post-TACE CT, Lipiodol deposition was correlated with enhancing tumor volume (ETV) on BL MRI and F/U MRI, using Wilcoxon signed-rank test, Mann-Whitney U test, Kruskal Wallis test, Spearman's rank correlation, and linear regression.

#### RESULTS

Cut-off values of 87 HU, 155 HU, and 241 HU were found to achieve good separation of areas with low, mid and high Lipiodol density. ETV on BL MRI was significantly correlated with Lipiodol deposition on 24h CT (p<0.0001). Tumor regions where Lipiodol was present became necrotic at a higher rate on F/U MRI than areas without Lipiodol (p=0.0475). Specifically, ETV decrease in tumor areas with low, mid and high density Lipiodol compared to areas without Lipiodol was -0.87% ± -15.98 (p=0.3393), -9.32% ± -22.20 (p=0.0066) and -17.91% ± -23.42 (p=0.0003), respectively. Moreover, homogeneous (p=0.0006), non-sparse (p<0.0001), rim deposition within sparse tumors (p=0.045), and peripheral deposition (p<0.0001) of Lipiodol showed improved response on F/U MRI.

## CONCLUSION

In this study, a quantitative automated threshold-based technique was developed and applied to characterize Lipiodol patterns and densities on post-cTACE CT. Strong correlation with radiographic tumor response supports the prognostic value of Lipiodol as an imaging biomarker that can be easily incorporated into the management of liver cancer patients treated using cTACE.

#### **CLINICAL RELEVANCE/APPLICATION**

Automated tools to characterize Lipiodol deposition may improve clinical workflow efficiency and allow for a more personalized treatment by earlier identification of non-responders to cTACE.

## SSG16-09 Comparison between Percutaneous and Laparoscopic Microwave Ablation of Hepatocellular Carcinoma

Tuesday, Dec. 3 11:50AM - 12:00PM Room: E260

Participants

Angelo Della Corte, MD, Vimodrone, Italy (*Presenter*) Nothing to Disclose Paolo Marra, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose Lorenzo Monfardini, Brescia, Italy (*Abstract Co-Author*) Nothing to Disclose Simone Gusmini, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose Luca Aldrighetti, MD, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose Francesco A. De Cobelli, MD, Bergamo, Italy (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

Based on patient and nodule characteristics, some authors favor laparoscopic over percutaneous HCC microwave ablation (MWA), however data are controversial. We compared the two approaches in terms of technical success, complication and local tumor control rates.

#### **METHOD AND MATERIALS**

From October 2014 to February 2019, 86 consecutive patients underwent percutaneous or laparoscopic MWA of 98 HCC nodules with a 2450MHz/100W Microwave generator (Emprint, Medtronic). Complete ablation (technical success) and Local Tumor Progression (LTP) at follow-up were assessed by contrast-enhanced CT/MRI. Seventy patients (79 HCC nodules) satisfied inclusion criteria, of which 49 (52 nodules) underwent percutaneous MWA and 21 (27 nodules) underwent laparoscopic MWA.

## RESULTS

Baseline analysis showed higher rates of multifocal disease in the laparoscopic group (p=0.0001) and higher rates of patients previously treated for HCC in the percutaneous group (p=0.034). All other patient and nodules characteristics were homogeneous. Technical success did not significantly differ between the two groups (p= 0.3). 7/64 patients (10.9%) suffered procedure-related complications (CIRSE classification grade-3): 2 cases (abscess, haematoma) in the percutaneous group (3.4%) and 5 (pneumothorax, respiratory failure, fever, portal thrombosis, hematoma) in the laparoscopic group (18.5%) (p=0.02). 6/79 (7.6%) HCC nodules showed local progression with 1- and 2-year LTPFS rates of 95% and 83.8%, respectively. Five LTPs occurred in the percutaneous group (9.6%), while 1 LTP in the laparoscopic one (3.7%) (p=0.9). At logrank analysis, operative approach was not a statistically significant predictor of LTPFS (p=0.48). Subgroup analysis showed a trend toward worse LTPFS after percutaneous procedures of subcapsular nodules (2-year LTPFS 100% laparoscopic vs 65.2% percutaneous, p=0.15)

## CONCLUSION

Higher complication rate in the Laparoscopic group can be explained by the greater technical invasiveness and by the higher rate of multifocal disease treated in one session. Tendency toward better local tumor control in the laparoscopic group when dealing with subcapsular nodules is possibly due to the better visualization and monitoring of the ablation area achieved through laparoscopic guidance.

## **CLINICAL RELEVANCE/APPLICATION**

Despite its higher complication rate, laparoscopic MWA is a an effective therapeutic option and should be considered for treatment of subcapsular HCC.





#### VIS-TUA

## Vascular Interventional Tuesday Poster Discussions

Tuesday, Dec. 3 12:15PM - 12:45PM Room: VI Community, Learning Center

# VA

AMA PRA Category 1 Credit <sup>™</sup>: .50

**FDA** Discussions may include off-label uses.

## Participants

Sarah B. White, MD, Milwaukee, WI (*Moderator*) Research support, Guerbet SA; Research support, Siemens AG; Research support, Instylla; Research support, InSightec Ltd; Consultant, Guerbet SA; Consultant, BTG International Ltd; Consultant, Cook Group Incorporated; Consultant, Strategies MD

## Sub-Events

## VI227-SD- 'SpineJack®' Percutaneous Placement in Magerl A2 and A3 Traumatic Vertebral Compression TUA1 Fractures of the Thoracolumbar Spine

Station #1

Participants Matteo Bellini, MD, Siena, Italy (*Presenter*) Consultant, Stryker Corporation Lucia Monti, MD, Siena, Italy (*Abstract Co-Author*) Nothing to Disclose Dario Notaro, MD, Siena, Italy (*Abstract Co-Author*) Nothing to Disclose Chiara Zini, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Giulia Sadotti, MD, Siena, Italy (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

To prospectively evaluate safety and effectiveness of SpineJack® device (SJ) (Stryker, Kalamazoo, MI, USA) to achieve anatomical restoration of traumatic vertebral compression (VCFs) in Magerl A2 and A3 thoracolumbar fractures

## METHOD AND MATERIALS

18 patients (16 male; mean age 57 years, age range 27-83 years) with traumatic thoracic (N=12) and the lumbar VCFs (N=7) within 3 weeks from the time of injury classified as Magerl type A2.2 (N=2), A2.3 (N=11) and A3.1 (N=6) were enrolled; exclusion criteria were spontaneous/osteoporotic and neoplastic vertebral fractures, posterior wall involvement of more than 1/3 than of the spinal canal. Visual analog scale (VAS) score and CT and/or MRI has been perforfed before and 48 hours, 1 and 6 months after procedure. Technical success was defined as correct placement of SJ implant.

#### RESULTS

A total of 11 VCFs has been treated with 100% technical success. 1 patient performed at 2 levels in the same session. No major complications related to procedure were registered; asymptomatic cement leakages occurred in 4 patients along fractures lines. All cases showed relevant improvement of symptoms with preoperatively mean VAS score of 7.4 dropped to 1,05, 0,22 and 0,11 within 48 hours,1 and 6 months respectively. Mean height lift of 8.5 mm has been registered after procedure; 5 VCFs presented height lifting greater than 11 mm.

## CONCLUSION

SJ placement can be effective and safe in traumatic VCFs, leading to immediate and lasting relief of pain and vertebral height recovery.

## **CLINICAL RELEVANCE/APPLICATION**

Respect to standar balloon kyphoplasty, the Spinejack System permits unidirectional controlled anatomical vertebral high restoration even in A.2 and A.3 Magerl burst fractures. Replace the anatomy & biomechanics of the disc-vertebral joint.

#### VI228-SD-TUA2 The Influence of High-Intensity Focused Ultrasound Ablation of Uterine Diseases with an Immediate Non-Perfused Volume Ratio > 90% on Ovarian Reserve

Station #2

Participants Nguyen Minh Duc, MD, Ho Chi Minh, Vietnam (*Presenter*) Nothing to Disclose Chandran Nadarajan, MD, Kota Bharu, Malaysia (*Abstract Co-Author*) Nothing to Disclose Mohd Shafie Abdullah, MMed,RT, Kota Bharu, Malaysia (*Abstract Co-Author*) Nothing to Disclose Rajiv Chopra, PhD, Dallas, TX (*Abstract Co-Author*) Stockholder, Profound Medical Corporation; Stockholder, Solenic Medical Inc Bilgin Keserci, PhD, Kota Bharu, Malaysia (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

To assess whether HIFU ablation with the achievement of a non-perfused volume (NPV) ratio greater than 90% should be recommended for women in childbearing age with extensive fibroids or adenomyosis, or whether it should be restricted only to patients who do not wish to preserve their fertility.

#### **METHOD AND MATERIALS**

One hundred twenty women ( $39.5 \pm 5.8$  years) with symptomatic fibroids (group 1) and 66 women ( $40.6 \pm 6.6$  years) with symptomatic adenomyosis (group 2) underwent HIFU treatment. In group 1, the patients were subdivided into "group 1A, n = 72" comprised of patients with an NPV ratio > 90% and "group 1B, n = 48" comprised of patients with an NPV ratio < 90%. In group 2, the patients were subdivided into "group 2A, n = 26" comprised of patients with an NPV ratio > 90% and "group 2B, n = 40" comprised of patients with an NPV ratio < 90%. The Anti-Müllerian hormone (AMH) level (ng/mL) prior to treatment and at 6-month follow-up was assessed as a measure of ovarian reserve.

#### RESULTS

The AMH levels before and at 6-months follow-up were  $1.98 \pm 1.86$  (0.03-9.23) and  $1.97 \pm 1.85$  (0.02-9.2; p = 0.077) in group 1A and  $1.81 \pm 1.42$  (0.21-7.1) and  $1.79 \pm 1.42$  (0.21-7.1; p = 0.06) in group 1B, respectively. The AMH concentrations before and at 6 months after treatment were respectively  $1.98 \pm 1.15$  (0.57-4.61) and  $1.98 \pm 1.15$  (0.57-4.61; p = 0.327) in group 2A and  $1.65 \pm 0.94$  (0.09-4.11) and  $1.65 \pm 0.95$  (0.09-4.11; p = 0.160) in group 2B. There was no significant difference between the AMH levels before or at 6-months follow-up within groups 1 and 2. In group 1, five patients conceived (2 still conceiving while 3 delivered live-birth with mean weight of  $3200g \pm 120$ ); meanwhile, in group II, 3 patients conceived (1 still conceiving while 2 delivered live-birth with mean weight of  $3150g \pm 110$ ).

## CONCLUSION

Our findings suggest that there was no significant change in AMH levels before and 6 months after HIFU treatment both in fibroids and adenomyosis patients, suggesting that the ovary and its vessels were not adversely affected even with the achievement of a nonperfused volume (NPV) ratio greater than 90%.

## **CLINICAL RELEVANCE/APPLICATION**

MRI guided HIFU treatment of both uterine leiomyomas and adenomyosis with the targeted endpoint of nonperfused volume (NPV) ratio of at least 90% can be achieved safely for women who wish to preserve their fertility.

## VI229-SD- CT-Perfusion in Peripheral Arterial Disease - Correlation of Baseline with Post-interventional TUA3 Perfusion Parameters

Station #3 Participants

Bert-Ram Sah, MD, Bern, Switzerland (Presenter) Nothing to Disclose

Martin W. Huellner, MD, Lucerne, Switzerland (Abstract Co-Author) Institutional Grant, General Electric Company

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Johannes T. Heverhagen, MD, PhD, Bern, Switzerland (*Abstract Co-Author*) Research Grant, Bracco Group Research Grant, Guerbet SA Research Grant, Siemens AG Speaker, Bayer AG

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Patrick Veit-Haibach, MD, Toronto, ON (*Abstract Co-Author*) Research Grant, Bayer AG Resaarch Grant, F. Hoffmann-La Roche Ltd Research Grant, General Electric Company

### PURPOSE

The purpose of this study was the assessment of volumetric CT-perfusion (CTP) of the lower leg musculature in patients with symptomatic peripheral arterial disease (PAD) before (pre) and after (post) interventional revascularization, and comparing it with established angiographic and hemodynamic parameters.

## METHOD AND MATERIALS

Thirty-five consecutive patients with symptomatic PAD of the lower extremities requiring interventional revascularization were assessed prospectively. All patients underwent a CTP scan of the lower leg, and hemodynamic and angiographic assessment, before and after intervention. Hemodynamic parameters such as ankle-brachial pressure index (ABI) were determined. CTP parameters were calculated with a perfusion software, acting on a no outflow assumption. A sequential two-compartment model was used. Differences in CTP parameters and correlations between CTP, hemodynamic and angiographic parameters were assessed with non-parametric tests.

#### RESULTS

The cohort consisted of 27 subjects with an occlusion, and eight with a high-grade stenosis. The mean blood flow pre/post (BFpre and BFpost) was  $7.71 \pm 2.96 / 10.95 \pm 6.64$  mL/100mL\*min-1, and mean blood volume pre/post (BVpre and BVpost)  $0.71 \pm 0.33 / 1.24 \pm 1.07$  mL/100mL. BFpost and BVpost values were significantly higher than BFpre and BVpre in the symptomatic limb (p=0.003/0.02) but not in the asymptomatic limb (p=0.641/0.719). The ratios BFpost/BFpre and BVpost/BVpre, were not correlated to the ratio ABIpost/ABIpre.

# CONCLUSION

Treatment options in PAD patients are still limited, but this might change shortly, since several new molecular and regenerative therapeutic agents are under investigation. Hence, there is a basic need for a non-invasive method that provides reliable, reproducible, and observer-independent data on muscle perfusion in the lower leg. In our study, we have proven CTP to be feasible for assessing PAD before and after revascularization.

#### **CLINICAL RELEVANCE/APPLICATION**

CTP might serve as a non-invasive method for the surveillance and therapy control of patients with PAD.

VI257-SD-Local Tumor Control and Survival Rates in Unresectable or Recurrent Hepatic Cholangiocarcinoma (CCC): Transarterial Chemoembolization (TACE) versus Combined TACE and Microwave Ablation Station #4 Participants

Thomas J. Vogl, MD, PhD, Frankfurt, Germany (*Presenter*) Nothing to Disclose Elsayed M. Elhawash, BMedSc,MS, Frankfurt am Main, Germany (*Abstract Co-Author*) Nothing to Disclose Nagy N. Naguib, MD, MSc, Frankurt, Germany (*Abstract Co-Author*) Nothing to Disclose Nour-eldin A. Nour-Eldin, MD,PhD, Frankfurt am Main, Germany (*Abstract Co-Author*) Nothing to Disclose

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## PURPOSE

To evaluate the effect of local targeted liver therapy using transarterial chemoembolization (TACE) with or without microwave ablation (MWA) in patients with unresectable or recurrent cholangiocarcinoma (CCC) regarding overall survival and local tumor control.

#### **METHOD AND MATERIALS**

In this retrospective study from January 2007 to December 2017 152 patients (69 males/83 females; mean 58.7 years; range 25-86) with CCC with either unresectable (123/152=80.2%) or recurrent (29/152=19.8%) lesions were treated with at least three sessions (range 3-26) of TACE. Patients were subclassified into non-metastatic (86/152=56.5%), nodal metastatic (39/152=25.7%), systemic metastatic (18/152=11.8%) and both nodal and systemic metastatic (9/152=5.9%). 30 patients received combined TACE and MWA. Follow-up was performed using MRI and CT to evaluate local tumor control according to the modified RECIST criteria and survival was evaluated using the Kaplan-Meier method.

#### RESULTS

Mean survival for all patients was 28.7 months (CI 21.8-35.7). The survival for patients with non-metastatic, nodal, systemic metastatic and combined metastases was 37, 23.4, 17.5 and 12.4 months, respectively (p value = 0.006). Tumor response after three cycles of TACE was either stable (35.5%), partial response (41.4%) or progressive (23%) and the response at the last follow up was 25.7%, 15.2%, 59.2% and 3.5%, respectively. Patients who received additional MWA showed significantly longer survival vs those with only TACE (median 28 momths and 18 months, respectively, p<0.007). Significant prognostic factors for local tumor control and survival were nodal and/or systemic metastases, pre-therapeutic tumor size, initial local tumor response and additional application of MWA. However, no significant correlation was found between recurrent and unresectable tumors.

#### CONCLUSION

Local targeted liver therapy of unresectable or recurrent hepatic CCC using TACE or combined TACE and MWA provides an adequate therapeutic option for loca tumor control and improves patient survival

## **CLINICAL RELEVANCE/APPLICATION**

TACE with additional MWA is a promising therapeutic tool in patients with advanced CCC involvement.

#### VI254-SD-TUA6 Impact of Dynamic Intima Motion on Renal Injury in Patients with Type B Acute Aortic Dissection: Quantitative Assessment with Dose-Regulated Retrospectively ECG-Gated CT Angiography in Dual-Source CT

Station #6

Participants Xinxin Yu, Jinan, China (*Presenter*) Nothing to Disclose Shuo Zhao, Jinan, China (*Abstract Co-Author*) Nothing to Disclose Ximing Wang, MD, Jinan, China (*Abstract Co-Author*) Nothing to Disclose Hui Gu, Jinan, China (*Abstract Co-Author*) Nothing to Disclose Zhaoping Cheng, MD, Jinan, China (*Abstract Co-Author*) Nothing to Disclose Yanhua Duan, MD, Jinan, China (*Abstract Co-Author*) Nothing to Disclose Baojin Chen, MD, Jinan, China (*Abstract Co-Author*) Nothing to Disclose Yang Lin, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To quantitatively evaluate the impact of dynamic intima oscillation on acute kidney injury (AKI) in patients with type B acute aortic dissection (TB-AAD) before thoracic endovascular aortic repair (TEVAR) with retrospectively ECG-gated CT angiography (CTA), and further identify the association with early adverse events postoperatively.

#### **METHOD AND MATERIALS**

With IRB approval, a total of 108 patients (mean age  $50.3\pm9.4$  years, 79 male) with TB-AAD who underwent retrospectively ECGgated CTA and received TEVAR were retrospectively enrolled. Patients were divided into AKI and non-AKI groups, respectively. Area of the true lumen (TLA) at the upper level of kidney artery origin was measured in the R-R intervals for every 5% step from 0-95% (Fig. 1, 2). The relative change of TLA (CreI-TLA) was calculated according to the formula (CreI-TLA = ([TLA]max - [TLA]min) / [TLA]max) in each cardiac cycle. Additionally, various morphologic parameters were further evaluated for the impact on AKI. Logistic regression analysis was performed to identify independent predictors for AKI. Receiver operating characteristic (ROC) analysis was used to determine the best cut-off value of each predictor. Freedom from early adverse events was estimated using the Kaplan-Meier method and log-rank test.

#### RESULTS

Forty-three patients were sorted into the AKI group (39.8%). Patients with AKI showed significantly larger Crel-TLA than those of the non-AKI group ( $49.1\pm18.7 vs 31.8\pm14.3$ , p<0.001) (Fig. 3). Significantly larger maximum diameters of the descending aorta (p=0.023) and the primary entry tear (p=0.012) were found in the AKI group. Crel-TLA and elevated systolic blood pressure were both independent predictors for AKI. Patients with Crel-TLA>=42.6% were associated with a high incidence of renal ischemia before TEVAR and early adverse events postoperatively (all p<0.001) (Fig. 4). Figure 5 showed an example of dynamic intima motion in one

54-year-old female patient, who ultimately developed acute renal failure after interventional surgery (Fig 5. A). The TLA change was variable in the entire cardiac cycle; Crel-TLA was 51.1% (Fig 5.B, C).

## CONCLUSION

Dynamic intima motion has a significant influence on renal injury and some other adverse events as quantitatively evaluated by CTA.

## **CLINICAL RELEVANCE/APPLICATION**

Retrospectively ECG-gated CTA can identify dynamic intima motion, which is helpful to guide clinical therapies for high-risk patients with TB-AAD.

#### VI255-SD-TUA7 Combined MR Imaging for Pulmonary Embolism and Deep Venous Thrombosis by Contrast-Enhanced MR Volume Interpolated Body Examination

Station #7 Participants

Qing Fu, MS, MS, Wuhan , China (*Presenter*) Nothing to Disclose

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## PURPOSE

MR pulmonary angiography(MRPA) combined with MR venography(MRV) was attempted by using contrast-enhanced MR volume interpolated body examination (CE-VIBE) sequence. Agreement rate for deep venous thrombosis (DVT) detection between MRV and duplex sonography(DUS) was evaluated; the potential of this method for venous thromoembolism (VTE) was also investigated.

#### **METHOD AND MATERIALS**

Thirty-four patients with DUS-identified DVT were enrolled in this feasibility study. MRI was performed after a single administration of Gadopentetate dimeglumine. Fat suppressed CE-VIBE was applied for visualizing pulmonary arteries, abdominal veins, pelvic and bilateral leg veins, ranging from lung apex to ankle level. Two radiologists observed the MR images in consensus, recorded the location and number of emboli. MRV of the abdominal, pelvis and lower extremities veins were assessed based on per-vein segment. The agreement rate between MRV and DUS for venous segment-to-segment comparison was analyzed by Wilcoxon rank sum test.

#### RESULTS

All patients were diagnosed with DVT by MRV. MRV detected 55 more venous segments with thrombi than DUS based on per-vein segment analysis. Twenty-three patients with pulmonary embolism (PE) were detected by MRPA. Twenty-one patients underwent both pulmonary CT angiography and MRPA, consistency for PE detection between the two examinations was 100%. Total examination time of the combined MR protocol was 7 minutes for each patient.

#### CONCLUSION

CE- VIBE can visualize pulmonary arteries, abdominal-pelvic veins and bilateral lower extremity veins by single administration of contrast material, which makes it possible for detecting PE and DVT simultaneously. This proved to be a promising method for VTE diagnosis in one-stop MR scanning procedure.

## **CLINICAL RELEVANCE/APPLICATION**

The combined MR protocol scanned by contrast-enhanced VIBE could diagnose PE and DVT simultaneously, which takes only 7 minutes for per patient and needs only a single administration of contrast material.

#### VI256-SD-TUA8 Comparison of Early Tissue Shrinkage Following Hepatic Microwave Ablation and Multipolar Radiofrequency Ablation in an In-Vivo Porcine Liver Model in CECT

Station #8

Participants

Christoph Erxleben, Berlin, Germany (Presenter) Nothing to Disclose

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- Franz Poch, Berlin, Germany (Abstract Co-Author) Nothing to Disclose
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# PURPOSE

Microwave ablation (MWA) and radiofrequency ablation (RFA) are minimally invasive local ablation techniques that use thermal tissue coagulation to eliminate solid tumors. It is known from several studies, mostly ex-vivo, that the methods are associated with tissue shrinkage. Our aim was to quantify the early tissue shrinkage following hepatic MWA and RFA in an in-vivo porcine liver model using contrast-enhanced computed tomography (CECT).

#### **METHOD AND MATERIALS**

Multiple hepatic MWAs and multipolar RFAs (with three applicators) with constant energy parameters were performed in healthy, anesthetized and laparotomized domestic pigs. Volumes of ablated areas were obtained from venous phase CT-scans immediately

after ablation and during a short-term course of up to 90 minutes after MWA or RFA.

## RESULTS

A total of 26 thermally ablated areas (13 MWA and 13 RFA) in 18 porcine livers were analyzed, each case with three volume measurements. In both cohorts CECT-scans showed a volume reduction of the ablated zones (p<0,001 [MWA and RFA]). There was no statistically significant difference in volume change between RFA and MWA-lesions detectable, even though the dimension and dynamics in RFA ablated zones seem slightly less and more homogenous.

#### CONCLUSION

In our study we observe significant tissue shrinkage directly after hepatic MWA or RFA. The volume reduction of ablated tissue was not significantly different in the two methods.

#### **CLINICAL RELEVANCE/APPLICATION**

Early tissue shrinkage following RFA or MWA must be taken into account in assessing the technical success of tumor treatment by these techniques in clinical practice.

# VI136-ED- Fire Burn and Cauldron Bubble: Contrast-Enhanced Ultrasound for Abdominal Interventions TUA9

Station #9

Participants Craig Wilsen, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose Maitraya K. Patel, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose Michael L. Douek, MD, MBA, Encino, CA (*Abstract Co-Author*) Nothing to Disclose Kristin M. Dittmar, MD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose David S. Lu, MD, Los Angeles, CA (*Abstract Co-Author*) Consultant, Medtronic plc Speaker, Medtronic plc Consultant, Johnson & Johnson Research Grant, Johnson & Johnson Consultant, Bayer AG Research Grant, Bayer AG Speaker, Bayer AG Steven S. Raman, MD, Santa Monica, CA (*Abstract Co-Author*) Consultant, Johnson & Johnson; Consultant, Bayer AG; Consultant, Merck & Co, Inc; Consultant, Amgen Inc; Consultant, Profound Medical Inc

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## **TEACHING POINTS**

Since FDA approval for contrast enhanced ultrasound (CEUS), its applications in an array of clinical arenas are rapidly expanding, including in image guided procedures. Intravascular ultrasound contrast agents use microbubbles to enhance imaging of solid tumors, with no nephrotoxicity. Lesions not discernible on grayscale or Doppler ultrasound become amenable to contrast enhanced ultrasound guided biopsy or ablation. Case studies will illuminate this primer on the use of contrast enhanced ultrasound in abdominal interventions. 1. Provide a how-to primer on contrast-enhanced ultrasound interventions 2. Demonstrate utility in hepatic, renal and peritoneal/soft tissue interventions, including improved targeted biopsies and thermal ablation guidance and monitoring

## TABLE OF CONTENTS/OUTLINE

1. Introduction to CEUS interventions to target the most enhancing parts of lesions and to avoid vascular structures 2. Ultrasound contrast agents and mechanism of action 3. Renal interventions: examples of targeted biopsies and pre and post ablation imaging 4. Hepatic interventions: examples of hyper and hypovascular lesion biopsies and pre and post ablation imaging 5. Peritoneal and soft tissue nodules: utility of CEUS for visualization and for biopsy and ablation targeting 6. Pearls and pitfalls 7. Summary and references

# VI135-ED- Transcaval Approach for Embolization of Abdominal Aortic Aneurysm Type II Endoleak

Station #10

Participants Howard S. Brent, MD, Brooklyn, NY (*Presenter*) Nothing to Disclose Dan I. Cohen-Addad, MD, Brooklyn, NY (*Abstract Co-Author*) Nothing to Disclose Suraj Patel, MD, Brooklyn, NY (*Abstract Co-Author*) Nothing to Disclose Aslan Efendizade, DO, Brooklyn, NY (*Abstract Co-Author*) Nothing to Disclose William Kwon, MD, New York City, NY (*Abstract Co-Author*) Nothing to Disclose

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#### **TEACHING POINTS**

Review the types of abdominal aortic aneurysm (AAA) endoleaks and current therapies. Discuss the different approaches for type II endoleak repair using images and illustrations. Learn the indication and technique of transcaval endoleak embolization

## TABLE OF CONTENTS/OUTLINE

Abdominal aortic aneurysm (AAA) is a life-threatening condition as rupture is usually fatal. Endovascular abdominal aortic aneurysm repair (EVAR) is now standard of care for most patients with high success rates and lower morbidity compared to open surgery. An endoleak is an EVAR complication and indicates persistent blood flow into an aneurysm sac after endoluminal graft placement. In this review we focus on type II endoleaks, which are the most common and arise from collateral arterial backflow commonly from the mesenteric and lumbar arteries. Treatment by embolization of collaterals can be difficult and thus techniques to embolize the aneurysm sac itself with CT guided percutaneous approach have started to increase in popularity. However, in cases where the aneurysm sac is located in a position that is difficult to access with standard percutaneous or transarterial technique, a transcaval approach provides an alternative with reduced risk of inadvertent abdominal organ injury. The transcaval approach offers an option when cases arise that were previously thought to be inoperable.





# VIS-TUB

# Vascular Interventional Tuesday Poster Discussions

Tuesday, Dec. 3 12:45PM - 1:15PM Room: VI Community, Learning Center



AMA PRA Category 1 Credit ™: .50

FDA Discussions may include off-label uses.

## Participants

Sarah B. White, MD, Milwaukee, WI (*Moderator*) Research support, Guerbet SA; Research support, Siemens AG; Research support, Instylla; Research support, InSightee Ltd; Consultant, Guerbet SA; Consultant, BTG International Ltd; Consultant, Cook Group Incorporated; Consultant, Strategies MD

## Sub-Events

#### VI209-SD-TUB1 Clinical Utility of Time Resolved MRA in Characterizing Complex Vascular Malformations: Correlation with Digital Subtraction Catheter Angiography and High Spatial Resolved MRA

Station #1

Participants David Gedeon, MD, Orange, CA (*Presenter*) Nothing to Disclose Mayil S. Krishnam, MBBS, MRCP, Orange, CA (*Abstract Co-Author*) Nothing to Disclose Thangavijayan Bosemani, MBBS, MD, Coimbatore, India (*Abstract Co-Author*) Nothing to Disclose Biraj Bista, Orange, CA (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

High spatial resolution single phase Magnetic Resonance Angiography (CE-MRA) is useful in determining fine vascular details but limited in reliably evaluating high flow vs slow flow vascular malformations (VMs) due to poor temporal resolution. Therefore, catheter-based angiography (DSA) would still be necessary to determine functional flow characteristics. Our aim is to evaluate the diagnostic utility of Time Resolved Magnetic Resonance Angiography (TR-MRA) to differentiate high-flow and slow-flow lesions of complex VMs.

## METHOD AND MATERIALS

Retrospective search utilizing Nuance Dictation Powerscribe Software (M-Power) for MRA studies (from 2009 to 2018) with TR-MRA and CE-MRA sequences for VM evaluation were obtained after IRB approval. All studies were performed at 3T (Trio, Siemens). Cases with VMs that involved the brain and spine were excluded. An experienced cardiovascular radiologist was asked to identify high-flow and slow-flow VMs based on TR-MRA and other characteristics such as feeding vessels, draining vessels, size and extent. The findings were then compared to the CE-MRA and also DSA for the patients who had catheter angiogram for treatment.

## RESULTS

The M-Power search resulted in a total of 69 patients (24 males, 45 females; age range 11 days to 74 years). There were 19 highflow VMs, 47 slow-flow VMs, 2 lymphatic malformations and 1 no-flow VM. TR-MRA was able to determine VM size, type (53 venous cases, 12 arteriovenous cases and 4 arterial cases), feeding vessels (18 cases), and draining vessels (40 cases). Of the total 69 patients, there were 25 that had confirmatory DSA performed for treatment. Of those with DSA, there was 100% concordance with the MRA for high-flow vs slow-flow lesions.

## CONCLUSION

TR-MRA is comparable to DSA by providing real time contrast flow dynamics that confidently differitates vascular malformations as high vs slow/no flow lesions. However, high spatial resolution single phase CE-MRA is a supplimentary technique to TR-MRA to depict fine anatomical details in complex VMs.

## CLINICAL RELEVANCE/APPLICATION

TR-MRA would provide functional data of contrast flow dynamics to differentiate VMs as high-flow or slow/no flow lesions for appropriate treatment planning.

# VI210-SD-TUB2 Conventional Fluoroscopy Conventional Fluoroscopy

Station #2

Participants Matthew Milam, San Antonio, TX (*Presenter*) Nothing to Disclose John A. Walker, MD, San Antonio , TX (*Abstract Co-Author*) Nothing to Disclose Jorge E. Lopera, MD, San Antonio, TX (*Abstract Co-Author*) Shareholder, Tecnostent SA; Advisor, Boston Scientific Corporation ; Proctor, Teleflex Incorporated

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PURPOSE
Inferior Vena Cava filters (IVCF) are commonly used in the prevention of pulmonary embolism. IVCFs traditionally are placed using fluoroscopy, however, bedside placement is an acceptable safe alternative for critically ill patients1,2. Outcomes for bedside placed IVCF with US guidance are available, however, outcomes using digital radiography (DR) as guidance are lacking. The purpose of this study is to assess the outcomes of IVCFs placed at bedside using DR compared to IVCFs placed by conventional fluoroscopy (CF).

# METHOD AND MATERIALS

This is an IRB approved retrospective study spanning a period from 7/2/2015 to 9/30/2016 in which all IVC filters placed by the IR department were assessed for inclusion. Multiple procedures at time of IVCF placement resulted in study exclusion. Our institution follows SIR guidelines for IVCF indications. For critically ill patients deemed high transfer risk, beside placements were performed at the operator's discretion. For analysis, placements were grouped by bedside with DR or by CF. Patient demographics, indication, radiation exposures, access site, procedural duration, dwell time, and complications were identified by the EMR. Filter positioning with measurements of tip to renal vein distance and lateral filter tilt were performed when cavograms or post placement CTs were available for review. Statistical analysis was performed using Stata IC 11.2.

# RESULTS

Among 161 filter placements identified, 32 were excluded, providing a sampling of 81 placed by CF and 48 at the bedside. Patient's were statistically younger among the bedside group with a mean age of 49 +/-18 vs 56 +/-17 years (p=0.027). Procedural duration was longer at the bedside lasting 14.5 +/-10.2 versus 6.7 +/-6.0 minutes (p<0.0001). The CF group had mean radiation exposure of 256.94mGy +/-158.6 and bedside group had a median number of KUBs of 5 (3-7) estimating an average of dose of 25mGy. There was no significant difference in distance of IVC tip to renal vein (p=0.31), misplacements (p=0.57), degree of filter tilt (p=0.33), or rate of complications (p=0.65) between the bedside group and the fluoroscopy group.

## CONCLUSION

IVCF placement at the bedside using DR is comparable to CF with no statistical difference in outcomes based on IVCF positioning, degree of lateral tilt or removal issues, with a tradeoff of decreased dose with increased time.

# **CLINICAL RELEVANCE/APPLICATION**

IVCFs can be placed safely at the bedside using DR.

#### VI211-SD-TUB3 Impact of Tissue Vascularity on the Outcome of High-Intensity Focused Ultrasound (HIFU) Treatment of Adenomyosis

Station #3

Participants

Nguyen Minh Duc, MD, Ho Chi Minh, Vietnam (*Presenter*) Nothing to Disclose Rajiv Chopra, PhD, Dallas, TX (*Abstract Co-Author*) Stockholder, Profound Medical Corporation; Stockholder, Solenic Medical Inc Chandran Nadarajan, MD, Kota Bharu, Malaysia (*Abstract Co-Author*) Nothing to Disclose Mohd Shafie Abdullah, MMed,RT, Kota Bharu, Malaysia (*Abstract Co-Author*) Nothing to Disclose Bilgin Keserci, PhD, Kota Bharu, Malaysia (*Abstract Co-Author*) Nothing to Disclose

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### PURPOSE

To comparatively evaluate the therapeutic efficacy of the magnetic resonance imaging (MRI)-guided high-intensity focused ultrasound (HIFU) ablation of adenomyosis based on T1-perfusion and T2 signal intensity (SI)-based classifications.

# METHOD AND MATERIALS

50 women (age,  $40.3 \pm 6.0$  years; range) who underwent HIFU treatment were classified according to (i) T2 SI-based classification as group I (focal adenomyosis, n = 32), group II (diffuse adenomyosis, n = 18,), and (ii) T1 perfusion-based classification as group A (if the time-signal intensity (SI) curve of lesion is lower than that of myometrium, n = 28) and group B (if the time-SI curve of lesion is equal to or higher than that of myometrium, n = 22). The adenomyosis volume, non-perfused volume (NPV) ratios immediately after treatment and volume reduction ratios and transformed symptom severity scores (tSSS) at the 6-month follow-up were retrospectively assessed.

#### RESULTS

The mean adenomyosis volume of group I, II, A, and B was 99.8ml and 126.5ml (p>0.05), 108.8ml and 110.2ml (p>0.05), respectively. The mean NPV ratio was significantly higher in group A than in group B (88.6% and 41.1%, respectively; p<0.05). No statistically significant difference was noted in the immediate NPV ratio among patients with the group I and II (64.9% and 72.6%, respectively; p>0.05). In group A, the mean NPV ratio was 89.6% (n = 16) for patients with focal adenomyosis and 87.3% (n = 12; p>0.05) for patients with diffuse adenomyosis. In group B, the mean NPV ratio was 41.1% (n = 22) for patients with focal adenomyosis and 40.3% (n = 6; p>0.05) for patients with diffuse adenomyosis. The 6-month adenomyosis volume reduction ratio in group A was significantly greater compared to that in group B (30.3% and 7.6%, respectively; p<0.05) whereas there was no statistically significant difference among the group I and II (19.5% and 21.7%, respectively; p>0.05). The tSSS improvement ratio was 46.4% and 47.3% in group I and II, and 72.2% and 14.3% in group A and B, respectively.

# CONCLUSION

The preliminary results of this study revealed that T1-perfusion based classification method could play an important role in classifying the adenomyosis and predicting the treatment outcome of MRI-guided HIFU ablation

# **CLINICAL RELEVANCE/APPLICATION**

T1 perfusion-based classification is an important predictor of MRI-guided HIFU treatment outcome of adenomyosis and should be considered by the treating physician in the screening phase.

#### VI261-SD-TUB5 Antitumor Effects of Transarterial Embolization and Simultaneous Treatment with Lenvatinib and Transarterial Embolization in a Rabbit VX2 Liver Tumor Model

#### Station #5 Participants

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#### PURPOSE

To evaluate the antitumor effects of transarterial embolization (TAE) and simultaneous treatment with lenvatinib and TAE in a rabbit VX2 liver tumor model.

#### **METHOD AND MATERIALS**

All experimental protocols were approved by our institutional animal experimentation committee. Fifteen Japanese white rabbits underwent VX2 tumor transplantation to the liver, and were randomly divided into three groups of five. Two weeks later, we performed magnetic resonance imaging (MRI) examinations and then treatments as follows: Group 1 (TAE and lenvatinib administration for 7 days started at the same time as TAE), Group 2 (TAE only), Group 3 (non-treatment). Two weeks after starting treatment, MRI was performed, and the rabbits were painlessly sacrificed, after which their livers were removed. Immunohistochemical staining (CD34) was also performed. Tumor growth rates were assessed by MRI examinations and the densities of intratumoral vessels were determined by immunohistochemical staining to evaluate the antitumor effects.

#### RESULTS

Tumor growth rates were  $544 \pm 141\%$  in Group 1,  $218 \pm 88\%$  in Group 2, and  $1086 \pm 171\%$  in Group 3. The tumor growth rate was significantly lower in Group 2 than in Group 1 and Group 3, and the difference between Group 1 and Group 3 was also significant. The ratio of CD34-positive regions to viable tumor areas was  $4.58 \pm 0.58\%$  in Group 1,  $4.59 \pm 1.01\%$  in Group 2, and  $4.97 \pm 1.36\%$  in Group 3. There was no statistically significant difference among the groups.

# CONCLUSION

We think that TAE alone in a rabbit VX2 liver tumor model results in a decrease of tumor growth rate compared with simultaneous treatment with lenvatinib and TAE.

# **CLINICAL RELEVANCE/APPLICATION**

In terms of antitumor effects, simultaneous treatment with lenvatinib and TAE might not be a recommended treatment for hepatocellular carcinoma.

#### VI259-SD-TUB6 The Diagnostic Performance of Dual-Layer Computed Tomography for Deep-Vein Thrombosis in Indirect Computed Tomography Venography

Station #6 Participants

Shota Taonue, MD, Kumamoto, Japan (*Presenter*) Nothing to Disclose Takeshi Nakaura, MD, Amakusa, Japan (*Abstract Co-Author*) Nothing to Disclose Yuji Iyama, MD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose Ayumi Iyama, MD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose Morikatsu Yoshida, Amakusa, Japan (*Abstract Co-Author*) Nothing to Disclose Yasuyuki Yamashita, MD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose Yasuyuki Yamashita, MD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose Yasunori Nagayama, MD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose

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## PURPOSE

Early diagnosis of deep vein thrombosis (DVT) is important for prevention of pulmonary embolism (PE). A phantom study suggested the usefulness of dual-energy computed tomography (DECT) for decreasing image noise and improving conspicuity and diagnostic accuracy of DVT. DECT can generate virtual monochromatic images (VMIs) at different monochromatic X-ray energies (keV) based on two different energy datasets. VMIs at low keV can increase both contrast enhancement and venous attenuation compared to conventional images, but they also markedly increase image noise. Dual-layer DECT (DL-DECT) can overcome the disadvantage of increased image noise at low energy levels. The purpose of this study was to evaluate the image quality and diagnostic performance of VMIs obtained with DL-DECT during indirect CT venography (CTV) for deep vein thrombosis.

#### **METHOD AND MATERIALS**

This retrospective study was approved by the Institutional Review Board, which waived the requirement for informed consent from patients. We retrospectively enrolled 45 patients who underwent CTV using DL-DECT, and VMIs (40-200 keV) were retrospectively generated. We compared the venous attenuation, image noise, contrast, and contrast-to-noise ratio (CNR) between the VMIs with the highest CNR and conventional CT images using a paired t-test. Furthermore, we compared the pooled area under the receiver-operating characteristic curve (AUC) of each technique with Delong's test in 34 patients who underwent color Doppler ultrasonography.

#### RESULTS

The 40-keV VMIs exhibited the best CNR. The image noise was significantly lower in 40-keV images (9.7 ± 2.5 HU) than in 120-kVp

images (10.5  $\pm$  2.5 HU) (p < 0.01). The contrast (120 kVp: 38.2  $\pm$  15.3 HU vs. 40 keV: 131.6  $\pm$  43.6 HU) and CNR (120 kVp: 3.8  $\pm$  1.7 vs. 40 keV: 14.4  $\pm$  6.1) were significantly higher in 40-keV images than in 120-kVp images (p < 0.01). Furthermore, the pooled AUC was significantly higher for 40-keV images (0.84) than for 120-kVp images (0.78) (p = 0.03).

# CONCLUSION

In indirect CT venography, 40-keV VMIs obtained with DL-DECT offer better image quality and diagnostic performance for deep vein thrombosis than conventional CT images.

# CLINICAL RELEVANCE/APPLICATION

We proved the following findings using ROC techniques by 9 reviewers. In indirect CTV, VMI at 40 keV with DL-DECT offers better image quality and diagnostic performance of DVT than conventional CT.

#### VI260-SD-TUB7 False Lumen Enhancement Characteristics on Computed Tomography Angiography Predict Risk of Aneurysm Formation Among Acute Type B Aortic Dissection Patients

Station #7

Participants Molly Roseland, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose Ignas B. Houben, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose Heather A. Knauer, PhD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose Bo Yang, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose Himanshu J. Patel, MD, Ann Arbor, MI (*Abstract Co-Author*) Research Consultant, W. L. Gore & Associates, Inc; Research Consultant, Medtronic plc; Research Consultant, Terumo Corporation; Research Consultant, Edwards Lifesciences Corporation Nicholas S. Burris, MD, Ann Arbor, MI (*Abstract Co-Author*) Royalties, Imbio, LLC

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# PURPOSE

Patients with type B aortic dissection are prone to aneurysmal degeneration of the false lumen (FL). Imbalance in FL outflow (reentry tears) relative to inflow (entry tears) leads to FL pressurization, lower FL flow rates, and may be a significant driver of FL aneurysm formation. Imaging features (i.e., decreased FL contrast filling) that suggest FL pressurization may improve patient risk stratification and inform timing of surgical repair. The purpose of this study was to examine the association between baseline CTA luminal enhancement properties and delayed aneurysm formation in acute type B aortic dissection.

#### **METHOD AND MATERIALS**

Baseline CTAs of patients with acute type B aortic dissections between 2007-2016 (n=50) were analyzed using 3D software (double-oblique technique) at multiple sites along the descending thoracoabdominal aorta. At each location, we measured contrast density in TL & FL (HU), maximal diameter (cm) and circumferential FL extent (degrees). Clinical and outcome data were collected via chart review. We used multivariate logistic regression to determine the association between TL-FL differential luminal enhancement and aneurysm formation (maximal diameter >=55mm).

# RESULTS

Patients were male (76%),  $52.9 \pm 13.1$  years old at diagnosis, with mean BMI  $32.3 \pm 6.6$  kg/m2. Mean follow-up was  $4.3 \pm 2.9$  y, and 34% (n=17) patients were diagnosed with thoracoabdominal aortic aneurysm during follow-up. Baseline anatomical means were:  $3.9 \pm 0.6$  cm aortic diameter,  $1.0 \pm 0.5$  cm primary entry tear,  $237 \pm 280$  FL circumferential extent,  $33.8 \pm 6.2$  cm dissection length, and  $4.2 \pm 5.3$  cm distance from the LSC. The baseline absolute difference in FL and TL (TL-FLabs) contrast density at 2 cm distal to primary entry tear was significantly higher among patients who developed aneurysm ( $36 \pm 27$  HU vs.  $22 \pm 27$  HU, p=0.01). Aneurysm formation was predicted by TL-FLabs (OR 1.05, 95% CI: 1.01-1.11, p=0.04), baseline maximal aortic diameter (OR 1.81, 95% CI: 1.21-2.72, p=0.004), age at diagnosis (OR 0.84, 95% CI: 0.71-0.99, p=0.04) and CT follow-up interval (OR 1.01, 95% CI: 1.002-1.0003, p=0.02).

# CONCLUSION

Differential luminal enhancement is a novel predictor of aneurysm formation among patients with type B aortic dissection.

# **CLINICAL RELEVANCE/APPLICATION**

Luminal contrast density is easily measured from baseline CTA and decreased FL enhancement may help identify patients with acute type B aortic dissections at risk of aneurysm formation.

#### VI137-ED-TUB8 Pelvic Congestion Syndrome: Normal Anatomy and Multimodality Imaging Evaluation of an Underdiagnosed Disease

Station #8

#### Awards Cum Laude

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Participants Rudra A. Pampati, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose Minhaj S. Khaja, MD, MBA, Ann Arbor, MI (*Abstract Co-Author*) Consultant, Penumbra, Inc; Speaker, Penumbra, Inc David M. Williams, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose

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# **TEACHING POINTS**

Pelvic congestion syndrome (PCS) is an underdiagnosed etiology of chronic pelvic pain in a large portion of female patients. While the etiology of primary pelvic congestion syndrome is attributed to incompetent venous valves in the gonadal veins or internal iliac veins, secondary causes of increased hydrostatic pressure and reflux may be due to extrinsic compression or intrinsic narrowing of central inflow or outflow veins. Clinical diagnosis of PCS can pose as a challenge for many general practitioners and women's health providers, delaying diagnosis and ultimately treatment. Familiarity with the diagnostic features of pelvic congestion syndrome may aid in timely diagnosis and guide patients to the appropriate treatment.

# TABLE OF CONTENTS/OUTLINE

1. Clinical significance of pelvic congestion syndrome 2. Normal female pelvic venous anatomy 3. Common anatomic variants 4. Etiology of Pelvic Congestion Syndrome a. Primary Etiology b. Secondary Etiologies 5. Noninvasive Preprocedural Imaging a. Ultrasound b. Computed Tomography c. Magnetic Resonance Imaging 6. Intraprocedural Imaging a. Angiography b. Intravascular Ultrasound 7. Treatment options and considerations

#### VI138-ED-TUB9 Don't Ever Go with the Flow, Be the Flow: A Comprehensive Pictorial Review of B-Flow Ultrasonography

Station #9

Participants Sandra M. Pinzon Ramirez, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose Juan A. Campos Sanchez, Ciudad de Mexico, Mexico (*Abstract Co-Author*) Nothing to Disclose Ibeth Melissa Echeverry Bolanos, MD, Mexico City, Mexico (*Abstract Co-Author*) Nothing to Disclose Julieta Viridiana Galicia, MD, Mexico City, Mexico (*Abstract Co-Author*) Nothing to Disclose

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#### **TEACHING POINTS**

B-flow ultrasonography (US) is an ultrasound technology which can be used during the evaluation of vascular diseases.
B-flow US is superior for the depiction of complex hemodynamics in the blood spaces.
This technique allows an easier discrimination between flowing blood and surrounding stationary structures (vessel wall, thrombus, hematoma, intimal flap, venous valve).
The use of digitally encoded ultrasound technology provides direct visualization of flowing blood cells.
The advantages of B-flow ultrasonography are: simultaneous visualization of flowing blood and surrounding stationary structures, higher frame rate for hemodynamic imaging, and higher spatial resolution for vascular anatomy.
In this pictorial essay, we demonstrate the B-flow in different vascular diseases.

# TABLE OF CONTENTS/OUTLINE

• Introduction. • Technical considerations of B-flow ultrasonography. • Advantages of B-flow US over other ultrasound modalities (B-mode, color Doppler and power Doppler). • Pictorial reviewof the clinical applications of B-flow US in vascular diseases. • Conclusions.





# SSJ25

# Vascular/Interventional (Aortic Disease)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: E352



AMA PRA Category 1 Credit ™: 1.00 ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

## Participants

Susan K. O'Horo, MD, MPH, Boston, MA (*Moderator*) Nothing to Disclose Raisa J. Durrani, MD, New York, NY (*Moderator*) Nothing to Disclose

## Sub-Events

# SSJ25-01 The Growth of Common Iliac Aneurysms (CIA) Coexisting with Abdominal Aortic Aneurysm (AAA): Correlation with AAA and Predictive Factors

Tuesday, Dec. 3 3:00PM - 3:10PM Room: E352

Participants

Yuting Wang, Chengdu, China (*Presenter*) Nothing to Disclose Chengcheng Zhu, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose Joseph Leach, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose Warren J. Gasper, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose David A. Saloner, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose Michael D. Hope, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

# PURPOSE

Common iliac aneurysms (CIA) frequently coexist with abdominal aortic aneurysm (AAA), and expand over time with risk of rupture. Previous studies of CIA growth rely mostly on ultrasound, which may not be accurate and reproducible enough to characterize slowly growing CIAs. Intraluminal thrombus (ILT) has been studied as a marker of growth in AAA, but has not been studied in CIA yet. This study aims to examine the factors associated with growth of CIAs using serial CTA with multiplanar reconstruction (MPR).

# METHOD AND MATERIALS

Data were collected from a single center from January 2000 to May 2018 in patients undergoing AAA surveillance. The maximal diameter of coexisting CIA was measured on CTA with MPR. Correlation of the baseline diameter and growth rate between CIA and AAA was evaluated. The presence of ILT in CIA and AAA was compared. Multivariate regression analysis was used to investigate the factors associated with CIA growth.

#### RESULTS

Seventy-one AAA patients (median age, 76 years old; all male) with 106 CIAs were identified, and were followed up for a median of 2.2 years (range, 0.6-9.2 years). The CIAs had baseline diameter of  $2.3\pm0.6$  cm with growth rate of  $0.9\pm1.3$  mm/year. CIA growth was positively correlated with AAA growth (r=0.43, P<0.01), whereas the baseline diameter of CIA and AAA were not significantly correlated (P=0.88). The presence of ILT in CIA was associated with that in AAA (P<0.01). Multivariate regression analysis showed that CIA baseline diameter, AAA baseline diameter, and smoking were positively related to CIA growth. In CIAs with diameters of 2-3cm (n=60), which consisted the largest subgroup (56.7%), the growth rate of CIA with ILT was more than double that of CIAs without ILT (1.6 mm/year vs. 0.7 mm/year, P=0.017).

## CONCLUSION

CIA baseline diameter, AAA baseline diameter, and smoking are predictive of CIA growth. In CIAs of 2-3cm, presence of ILT predicts faster aneurysm growth and this important feature should be described in the radiology report so that shorter-interval surveillance can be considered.

# CLINICAL RELEVANCE/APPLICATION

CIA baseline diameter, AAA baseline diameter, and smoking are predictive of CIA growth. In CIAs of 2-3cm, presence of ILT could be a risk factor for fast growth and may prompt earlier follow-up.

# SSJ25-02 Diagnostic Imaging Using Contrast-Enhanced Ultrasound (CEUS) in Comparison to Other Non-Invasive Imaging Strategies in the Management of Patients with Possible Endoleak Type I/III after Endovascular Aortic Repair: A Cost-Effectiveness Analysis

Tuesday, Dec. 3 3:10PM - 3:20PM Room: E352

Participants

Matthias F. Froelich, MD, Mannheim, Germany (*Presenter*) Consultant, Smart Reporting GmbH Wolfgang G. Kunz, MD, Munich, Germany (*Abstract Co-Author*) Grant, Medtronic plc Dirk-Andre Clevert, MD, Muenchen, Germany (*Abstract Co-Author*) Speaker, Siemens AG Speaker, Koninklijke Philips NV Speaker, Bracco Group Speaker, Samsung Electronics Co, Ltd Johannes Ruebenthaler, MD, Munich, Germany (Abstract Co-Author) Nothing to Disclose

# PURPOSE

To evaluate the cost-effectiveness of contrast-enhanced ultrasound (CE-US) in comparison to noninvasive imaging strategies in patients with possible type I or type III endoleak after endovascular aortic repair (EVAR).

# METHOD AND MATERIALS

A decision model based on Markov simulations estimated lifetime costs and quality-adjusted life years (QALY) associated with the imaging strategies contrast-enhanced ultrasound (CE-US), Duplex ultrasound (DU-US), contrast-enhanced computed tomography angiography (CE-CT), and contrast-enhanced magnet resonance imaging angiography (CE-MR). United States healthcare data were used for analysis. Model input parameters were based on best available and most recent evidence (Table 1). Starting age was 70 years. The prior probability of a type I / III endoleak was set at 12.8 %, the reported frequency of type I / III endoleaks in literature. Probabilistic sensitivity analyses (PSA) were performed using 30,000 Monte Carlo simulations to estimate model uncertainty. The percentage of cost-effective iterations was determined for different willingness-to-pay (WTP) thresholds.

#### RESULTS

The base-case analysis showed that CE-US is dominant over CE-CT and CE-MR in the proposed model. CE-US led to increased lifetime QALYs compared to DU-US (9.56 QALYs vs. 9.53 QALYs) at slightly higher lifetime costs (\$20,050 vs. \$19,868). Therefore, CE-US was the optimal strategy in the base-case analysis for a WTP threshold of \$100,000/QALY. In PSA, CE-US was the strategy with the highest percentage of cost-effective iterations if the WTP threshold was set higher than \$10,000/QALY. In accordance with contemporary WTP thresholds and adjusting for model uncertainty, CEUS was determined as the most cost-effective strategy.

# CONCLUSION

In patients undergoing endoleak surveillance after EVAR, CE-US is a cost-effective strategy for the detection and evaluation of type I and type III endoleaks.

# **CLINICAL RELEVANCE/APPLICATION**

CE-US should be considered as surveillance imaging modality of choice in patients after EVAR.

# SSJ25-03 Thoracic Endovascular Aortic Repair or Medical Treatment in Patients with Acute Uncomplicated Type B Aortic Dissection

Tuesday, Dec. 3 3:20PM - 3:30PM Room: E352

Participants Dongqiao Xiang, MD, Wuhan, China (*Presenter*) Nothing to Disclose Lixia Wang, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose Chuansheng Zheng, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose

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### PURPOSE

The purpose of this retrospective study was to further assess the early and long-term (10-year) outcomes of thoracic endovascular aortic repair (TEVAR) in patients with acute uncomplicated type B aortic dissection (TBAD) compared with those receiving best medical treatment (BMT).

# **METHOD AND MATERIALS**

Between February 2008 and March 2018, 357 patients with acute uncomplicated TBAD were retrospectively identified and divided into 2 groups, the TEVAR group (n = 191) and the BMT group (n = 166). Information about baseline characteristics and details of medical and endovascular management, in-hospital clinical events, length of stay, and in-hospital mortality were collected from the electronic medical record database. Initial diagnostic and follow-up computed tomography angiography images were retrieved from the imaging archiving system. The anatomic characteristics, extent of the dissection, thrombosis status of the false lumen and postoperative complications were retrospectively evaluated and documented. The final survival state was determined via the review of hospital admitting notes or telephone follow-up.

#### RESULTS

Clinical history was similar between groups. Although there is no significantly difference in in-hospital/30-day mortality rate, patients in TEVAR group had significantly higher early event rates than those in the BMT group (12.0% vs. 3.0%; p = 0.001). Late event rates were significantly higher in the BMT group compared with the TEVAR group (p = 0.004). Kaplan-Meier estimates demonstrated that patients in the BMT group had significantly more rupture and aortic enlargement than those in the TEVAR group (p = 0.014; p = 0.030, respectively). The cumulative survival rates from all causes of death at 1, 3, 5 years were 96.8%, 96.0%, 90.0% in the TEVAR group and 93.7%, 87.9%, 82.4% in the BMT group. Log-rank tests revealed a significantly higher all-cause mortality rate in the BMT group versus the TEVAR group (p = 0.020).

# CONCLUSION

Despite more early complications, TEVAR has proven to be an effective treatment for acute uncomplicated TBAD in this study, with lower late event rates and mortality than BMT during the long-term follow-up.

# **CLINICAL RELEVANCE/APPLICATION**

(dealing with acute uncomplicated type B aortic dissection) 'TEVAR has an advantage in stabilizing the dissected aorta, inducing aortic remodeling processes and promoting false lumen thrombosis, and it is recommended to consider it when formulating a treatment plan.'

# SSJ25-04 Aortic Changes Following Acute Uncomplicated Medically-Managed Stanford Type B Aortic Dissection

# Participants

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# PURPOSE

To characterize longitudinal changes in the descending thoracic aorta following acute uncomplicated medically-managed Stanford Type B aortic dissection (SBAD).

## **METHOD AND MATERIALS**

Longitudinal study of medically-managed SBAD after index admission to a single center between 1995-2015. Repeated measurements of the descending thoracic aorta were made using centerline oblique reformats of CT and MR imaging. Aorta-related events were captured including death, descending thoracic aorta aneurysm (max total diameter >40 mm), rupture, repair/fenestration, and intimomedial flap changes. Joint modelling was used to study the relationship between changing aortic anatomy and hazard of an aorta-related event.

## RESULTS

There were 94 patients identified with medically-managed SBAD. Of those, 74 (79%) survived the index hospitalization and had imaging available. The median [IQR] radiological follow-up was 3.1 years [1.1-7]. Measurements were taken from 442 studies (399 CT, 90%). At index admission, 11 (16%) had a complex intimomedial flap, 47 (64%) a totally patent false lumen, and the median maximum total aortic diameter was 42 mm [37-47]; this was located in proximity to the left subclavian artery origin (zone 3) for 42 patients (57%). The growth velocity of the maximum total aortic diameter over 0-6 months was 2 mm/month [95%CI: 1.3-2.6], 6-12 months was 0.4 mm/month [-1-1.8], and 1-5 years was 0.1 mm/month [0-0.2]. In follow-up, 49 patients (66%) had an aorta-related event [18 aneurysmal degenerations (36.7%), 2 ruptures (4%), 22 repairs (45%), 4 flap changes (8.2%), 3 deaths (6.1%)] with event-free-survival of 70% at 6 months [61-81], 57% at 1 year [47-69], and 34% at 5 years [24-47]. Joint modelling demonstrated univariate association between risk of aorta-related event and maximal total descending aortic diameter (HR [95%CI]: 1.026 [1.02-1.031], p<0.0001), true lumen diameter at point of maximal total diameter (0.983 [0.968-0.998], p=0.03), and maximal false lumen diameter (1.013 [1.003-1.022], p=0.009).

# CONCLUSION

For medically-managed SBAD, changes in the descending thoracic aorta over time, including maximum total, false lumen, and true lumen diameters, were associated with the hazard of aorta-related event.

# **CLINICAL RELEVANCE/APPLICATION**

This study relates changing aortic anatomy to clinically-relevant outcomes for medically-managed Stanford Type B aortic dissection which can be used to inform management decisions.

# SSJ25-05 Prediction of Abdominal Aortic Aneurysm Growth Rate Using Radiomic Feature Analysis of FDG PET-CT

Tuesday, Dec. 3 3:40PM - 3:50PM Room: E352

## Participants

Pratik Adusumilli, MBChB, Leeds, United Kingdom (*Presenter*) Nothing to Disclose Mohammed Waduud, MRCS, Leeds, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Marc Bailey, MRCS, Leeds, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Andrew F. Scarsbrook, FRCR, York, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

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## PURPOSE

Radiomics allows objective and quantitative assessment of medical images by analysing distribution and relationships of pixel grey levels. The technique has been used extensively to study tumours, however, the potential use for prediction of growth of abdominal aortic aneurysms (AAA) has not been established. The aim of this study was to explore the correlation between radiomic features extracted from FDG PET-CT and AAA growth.

# METHOD AND MATERIALS

Patients with an unrepaired AAA who underwent FDG PET-CT between January 2009 and December 2016 for malignancy evaluation were selected from an institutional database. Patients underwent subsequent AAA surveillance with serial ultrasound. Radiomic feature analysis was performed with LIFEx software. Regions of interest were drawn over the AAA and blood pool within the aortic arch on the PET scan. Ratio of AAA SUV to blood pool (BP) activity was calculated along with 40 radiomic features. Bivariate Pearson correlation was calculated with Bonferroni correction for multiple testing. A control group of patients without AAA were also analysed. AAA growth rate was calculated using initial and final aortic calibre measurements for the trial group and normal aortic growth rates in the control group.

#### RESULTS

50 patients (mean age 74 years, 40 male) were included in the study. A correlation was considered significant if it had a p value of < 0.001 in the trial group and no correlation in the control group. There was no correlation between AAA:BP SUV ratio and

aneurysm growth. Significant correlations were found between AAA growth rate and GLCM Homogeneity (a measure of local homogeneity), GLCM Contrast (a measure of local variation) and GLCM Dissimilarity (a measure that defines the variation of grey level pairs in an image). The Pearson correlation and significance for these features were .483; 0.001, -.428; 0.0001 and -.462; 0.001 respectively.

# CONCLUSION

Radiomic features extracted from AAA at FDG PET-CT may provide useful risk stratification metrics which could be used to identify patients at higher risk of rupture. Further evaluation in a larger prospective cohort with a more advanced method of estimating AAA growth is required to validate these initial findings.

## **CLINICAL RELEVANCE/APPLICATION**

Radiomic features extracted from AAA at FDG PET-CT might be considered as a risk stratification tool in future studies to predict aneurysms at higher risk of significant expansion.

# SSJ25-06 Investigation of the Quality Reserve Provided by Digital Variance Angiography in Fenestrated and Branched Endovascular Aortic Aneurysm Repair Setting

Tuesday, Dec. 3 3:50PM - 4:00PM Room: E352

#### Participants

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## PURPOSE

Kinetic imaging is a novel image processing algorithm providing enhanced image quality in X-ray angiography setting. The algorithm produces so;called Digital Variance Angiography (DVA) images. The study objective was to assess the quality reserve of DVA images by comparing the performance to standard digital subtraction angiography (DSA) in fenestrated and branched endovascular aortic aneurysm repair (F/B-EVAR) setting.

# METHOD AND MATERIALS

Retrospective evaluation of image data of 30 patients undergoing F/B-EVAR at our institution without any preselection. The signalto-noise ratio (SNR) of DSA and DVA images was measured and compared. The same raw image data were used to generate dynamic DSA and DVA runs. The videos were compared by six experts in a randomized blinded questionnaire. Fleiss' Kappa-test was used to determine interrater agreement.

# RESULTS

DVA images provided 1.49 times higher SNR than DSA (median value, Q1-Q3 interval 1.14-1.81). Evaluators preferred DVA over DSA images in 85.9% of comparisons. The interrater agreement was 91.3% and Fleiss's kappa was 0.21 (p<0.001).

## CONCLUSION

DVA-imaging enhances angiographic image quality compared to DSA-imaging in F/B-EVAR setting. The observed quality reserve of DVA provides opportunities to reduce both radiation-dose and the amount of contrast agent. A prospective study based on these results could confirm the achievable amount of dose reduction without significant image quality loss.

## **CLINICAL RELEVANCE/APPLICATION**

Digital Variance Angiography (DVA) is a novel medical image processing method that significantly improves the image quality of Xray angiograms compared to Digital Subtraction Angiography The quality reserve of DVA may allow a substantial amount of radiation dose reduction in the F/B-EVAR setting without affecting the quality and diagnostic value of angiograms. Further prospective research is necessary to determine the precise refinement of dose protocols.





# SSJ26

# Vascular/Interventional (Biliary and Portal Hypertension)

Tuesday, Dec. 3 3:00PM - 4:00PM Room: E350



AMA PRA Category 1 Credit ™: 1.00 ARRT Category A+ Credit: 1.00

# Participants

Mona B. Ranade, MD, Brookfield, WI (*Moderator*) Nothing to Disclose Seetharam C. Chadalavada, MD,MS, Cincinnati, OH (*Moderator*) Nothing to Disclose

## Sub-Events

# SSJ26-01 Clinical Effectiveness of Percutaneous Endoscopic Holmium Laser Lithotripsy for Symptomatic Intra/Extrahepatic Biliary Stones

Tuesday, Dec. 3 3:00PM - 3:10PM Room: E350

Participants

Riccardo Muglia, MD, Pieve Emanuele , Italy (*Presenter*) Nothing to Disclose Dario Poretti, MD, Rozzano, Italy (*Abstract Co-Author*) Nothing to Disclose Ezio Lanza, MD, Rozzano, Italy (*Abstract Co-Author*) Nothing to Disclose Francesca Colapietro, Pieve Emanuele , Italy (*Abstract Co-Author*) Nothing to Disclose Felice D'Antuono, MD, Rocchetta Sant'Antonio, Italy (*Abstract Co-Author*) Nothing to Disclose Vittorio Pedicini, Napoli, Italy (*Abstract Co-Author*) Nothing to Disclose

# PURPOSE

To retrospectively assess the efficacy, safety and follow-up of percutaneous endoscopic holmium laser lithotripsy for symptomatic intra/extrahepatic biliary stones.

# METHOD AND MATERIALS

We retrospectively evaluated 28 patients (M:F=19:9, median age=68.5 years) with intrahepatic and/or extrahepatic biliary stones, undergoing 43 percutaneous, transhepatic lithotripsies with holmium laser from 2012 to 2018 in a single center.Data collected were: patient characteristics; location and amount of stones; post-procedural symptoms and complications; length of hospital stay; clinical success rate.Endoscopic retrograde cholangiopancreatography was precluded due to bilio-enteric anastomosis in 12/28 (43%) patients, distal gastrectomy in 5/12 (18%), and for prior biliary interventions followed by a fistula, ultimately leading to biliary stenosis in 11/28 (39%).

# RESULTS

Twenty patients (71%) received one only lithotripsy, three (11%) underwent two procedures, five (18%) had 3 or more lithotripsies. Multiple interventions were scheduled due to the elevated amount of stones to treat (13/15, 87%) or for new symptomatic biliary stones (2/15, 13%) during follow-up. Stones were localized in intrahepatic ducts (21/43, 49%), extrahepatic ducts (15/43, 33%) or both in intra- and extrahepatic ducts (8/43, 18%). Treatments lasted averagely 115 minutes; we fragmented 1 to 3 stones in 12 treatments (28%) and more than 3 stones in 31 (72%). After lithotripsy, 15 patients (53%) had sepsis with positive hemoculture treated with antibiotics, 2 (7%) had mild intrahepatic bleeding, treated conservatively. Only 1/15 septic patient was admitted in the intensive care unit and discharged after 26 days. Median hospital stay was 5.5 days (range 2-42). Our cohort was followed up for a median time of 17.5 months (0-66) from the first treatment. Twenty-two patients (79%) reached clinical success after lithotripsy, while six (21%) experienced further cholangitis and were readmitted for antibiotic therapy (3/6) or ERCP (3/6).

# CONCLUSION

Percutaneous endoscopic holmium laser lithotripsy is effective in treating symptomatic intrahepatic and extrahepatic biliary stones, though burdened by a high incidence of postoperative sepsis.

# **CLINICAL RELEVANCE/APPLICATION**

Percutaneous endoscopic holmium laser lithotripsy could be considered an option for first-line treatment of symptomatic intrahepatic and extrahepatic biliary stones, when ERCP is precluded.

# SSJ26-02 Comparison of Percutaneous Endobiliary Radiofrequency Ablation with Stent Placement versus Stent Placement Alone for Treating Malignant Biliary Obstruction: Is There an Added Benefit?

Tuesday, Dec. 3 3:10PM - 3:20PM Room: E350

Participants Wei Cui, Guangzhou, China (*Presenter*) Nothing to Disclose Jiaping Li, Guangzhou , China (*Abstract Co-Author*) Nothing to Disclose Xiaoming Chen, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

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### PURPOSE

To retrospectively compare the outcomes of endobiliary radiofrequency ablation and stent placement (RFA-Stent) with stent placement alone (Stent) in treating unresectable malignant biliary obstruction (MBO).

## **METHOD AND MATERIALS**

The study was approved by the institutional review board, and the requirement to obtain informed consent was waived. Seventy patients (mean age, 61.4 years; 45 men [64.3%]) who underwent RFA-Stent and 63 (mean age, 65.6 years; 34 men [54.0%]) who underwent Stent for unresectable MBO from June 2013 to June 2018 were included. Overall survival (OS), primary and secondary stent patency (PSP, SSP), complications were compared according to level of biliary obstruction (subgroup): Type A (distal, Bismuth Types I and II biliary obstruction) and Type B (Bismuth Types III and IV biliary obstruction). Survival curves were calculated by performing the Kaplan-Meier method and compared by using the log-rank test and Cox regression models.

## RESULTS

PSP and SSP were significantly longer for the RFA-Stent group than the stent group (PSP: 8.5 months vs. 4.5 months, P < 0.001; SSP: 9.0 months vs. 5.1 months, P < 0.001), but with OS being comparable (6.0 months vs. 4.5 months, P = 0.160). In subgroup analysis, RFA-Stent showed significant OS (8.0 months vs. 5.0 months; P = 0.026) benefits compared to Stent in patients with Type A MBO, but with comparable outcomes in patients with Type B MBO (5.0 months vs. 3.2 months; P = 0.962). The PSP and SSP was improved in both subgroups (Type A, PSP: 8.5 months vs. 4.5 months; P = 0.002; SSP: 9.0 months vs. 5.0 months, P < 0.001; Type B, PSP: 8.0 months vs. 6.0 months, P = 0.045; SSP: 12.0 months vs. 6.0 months, P = 0.005, respectively). The rate of complication was comparable for the RFA-stent group when compared to the stent group (all P > 0.05). In Cox analysis, RFA-Stent modality, performance status score 0, A type of biliary obstruction, total bilirubin<=166.8µmol/L and total bilirubin decrease value after stent placement procedure greater than 21.5µmol/L were favorable prognostic factors for OS. RFA-Stent modality, total bilirubin<= 166.8µmol/L were favorable prognostic factors for PSP. RFA-Stent modality, age older than 65 years, total bilirubin <= 166.8µmol/L were favorable prognostic factors for PSP (all P < 0.05).

## CONCLUSION

In this retrospective study, RFA-Stent was associated with improved stent patency in patients with MBO. In addition, RFA-Stent may be associated with improved survival in patients with Type A MBO.

# **CLINICAL RELEVANCE/APPLICATION**

RFA-Stent was associated with improved stent patency in patients with MBO. In addition, RFA-Stent may be associated with improved survival in patients with Type A MBO.

# SSJ26-03 Effect of Intra-Gastric Satiety-Inducing Device on Food Intake, Body Weight Gain, and Satiety-Related Hormones in Rat Model

Tuesday, Dec. 3 3:20PM - 3:30PM Room: E350

Participants

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# PURPOSE

To evaluate the effect of an intra-gastric satiety-inducing device (ISD) on food intake, body weight gain, and satiety-related hormones in a rat model.

# METHOD AND MATERIALS

The institutional animal care and use committee approved this study. Thirty-two male Sprague Dawley rats weighing 250-300g were randomly divided into four groups of eight each. The ISD (constructed in-house) used was comprised of a 4-mm-diameter 1.5-cm-length straight nitinol stent for the lower esophagus, and one (single-disk) or two (double-disk) 2.5-diameter flat star-shaped nitinol disks for the fundus of stomach. Single-disk and double-disk group rats underwent peroral placement of a single- and double-disk ISD, respectively, and control group rats underwent peroral placement of an ISD with no disk. To prevent migration, the stent part of the ISD was surgically fixed to the esophageal wall using sutures. All operations were performed under direct visualization *via* a laparotomy with fluoroscopy assistance. Sham group rats underwent sham operation. All rats were supplied with food and water ad libitum and were euthanized 4 weeks after the operation.

## RESULTS

Technical success was achieved in all rats. One rat in double-disk group died 2 weeks after the operation due to gastric perforation. The remaining rats survived until the end of the study without any complications. The mean food intake over the 4 weeks after the operation was significantly different between the four groups (all P < .05). Specifically, the mean food intake was significantly lower in both ISD groups than it was in the control and sham groups (all P < .05) but was not significantly different between the four groups (all P < .05) but was not significantly different between the single- and double-disk ISD groups (P > .05) and the control and sham groups (P > .05). The mean body weight gain 4 weeks after the operation was significantly different between the four groups (P < .05). Specifically, the mean body weight gain was significantly lower in the double-disk ISD group than it was in the single-disk ISD, control, and sham groups (all P < .05), and was significantly lower in the single-disk ISD group than it was in the sham group (P < .05), but was not significantly different between the single-disk ISD group than it was in the sham group (P < .05), but was not significantly different between the single-disk ISD group than it was in the sham group (P < .05), but was not significantly different between the single-disk ISD and control groups (P > .05). The mean fasting serum ghrelin and leptin levels 2 and 4 weeks after the operation were not significantly different between the four groups (P > .05).

ISD could reduce food intake and body weight gain but does not affect satiety-related hormones in a rat model.

# **CLINICAL RELEVANCE/APPLICATION**

ISD might be an effective treatment for obesity which can overcome existing problems. (This is a proof-of-concept animal study.)

# SSJ26-04 Non-Invasive Assessment of Portal Hypertension in HBV-Related Liver Cirrhosis with Spectral CT Iodine Density: A Correlation Study with HVPG

Tuesday, Dec. 3 3:30PM - 3:40PM Room: E350

Participants

Jian Dong, PhD, Beijing, China (*Presenter*) Nothing to Disclose Weimin An, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose Jinghui Dong, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Changchun Liu, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

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## PURPOSE

To investigate the feasibility of spectral CT iodine density in evaluation of portal hypertension by correlation with hepatic venous pressure gradient (HVPG) in patients with liver cirrhosis.

# METHOD AND MATERIALS

Thirty-one patients (F/M,13/18, mean age 44.2  $\pm$  7.8 years old) with liver cirrhosis were recruited in this study, and they were all performed three phases contrast enhanced spectral CT within 1 week before TIPS, with HVPG recorded during the interventional surgery. All CT raw data were reconstructed at 1.25 mm slice thickness, and liver and spleen volume were measured in venous phase images. Iodine density (in milligrams per milliliter) were measured on iodine-based material decomposition images. Multiple regions of interest (ROIs) in liver parenchyma, aorta and portal vein were selected from three slices of images with portal vein trunk as the central one, and mean liver parenchymal iodine density from arterial phase, venous phase and delayed phase were recorded. Quantitative indices of iodine density (ID) of liver (IDLAP) and spleen (IDSAP) parenchyma for arterial phase, venous phase (IDLVP) and (IDSVP), ID of portal vein in venous phase (IDPVP) were measured and correlated with HVPG, with statistical significance as P<0.05.

# RESULTS

For Child-Pugh stage in 31 patients, 12 were grade A, 15 grade B, and 4 grade C. Correlation of quantitative indices with HVPG were as following: (1) no correlation was found between liver and spleen volume, IDLAP, IDSAP, IDSVP and IDLVP with HVPG; (2) IDPVP was found to be independently correlated with the HVPG (P<0.01); (3) With threshold set as 54.3, IDPVP demonstrates 69.5% sensitivity, 62.1% specificity, 72.6% positive predictive value and 64.7% negative predictive value in the diagnosis of clinically significant portal hypertension (HVPG >=12mmHg), respectively.

# CONCLUSION

Spectral CT Iodine density demonstrates feasibility in evaluation of clinically significant portal hypertension in liver cirrhosis as a noninvasive imaging modality.

# **CLINICAL RELEVANCE/APPLICATION**

It is possible to evaluate clinically significant portal hypertension with quantitative index of iodine density in spectral CT noninvasively.

# SSJ26-05 Intravascular Ultrasound (IVUS) Guided Transjugular Intrahepatic Portosystemic Shunts (iTIPS): One-Year Clinical Outcomes

Tuesday, Dec. 3 3:40PM - 3:50PM Room: E350

Participants

Philip A. Velez, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose Raja Ramaswamy, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose Olaguoke K. Akinwande, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose Seung Kwon Kim, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose Christopher D. Malone, MD, St. Louis, MO (*Presenter*) Nothing to Disclose

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## PURPOSE

Use of intravascular ultrasound (IVUS) to guide portal vein puncture for transjugular intrahepatic portosystemic shunts (iTIPS) has increased in recent years, showing improved procedural metrics such as procedure time, contrast, and radiation doses over conventional techniques. Here we aim to evaluate the one-year clinical outcomes of patients undergoing iTIPS placement at our institution.

# METHOD AND MATERIALS

All patients having undergone iTIPS placement between January 2016-March 2018 with 1-year clinical follow up were retrospectively analyzed. Medical records were reviewed for TIPS indication, clinical and demographic data, procedural details, clinical outcomes, and need for TIPS revisions. Clinical success was defined as requiring a decrease need or discontinuation of paracentesis/thoracentesis or absence of variceal bleeding for those respective primary indications. Technical success, 30-day complication rate, and need for TIPS revisions through one year post procedure were evaluated.

## RESULTS

A total of 43 patients underwent iTIPS for refractory ascites (58%), control or secondary prevention of variceal bleeding (38%), or other (4%) with median Na-MELD of 14 (range 7-25). Technical success rate was 98%, with only one procedure having been aborted due to unfavorable anatomy and presence of portal vein thrombus, and was successfully reattempted with IVUS 1 month later. Complications within 30 days were only seen in 2 patients (4.7%) consisting of acute respiratory failure and heart failure decompensation. There were no bleeding complications. The clinical success rate at one year was 88.4%. 13 patients (30%) underwent revision(s) within one year. However, of these revisions only 4 (9%) had clinical evidence of TIPS malfunction (3 with reaccumulated ascites burden and 1 with variceal rebleed).

# CONCLUSION

Use of IVUS for TIPS placement is highly technical successful with low 30-day complication rates and provides durable 1 year efficacy in controlling ascites and variceal bleeding. While the revision rate over 1 year was 30%, only a minority of these manifested with clinical signs of TIPS malfunction.

## **CLINICAL RELEVANCE/APPLICATION**

iTIPS not only provides improved procedural metrics as previously reported, but shows durable 1-year clinical success, acceptable revision rates, and low 30-day complications.

# ssj26-06 Creation of a Haptic 3D Printed Simulator for TIPS Training in Augmented and Virtual Reality

Tuesday, Dec. 3 3:50PM - 4:00PM Room: E350

Participants

Tyler A. Smith, MD, Salt Lake City, UT (*Presenter*) Nothing to Disclose Adriene Eastaway, MD, Sandy, UT (*Abstract Co-Author*) Nothing to Disclose Gabriel C. Fine, MD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose Abigail R. Cogman, DO, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose Michael D. Weintraub, MD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose Claire Kaufman, MD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose Keith B. Quencer, MD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose Brendan Crabb, BS, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose Edward P. Quigley III, MD,PhD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

TIPS creates artificial channel within the cirrhotic liver from inflow portal vein to outflow hepatic vein. TIPS morbidity and mortality is high due to patient risk factors and complex anatomy.

# **METHOD AND MATERIALS**

Our developments in 3D printing biomimetic haptic simulators coregisters patient specific anatomy to produce a realistic VR/AR environment. Patient CTA images (Siemens, Germany) are converted to 3D objects using Mimics (Materialis, Belgium). Individual models of liver, portal, hepatic, caval veins, arteries, and bones were used to create multicolor virtual models of operative field. Each model components are individually 3D printed. Osseous structures are printed using fused deposition modeling on Fusion 3D and Ultimaker 3 printers, using polylactic acid (PLA). Hollow vessels were made in Formlabs elastic resin and connected to 3D printed manifolds and pumps. Liver is molded into 3D printed reusable liver mold. VR model, patient CT abdomen images are coregistered and overlaid upon haptic simulator using the Novarad Opensight software (Novarad Corporation, South American Fork, UT) and Microsoft HoloLens augmented reality platform (Microsoft Corporation, Redmond, WA.

## RESULTS

Trainees in AR/VR/MR environment can see virtual model while doing TIPS on realistic 3D-printed haptic model. Prior to patient procedure, they can practice critical skills: TIPS creation, stent deployment, TIPS remodeling.

#### CONCLUSION

Virtual reality/augmented reality (VR/AR) is a critical training tool for patient-specific image-guided procedures such as TIPS. Training VR/AR simulation environments prior to performing TIPS enhances user confidence, decrease complications, procedural time, and radiation exposure. We demonstrate an ideal TIPS teaching model utilizing 3D printed haptic simulator, the Microsoft HoloLens, and the co-registered haptic/virtual simulator using the Novarad Opensight Software.

## **CLINICAL RELEVANCE/APPLICATION**

To create 3D printed patient specific transjugular intrahepatic portosystemic shunt (TIPS) simulators fused with virtual reality (VR) and augmented reality (AR) to improve trainee performance, decrease procedure time, radiation dose, and clinical morbidity and mortality.





# RC412

# Diseases of the Thoraco-abdominal Aorta

Tuesday, Dec. 3 4:30PM - 6:00PM Room: S404AB



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

## Participants

Phillip M. Young, MD, Rochester, MN (*Moderator*) Consultant, Arterys Inc Kate Hanneman, MD, FRCPC, Toronto, ON (*Moderator*) Medical Advisory Board, sanofi-aventis Group

# LEARNING OBJECTIVES

1) Discuss the epidemiology of aortic dissections. 2) Review multi-modality imaging findings in patients with acute and chronic dissections. 3) Describe protocols for imaging and techniques for accurately measuring aortic aneurysms. 4) Indicate key measurements and observations relevant to the clinician when interpreting aortic aneurysms. 5) Discuss important secondary findings that may indicate increased risk of aneurysm rupture or influence management decisions. 6) Understand the typical imaging features of large vessel vasculitis and its complications. 7) Discuss challenging cases with insights from pathologic correlation. 8) Understand the role of imaging in diagnosis and management of these disorders. 9) Identify the significance of early versus delayed endograft complications. 10) Describe types of endoleaks including fenestrated aortic grafts. 11) Present treatment of endoleaks and follow-up imaging.

# Sub-Events

# RC412A Imaging of Aortic Dissection

Participants

Kate Hanneman, MD, FRCPC, Toronto, ON (Presenter) Medical Advisory Board, sanofi-aventis Group

# LEARNING OBJECTIVES

1) Discuss the epidemiology of aortic dissections. 2) Review multi-modality imaging findings in patients with acute and chronic dissections.

# RC412B Imaging of Aortic Aneurysm

Participants

Iain D. Kirkpatrick, MD, Winnipeg, MB (Presenter) Speaker, Siemens AG

# For information about this presentation, contact:

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# LEARNING OBJECTIVES

1) Describe protocols for imaging and techniques for accurately measuring aortic aneurysms. 2) Indicate key measurements and observations relevant to the clinician when interpreting aortic aneurysms. 3) Discuss important secondary findings that may indicate increased risk of aneurysm rupture or influence management decisions, including the findings of impending aneurysm rupture.

#### ABSTRACT

Aortic aneurysms are a frequent finding on thoracoabdominal CT, and in an era of minimally invasive treatment it is increasingly important to be able to accurately image, measure and characterize them. This session will discuss how to optimize your scanning protocols for assessing aortic aneurysms as well as how to most accurately measure them. Key measurements and observations useful for clinicians will be reviewed. Signs of impending rupture or which suggest an infectious/inflammatory aneurysm will be discussed, as well as risk assessment for rupture.

# RC412C Imaging of Vasculitis

Participants Phillip M. Young, MD, Rochester, MN (*Presenter*) Consultant, Arterys Inc

# LEARNING OBJECTIVES

1) Understand the typical imaging features of large vessel vasculitis and its complications. 2) Discuss challenging cases with insights from pathologic correlation. 3) Understand the role of imaging in diagnosis and management of these disorders.

# RC412D Aortic Repair Complications: CT Imaging Findings You Need to Know

Participants Terri J. Vrtiska, MD, Rochester, MN (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

# LEARNING OBJECTIVES

- ,

1) Identify the significance of early versus delayed endograft complications. 2) Describe types of endoleaks including fenestrated aortic grafts. 3) Present treatment of endoleaks and follow-up imaging.





## MSCP41

Case-based Review of Pediatric Radiology (Interactive Session)

Wednesday, Dec. 4 8:30AM - 10:00AM Room: E450B



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

## Participants

Edward Y. Lee, MD, Boston, MA (Director) Nothing to Disclose

# LEARNING OBJECTIVES

1) Review clinical presentations of congenital and acquired pediatric disorders. 2) Discuss optimal imaging techniques for assessing various pediatric disorders. 3) Learn characteristic imaging findings of congenital and acquired pediatric disorders.

## Sub-Events

# MSCP41A Pediatric Brain Disorders

Participants Noor A. Al Khori, MD, Doha, Qatar (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

nalkhori@sidra.org

# LEARNING OBJECTIVES

1) Review imaging features of a few disorders. 2) Review relevant clinical features, pathophys, and associations. 3) Review the role of various imaging modalities in diagnosis and management.

# MSCP41B Pediatric Vascular Disorders

Participants

Jared R. Green, MD, Chicago, IL (Presenter) Nothing to Disclose

# ABSTRACT

During this interactive session, vascular anomalies cases will be presented allowing the learners to recognize the imaging findings and to understand the importance of performing US and MR for diagnosis. Key points will be discussed to avoid misdiagnosis.

# MSCP41C Pediatric Abdominal Disorders

Participants

Grace S. Phillips, MD, Seattle, WA (Presenter) Nothing to Disclose

# LEARNING OBJECTIVES

1) To describe the imaging appearance of various pediatric abdominal tumors and tumor-like conditions. 2) To discuss an appropriate imaging algorithm for pediatric abdominal masses. 3) To highlight specific imaging and patient characteristics that help to narrow the differential diagnosis.

# ABSTRACT

During this interactive session, pediatric abdominal disorder cases will be presented allowing the learners to recognize and describe the imaging features of various diagnostic entities. Key points will be discussed to avoid misdiagnosis.

# MSCP41D Pediatric Pelvic Disorders

Participants

Domen Plut, MD, Ljubljana, Slovenia (Presenter) Nothing to Disclose

## ABSTRACT

During this case-driven, interactive session, pediatric pelvic disorders will be presented allowing the participants to recognize and describe the imaging features of various diagnostic entities.





# RC512

# Vascular Series: MR Angiography-New Techniques and Their Application

Wednesday, Dec. 4 8:30AM - 12:00PM Room: S503AB



AMA PRA Category 1 Credits ™: 3.00 ARRT Category A+ Credits: 3.50

**FDA** Discussions may include off-label uses.

# Participants

Thomas K. Foo, PhD, Niskayuna, NY (Moderator) Employee, General Electric Company

Martin R. Prince, MD,PhD, New York, NY (*Moderator*) Patent agreement, General Electric Company; Patent agreement, Hitachi, Ltd; Patent agreement, Siemens AG; Patent agreement, Koninklijke Philips NV; Patent agreement, Nemoto Kyorindo Co, Ltd; Patent agreement, Bayer AG; Patent agreement, Lantheus Medical Imaging, Inc; Patent agreement, Bracco Group; Patent agreement, Mallinckrodt plc; Patent agreement, Guerbet SA; Patent agreement, Toshiba Corporation

Tim Leiner, MD, PhD, Utrecht, Netherlands (Moderator) Speakers Bureau, Koninklijke Philips NV Research Grant, Bayer AG

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# LEARNING OBJECTIVES

1) Understand the latest MR Angiography methods. 2) Identify optimal approaches to using MR Angiography techniques throughout the body. 3) Appraise the strengths and weaknesses of various MR approaches to vascular imaging.

# Sub-Events

# RC512-01 K-Space Options for Improving MRA

Wednesday, Dec. 4 8:30AM - 9:00AM Room: S503AB

Participants

Walter F. Block, PhD, Madison, WI (*Presenter*) Stockholder and Co-founder, TherVoyant; Research support, General Electric Company;

For information about this presentation, contact:

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# LEARNING OBJECTIVES

1) Understand basic strategies used in MR Angiography to subsample the MR raw data space (k-space) to improve the temporal and spatial performance parameters of MRA. 2) Learn how spatial resolution, temporal resolution, and SNR performance are linked. 3) Learn the difference between an acquisition method's temporal footprint and temporal frame rate.

# ABSTRACT

MR Angiography is hampered by MR's need to acquire data in an alternative domain (k-space) with a relative lack of sensors (receivers) relative to CT and US, where thousands of detectors can be active at once. To capture the human vascular system at the temporal and spatial resolution necessary to answer important diagnostic questions, clinical MRA pulse sequences sub-sample the k-space acquisition space in a myriad of ways that tradeoff performance in spatial resolution, temporal resolution, and SNR. The presentation will highlight the general classes of these methodologies, which usually acquire lower spatial frequency data more often than higher spatial frequencies (variable k-space density). Often these k-space acquisition strategies are paired with a reconstruction methodology that iteratively works to generate the mostly likely image reconstruction possible for the given subsampled k-space data. The presentation will discuss the assumptions that all these methodologies make and ways physicians can assess the effects these assumptions may make on clinical decision-making.

# RC512-02 Added Value of MRI-Based Vascular Calcification Visualization for the Assessment of Arterial Stenosis in Patients with Lower-Extremity Peripheral Artery Disease Undergoing Non-Contrast Quiescent Interval Slice-Selective (QISS) MRA

Wednesday, Dec. 4 9:00AM - 9:10AM Room: S503AB

Participants

Akos Varga-Szemes, MD, PhD, Charleston, SC (*Presenter*) Research Grant and Travel Support, Siemens AG Research Consultant, Elucid Bioimaging

Megha Penmetsa, Charleston, SC (Abstract Co-Author) Nothing to Disclose

Thomas M. Todoran, MD, Charleston, SC (*Abstract Co-Author*) Research Consultant, Medtronic plc; Research Consultant, General Electric Company

Pal Suranyi, MD, PhD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose Stephen R. Fuller, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose Andreas Fischer, MD, Charleston, SC (*Abstract Co-Author*) Nothing to Disclose Robert R. Edelman, MD, Evanston, IL (*Abstract Co-Author*) Research support, Siemens AG; Royalties, Siemens AG Ioannis Koktzoglou, PhD, Evanston, IL (*Abstract Co-Author*) Research support, Siemens AG U. Joseph Schoepf, MD, Charleston, SC (*Abstract Co-Author*) Research Grant, Astellas Group; Research Grant, Bayer AG; Research Grant, Bracco Group; Research Grant, Siemens AG; Research Grant, Heartflow, Inc; Research support, Bayer AG; Consultant, Elucid BioImaging Inc; Research Grant, Guerbet SA; Consultant, HeartFlow, Inc; Consultant, Bayer AG; Consultant, Siemens AG; ; ;

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#### PURPOSE

This study sought to investigate the added value of prototype proton density weighted, in-phase 3D stack-of-stars (PDIP-SOS) MRI-based calcification visualization on the diagnostic accuracy of detecting peripheral artery disease (PAD) using non-contrast quiescent interval slice-selective (QISS) MRA.

## METHOD AND MATERIALS

Twenty-six patients (70±8 years) with suspected PAD, referred for lower extremity CTA prior to digital subtraction angiography (DSA), were prospectively enrolled for a same-day 1.5T or 3T MRI. PDIP-SOS MRI and QISS MRA were acquired covering the iliofemoral run-off. Two readers rated image quality (4-point scale) and graded stenosis (>=50%) on QISS-MRA without and with the visualization of calcification. Sensitivity and specificity were calculated using DSA as reference. Intra-arterial calcium was quantified using ImageJ (NIH) and compared between MRI and non-contrast CT (NCCT) using paired t-test, Pearson's correlation and Bland-Altman analysis.

# RESULTS

Overall subjective image quality ratings were significantly higher for CTA compared to MRA (4.0[3.0-4.0] and 3.0[3.0-4.0]; p=0.0369) with good to excellent inter-reader agreement (all ICCs >0.746). The sensitivity and specificity of QISS MRA, QISS MRA with PDIP-SOS, and CTA for the detection of >=50% stenosis were 85.4%, 92.2%, 90.2% and 90.3%, 93.2%, 94.2%, respectively. Calcification was visualized by PDIP-SOS and NCCT in 123 (59.4%) and 126 (60.8%) vascular segments, respectively (p=0.2500). Quantification of calcification showed statistically significant differences between PDIP-SOS and NCCT (80.6±31.2mm3 vs 88.0±29.8mm3; p=0.0002) with high correlation (r=0.77, p<0.0001) and moderate mean of differences (-7.4mm3) between the techniques.

# CONCLUSION

PDIP-SOS MRI increases the accuracy of non-contrast QISS MRA in patients evaluated for PAD. This combined protocol may prove especially useful for the comprehensive assessment of vascular anatomy prior to interventional procedure planning.

# **CLINICAL RELEVANCE/APPLICATION**

The visualization and quantification of vascular calcification by MRI may prove especially useful for the comprehensive assessment of vascular anatomy prior to interventional procedure planning.

# RC512-03 Radial Self-Navigated Native MRA in Comparison to Conventional Navigator-Gated Contrast-Enhanced MRA of the Thoracic Aorta in an Aortic Patient Collective

Wednesday, Dec. 4 9:10AM - 9:20AM Room: S503AB

Participants

Martina Roxane Correa Londono, MD, Bern, Switzerland (*Presenter*) Nothing to Disclose Verena Obmann, MD, Cleveland Heights, OH (*Abstract Co-Author*) Nothing to Disclose Nino Trussardi, Bern, Switzerland (*Abstract Co-Author*) Nothing to Disclose Davide Piccini, Erlangen, Germany (*Abstract Co-Author*) Employee, Siemens AG Michael Ith, Bern, Switzerland (*Abstract Co-Author*) Nothing to Disclose Hendrik von Tengg-Kobligk, MD, Bern, Switzerland (*Abstract Co-Author*) Research Grant, W. L. Gore & Associates, Inc Bernd Jung, Freiburg, Germany (*Abstract Co-Author*) Nothing to Disclose

#### For information about this presentation, contact:

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#### PURPOSE

The non-enhanced balanced steady state with free precession MRA technique has been shown to provide high diagnostic image quality of thoracic aortic disease.

## METHOD AND MATERIALS

In this retrospective study, 92 patients were enrolled, 31 patients received a native MRA (mean age 63.9 years) and 61 patients a CE-MRA (mean age 63.1 years). Scan time was recorded and image quality with respect to vessel contrast, vessel sharpness and artifact level was assessed in three thoracic aortic segments: aortic root/ascending aorta, aortic arch and descending aorta. Imaging protocol: Native MRA based on an ECG-triggered self-navigated prototype 3D radial bSSFP sequence (TE=1.83 ms; TR=3.6 ms) was acquired with an inherent isotropic FOV of 250 mm and spatial resolution of 1.3 mm. A ECG-triggered first-pass CE-MRA (TE=1.33 ms; TR=3.4 ms) with navigator respiration control was acquired with a FOV of  $340 \times 255 \times 83$  mm and a spatial resolution of  $1.4 \times 1.3 \times 1.3$  mm with 0.1 ml/kg body weight gadobenate dimeglumine at a flow rate of 0.4 ml/s. To measure the inter-rater agreement the weighted Cohen's kappa coefficient ( $\kappa$ ) was calculated. To assess statistical differences between the two MRA sequences, first the Fisher's Exact test and than the Mann-Whitney-U test were applied.

# RESULTS

The overall diagnostic image quality of native MRA was superior at all areas analyzed, compared to the CE-MRA (p<0.001, p<0.001, p=0.005, respectively). A detailed analysis of how the presence of foreign materials like sternal cerclage or artificial heart valves deteriorates image quality for different MRA methods is of interest for future analysis. Scan time of the non CE-MRA was significantly reduced, mean 05:56 ±01:32 min vs. 08:51± 02:57 min in the CE-MRA (p<0.001).

### CONCLUSION

In conclusion diagnostic image quality of the entire thoracic aorta including the aortic root can be obtained without administration of contrast media offering a benefit in potential side effects of contrast media, especially in patients with impaired renal function or by avoiding deposition of Gd in the body in general. In addition this superior image quality is gained within a faster scan time, a valuable feature in daily radiological routine.

# CLINICAL RELEVANCE/APPLICATION

Superior diagnostic image quality of the entire thoracic aorta can be obtained without contrast media and within a faster scan time, a highly valuable feature in daily routine.

# RC512-04 Reproducibility of High-Resolution DANTE-Prepared 3D FLASH MRI in Serial Studies of Atherosclerotic Femoral Arteries

Wednesday, Dec. 4 9:20AM - 9:30AM Room: S503AB

Participants

Yuting Wang, Chengdu, China (*Presenter*) Nothing to Disclose Xinke Liu, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Henrik Haraldsson, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose Chengcheng Zhu, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose Megan Ballweber, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose Warren J. Gasper, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose David A. Saloner, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

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# PURPOSE

To evaluate the reproducibility of high-resolution MR imaging of atherosclerotic femoral arteries in serial follow-up scans, and calculate the sample size needed for future longitudinal studies.

# METHOD AND MATERIALS

Ten patients with known femoral artery atherosclerosis were imaged with a 3D isotropic FLASH sequence with DANTE-prepared black blood contrast. Studies were acquired at baseline, within 1 week and 1 month. Five of these patients were also scanned at 6 months. Using internal fiducials strict registration of arterial segment levels was obtained. Total vessel area, lumen area, wall area and wall volume were measured to assess atheroma in the wall. Measurements were compared among the scans repeated at different timepoints. Agreement was measured by the intraclass correlation coefficient (ICC). Measurement error was quantified by pairwise slice-based/ patient-based coefficient of variance (CV) as defined by pooled variance/mean. Sample sizes needed to detect 5% and 10% changes in vessel area/volume were calculated using 80% power and 5% significance level.

#### RESULTS

The measurement of vessel area, lumen area, wall area and wall volume showed excellent agreement among repeated scans, with ICCs ranging from 0.97 to 0.99 for 3 scans, and 0.96 to 0.99 for 4 scans. Relatively small interscan measurement errors were observed. The slice-based CVs for the vessel area, lumen area and wall area were 5.0%, 6.8%, 8.4%, and the patient-based CV for volume measurement was 5.9% among 3 scans. Similar results were observed for patients who had 4 scans, with above-mentioned CVs of 5.5%, 6.6%, 9.4% and 7.2% respectively. These results indicate to compare treatment efficacy for two strategies for treatment of femoral artery atherosclerosis, it would be necessary to recruit 89 subjects if differences in wall area/volume changes were 5%, and 22 subjects if the differences were 10%.

# CONCLUSION

High resolution DANTE-FLASH MRI is useful for quantifying atherosclerotic vessel area and volume of femoral arteries with low variability among serial repeated scans. Volume measurement tends to be more reproducible than vessel wall area measurements.

# CLINICAL RELEVANCE/APPLICATION

High resolution DANTE-FLASH MRI is useful for quantifying atherosclerotic vessel area and volume of femoral arteries, and measuring the corresponding changes due to therapeutic effects.

# RC512-05 4D Flow MRA

Wednesday, Dec. 4 9:30AM - 10:00AM Room: S503AB

# Participants

Shreyas S. Vasanawala, MD, PhD, Palo Alto, CA (*Presenter*) Research collaboration, General Electric Company; Consultant, Arterys Inc; Consultant, Inkspace; Research Grant, Bayer AG;

# LEARNING OBJECTIVES

1) To know components required to implement clinically 4D flow. 2) To know types of clinically relevant data that can be extracted from 4D flow. 3) Become familiar with applications of 4D flow for MRA.

#### ABSTRACT

4D flow is a time resolved volumetric phase contrast MRI technique. This presentation will cover essential components required to implement 4D flow in a clinical setting, review types of clinically relevant data that can be extracted from 4D flow, and present several approaches to integrating 4D flow into clinical MRI protocols. Essential components include a pulse sequence and postprocessing software. Data that can be extracted includes blood flow, cardiovascular function, and anatomy. Protocols can be greatly simplified with 4D flow, enabling a decoupling of image acquisition and interpretation, thereby enhancing efficiency of patient, technologist, and radiologist time. Representative thoracic and abdominal applications will be presented.

## RC512-06 Non-Contrast MRA

Wednesday, Dec. 4 10:30AM - 11:00AM Room: S503AB

Participants

Robert R. Edelman, MD, Evanston, IL (Presenter) Research support, Siemens AG; Royalties, Siemens AG

# For information about this presentation, contact:

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## LEARNING OBJECTIVES

1) Explore rationale for non-contrast MR angiography. 2) Discuss techniques for optimized non-contrast MR-based vascular imaging in clinical practice, including advantages and limitations. 3) Review current evidence for clinical utility in comparison to contrast-enhanced MRA and CT angiography.

# ABSTRACT

Non-contrast MRA techniques offer a viable alternative to CTA and contrast-enhanced MRA (CEMRA) for cross-sectional vascular imaging without the risks or costs associated with contrast agent administration. They can evaluate the renal and peripheral arteries with image quality and accuracy that is competitive with CTA. Recently developed non-contrast neurovascular imaging techniques can substantially outperform legacy 2D and 3D time-of-flight MRA, providing image quality that approaches that of CEMRA. In addition to the use of non-contrast MRA for depiction of the vascular lumen, high-resolution non-Cartesian 3D MRI can now show vessel wall calcifications comparably to CT. This information (hitherto unavailable using MRI) can be critical to the planning of interventional vascular procedures. The anatomic information provided by non-contrast MRA can also be efficiently complemented with hemodynamic information that is not available from CTA using phase contrast and ASL-based approaches.

# RC512-07 Free-Breathing Fast Low-Angle Shot Quiescent-Interval Slice-Selective MR Angiography for Improved Detection of Vascular Stenoses in the Pelvis and Abdomen

Wednesday, Dec. 4 11:00AM - 11:10AM Room: S503AB

Participants

Akos Varga-Szemes, MD, PhD, Charleston, SC (*Presenter*) Research Grant and Travel Support, Siemens AG Research Consultant, Elucid Bioimaging

Emily A. Aherne, MBBCh, FFR(RCSI), New York, NY (Abstract Co-Author) Nothing to Disclose

U. Joseph Schoepf, MD, Charleston, SC (*Abstract Co-Author*) Research Grant, Astellas Group; Research Grant, Bayer AG; Research Grant, Bracco Group; Research Grant, Siemens AG; Research Grant, Heartflow, Inc; Research support, Bayer AG; Consultant, Elucid BioImaging Inc; Research Grant, Guerbet SA; Consultant, HeartFlow, Inc; Consultant, Bayer AG; Consultant, Siemens AG; ; ; Thomas M. Todoran, MD, Charleston, SC (*Abstract Co-Author*) Research Consultant, Medtronic plc; Research Consultant, General Electric Company

Ioannis Koktzoglou, PhD, Evanston, IL (Abstract Co-Author) Research support, Siemens AG

Robert R. Edelman, MD, Evanston, IL (Abstract Co-Author) Research support, Siemens AG; Royalties, Siemens AG

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redelman999@gmail.com

## PURPOSE

Balanced steady-state free precession (bSSFP)-based quiescent-interval slice-selective (QISS) magnetic resonance angiography (MRA) is accurate for the non-contrast evaluation of peripheral artery disease (PAD); however, drawbacks include the need for breath-holding and sensitivity to off-resonance artifacts. The purpose of this study was to evaluate the image quality and diagnostic accuracy in the pelvis and abdomen of free-breathing fast low-angle shot (FLASH)-based QISS techniques in comparison to standard QISS in patients with PAD, using computed tomographic angiography (CTA) as the reference.

## **METHOD AND MATERIALS**

Twenty-seven patients (69±10 years, 17 men) with PAD were enrolled in this IRB approved, HIPAA compliant prospective study between April and December 2018. Patients underwent non-contrast MRA using standard bSSFP-based QISS and prototype free-breathing radial-FLASH and Cartesian-FLASH-based QISS at 3T. A subset of patients (n=22) also underwent CTA as the reference standard. Nine arterial segments per patient were evaluated spanning the abdomen, pelvis, and upper thigh regions. Objective (signal intensity ratio (SIR) and relative standard deviation (SD)) and subjective image quality (4-point scale) and stenosis (>50%) were evaluated by two readers and compared using one-way analysis of variance, Wilcoxon and McNemar tests, respectively.

#### RESULTS

A total of 179 vascular segments were available for analysis by all QISS techniques. No significant difference was observed among bSSFP, radial-FLASH, and Cartesian-FLASH-based techniques in SIR (p=0.428) and relative SD (p=0.220). Radial-FLASH-based QISS demonstrated the best image quality (p<0.0001) and the highest inter-reader agreement ( $\kappa=0.721$ ). The sensitivity values of bSSFP, radial-FLASH, and Cartesian-FLASH-based QISS for the detection of >50% stenosis were 76.0%, 84.0%, and 80.0%, respectively, while specificity values were 97.6%, 94.0%, and 92.8%, respectively. Moreover, FLASH-based QISS consistently reduced off-resonance artifacts compared to the bSSFP-based approach.

#### CONCLUSION

Free-breathing FLASH-based QISS MRA techniques provide improved image quality and sensitivity, high specificity, and reduced offresonance artifacts for vascular stenosis detection in the abdomen and pelvis.

# **CLINICAL RELEVANCE/APPLICATION**

FLASH-based QISS MRA provides improved image quality, accuracy and reduced off-resonance artifacts, thereby enhancing the utility of QISS for the non-contrast evaluation of PAD.

# RC512-08 Advanced Fresh Blood Imaging (FBI) Using Centric ky-kz Trajectory with a New Exponential

# **Refocusing Flop Angle**

Wednesday, Dec. 4 11:10AM - 11:20AM Room: S503AB

Participants

Mitsue Miyazaki, PhD, La Jolla, CA (*Presenter*) Employee, Canon Medical Systems Corporation Masaaki Umeda, Otawara, Japan (*Abstract Co-Author*) Employee, Canon Medical Systems Corporation Yoshimori Kassai, MS, Otawara, Japan (*Abstract Co-Author*) Employee, Canon Medical Systems Corporation Lijun Zhang, Beijing, China (*Abstract Co-Author*) Employee, Canon Medical Systems Corporation Cheng Ouyang, La Jolla, CA (*Abstract Co-Author*) Nothing to Disclose Sheronda Statum, La Jolla, CA (*Abstract Co-Author*) Nothing to Disclose Won C. Bae, PhD, La Jolla, CA (*Abstract Co-Author*) Nothing to Disclose Katsumi Nakamura, MD, Kitakyushu, Japan (*Abstract Co-Author*) Nothing to Disclose Christine B. Chung, MD, Solana Beach, CA (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

To advance fresh blood imaging (FBI) in peripheral non-contrast MR angiography (NC-MRA) using a new centric ky-kz trajectory with an exponential flop angle to reduce specific absorption rate (SAR) and tremendous reduction in scan time.

# METHOD AND MATERIALS

FBI utilizes a physiological signal difference between systolic and diastolic triggered images. The centric ky-kz trajectory is implemented in FBI (cFBI), acquiring multiple slice-encodings (SEs) and phase-encodings (PEs) per TR; whereas, standard FBI acquires one SE per TR. By applying exponential flop angle (eFA), cFBI enables reduction of SAR. The design of eFA has high flop angles (Hflop) at the center of k space (about 36 lines or more) for bright blood imaging and exponentially decreasing flop angles at periphery of k space to reduce SAR. Having about 36-line Hflop of 180 deg is required to ensure depiction of bright blood; imaging of cFBI was performed maintaining Hflop and varying low flop angles (Lflop), Hflop/Lflop of 180/180, 180/90, 180/60, 180/30 and 180/1 deg. Parameters are: for all lower flop <180 (TR of 2RR intervals) and constant (180/180) flop (TR of 3RR intervals due to SAR), TEeff of 60 ms, 1NAQ, 320x320 matrix, 100 1.4-mm slices, FOV of 40x40 cm, parallel imaging of 3, and resolution of 0.63(PE)x0.63(RO)x 0.7(SE) mm after interpolation. All exteriments were performed using a 3T clinical system on healthy volunteers (5 males, 24-68 yo).

# RESULTS

The scan time of cFBI was reduced to about 1/2 to 1/3 (1:30-2:00 min) by acquiring multiple SEs and PEs data compared to standard FBI. The Hflop/Lflop of 180/180 deg. causes lengthen of TR due to high SAR and longer scan time. Regarding artifacts, standard FBI often causes N/2 artifacts in the PE direction that degrade image quality; whereas, cFBI minimizes N/2 artifacts. As shown in Fig. 1, image quality of all 5 images was evaluated all 'excellent' without any N/2 artifacts.

# CONCLUSION

Advanced cFBI with eFA enables high resolution quality NC-MRA images with fast acquisition without major artifacts like N/2 artifacts. Compared to standard FBI, cFBI reduces the scan time to 1/3 to 1/2, opening a possibility of scanning entire peripheral vasculature in 5 to 6 mins.

# CLINICAL RELEVANCE/APPLICATION

This study demonstrates tremendous scan time reduction in centric ky-kz FBI (cFBI) with eFA compared to standard FBI. This advanced cFBI enables obtaining quality NC-MRA images without N/2 artifacts seen in standard FBI.

# RC512-09 Low-Dose Contrast-Enhanced MR Angiography of the Lower Extremities at 3T with Dynamic 3 Station Imaging

Wednesday, Dec. 4 11:20AM - 11:30AM Room: S503AB

#### Participants

Guenther K. Schneider, MD, PhD, Homburg, Germany (*Abstract Co-Author*) Research Grant, Siemens AG; Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Research Grant, Bracco Group;

Tobias Woerner, MD, Homburg, Germany (Presenter) Nothing to Disclose

Arno Buecker, MD, Homburg, Germany (*Abstract Co-Author*) Consultant, Bracco Group Speaker, Bracco Group Consultant, Medtronic plc Speaker, Medtronic plc Research Grant, Novartis AG Research Grant, GlaxoSmithKline plc Research Grant, Biotest AG Research Grant, OncoGenex Pharmaceuticals, Inc Research Grant, Bristol-Myers Squibb Company Research Grant, Eli Lilly & Company Research Grant, Pfizer Inc Research Grant, F. Hoffmann-La Roche Ltd Research Grant, sanofi-aventis Group Research Grant, Merrimack Pharmaceuticals, Inc Research Grant, Sirtex Medical Ltd Research Grant, Concordia Healthcare Corp Research Grant, AbbVie Inc Research Grant, Takeda Pharmaceutical Company Limited Research Grant, Merck & Co, Inc Research Grant, Affimed NV Research Grant, Bayer AG Research Grant, Johnson & Johnson Research Grant, Seattle Genetics, Inc Research Grant, Onyx Pharmaceuticals, Inc Research Grant, Synta Pharmaceuticals Corp Research Grant, Siemens AG Research Grant, iSYMED GmbH Research Grant, Abbott Laboratories Co-founder, Aachen Resonance GmbH

Paul S. Raczeck, MD, Homburg, Germany (Abstract Co-Author) Nothing to Disclose

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# PURPOSE

In our study we evaluated the diagnostic performance of lower extremity MR Angiography in patients with suspected lower limb atherosclerotic disease using a three-station dynamic MRA approach.

#### **METHOD AND MATERIALS**

10 consecutive adult nations perceptating diagnostic imaging of the lower limb arteries for suspected athemscleratic disease

underwent MRA at 3 T. Imaging was performed by acquiring a three-station dynamic MRA using a TWIST-sequence. For each station a 3ml contrast medium bolus (Gd-HP-DO3A / Prohance) was injected (1.5ml/sec) each followed by a 20 ml saline flush. Images were retrospectively reviewed and evaluated with regard to image quality and visualization of arterial segments; severity of stenosis; and presence of venous contamination. 16 patients underwent subsequent DSA yielding 256 artery segments for correlation between MRI and DSA.

# RESULTS

Dynamic three station low dose CE-MRA at 3T allows for diagnostic, dynamic imaging in every vessel territory of the lower limb even in patients with advanced arteriosclerotic disease. Diagnostic performance based on the vessel segments both evaluated by CE MRA and DSA for > 50 % stenosis demonstrated a sensitivity of 93.55% [84.3 -98.2% (95%-CI)] and specifity of 98.51% [95.7-99.8%(95%-CI)] for CE-MRA; For vessel occlusion sensitivity was 93.1% [77.23 -99.15 % (95%-CI] and specifity of 99.13% [96.91 - 99.89%](95%-CI)]. No studies were rated non-diagnostic due to venous overlay, since always an optimal 3D-dataset from dynamic imaging could be chosen.

# CONCLUSION

With a total of only 9 ml ProHance (corresponding to 0.05 mmol/kg BW in a 90 kg patient resp. 0.06 mmol/kg in a 75 kg patient) three station dynamic CE MRA of the lower extremity is possible.Advantages of this approach include the possibility to look at the optimal time of arterial enhancement of each leg separately and the possibility of avoiding venous contamination of images. Time for each dataset typically is approximately 5 sec. to allow for a high enough spatial resolution, nevertheless this temporal resolution is enough to achieve a solely arterial image.

# **CLINICAL RELEVANCE/APPLICATION**

Regarding the discussion on safety of Gd-based contrast agents the lowest possible dose should be used in any indication for CE MRI. Our study shows the feasibility of low dose CE MRA with a macrocyclic contrast agent only using a total of 9 ml of a 0.5 M contrast agent for the evaluation of the complete run-off vessels.

# RC512-10 Phase Contrast MRA: Technology Advances and Impact of High Performance Gradients

Wednesday, Dec. 4 11:30AM - 12:00PM Room: S503AB

Participants

Thomas K. Foo, PhD, Niskayuna, NY (Presenter) Employee, General Electric Company

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## LEARNING OBJECTIVES

1) To know the impact on gradient performance on phase-contrast velocity imaging 2) To know how phase-velocity noise, vascular signal-to-noise ratio, and sequence echo time (TE) impacts the measurement of flow volume 3) To know how high-performance gradients with 3-4x the maximum gradient amplitude and 2.5-4.0x the maximum slew rate impacts phase-contrast MRA and 4D Flow.

# ABSTRACT

With increasing capability in gradient amplitude to 80 mT/m, the echo time (TE) can be reduced. However, in whole-body systems, there is still a limitation of peripheral nerve stimulation as to how fast the gradient amplitudes can be switched. With the development of new high-performance head-only gradient systems, maximum gradient amplitudes of 3-4x and maximum slew rates of 2.5-4.0x can be achieved. This benefits phase-contrast MRA, especially for low-velocity encoding values (VENC) for slow flow, as in the CSF.







# SSK04

# Science Session with Keynote: Cardiac (Great Vessels)

Wednesday, Dec. 4 10:30AM - 12:00PM Room: E352



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

## Participants

Daniel Ocazionez-Trujillo, MD, Houston, TX (*Moderator*) Nothing to Disclose Tina D. Tailor, MD, Durham, NC (*Moderator*) Nothing to Disclose

## Sub-Events

# SSK04-01 Cardiac Keynote Speaker: Imaging of Aortitis

Wednesday, Dec. 4 10:30AM - 10:50AM Room: E352

Participants

Daniel Ocazionez-Trujillo, MD, Houston, TX (Presenter) Nothing to Disclose

# SSK04-03 Ascending Aortic Diameter, Pulmonary Artery to Ascending Aorta Ratio, and Cardiovascular Death in the National Lung Screening Trial (NLST)

Wednesday, Dec. 4 10:50AM - 11:00AM Room: E352

# Participants

Yasuka Kikuchi, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose John Sukumar Aluru, MBBS,MS, Quincy, MA (*Presenter*) Nothing to Disclose Sarah Mercaldo, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Jana Taron, MD, Tuebigen, Germany (*Abstract Co-Author*) Nothing to Disclose Borek Foldyna, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Udo Hoffmann, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Udo Hoffmann, MD, Boston, MA (*Abstract Co-Author*) Research Grant, Kowa Company, Ltd ; Research Grant, Abbott Laboratories; Research Grant, HeartFlow, Inc; Research Grant, AstraZeneca PLC; Michael T. Lu, MD, Boston, MA (*Abstract Co-Author*) Grant, NVIDIA Corporation; Institutional Research Grant, Kowa Company, Ltd ; Institutional Research Grant, AstraZeneca PLC

## PURPOSE

Older heavy smokers undergoing lung cancer screening CT are at high risk of cardiovascular (CV) death. Ascending aortic (Ao) diameter and a pulmonary artery to Ao diameter (PA/Ao) ratio >=1 have been associated with death in non-lung screening populations. We sought to determine normal ranges for Ao diameter and PA/Ao ratio and their association with CV death in heavy smokers from the National Lung Screening Trial (NLST).

# METHOD AND MATERIALS

In 994 randomly selected NLST participants having non-contrast non-ECG gated low-dose lung screening CT, Ao and PA diameters were measured at the level of the PA bifurcation. Uni- and multivariable Cox regression models were used to estimate hazard ratios (HR) for Ao diameter and PA/Ao ratio >=1 for CV death. Multivariable models were adjusted for age, sex, smoking status, and body surface area. Inter-observer reproducibility for Ao diameter and PA/Ao ratio were assessed in 30 participants by 2 independent observers.

## RESULTS

In 994 participants (age  $61.5\pm5.2$  yr; 43% female), 2% (20/994) suffered CV death over median follow up of 6.7 years. Mean Ao diameter was  $34.0\pm3.7$  mm. Ao diameter was significantly associated with CV death (CV death;  $36.6\pm4.3$  mm vs. no CV death;  $34.0\pm3.7$  mm, p=0.007), with an unadjusted HR of 2.5 per 5 mm increase (95% CI: 1.6-3.7, p<0.001). Ao diameter remained an independent predictor of CV death after adjustment (adjusted HR; 2.5 per 5mm increase, 95% CI: 1.2-3.7, p=0.009). The mean PA/Ao ratio was  $0.8\pm0.1$ . In unadjusted analysis, there was borderline significant association between PA/Ao ratio >=1 with CV death (10% (2/20) vs. 2% (24/972), p=0.037 and unadjusted HR 4.3 (0.99-18, p=0.052). After adjustment, there was insufficient evidence to suggest a PA/Ao ratio >=1 is associated with CV death (HR 1.3, 0.18-10.3, p=0.78). Inter-observer reproducibility for Ao diameter and PA/Ao ratio was good (ICC: 0.95 and 0.91).

# CONCLUSION

Greater Ao diameter, but not greater PA/Ao ratio, was associated with CV death after adjusting for risk factors.

# **CLINICAL RELEVANCE/APPLICATION**

Larger ascending aortic diameter is a risk factor for cardiovascular death in persons having lung screening CT.

# SSK04-04 Assessment of Disease Activity in Takayasu Arteritis: A Quantitative Study with Computed Tomography Angiography

Participants Baojin Chen, MD, Jinan, China (*Presenter*) Nothing to Disclose Ximing Wang, MD, Jinan, China (*Abstract Co-Author*) Nothing to Disclose Shuo Zhao, Jinan, China (*Abstract Co-Author*) Nothing to Disclose

# PURPOSE

Identifying disease activity in Takayasu arteritis (TAK) is challenging. The aim of this study was to investigate the value of quantitative characterization with computed tomography angiography in the assessment of disease activity in patients with TAK.

## **METHOD AND MATERIALS**

We retrospectively analyzed the data on 162 aortic CT angiography from 140 TAK patients. Patients were categorized based on disease activity according to National Institutes of Health criteria into two groups: active disease group (n = 65) and inactive disease group (n = 97).

#### RESULTS

Patients with active TAK had a thicker wall compared with patients with inactive TAK ( $5.2 \pm 2.4 \text{ mm vs}$ .  $2.5 \pm 0.8 \text{ mm}$ , p < 0.001). The ratio of mural CT attenuation over that of the paravertebral muscle was higher in active TAK than in inactive TAK ( $1.5 \pm 0.3 \text{ vs}$ .  $1.1 \pm 0.2$ , p < 0.001). Given a thickness cutoff of 3.3 mm, sensitivity for active-phase TAK was 83.1%, specificity 89.7%, positive predictive value 84.4%, and negative predictive value 88.8%. With enhancement ratio cutoff of 1.2, sensitivity for active-phase TAK was 89.2%, specificity 76.3%, positive predictive value 71.6%, and negative predictive value 91.3%. In receiver-operating characteristic curves comparison, wall thickness and enhancement ratio were superior to C-reactive protein and erythrocyte sedimentation rate for determining active phase disease (p < 0.05).

# CONCLUSION

Quantitative characterization with CT angiography was a useful tool to assess disease activity in TAK patients. Arterial wall thickness and enhancement have a high sensitivity and specificity for detecting TAK activity.

# **CLINICAL RELEVANCE/APPLICATION**

Takayasu Arteritis (TAK) is a primary granulomatous large vessel vasculitis, affecting predominantly young women with substantial morbidity and mortality. Assessment of disease activity is crucial in the management of TAK. We analyzed the data on 162 aortic CT angiography from 140 TA patients. We described the quantitative utility of wall thickness and enhancement in the discrimination of active and inactive TAK and proposed a cutoff value for wall thickness and enhancement ratio. This will provide a quantitative reference, giving more valuable information to discriminate better active inflammation from quiescent disease, thereby aiding the decision to clinical management.

# SSK04-05 Comparison of a Novel Compressed Sense Accelerated 3D Non-Contrast Modified REACT MRA with Standard Contrast-Enhanced MRA in Patients with Connective Tissue Diseases or Other Aortic Pathologies

Wednesday, Dec. 4 11:10AM - 11:20AM Room: E352

Participants

Lenhard Pennig, MD, Cologne, Germany (*Presenter*) Nothing to Disclose Anton Wagner, MD, Cologne, Germany (*Abstract Co-Author*) Nothing to Disclose Kilian Weiss, PhD, Hamburg, Germany (*Abstract Co-Author*) Employee, Koninklijke Philips NV Simon Lennartz, MD, Cologne, Germany (*Abstract Co-Author*) Institutional Research Grant, Koninklijke Philips NV David C. Maintz, MD, Koln, Germany (*Abstract Co-Author*) Nothing to Disclose Tilman Hickethier, MD, Cologne, Germany (*Abstract Co-Author*) Nothing to Disclose Claas P. Naehle, MD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose Alexander C. Bunck, Koln, Germany (*Abstract Co-Author*) Nothing to Disclose Jonas Doerner, MD, Cologne, Germany (*Abstract Co-Author*) Nothing to Disclose

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# PURPOSE

Patients with connective tissue diseases (CTD) require repetitive vascular imaging such as magnetic resonance angiography (MRA). Potential effects of gadolinium retention are ambiguous. This study investigated the use of a novel Compressed SENSE (Philips Healthcare) accelerated (factor 10) ECG- and respiratory-triggered 3D modified Relaxation-Enhanced Angiography without Contrast and Triggering (REACT) (non-CE-MRA) in comparison to standard non-ECG-triggered 3D contrast-enhanced MRA (CE-MRA) for imaging of the thoracic aorta.

# METHOD AND MATERIALS

Retrospective analysis independently conducted by two radiologists in 30 patients with CTD (25 of 30 patients) or other aortic diseases on non-CE- and CE-MRA using a manual (Multiplanar-Reconstruction, MPR; Agfa HealthCare) and a semiautomatic (Advanced Vessel Analysis, AVA; Philips Healthcare) measurement tool on seven dedicated points (inner edge): Aortic annulus, aortic sinus, sinotubular junction, mid-ascending aorta, high-ascending aorta, aortic isthmus, descending aorta. Image quality was evaluated on a four-point scale and evaluation time for each measurement technique was noted (min).

#### RESULTS

There was a high agreement (r>0.9) and no significant interobserver difference between non-CE-MRA and CE-MRA using both tools with smaller differences for non-CE- than CE-MRA. However, descending aorta showed the highest difference without being clinically significant (mean 2.21% between non-CE- and CE-MRA using MPR). For non-CE-MRA, average acquisition time was 6:34 min. Non-CE-MRA showed significant better image quality from aortic annulus to mid-ascending aortae (p<0.05), at the distal points, no significant difference was noted (p>0.05). Regarding time requirement, no statistical significance was found between both measurement techniques (p=0.08).

## CONCLUSION

Compressed SENSE accelerated (factor 10) 3D modified REACT allows for fast and reliable imaging of the thoracic aorta using a manual and semiautomatic measurement approach with higher image quality in the aortic root and mid-ascending aorta than CE-MRA without contrast agent and its disadvantages. This is of particular relevance for patients requiring repetitive imaging.

# **CLINICAL RELEVANCE/APPLICATION**

Patients with connective tissue diseases require repetitive vascular imaging. Therefore, modified non-CE-MRA REACT may be an alternative since it lacks the disadvantages of contrast agent and shows high diagnostic accuracy.

# SSK04-06 Inter-Examination Reproducibility of Phase-Specific Systolic Aorta Segmentation: 4D Flow MRI in Healthy Volunteers

Wednesday, Dec. 4 11:20AM - 11:30AM Room: E352

Participants

Joe F. Juffermans, MSc, Leiden, Netherlands (*Presenter*) Nothing to Disclose Jos Westenberg, PhD, Leiden, Netherlands (*Abstract Co-Author*) Nothing to Disclose Pieter J. van Den Boogaard, Leiden, Netherlands (*Abstract Co-Author*) Nothing to Disclose Roel L. van der Palen, MSc, Leiden, Netherlands (*Abstract Co-Author*) Nothing to Disclose Arno A. Roest, Leiden, Netherlands (*Abstract Co-Author*) Nothing to Disclose Hildo J. Lamb, MD, PhD, Leiden, Netherlands (*Abstract Co-Author*) Nothing to Disclose

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## PURPOSE

Hemodynamic aorta parameters can be derived from 4D flow MRI and requires lumen segmentation. The aim of this study was to determine the inter-examination reproducibility of phase-specific aorta segmentation of 4D flow MRI in healthy volunteers.

## **METHOD AND MATERIALS**

Ten volunteers (26.5±2.6years) underwent 4D flow MRI at 3T MRI (Ingenia, Philips Healthcare) twice. The 4D flow acquisition parameters were: respiratory navigator-gated, retrospective ECG-gated, velocity encoding: 200cm/s, isotropic spatial resolution: 2.5mm, temporal resolution: 35.1-36.1ms and field of view: 350x250x75mm. Thoracic aorta was segmented at five systolic phases using CAAS MR 4D flow v1.1 (Pie Medical Imaging). By positioning six perpendicular planes on the segmentation's centerline the aorta was divided into five segments; proximal and distal ascending aorta, aortic arch, proximal and distal descending aorta (pAAo, dAAO, AoA, pDAo and dDAo respectively). To evaluate the inter-examination variability the image analysis was performed for both 4D flow examinations. Finally, the centerline length (CL) and mean diameter (MD) were determined for each segment using an inhouse developed tool. The paired T-test (TT), absolute mean difference (DIFF), coefficient of variation (COV) and interclass correlation coefficient (ICC) were calculated between both examinations.

#### RESULTS

The TT showed no significant (p<0.05) group difference between both examinations, except for AoA MD at the fifth phase (p=0.03). The inter-examination analysis showed for MD low DIFF (0.1-1.2mm), low COV (1.6-8.8%), with good-to-excellent ICC (0.78-0.99) over all phases, excluding pAAo which had moderate-to-good ICC (0.53-0.77). For CL low DIFF (0.0-1.6mm), intermediate-to-low COV (7.5-15.2%) with good-to-strong ICC (0.71-0.91) were found over all phases, excluding pAAo which had a poor ICC (0.36-0.48).

# CONCLUSION

In general, for MD and CL a good-to-excellent reproducibility was found for all segments and phases, except for pAAo. This observation can be explained by ease-of-use image analysis within the applied software, resulting in DIFF well below the spatial acquisition resolution. The reduced reproducibility of pAAo is most likely related to pronounced systolic stretching and lumen distension in the ascending aorta.

# **CLINICAL RELEVANCE/APPLICATION**

Good-to-excellent inter-examination reproducibility of phase-specific aorta segmentation based on 4D flow MRI was found in healthy volunteers.

# SSK04-07 A 3D Deep Convolutional Neural Network for Automatic Segmentation and Measurement of Type B Aortic Dissection

Wednesday, Dec. 4 11:30AM - 11:40AM Room: E352

Participants

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### PURPOSE

This study aimed to develop an automatic aorta segmentation and measurement method based on 3D convolutional neural network in aortic computed tomography angiography (CTA) of the patient with type B aortic dissection (TBAD).

# **METHOD AND MATERIALS**

149 patients with TBAD underwent CTA at initial presentation were consecutively included in this study. Areas and volumes of true and false lumen were measured at eight levels relevant to preoperative planning and postoperative evaluation with the centerline technique based on automatic centerline analysis and vessel straightening. The measurements of three blinded radiologists as the standard references. Deep learning based on 3D Unet combined intersection over union tracing algorithm was used for automatic lumen segmentation. Splitting the data into training set and test set (87% VS 13%) randomly. Data between the test set and standard reference were compared using Bland-Altman and paired Student t test. Reliability of measurement was determined using intra-class correlation analyses and the excellent agreement was defined as an ICC coefficient of > 0.8.

## RESULTS

The proposed model achieved a mean dice similarity score of 0.948, 0.941 and 0.963 for the true lumen, false lumen and entire aorta respectively. Measurement derived from the proposed model showed excellent agreement with the reference standard, with mean difference  $0.0620 \pm 0.6715$ , 95% limits of agreement -0.0119 to 0.1358. Correlation coefficient between deep learning and standard reference was 0.997 (P < 0.001), and ICC coefficient was 0.999. As for manual method, however, mean difference was 0.3881  $\pm$  2.0769 with statistical significance (P = 0.001), 95% limits of agreement 0.1596 to 0.6165. Correlation coefficient between manual method and standard reference was 0.975 (P < 0.001), and ICC coefficient was 0.987. Proposed deep learning method was more efficient (3.16 $\pm$ 0.47min) than radiologists (2 $\pm$ 0.4h) in generating the centerlines and measurement on each case (P<0.01).

# CONCLUSION

This study showed that our proposed model had good accuracy in automatic segmentation of the aorta and time saving. The accuracy and repeatability of the quantitative parameters measurement were better than manual measurement results.

# **CLINICAL RELEVANCE/APPLICATION**

With deep learning, the accurate, uniform and efficient measurement of aorta in CTA can be obtained, can benefit individualized preoperative planning and predict survival risk in the future.

# SSK04-08 Sexual Dimorphism in the Association between Coronary Plaque Burden and Ascending Aorta 4D Deformation

Wednesday, Dec. 4 11:40AM - 11:50AM Room: E352

Participants

Ahmed H. Hamimi, MD, Bethesda, MD (*Presenter*) Nothing to Disclose Ahmed Abdelfadeel, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose Jatin R. Matta, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose Khaled Z. Abd-Elmoniem, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose Ahmed M. Gharib, MBChB, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose

# PURPOSE

To develop and implement automatic 4D deformation analysis for Ascending Aorta (AA) and investigate the significance of sex difference on the association between AA deformation and coronary plaque burden as measured by Coronary Computerized Tomography Angiography (CCTA). The purpose is to provide an objective estimation for the 4D AA image-based surrogates of the plaque burden in asymptomatic subjects with low/intermediate risk (Framingham score (FrS) of coronary artery diseases (CAD).

# METHOD AND MATERIALS

CCTA was obtained in 50 asymptomatic adults after signing informed consent. FrS, coronary calcification, and plaque burden score were obtained for all subjects. Automatic in-house AA 4D deformation algorithm and analysis were performed to assess time to peak distensibility (TPD). Univariable and multivariable generalized nonlinear regression modeling were performed to investigate the association of FrS, and TPD, with coronary plaque burden (segment involvement score (SIS) >5). Receiver Operator Curves (ROC) and Area Under the Curve (AUC) were obtained for FrS, TPD and combined for the detection of SIS>5.

#### RESULTS

Males subjects (n=31) were age and BMI matched to the female subjects. TPD individually, was significant predictor of SIS > 5 (regression coefficient ( $\beta$  = -0.15034), P-value = 0.008). Additionally, sex was a significant effect modifier of TPD, with a stronger statistically significant association with women ( $\beta$  = -0.0311, P-value = 0.030). ROC showed significant improvement (p=0.001) in the performance of FrS when combined with TPD for the detection of SIS>5.

## CONCLUSION

In low/intermediate CAD risk asymptomatic women, there is strong association between TPD and substantial of coronary plaque burden beyond and independent of tradition CAD risk factors. AA 4D deformation analysis may supplement traditional risk scores for CAD risk stratification in women. This is in line with previous studies that demonstrated the suboptimal performance of CAD risk score models for women compared to men.

# **CLINICAL RELEVANCE/APPLICATION**

AA 4D deformation analysis (also attainable by other imaging modalities) can be used as an independent surrogate for subclinical atherosclerosis in low /intermediate FrS asymptomatic women. This method reduces subjectivity for CCTA analysis as an additional quantitative objective measurement for CAD risk stratification, life style modification and therapy of CAD particularly in women.

# SSK04-09 Dual-Energy CT in Patients with Suspect Acute Pulmonary Embolism: A Diagnostic Accuracy Systematic Review and Meta-Analysis

Wednesday, Dec. 4 11:50AM - 12:00PM Room: E352

Participants

Moreno Zanardo, MSc, San Donato Milanese, Italy (*Presenter*) Nothing to Disclose Caterina B. Monti, MD, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose Simone Schiaffino, MD, Bogliasco, Italy (*Abstract Co-Author*) Nothing to Disclose

Andrea Cozzi, MD, Uboldo, Italy (*Abstract Co-Author*) Nothing to Disclose Francesco Sardanelli, MD, San Donato Milanese, Italy (*Abstract Co-Author*) Speakers Bureau, Bracco Group Advisory Board, Bracco Group Research Grant, Bayer AG Advisory Board, General Electric Company Reserach Grant, General Electric Company Speakers Bureau, Siemens AG Reserach Grant, Real Imaging Ltd

Francesco Secchi, MD, PhD, Milano, Italy (Abstract Co-Author) Nothing to Disclose

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## PURPOSE

To review the diagnostic performance of dual-energy CT (DECT) in diagnosing acute pulmonary embolism (PE).

# **METHOD AND MATERIALS**

No IRB approval was needed, the study protocol was registered on PROSPERO and reported according to PRISMA. In February 2019, a systematic search was performed on MEDLINE/EMBASE, for articles reporting the diagnostic performance of DECT in diagnosing acute PE. Pooled sensitivity, specificity, positive and negative likelihood ratios (LR) and diagnostic odds ratio (DOR) were calculated according to the approach by Reitsma. A summary receiver operating characteristics (sROC) curve was constructed. Data were reported as estimate and 95% confidence interval (CI). The pooled effective radiation dose for the chest was calculated using the random effect model and the impact of year of publication was evaluated through meta-regression analysis. Risk of publication bias was assessed using the Egger test.

# RESULTS

Of 159 initially retrieved articles, 14 studies were identified, including 23 independent study parts, for a total of 993 patients. Patients' median age ranged from 40 to 68 years. Twelve studies used a dual-tube/dual-detector DECT, while 2 used rapid-kV switching DECT. Lower voltages ranged from 80 to 100 kVp, while high voltages ranged from 135 to 140 kVp. Pooled sensitivity was 84.1% (95% CI 78.3-88.6%), pooled specificity was 88.6% (95% CI 83.9-92.1%), positive LR was 7.52 (95% CI 5.21-10.60), negative LR was 0.18 (95% CI 0.13-0.25), DOR was 42.8 (95% CI 24.2-70.3). The sROC curve had an area under the curve of 0.93. Effective radiation dose to the chest showed high heterogeneity (I2=97%), and its pooled estimate was 4.52 mSv (95% CI 3.68-5.36 mSv). At meta-regression analysis, year of publication did not significantly impact on radiation dose (coefficient .152, P=.703). A significant risk of publication bias was found (Egger's test reporting P=.006).

# CONCLUSION

The diagnostic performance of DECT in acute PE is substantially comparable to that of single-energy CT, in presence of a comparable effective radiation dose to the chest.

# CLINICAL RELEVANCE/APPLICATION

DECT may be used instead of single-energy CT in patients with suspect of acute PE. This may be especially useful, since DECT has been shown to provide more information with regards to lung ventilation and tissue characterization than single-energy CT, thus leading to a more accurate, comprehensive evaluation of the lungs.





## SSK21

# Vascular/Interventional (Peripheral Arterial Disease)

Wednesday, Dec. 4 10:30AM - 12:00PM Room: E260



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

#### Participants

Dimitrios Filippiadis, MD, PhD, Athens, Greece (*Moderator*) Nothing to Disclose Bora Peynircioglu, MD, Ankara, Turkey (*Moderator*) Nothing to Disclose Ava Star, MD, Olympia, WA (*Moderator*) Nothing to Disclose

#### Sub-Events

# SSK21-01 Inguinal Lymphadenopathy as a Negative Prognostic Factor for Clinical Success after Technically Successful Endovascular Treatment in Patients with Critical Limb Ischemia

Wednesday, Dec. 4 10:30AM - 10:40AM Room: E260

Participants

Daniel Raskin, Ramat - Gan, Israel (*Presenter*) Research Consultant, AIDOC Boris Khaitovich, Ramat Gan, Israel (*Abstract Co-Author*) Nothing to Disclose Shmuel Balan, Ramat Gan, Israel (*Abstract Co-Author*) Nothing to Disclose Daniel Silverberg, MD, Ramat Gan, Israel (*Abstract Co-Author*) Nothing to Disclose Moshe Halak, Ramat Gan, Israel (*Abstract Co-Author*) Nothing to Disclose Uri Rimon, MD, Tel-Hashomer, Israel (*Abstract Co-Author*) Nothing to Disclose

## PURPOSE

To assess the correlation between inguinal lymph node characteristic and ipsilateral primary amputation rates in patients with ischemic foot ulcers who had a technically successful endovascular treatment.

# METHOD AND MATERIALS

A retrospective review of patients who were endovascularly treated for ischemic foot ulcers between January 2015 and May 2017 was performed. Two hundred and two limbs in 202 patients (135 male, 67 female; median age 72.8; range, 42.2-93.7 y) were technically successfully treated. Technical success was defined as occluded artery recanalization with residual stenosis < 30%, and ABI improvement by at > 0.2 after 24 hours. Unilateral lymph node size, contrast enhancement, necrosis and perinodular fat infiltration were assessed on a preprocedural computer tomography angiography (CTA). Primary end points were amputation and sepsis within six months. Independent-samples t-tests and chi-square test of independence were conducted to examine relation between lymph node characteristics and amputation or septic shock.

## RESULTS

Forty-two (20.8%) patients had undergone amputation. Sepsis occurred in 6 out of 202 patients (3%). There was a significant difference in the scores of lymph node sizes between amputated and non-amputated limbs (p = 0.000). Relations between lymph node characteristics and amputation was significant (p < 0.001). Patients with perinodular fat infiltration or increased node size were 5.940 and 1.109 times (respectively) more likely to undergo limb amputation than those without. The relation between lymph node characteristics and septic shock was significant (p < 0.05).

## CONCLUSION

Unilateral lymph node size and characteristics are associated with limb amputation in technically successful endovascular treatment of patients with ischemic foot ulcers. Moreover, increased lymph node size and perinodular fat infiltration predicted limb amputation.

# **CLINICAL RELEVANCE/APPLICATION**

Lymph node size and characteristics are associated with limb amputation in critical ischemia patients who were successfully treated endovascularly.

# SSK21-02 Exosomes from Endothelial Progenitor Cells Facilitate Vascular Endothelial Cell Repair through Transferring miR-21-5p to Suppress THBS1 Expression

Wednesday, Dec. 4 10:40AM - 10:50AM Room: E260

Participants

Jungong Zhao, MD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose Hui Hu, Shanghai, China (*Presenter*) Nothing to Disclose Xiaohong Liu, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

we sought to investigate the mechanisms of exosomes released from endothelial progenitor cell(EPC) mediated endothelial cell (EC) repair by studying their miRNA content and uptake

# **METHOD AND MATERIALS**

The efficacy of EPC derived exosome-mediated reendothelialization was examined by histological examinations and Evans blue dye in the balloon-induced carotid artery endothelial injury model of rats in vivo. The effects of EPC-exosomes on human vascular endothelial cells (HUVECs) were also studied by the evaluation of growth rates, migratory ability and tube-formation activity. To dissect the underlying mechanisms, RNA-sequencing assays were performed to determine miRNA abundancy in exosomes and mRNA profiling in exosome-treated HUVEC. Meanwhile, by using specific miRNA inhibitors or siRNAs, the roles of the candidate miRNA and its target genes in exosomes induced regulation of function of HUVEC were assessed.

## RESULTS

Administration of EPC-derived exosomes accelerated the reendothelialization in the early phase after endothelial damage in the rat carotid artery. The uptake of exogenous EPC-exosomes intensified HUVEC cells in the proliferation rate, migratory and tube-forming ability. Integrative analyses of miRNA-mRNA profiles and the following functional studies revealed that miR-21-5p was highly enriched in EPC-exosomes, which specifically suppressed THBS1 expression in the recipient vascular endothelial cells and contributed to the pro-angiogenic activities of EPC derived exosome.

# CONCLUSION

Our study indictated that EPC-exosome delivered miR-21-5p into vascular endothelial cells to inhibit the expression of THBS1, and therefore promoted endothelial cell repair.

#### **CLINICAL RELEVANCE/APPLICATION**

EPC derived exosome mediated reendothelialization after vascular injury

# SSK21-03 Impact of Calcification Modeling and Planning Circles with Fusion Imaging for the Chronical Total Occlusion of Iliac and Femoral Arteries

Wednesday, Dec. 4 10:50AM - 11:00AM Room: E260

Participants Nicolas Louis, Nimes , France (*Presenter*) Research Consultant

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# PURPOSE

To examine the contribution of calcification modeling and planning circles with fusion imaging for the chronical total occlusion (CTOs) of iliac and femoro-popliteal arteries.

## **METHOD AND MATERIALS**

We analyzed a cohort of 180 patients who were treated by endovascular means for iliac and femoro-popliteal arteries CTOs during a period of 3 years. The procedures were performed in a hybrid room equipped with the IGS 530 system (GE Healthcare). The preoperative imaging fusion was edited on the dedicated workstation Advantage Windows 4.7 with vessel ASSIST. A centerline was manually adjusted inside the occluded artery. The planning circles were strategically positioned inside the calcifications edited by the centerline. The Workstation allows to combined in the the same volume the modeling of all the calcifications and the planning circles. The fusion technic was a fusion between 3D volume extracted from preoperative CT and 2D live fluoroscopy with bone registration. An arteriography was systematically achieved allowing to adjust if necessary the vascular ans calcifications volumes.

#### RESULTS

46 Iliac CTOs (mean length occlusion= 61.6 mm), and 84 femoro-popliteal CTOs (80.2 mm) were performed. The success of the recanalisation reach 94% (n=122/130). In 51.5% (n=67/130) the recanalisation have been directly in transluminal inside the planning circles. In 35.3% (n=46/130) the recanalization have been subintimal and have been redirected in transluminal between two circles. In 6.9% (n=9/130) the subintimal recanalisation can't be redirected transluminal and an IVUS-guided re-entry catheter have been used.

## CONCLUSION

The CTOs under fusion imaging with calcification modeling and planning circles is a reliable and reproductible technic. It allows to redirect easily between two circles inside the calcification. It might have an economic impact by reducing the use of re-entry device, and might have an impact on the radiation exposure.

# **CLINICAL RELEVANCE/APPLICATION**

This new technic allows to navigate step by step in an occluded artery by knowing constantly when the guide wire is positioning compared to the calcifications and the good lumen.

# SSK21-04 Long-Term Outcome of Percutaneous Coronary Intervention in Prediabetes and Normoglycaemia Patients: A Systematic Review and Meta-Analysis

Wednesday, Dec. 4 11:00AM - 11:10AM Room: E260

Participants Rui Shi, Chengdu, China (*Presenter*) Nothing to Disclose Zhigang Yang, MD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose Kaiyue Diao, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose Yue Gao, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose

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# PURPOSE

Prediabetes, an abnormal glucose metabolism before onset diabetes, was proven to be risk factor for coronary artery disease (CAD) in previous studies. However, whether prediabete would impact the long-term prognosis for CAD patients after percutaneous coronary intervention (PCI) remains controversial. Thus, the purpose of this study was to summarize the previous studies and to demonstrate the difference of long term prognosis between CAD patients with and without prediabetes after PCI.

## **METHOD AND MATERIALS**

Pubmed and EMBASE were systematically searched, supplemented with manual searches of the included reference lists. Studies reporting long-term (>/=1 year) cardiovascular outcomes including all-cause mortality, myocardial infarction (MI), revascularization and other mentioned major adverse cardiac events (MACE) in prediabetes patients were included. Odds ratio (OR) with 95% confidence interval (CI) was used to express the pooled effect on discontinuous variables and the pooled analyses were performed with Stata 15.1.

# RESULTS

Nine cohort studies were finally included in this meta-analysis consisting of a total of 10266 patients (3112 prediabetes, 3783 diabetes and 5171 normoglycaemia). In CAD patients treated with PCI, prediabetes individuals were found to have significantly higher long-term mortality and more MACE than normoglycaemia patients (odds ratio (OR):1.85;95% confidence interval (CI): 1.25-2.74; P=0.002; $I^2 = 36.6\%$ ), (OR:1.43; 95% CI:1.05-1.94;P=0.022; $I^2=69.3\%$ ) respectively. No statistical difference was found on MI and revascularization between the two groups (MI: OR:1.06;95% CI:0.86-1.31; P=0.561;  $I^2=0\%$ ) and (revascularization: OR:1.20; 95% CI: 0.88-1.63; P=0.242;  $I^2=31\%$ ) respectively.

## CONCLUSION

The present meta-analysis suggests that following PCI, long-term rates of death and MACE were significantly higher in prediabetes. However, there were no difference on MI and repeat revascularization between prediabetes and normoglycaemia patients.

# **CLINICAL RELEVANCE/APPLICATION**

The present meta-analysis provide evidence that health care practitioners should put emphasize on screening and management of abnormal glucose metabolism before and after PCI to combat adverse cardiovascular outcomes.

# SSK21-05 Micro-Channel Recanalization with Orbital Atherectomy as a Viable Method to Failed Standard Recanalization of TASC-II D Aorto-Iliac Occlusive Disease

Wednesday, Dec. 4 11:10AM - 11:20AM Room: E260

Participants

Roger T. Tomihama, MD, Loma Linda, CA (*Presenter*) Nothing to Disclose Yuki Miura, MD, Loma Linda, CA (*Abstract Co-Author*) Nothing to Disclose Ahmed Abou-Zamzam, MD, Loma Linda, CA (*Abstract Co-Author*) Nothing to Disclose Sharon C. Kiang, MD, Loma Linda, CA (*Abstract Co-Author*) Nothing to Disclose

# PURPOSE

Endovascular treatment of TASC II D aorto-iliac lesions now an accepted form of revascularization. We sought to demonstrate that native micro-channel recanalization and orbital atherectomy is a successful recanalization method of TASC II D aorto-iliac lesions refractory to standard recanalization techniques.

## **METHOD AND MATERIALS**

Four consecutive patients from 2016-2018 with symptomatic TASC-II D Aorto-Iliac Occlusive Disease (AIOD) prohibitive for open bypass and failed traditional prodding guidewire or device recanalization technique were identified and underwent advanced native micro-channel selection and subsequent orbital atherectomy. Native micro-channels were probed and traversed with a 0.014 wire. Orbital atherectomy is initiated with the 1.25 crown and continued until the micro-channel is sufficiently large to track a microcatheter. Lesion characteristics, survival, limb salvage, patency, and change in clinical symptoms were analyzed.

## RESULTS

Four patients underwent successful native micro-channel recanalization and orbital atherectomy of the CIA. There were no intraoperative ruptures or dissections. Three patients presented with rest pain and 1 with CLTI. Average age was 68, average Rutherford class was 3 and 2 of the patients smoked. All 4 patients presented with unilateral CIA occlusion with contralateral CIA stenosis. Average occlusion lesion length of the R CIA was 5.8 cm and of the L CIA was 6.2 cm. Kissing stent technique was used in all patients for reconstruction of the aortic bifurcation. Two of the patients had outflow lesions (SFA stenosis or occlusion) but had patent profunda arteries. At 30 days, all patients had improvement in pain and primary patency of 100%. Long-term follow up at 21.6 months noted continued improvement in symptoms and primary patency of 75%. The fourth patient died at 4 mo from lung cancer with occluded iliac stents by imaging at that time.

# CONCLUSION

Native micro-channel recanalization with subsequent orbital atherectomy is an option in high-risk patients with TASC II D aorto-iliac disease whom have failed traditional prodding recanalization. Further work in proper patient selection and safe utilization of atherectomy devices in the CIA is needed.

# **CLINICAL RELEVANCE/APPLICATION**

Native micro-channel recanalization with subsequent orbital atherectomy is an option in high-risk patients with TASC II D aorto-iliac disease whom have failed traditional prodding recanalization.

# SSK21-06 Evaluation of Collateral Circulations for Therapeutic Effects in Chronic Leriche's Syndrome: A Preliminary Case-Control Study between Bypass Grafting and Intraluminal Stent Implantation

Wednesday, Dec. 4 11:20AM - 11:30AM Room: E260

Participants Yang Peng, Guangzhou, China (*Presenter*) Nothing to Disclose Qiuxia Xie, Shenzhen, China (*Abstract Co-Author*) Nothing to Disclose Fan Zhang, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose Jian Guan, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

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## PURPOSE

To investigate the changes in collateral arteries after bypass grafting or intraluminal stent implantation in chronic Leriche's syndrome, and to compare effects of the two operations.

## **METHOD AND MATERIALS**

From January 2015 to December 2018, there were 26 patients diagnosed as chronic Leriche's syndrome. They were treated with bypass grafting (n=14, group A) or intraluminal stent implantation (n=12, group B). All the patients received aorta and common iliac CT angiography before and one month after the operations. CT angiography findings and clinical records were reviewed retrospectively. Sectional areas of the occlusive aorta before operation (a0), the systemic collateral pathways before (a1) and after (a2) operation, and the recanalization pathway (the grafts or the stent lumen) (ar) were manually measured at aortic bifurcation level by two experienced radiologists, and the mean values were admitted. The compensation rate before (C1) and after (C2) operation as well as the reduction rate of the systemic collateral pathways after operation (R) were defined as follow: C1=a1/a0; C2=(a2+ar)/a0; R=(a1-a2)/a1. The values of C1, C2 and R of both groups were calculated respectively, and independent sample *T*-test was performed.

## RESULTS

C1 of bypass grafting group and intraluminal stent implantation group were  $30.67\%\pm16.77\%$  and  $31.35\%\pm23.70\%$  respectively, and there was no significant difference (*P*=0.933). C2 of bypass grafting group were significantly higher than those of intraluminal stent implantation group ( $98.83\%\pm26.01\%$  vs.  $44.44\%\pm7.62\%$ , *P*<0.001), while R of both groups had no significant difference ( $81.98\%\pm7.12\%$  vs.  $85.81\%\pm5.95\%$ , *P*=0.154).

## CONCLUSION

According to the changes in collateral arteries after operation, intraluminal stent implantation was non-inferior to bypass grafting for patients with chronic Leriche's syndrome, although the recanalization pathway seemed much smaller.

## **CLINICAL RELEVANCE/APPLICATION**

The changes in collateral circulation can reflect short-term effects of operation. And Intraluminal stent implantation could be the favorable treatment for patients with high risk of operation.

### SSK21-07 To Evaluate the Role of FDG PET/CT in Assessing Disease Activity in Large Vessel Vasculitis

Wednesday, Dec. 4 11:30AM - 11:40AM Room: E260

Participants Sikandar M. Shaikh, DMRD, Hyderabad, India (*Presenter*) Nothing to Disclose

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#### PURPOSE

To evaluate the role of FDG PET-CT in the assessment of disease activity in large vessel vasculitis (LVV).

#### **METHOD AND MATERIALS**

54 PET/CT scans were performed in 19 pts with suspected and diagnosed LVV (giant cell arteritis, Takayasu arteritis or idiopatic aortitis). The amount of vascular uptake was graded using a 4-point scale (0=no uptake, 1=less than liver, 2=similar to liver, 3=higher than liver). Grade 0-1 was negative, 2 was moderately positive and 3 was markedly positive. This PET/CT was correlated with clinical indices of ITAS (Indian Takayasu Activity Score) and Kerr/National Institute of Health (Kerr/NIH), serum acute-phase reactants (ESR, C-reactive protein [CRP]) levels as well as interleukin-6 (IL-6) and the soluble IL-6 receptor (sIL-6R).

#### RESULTS

43% of 54 PET-CT were negative, 31% were moderately positive, and 26% were markedly positive. A significant correlation between the SUV uptake and both ESR and CRP levels was found and correlated. Significantly higher ESR values were observed in pts with markedly positive PET/CT (49.4 + 36.5 mm/1st h) compared with moderately positive (27 + 21 mm/1st h, p = 0.0001) and inactive scans (22.7 + 15.9 mm/1st h, p=0.0001). CRP levels were 0.8+1.0 mg/dL in pts with inactive scans, 1.3 + 2.2 mg/dL in pts with moderately positive (p=0.001) and 3.0 + 3.6 in patients with markedly positive scans (p = 0.0001). Higher levels of IL-6 resulted in patients with markedly positive scans (10.0 + 8.9 gg/ml) compared to those with inactive scans (8.1+18.5 gg/ml, p=0.013). We found no association between sIL-6R levels and vascular FDG uptake. There was a significant association between vascular FDG uptake and both ITAS and Kerr/NIH scores

#### CONCLUSION

The above findings of PET/CT is a very useful tool for evaluating disease activity in patients with LVV.

## **CLINICAL RELEVANCE/APPLICATION**

The relevance of FDG PET-CT in evaluation of Large vessel vasculitis is having importnat and significant role.

# SSK21-08 Spectral CT Imaging for the Assessment of Non-Calcified Plaque Compositions in Lower Extremity Atherosclerosis

Wednesday, Dec. 4 11:40AM - 11:50AM Room: E260

Participants

Tingting Qu, Xian, China (*Presenter*) Nothing to Disclose Jianxin Guo, Xian, China (*Abstract Co-Author*) Nothing to Disclose Jianying Li, Beijing, China (*Abstract Co-Author*) Employee, General Electric Company Ningning Ding, Xian, China (*Abstract Co-Author*) Nothing to Disclose Yun Shen, PhD, Beijing, China (*Abstract Co-Author*) Employee, General Electric Company Researcher, General Electric Company Jian Yang, Xian, China (*Abstract Co-Author*) Nothing to Disclose

# PURPOSE

To assess the composition of non-calcified plaques in patients with lower extremity atherosclerosis using spectral CT imaging.

# METHOD AND MATERIALS

Thirty-four patients with lower extremity atherosclerosis underwent CT angiography (CTA) with the dual-energy spectral imaging mode. Monochromatic images were reconstructed to measure CT values at 74keV and to generate spectral curve for calculating the slope: [(CT(40keV)-CT(110keV))/70] and the effective-Z for plaques; Material decomposition (MD) images of iodine-based and lipid-based were generated to measure the iodine and lipid density, respectively. Measurements for different plaque types were statistically compared.

# RESULTS

A total of 116 non-calcified plaques were found in 34 patients, including 87 fibrous plaques, 21 plaques with intra-plaque hemorrhage and 8 plaques with lipid components with slopes of the spectral curve of  $1.05\pm0.54$ ,  $0.36\pm0.26$ , and  $-0.20\pm0.20$ , and the effective-Z values of  $8.21\pm0.30$ ,  $7.80\pm0.18$  and  $7.40\pm0.15$ , respectively. The iodine contents (in 100ug/ml) were  $9.99\pm5.13$ ,  $3.42\pm2.60$ , and  $-1.97\pm1.95$ , and lipid contents (in 1mg/ml) were  $-755.12\pm387.89$ ,  $-258.05\pm195.75$ , and  $148.95\pm148.14$ , respectively for the fibrous plaque, intra-plaque hemorrhage and lipid plaque. There were statistical differences in all measurements between any two types of plaques (all p<0.001). CT values at 74keV was  $54.54\pm14.16HU$ ,  $23.35\pm13.80HU$  and  $28.88\pm11.69HU$  for these three groups. There was significant difference between fibrous plaque and the other two contents (p<0.001), but no significant difference between the intra-plaque hemorrhage and lipid plaque (p=0.652).

## CONCLUSION

Fibrous plaque, plaque with intra-plaque hemorrhage and lipid components in non-calcified plaque have distinctive spectral imaging characteristics. The parameters of dual-energy spectral CT imaging can provide quantification information for the differentiation of fibrous, lipid and hemorrhage plaques.

# **CLINICAL RELEVANCE/APPLICATION**

The use of imaging methods to distinguish stable plaques and unstable plaques can provide guidance for the selection of clinical pathways.

# SSK21-09 Improving Diagnostic Accuracy for Inferior Genicular Arteries in Lower Extremity with Dual-Energy Spectral CT Imaging

Wednesday, Dec. 4 11:50AM - 12:00PM Room: E260

#### Participants

Xianghui Zhang, Xian, China (*Presenter*) Nothing to Disclose Jia Xiaoqian, Xian, China (*Abstract Co-Author*) Nothing to Disclose Jianying Li, Beijing, China (*Abstract Co-Author*) Employee, General Electric Company Jingtao Sun, Xian, China (*Abstract Co-Author*) Nothing to Disclose Shumeng Zhu, Xian, China (*Abstract Co-Author*) Nothing to Disclose Qian Tian, Xian, China (*Abstract Co-Author*) Nothing to Disclose Yue Yao, Xian, China (*Abstract Co-Author*) Nothing to Disclose Yun Shen, PhD, Beijing, China (*Abstract Co-Author*) Employee, General Electric Company Researcher, General Electric Company Jianxin Guo, Xian, China (*Abstract Co-Author*) Nothing to Disclose Jian Yang, Xian, China (*Abstract Co-Author*) Nothing to Disclose

# PURPOSE

Investigate the clinical value of improving diagnostic accuracy for inferior genicular arteries in the lower extremity with low energy images in spectral CT imaging.

# METHOD AND MATERIALS

110 (mean age 67±10 years) and 72 (mean age, 65±13 years) patients underwent CT angiography (CTA) in the lower extremities using spectral and conventional (at 120kVp) imaging mode, retrospectively with similar radiation dose and contrast dose. The 50keV monochromatic images were reconstructed in the spectral CT group. CT value and standard deviation of vessels and psoas major muscle was measured to calculate to the signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) for vessels. Two independent observers assessed the subjective image quality of the lower extremities using a 4-point scale. The quantitative and qualitative image quality of the two groups were compared and the diagnostic accuracy for the degree of occlusion of the vessels (Each patient received one time DSA for 11 vessels) were also compared using DSA as the gold standard. Chi-square test, independent sample T test and Mann-Whitney test was used for counting data, quantitative measurement data and subjective image quality score, respectively.

The use of 50keV images in the spectral CT significantly increased the CT values in the abdominal iliac, femoral popliteal and lower knee segments ( $618.52\pm100.78$  vs.  $371.10\pm98.36$  on average, p<0.001) and provided higher SNR ( $50.48\pm12.47$  vs.  $45.97\pm12.90$ , P=0.014) and higher CNR ( $44.08\pm11.45$  vs.  $38.86\pm12.35$ , P<0.01) compared with the conventional images. Mann-Whitney test showed that the subjective image quality of femoral popliteal in the spectral CT group was higher than in the conventional group (P=0.01), while there was no difference in the abdominal iliac segment (P=0.10) and lower knee segment (P=0.07). The spectral CT images also significantly improved the diagnostic accuracy for the vessels in the lower knee segment (92.05% vs. 84.03%, P<0.01).

# CONCLUSION

The use of 50keV spectral CT images enhances the contrast in the lower extremity arteries and improves the diagnostic accuracy for the vessels in the lower knee segment, compared with the conventional CTA protocols.

# **CLINICAL RELEVANCE/APPLICATION**

Low-energy images in spectral CT can improve the diagnostic accuracy of the lower knee arteries while achieving higher SNR and CNR.







# VIS-WEA

Vascular Interventional Wednesday Poster Discussions

Wednesday, Dec. 4 12:15PM - 12:45PM Room: VI Community, Learning Center



AMA PRA Category 1 Credit ™: .50

**FDA** Discussions may include off-label uses.

# Participants

D. T. Johnson, MD, PhD, South San Francisco, CA (Moderator) Inventor, Thunar Medical, Inc

# Sub-Events

#### VI212-SD-WEA1 Capembol: Safety, Feasibility and Early Oncological Outcomes of Prostatic Artery Embolization in the Management of Low-Grade Localized Prostate Cancer in Patients Candidate to Active Surveillance: A Monocentric Pilot Study - Preliminary Results

Station #1

Participants Helene Mohammad, Nimes, France (*Presenter*) Nothing to Disclose Julien Frandon, MD, Grenoble Cedex 9, France (*Abstract Co-Author*) Nothing to Disclose Jean-Paul Beregi, MD, Nimes, France (*Abstract Co-Author*) Nothing to Disclose Stephane Droupy, Nimes, France (*Abstract Co-Author*) Nothing to Disclose

# PURPOSE

We aim to assess the feasibility, short-term oncologic and functional outcomes of unilateral prostate artery embolization (PAE) as a focal therapy in patients with localized low-risk prostate cancer candidate to active surveillance (AS).

# METHOD AND MATERIALS

This first-results prospective monocentric pilot study enrolled patients with unilateral prostate cancer Gleason 6 (3+3), prostate specific antigen < 10ng/ml, clinical stage < T2b and concordant PIRADS >= 3 target lesion on multiparametric MRI (mpMRI). Primary endpoint was the feasibility defined by the technical success of PAE and absence of severe adverse effects according to the Clavien-Dindo classification. Secondary endpoints were overall survival, need for radical treatment, necrosis of the treated lobe on mpMRI, histological evaluation at 6-month follow-up and urinary and erectile functions evaluation after PAE at 1, 3 and 6-month.

# RESULTS

Six patients were included in the study from June 2018 to January 2019. Median age was 74,5 years (71-77), median initial PSA rate was 6,9 ng/ml (3,2-10,14), all cancers were Gleason 6 (3+3) and T2a clinical. All lesions ranked PIRADS 4. Technical success was 100%. Median procedure time was 40,5 minutes (35 - 48). No major complication occurred. No decrease in urinary and erectile functions was observed in the first four patients at 3-month follow-up. An improvement in urinary continence was even noted in the first four patients at 3 months. In one of the two patients followed 6 months, the target lesion was no longer visible on mpMRI and was negative on the targeted biopsy.

# CONCLUSION

Unilateral prostate artery embolization as a focal therapy to manage localized low-risk prostate cancer is a feasible and well tolerated procedure. First early oncological results are promising. Further research are required to demonstrate its long-term oncologic efficiency and functional outcomes.

# **CLINICAL RELEVANCE/APPLICATION**

This first "proof of concept" prospective study demonstrated the feasibility, safety, well tolerance and early oncological efficacy of PAE in the management of unilateral low-risk localized prostate cancer and may represent an alternative treatment approach to active surveillance in order to delay standard therapy in carefully selected patients.

#### VI213-SD-WEA2 Measurement of Scatter Radiation Dose to the Eye of Interventional Radiologists Performing Fluoroscopically Guided Procedures: Are You Sure You Are Protected?

Station #2

Participants Edison Lee, DO, Vancouver, BC (*Presenter*) Nothing to Disclose Yogesh Thakur, PhD, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose Lindsay S. Machan, MD, Vancouver , BC (*Abstract Co-Author*) Stockholder, Analytics for Life, Inc Stockholder, Calgary Scientific, Inc Stockholder, Harmonic Medical Stockholder, IKOMED Technologies Inc Stockholder, Innovere Medical Inc Stockholder, Confluent Medical Inc John B. Chung, MD, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose Anastasia Hadjivassiliou, MBBS, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose Stephen G. Ho, MD, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose Darren Klass, MD, PhD, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose Dave M. Liu, MD, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose

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# PURPOSE

To quantify radiation eye dose during the typical variety of fluoroscopic procedures faced by interventional radiologists in real world situations--as opposed to optimized phantom studies--ranging from fistulograms to stent grafts; assessing the impact of different shielding devices, lead glasses and the position of the radiologist.

#### **METHOD AND MATERIALS**

Prior to the procedure, Optically Stimulated Luminescent (OSL) dosimeters were affixed using eyelash glue to each cheek and under each lower eyelid of the principal operator. Procedure, access site, imaging parameters, and patient, monitor and shield positions were recorded. The OSL chips were read immediately after each study using a Landauer Microstar radiation dose chip reader.

## RESULTS

In an ongoing study, eye doses during 125 cases have been recorded. Total procedural dose range 2-6335mGy (mean 873.5mGy), DAP range 17-148333uGym2 (mean 17173 uGym2), and fluoroscopy time range 4-5146s (mean 1042s). Recorded doses: right eye range 0-0.472mGy (mean 0.027mGy), right cheek range 0-0.522mGy (mean 0.032mGy), left eye range 0-0.738mGy (mean 0.050mGy), and left cheek range 0-0.905mGy (mean 0.061mGy). The left side of the face closer to the fluoroscope record 1.89x higher radiation dose than the opposite. Wearing lead glasses frequently did not result in significant decrease in eye dose.

# CONCLUSION

The side of the face closer to the fluoroscope consistently received higher radiation doses than the opposite. As opposed to optimized phantom studies, lead glasses did not consistently demonstrate a significant decrease in radiation dose to eyes. Orientation of the head to the radiation source appears to be critical and may significantly reduce the impact of leaded glasses. Barrier protection alone may be providing a false sense of security to the interventionist.

# **CLINICAL RELEVANCE/APPLICATION**

Under real world situations, lead glasses provided less protection compared to previous phantom studies and monitor position during IR procedure is important in terms of radiation exposure.

#### VI214-SD-WEA3 Effects of Oxytocin on High-Intensity Focused Ultrasound Ablation of Leiomyoma: A Clinical Trial Study

## Station #3

Participants

Nguyen Minh Duc, MD, Ho Chi Minh, Vietnam (*Presenter*) Nothing to Disclose Rajiv Chopra, PhD, Dallas, TX (*Abstract Co-Author*) Stockholder, Profound Medical Corporation; Stockholder, Solenic Medical Inc Bilgin Keserci, PhD, Kota Bharu, Malaysia (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

To investigate the impact of oxytocin on high-intensity focused ultrasound (HIFU) ablation for the treatment of leiomyoma.

#### **METHOD AND MATERIALS**

This clinical trial study was approved by institutional review board. 40 patients with symptomatic leiomyoma underwent HIFU treatment. They were divided into two groups based on perfusion classification: group A (n = 20, if time-signal intensity curve of leiomyoma lower than that of myometrium regarded as weak perfusion group) and group B (n = 20, if time-signal intensity curve of leiomyoma equal to or higher than that of myometrium). Groups A and B was subdivided into two subgroups A1 (n = 10), B1 (n = 10) (with only intravenous infusion normal saline) considered as control group and two subgroups A2 (n = 10), B2 (n = 10) with intravenous infusion oxytocin 0.2 U/min (with 500 ml of 0.9% normal saline added 60 units of oxytocin running at the rate of 2 ml/min) considered as oxytocin group. Treatment results, adverse events were compared.

#### RESULTS

The mean non-perfused volume ratio (NPVr) of groups A and B was  $92\% \pm 18$  and  $67\% \pm 24$  (p<0.05). The mean power of groups A and B was  $160W \pm 28$  and  $200W \pm 34$  (p<0.05). The mean time treatment of groups A and B was 134minute  $\pm 12$  and 155minute  $\pm 30$  (p<0.05). The mean NPVr of subgroup A1 and A2 was 93% and 90% (p>0.05). The mean power of subgroups A1 and A2 was 158W and 164W (p>0.05). The mean treatment time of subgroup A1 and A2 was 126minute and 138minute (p>0.05). The mean NPVr of subgroup B1 and B2 was 72% and 60% (p<0.05). The mean power of subgroup B1 and B2 was 126minute and 128 was 192W and 222W (p<0.05). The mean treatment time of subgroup B1 and B2 was 140minute and 168minute (p<0.05). There were no differences in adverse events between group A and group B, subgroups A1 and A2, B1 and B2. There were no oxytocin-related adverse events reported.

## CONCLUSION

Oxytocin could solely improve the treatment efficacy by reducing the power, enhancing the treatment speed, thus achievement of higher NPVr for patients with strong perfusion leiomyoma.

# **CLINICAL RELEVANCE/APPLICATION**

The clinicians should take oxytocin into consideration during ablation procedure in cases of strong perfusion leiomyoma to obtain better HIFU outcomes for patients.

# VI266-SD- Effect of Hepatic Flow Parameters on Coagulation Range of Radiofrequency Ablation in Liver WEA4 Malignancies Patients: A Prospective Clinical Study

Station #4

Hong Wang, MD, MD, Beijing, China (*Presenter*) Nothing to Disclose Wei Yang, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

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# PURPOSE

To assess the difference in hepatic flow parameters of contrast enhanced ultrasound (CEUS) between liver cirrhosis and normal liver and investigate the effect of hepatic blood flow on coagulation range of radiofrequency (RF) ablation in patients with liver malignancies.

# METHOD AND MATERIALS

Between 2015 and 2018, 194 patients who had liver malignancies and underwent ultrasound guided percutaneous RF ablation in our center prospectively enrolled into this study. They were 63 females and 131 males with average age of 57.6±10.5 years old (range 48-71 years old). According to imaging findings, there were 86 patients had liver cirrhosis and 108 patients had normal liver background. The arrive time (AT) of contrast agent at hepatic artery, portal vein and hepatic vein were measured on CEUS before RFA. RFA was conducted with 3cm or 4cm celon electrode. 4D CEUS was used to evaluate the coagulation ranges in 24hr after RFA, including length, width, thickness and volume. Then the coagulation ranges were compared between liver cirrhosis and normal liver.

#### RESULTS

Based on CEUS before RFA, the average AT of hepatic artery, portal vein and hepatic vein in cirrhosis liver was significantly longer than normal liver (16.1 $\pm$ 5.3 vs. 14.3 $\pm$ 3.4 cm/s, p=0.002; 22.1 $\pm$ 6.4 vs. 18.9 $\pm$ 4.2cm/s, p<0.001; 29.2 $\pm$ 7.4 vs. 24.3 $\pm$ 4.7cm/s, p<0.001). With two 3cm tip RF electrodes, the average coagulation in cirrhosis liver was significantly larger than those in normal liver (width 2.6 $\pm$ 0.5 vs. 2.4 $\pm$ 0.5 cm, p=0.005; thickness 2.2 $\pm$ 0.4 vs. 1.9 $\pm$ 0.4 cm, p<0.001; volume 94.4 $\pm$ 48.7 vs. 69.0 $\pm$ 35.3 cm3, p=0.001). With three 4cm tip RF electrodes, the average coagulation in cirrhosis liver was significantly larger than those in normal liver (length 4.8 $\pm$ 0.8 vs. 4.5 $\pm$ 0.7 cm, p=0.012; width 3.8 $\pm$ 0.6 vs. 3.4 $\pm$ 0.5 cm, p<0.001; thickness 3.3 $\pm$ 0.7 vs. 2.8 $\pm$ 0.6, p=0.005; volume 248.3 $\pm$ 107.3 vs. 189.3 $\pm$ 76.0 cm3, p=0.013).

#### CONCLUSION

There were significant differences in hepatic blood flow parameters between cirrhosis and normal liver. The coagulation range of RF ablation in cirrhosis liver was significantly larger than that in normal liver, especially for shortest length (7mm difference between cirrhosis and normal liver background).

## **CLINICAL RELEVANCE/APPLICATION**

This data was clinical application related and could help to accurately ablate live tumors with RF ablation.

# VI267-SD- Non-Contrast-Enhanced Renal MRA Using Multi-Shot Gradient Echo EPI at 3-T MR System WEA5

Station #5

Participants Shogo Fukuda, Kumamoto, Japan (*Presenter*) Nothing to Disclose Takeshi Nakaura, MD, Amakusa, Japan (*Abstract Co-Author*) Nothing to Disclose Kosuke Morita, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose Seitaro Oda, MD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose Yasunori Nagayama, MD, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose Hiroyuki Uetani, Amakusa, Japan (*Abstract Co-Author*) Nothing to Disclose Masataka Nakagawa, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose Masataka Nakagawa, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose Masahiro Hatemura, Kumamoto, Japan (*Abstract Co-Author*) Nothing to Disclose Yasuyuki Yamashita, MD, Kumamoto, Japan (*Abstract Co-Author*) Consultant, DAIICHI SANKYO Group

#### PURPOSE

The purpose of this study was to investigate the feasibility of non-contrast-enhanced renal magnetic resonance angiography (MRA) using multi-shot gradient (MSG) echo planar imaging (EPI) with a 3-T MR system.

# METHOD AND MATERIALS

Experimental data were collected from 17 healthy male volunteers who underwent non-contrast-enhanced renal MRA using standard balanced turbo field echo (bTFE) sequence and MSG-EPI sequence with a 3-T MR system. We evaluated the signal-to-noise ratio (SNR) for the renal artery and the contrast ratio (CR) between the renal artery and erector spinae and acquisition time. Two radiologists independently recorded the image contrast, noise, sharpness, artifacts, and overall quality on a 4-point scale.

# RESULTS

SNR and CR were significantly higher in the MSG-EPI than in the bTFE sequence  $(17.80 \pm 3.67 \text{ vs. } 10.84 \pm 2.86 \text{ and } 0.78 \pm 0.04 \text{ and } 0.67 \pm 0.08$ , respectively; p < 0.05). The acquisition time was significantly lower in the MSG-EPI than in the bTFE sequence  $(164.5 \pm 34.0 \text{ s vs. } 261.5 \pm 39.3 \text{ s; } p < 0.05)$ . Significant differences were found in the image contrast, noise, sharpness, and artifacts as well as overall image quality between the two sequences (p < 0.05).

#### CONCLUSION

The MSG-EPI sequence is a promising technique to shorten the scan time and to improve the image quality of the non-contrastenhanced real MRA with a 3-T system.

### **CLINICAL RELEVANCE/APPLICATION**

The MSG-EPI sequence can offer higher-quality non-contrast-enhanced renal MRA with a shorter scan duration than the standard bTFE.

VI263-SD- Evaluation of Technical Success and Complication Rates Following Endovascular Thrombolysis WEA6

# Interventions

Station #6

Participants Dennis Parhar, MD, Vancouver, BC (*Presenter*) Nothing to Disclose Patrick J. Kennedy, MD, Hamilton, ON (*Abstract Co-Author*) Nothing to Disclose Bonnie Niu, BSC, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose John B. Chung, MD, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose Gerald M. Legiehn, MD, Vancouver, BC (*Abstract Co-Author*) Nothing to Disclose

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# PURPOSE

This study aims to evaluate the technical success and complication rates following endovascular thrombolysis in arterial, venous, and pulmonary arterial systems, as well as in hemodialysis circuits, in a large tertiary care center.

## **METHOD AND MATERIALS**

Following approval by an institutional ethics review board, a retrospective chart review was performed for all thrombolysis cases performed in the 5-year period between November 1, 2013 and November 1, 2018. Cases were identified by conducting a search of our local RIS for any studies containing the words 'thrombectomy' or 'thrombolysis'. Any patients older than 18 years who had received endovascular thrombolysis were included. Stroke thrombolysis cases were excluded. Patient demographic data, procedural details, thrombolytic agents used, as well as technical success and complications (as defined by the SIR) were recorded. Analysis of statistical significance was performed using Chi-squared contingency tests.

#### RESULTS

There were a total of 208 thrombolysis cases, of which 120 were in males (mean age 55) and 88 in females (mean age 53). Overall technical success rate was 83%. There was a significant difference in the success rate between procedure types, with venous thrombolysis cases demonstrating the greatest success (90%), followed by pulmonary arterial (88%), arterial (75%), and dialysis fistulae (61%), p < 0.05. Relative to published guidelines, these were within the accepted thresholds. Overall complication rates were 17%, with 4.8% of cases having major complications. There was a significant difference in complication rate depending on procedure type, with complications highest in the arterial cases (33%), followed by pulmonary arteries (12%), hemodialysis circuits (11%), and veins (11%), p < 0.05. The overall 30-day mortality rate was 4.8%, with pulmonary arterial cases demonstrating the highest mortality (14%).

## CONCLUSION

Endovascular thrombolysis in the arterial system carries a lower success rate and greater complication rate than the venous or pulmonary arterial systems. Despite adherence to published guidelines, the complication rate for endovascular thrombolysis can exceed the published thresholds, indicating that further studies are needed in this area.

#### **CLINICAL RELEVANCE/APPLICATION**

With the advent of new and exciting technologies for endovascular thrombolysis, rigorous review of their safety and efficacy is crucial. Here, we present comparative results over a 5-year period.

# VI264-SD- Split Renal Function after Treatment of Small Renal Masses: Comparison between Radiofrequency WEA7 Ablation and Laparoscopic Partial Nephrectomy

Station #7 Participants

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## PURPOSE

Radiofrequency ablation (RFA) and laparoscopic partial nephrectomy (LPN) are used to treat small renal masses (SRM, <=4cm). Studies report conflicting results in creatinine and eGFR changes following treatment, without evaluating how the affected renal parenchyma responds to treatment. On contrast enhanced CT (CE-CT) images quantity and quality of renal function can be evaluated by calculating the split renal function (SRF). We aimed to compare renal function after RFA or LPN treatment of SRMs by evaluation of the SRF in the affected kidney.

# METHOD AND MATERIALS

Single T1a renal tumors successfully treated (without tumor progression, mean follow up 3.2 years) with RFA (n=60) or LPN (n=31) were retrospectively compared. The SRF was calculated on pre-treatment CE-CT images and on the first follow up exam 3 months after completed treatment. Serum creatinine and eGFR values were collected simultaneously. To compare renal function outcomes Students t-test and multivariable linear regression models (adjusted to RFA/LPN treatment, pre-treatment SRF/eGFR, BMI, age, tumor characteristics and Charlson comorbidity index) were used.

#### RESULTS

Both groups showed a reduction in SRF following treatment. The LPN group had a greater reduction (RFA - 5.7% vs LPN - 3.5%;
difference 2.2, p = 0.001). After adjusted analysis the LPN group still showed a significantly greater SRF reduction (SRF -3.2%, CI 1.3 to 5.1; p=0.001). There was no difference between groups in pre-treatment values or in change of creatinine/eGFR following treatment.

### CONCLUSION

Both RFA and LPN are nephron sparing when treating SRMs. However in this series LPN showed a significantly greater SRF reduction in the affected kidney in comparison to RFA.

### CLINICAL RELEVANCE/APPLICATION

Patients with renal tumors treated with RFA showed a smaller reduction in renal function compared to those treated with LPN in these series. RFA should be favoured for patient with low renal function.

### VI139-ED- Five Stages of Artifacts: Denial, Anger, Bargaining, Depression, and Acceptance

WEA9 Awards

Station #9

# **Certificate of Merit**

### Participants

Ece Meram, MD, Madison, WI (*Presenter*) Nothing to Disclose Carson Hoffman, Madison, WI (*Abstract Co-Author*) Nothing to Disclose Sarvesh Periyasamy, MS, Madison, WI (*Abstract Co-Author*) Nothing to Disclose Mark G. Kleedehn, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose Orhan S. Ozkan, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose Paul F. Laeseke, MD, PhD, Madison, WI (*Abstract Co-Author*) Consultant, NeuWave Medical, Inc ; Shareholder, Elucent Medical ; Consultant, Elucent Medical ; Shareholder, HistoSonics, Inc; Consultant, HistoSonics, Inc; Shareholder, McGinley Orthopaedic Innovations, LLC; Grant, Siemens AG

# **TEACHING POINTS**

Image-guided interventions (such as biopsy, ablation, transarterial embolization, etc) are frequently utilized for diagnostic and therapeutic purposes. Image guidance improves target accuracy and increases the safety of procedures. However, intraprocedural imaging can also be challenging to interpret if the image quality is degraded by artifacts. This exhibit aims to (1) demonstrate different types of artifacts commonly encountered during image-guided interventions, including those guided by ultrasound or x-ray based technologies, (2) highlight common limitations of imaging modalities that can delay or impede interventional procedures, and (3) provide alternative approaches to improve image quality or alternative modalities that can be utilized.

### **TABLE OF CONTENTS/OUTLINE**

a. Ultrasound-guidance Types of procedures that US can be used with Types of artifacts How to optimize view and alternatives b. Fluoroscopy-guidance Types of procedures that fluoroscopy can be used with Types of artifacts How to optimize view and alternatives c. Conventional and cone-beam CT-guidance Types of procedures that CT can be used with Types of artifacts How to optimize view and alternatives d. Quiz Cases

#### VI142-ED- Apneic Ventilation Strategies to Limit Respiratory Motion During Percutaneous Ablation WEA10

Station #10

Participants

Sanjit Datta, MS, Cleveland Heights, OH (*Presenter*) Nothing to Disclose Charles Martin III, MD, Pepper Pike, OH (*Abstract Co-Author*) Scientific Advisory Board, Boston Scientific Corporation Scientific Advisory Board, BTG International Ltd Consultant, Terumo Corporation

# **TEACHING POINTS**

1. Techniques for limiting respiratory motion during critical periods of interventional procedures include breath holds, pre-ventilation, and apneic ventilation techniques. 2. Common apneic ventilation strategies include high- and low-frequency jet ventilation and transnasal humidified rapid-insufflation ventilator exchange (THRIVE). 3. Apneic ventilation techniques can limit respiratory motion, thereby simplifying percutaneous access, during difficult ablation cases.

# TABLE OF CONTENTS/OUTLINE

1. Overview of Respiratory Motion Restriction 2. Limitations of Breath Holds 3. Jet Ventilation 4. Case 1: Pleural-Based Nodule Cryoablation with Jet Ventilation 5. Transnasal Humidified Rapid-Insufflation Ventilator Exchange 6. Case 2: Liver Dome Neuroendocrine Tumor Microwave Ablation with THRIVE





### VIS-WEB

Vascular Interventional Wednesday Poster Discussions

Wednesday, Dec. 4 12:45PM - 1:15PM Room: VI Community, Learning Center

# NR RO OI VA

AMA PRA Category 1 Credit ™: .50

**FDA** Discussions may include off-label uses.

# Participants

D. T. Johnson, MD, PhD, South San Francisco, CA (Moderator) Inventor, Thunar Medical, Inc

# Sub-Events

# VI215-SD-WEB1 Station #1

Participants

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# PURPOSE

To compare increasing rate of future liver remnant (FLR) in modified associating liver partition with portal vein ligation or embolization (ALP combination) group and trans-ileocecal portal vein embolization (TIPE) group for staged hepatectomy.

# METHOD AND MATERIALS

Recently, a new technique for hepatic resection that is performed in two stages called associating liver partition and portal vein ligation for staged hepatectomy (ALPPS) has been described. In our hospital, modified ALPPS or associating liver partition and TIPE (ALP-TIPE) have been adopted. From 2012 to 2018, 4 patients underwent modified ALPPS, 3 patients underwent ALP-TIPE [ALP combination group (n=7)], and 14 patients underwent TIPE [TIPE group (n=14)] for right or extended right hepatectomy. The indication for ALP combination was small %FLR: less than 30% [%FLR = FLR ml/[total liver volume; TLV (ml) - tumor volume (ml)] × 100] or large tumor (<7cm) with future liver remnant plasma clearance rate of indocyanine green (ICGK-F) <0.07. TIPE was performed using absolute ethanol. Computed tomography volumetry was performed before and 1 week (ALP combination group) or 3 weeks (TIPE group) after the procedure. The FLR ml ratio (post FLR ml/pre FLR ml) was calculated. We compared the FLR ml ratio of the ALP combination group with that of the TIPE group.

# RESULTS

All procedures succeeded. No procedure-related complications were recorded. The median FLR ml ratio of the ALP combination group was 1.48 (mean  $\pm$  SD 1.49  $\pm$  0.24), that of the TIPE group was 1.24 (mean  $\pm$  SD 1.26  $\pm$  0.13). There was a significant difference (Mann-Whitney *U* Test: *P* =0.03).

# CONCLUSION

Combination of associating liver partition could increase the FLR more than only TIPE.

# **CLINICAL RELEVANCE/APPLICATION**

Combination of associating liver partition could increase the future liver remnant (FLR) more than only trans-ileocecal portal vein embolization (TIPE).

# VI216-SD- Can Computational Fluid Dynamics Predict the Progression of Visceral Artery Aneurysms? WEB2

Station #2

Participants

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# PURPOSE

Progressive visceral aneurysms should be coil-embolized because their rupture is fatal. As aneurysmal blood flow dynamics may be related with progression, its prediction by hemodynamics study may make early intervention possible, save lives, and decrease the complication rate and cost. We investigated whether computational fluid dynamics (CFD) can predict the progression of splenic artery aneurysms, the most frequently-occurring visceral aneurysms.

### **METHOD AND MATERIALS**

This retrospective study included 4 males and 6 females (age range 42 - 74 years) who underwent contrast-enhanced computed tomography (CECT) studies between January 2017 and December 2018. They confirmed splenic artery aneurysms. The patients were divided into a progression- and a non-progression group and followed up for a median of 26 months. For CFD analysis we extracted a 3D vessel model of the aneurysm with proximal and distal vessels in the arterial phase. Blood density was set at 1056 kg/m2, viscosity at 0.0035Pa·s, and the flow volume at 0.0036 kg/s. The blood flow velocity was acquired by Doppler ultrasound; the peak flow was 35 cm/s. The time-arranged wall shear stress (TAWSS) and the oscillatory shear index (OSI) of each aneurysm were calculated with the CFD model and differences between the progression- and the non-progression group were analyzed with the Mann-Whitney U-test.

### RESULTS

The median TAWSS was 166 (range1.38-434) Pa/cycle in patients with- and 1720 (967-5930) Pa/cycle in patients without progression (p = 0.008). The OSI was not different (p = 0.421).

### CONCLUSION

As lower TAWSS may be indicative of an arteriosclerotic process, it may be related with the progression of splenic artery aneurysms; vessel-wall destruction by inflammatory cells may also be related. Additional studies on larger populations are necessary to confirm the validity of CFD analysis to predict the progression of visceral artery aneurysms.

# **CLINICAL RELEVANCE/APPLICATION**

Lower TAWSS, calculated by CFD analysis, may relate to the progression of splenic artery aneurysms. The prediction of progression based on hemodynamics studies may guide the timing of intervention.

#### VI217-SD-WEB3 The Impact of Tissue Characteristics on Outcome of High-Intensity Focused Ultrasound Treatment of Uterine Leiomyomas

# Station #3

Participants

Bilgin Keserci, PhD, Kota Bharu, Malaysia (*Presenter*) Nothing to Disclose Nguyen Minh Duc, MD, Ho Chi Minh, Vietnam (*Abstract Co-Author*) Nothing to Disclose Younis M. Firwana, MSc,BMBCh, Kota Bharu, Malaysia (*Abstract Co-Author*) Nothing to Disclose Chandran Nadarajan, MD, Kota Bharu, Malaysia (*Abstract Co-Author*) Nothing to Disclose Rajiv Chopra, PhD, Dallas, TX (*Abstract Co-Author*) Stockholder, Profound Medical Corporation; Stockholder, Solenic Medical Inc

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### PURPOSE

To comparatively evaluate therapeutic efficacy of high-intensity focused ultrasound (HIFU) ablation of uterine leiomyomas based on T1-perfusion and T2 signal intensity (SI)-based classifications.

# METHOD AND MATERIALS

A total of 74 women with symptomatic leiomyomas (age,  $39.1 \pm 5.9$  years) who underwent HIFU treatment were classified according to (i) T2 SI-based classification as type I (n = 10, if SI of lesion was lower than or equal to that of skeletal muscle), type II (n = 40, if SI of lesion was lower than that of the myometrium but higher than that of skeletal muscles) and type III (n = 17, if SI of lesion was higher than that of the myometrium ), and (ii) T1 perfusion-based classification as group A (n = 44, if the time-SI curve of lesion was lower than that of myometrium) and group B (n = 23, if the time-SI curve of lesion was higher than that of myometrium). The non-perfused volume (NPV) ratios immediately after treatment and volume reduction ratios and transformed symptom severity scores (tSSS) at the 6-month follow-up were retrospectively assessed.

### RESULTS

The mean fibroid volume in type I, II, III, and groups A and B was 155.4ml, 207.7ml, 156.5ml (p > 0.05), and 206.1ml, 150.0ml (p > 0.05), respectively. The mean NPV ratio was significantly higher in group A than in group B (95.6%, 51.9%, respectively; p<0.05). However, no statistically significant difference was observed in the immediate NPV ratio among patients with type I, II and III (80.6%, 79.5%, 83.2%, respectively; p>0.05). The 6-month fibroid volume reduction ratio in group A was significantly greater compared to that in group B (52.7% and 3.6%, respectively; p<0.05), whereas no statistically significant difference was observed among type I, II and III (44.3%, 32.8%, 38.2%, respectively; p>0.05). The corresponding symptom improvement ratio was 70.3%, 53.7%, 55.3% in type I, II and III and 80.9% and 10.1% in group A and group B, respectively.

### CONCLUSION

This study suggests that tissue vascularity based on T1-perfusion based classification could play an important role in not only classifying and stratifying the uterine leiomyomas but also predicting the treatment outcome of HIFU ablation.

### **CLINICAL RELEVANCE/APPLICATION**

In addition to tissue cellularity, vascularity also should be considered in the screening phase to improve the prediction of treatment response.

Station #4

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### PURPOSE

To explore the guiding value of preoperative trigeminal nerve/facial nerve three dimensional brainvolume (3D-BRAVO) and threedimensional time-of-flight (3D-TOF) MRA scanning for microvascular decompression.

# METHOD AND MATERIALS

113 patients treated with microvascular decompression from February 2016 to February 2018 in First Affiliated Hospital of Dalian Medical University were retrospectively analyzed. All patients received 3D-BRAVO combined with 3D-TOF MRA sequence reconstruction before operation(Fig.1). Magnetic resonance scanning sequence includes 3D-BRAVO sequence, 3D-TOF sequence and 3D-FIESTA sequence. The anatomical relationship of neurovascular was analyzed and compared with the results of intraoperative exploration. The data were analyzed by SPSS 22.0. P < 0.05 was considered statistically significant.

### RESULTS

After reconstruction of 3D-BRAVO combined with 3D-TOF sequence,3D-FIESTA combined with 3D-TOF sequence, all patient images can visually observe trigeminal nerve, facial nerve and three-dimensional images of peripheral blood vessels from different angles. The relationship between the blood vessels and nerves were assessed. Responsible blood vessels are obtained by intraoperative exploration as the gold standard. The results of MVD showed that the number of positive cases is 108 (95.6%) on the involved side. 3D-BRAVO combined with 3D-TOF sequence reconstruction showed positive 106 cases (93.8%) with 98.1% positive coincidence rate and 5.3% false positive rate. 3D-FIESTA combined with 3D-TOF sequence reconstruction showed positive 98 cases (86.7%) with 90.7% positive coincidence rate.

# CONCLUSION

3D-BRAVO combined with 3D-TOF sequence reconstruction before microvascular decompression can fully evaluate the morphology, location and anatomical relationship of the lesions, and improve the clarity and recognition of neurovascular tissue, which is of guiding value for clinical diagnosis and treatment.

### **CLINICAL RELEVANCE/APPLICATION**

3d-BRAVO combined with 3D-TOF MRA sequence reconstruction technology improves the definition and identification of neurovascular tissue, carefully understands the size range, morphology, location and anatomical relationship of the lesion, and assists neurosurgeons to make surgical plans, increasing the probability of finding the responsible vessel and successful MVD surgery.

### VI271-SD- Digital Variance Angiography as a Risk Reduction Measure in Peripheral Endovascular Interventions WEB5

Station #5

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### PURPOSE

Digital Variance Angiography (DVA) - that is based on the kinetic imaging technology - is a novel, patented X-ray image processing method visualizing contrast motion by calculating the variance of each pixel intensity in a recorded series of images. The image processing algorithm is built in a software that is able to generate DVA images from raw X-ray image series. Our aim was to determine the potential benefits of DVA in peripheral endovascular interventions.

### **METHOD AND MATERIALS**

Two observational studies enrolled 66 patients undergoing lower limb X-ray angiography due to symptomatic peripheral arterial disease. A subgroup of 24 patients received carbon-dioxide (CO2) as contrast agent. We compared the signal-to-noise ratios (SNRs) of Digital Subtraction Angiography (DSA) and DVA image pairs. Visual quality comparisons were also performed by vascular specialists using an online questionnaire. Interrater agreement was characterized by percent agreement and Fleiss' kappa.

### RESULTS

A total of 6814 regions of interest were selected on image pairs to calculate and compare SNRs. The ratio of SNR(DVA)/SNR(DSA) was calculated. DVA provided 3.3 times (median) higher SNR than DSA on angiograms obtained using iodinated contrast medium (ICM). The ratio was 3.0 times (median) higher in the images of the CO2 subgroup. In 69% of the ICM group comparisons it was judged that DVA provided higher quality images than DSA. Fleiss's kappa was 0.17 (p<0.001). DVA was preferred over DSA in 85% of paired image comparisons in the CO2 subgroup. Fleiss's kappa was 0.27 (p<0.001).

### CONCLUSION

In conclusion, DVA provides significantly higher image quality than DSA while performing catheter angiography with ICM or CO2. The higher image quality makes CO2 angiography more feasible for patients with renal insufficiency and iodine allergy. The significant SNR difference suggests a remarkable reduction of radiation and ICM exposure, thus ongoing studies are investigating the optimal protocols for low-dose DVA acquisition.

# CLINICAL RELEVANCE/APPLICATION

Digital Variance Angiography (DVA) significantly improves the image quality of X-ray angiograms compared to DSA. The quality reserve of DVA allows a substantial amount of iodinated contrast agent and radiation dose reduction but further studies are needed for the precise refinement of image acquisition protocols. The new technique helps the widespread use of CO2 as a safer contrast agent.

#### VI268-SD-WEB6 Time-Driven Activity-Based Costing in Interventional Oncology: Calculating the Longitudinal Costs of Care for Multidisciplinary HCC Care

Station #6

Trainee Research Prize - Medical Student

Participants

Awards

Damir Ljuboja, MBA, Cambridge, MA (*Presenter*) Nothing to Disclose Enio T. Perez, MPH, Milton, WI (*Abstract Co-Author*) Nothing to Disclose Michael Subrize, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Jeffrey Weinstein, MD, Wellesley, MA (*Abstract Co-Author*) Nothing to Disclose Salomao Faintuch, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Muneeb Ahmed, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose Scientific Advisory Board, Agile Devices, Inc Robert S. Kaplan, Boston, MA (*Abstract Co-Author*) Advisory Board, Avant-Garde Health; Speaker, Medtronic plc Ammar Sarwar, MD, Boston, MA (*Abstract Co-Author*) Stockholder, Agile Devices, Inc; Grant Support, Sirtex Medical Inc

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#### PURPOSE

Only 36% of Medicare patients with hepatocellular carcinoma (HCC) undergo cancer therapy. Transarterial chemoembolization (TACE) is utilized 10 times more frequently than ablation for Medicare patients. Multidisciplinary care improves quality and utilization of cancer therapy; however, the true costs of such care are poorly understood. Therefore, the purpose of this study was to use time-drive activity-based costing (TDABC) to determine the costs of multidisciplinary liver clinic, TACE, yttrium-90 radioembolization (Y90) and ablation during HCC therapy.

### **METHOD AND MATERIALS**

In this HIPAA-compliant, IRB-approved study, three observers prospectively recorded the utilization time for staff members, consumables, and equipment used to treat ten HCC patients during multidisciplinary liver clinic, TACE, Y-90, and ablation procedures. Process maps captured patient flow from admission to discharge, and the total duration of each phase of care was determined with prospective measurements. Capacity cost rates (cost per minute) were calculated for all staff members and fixed equipment. These rates were multiplied by the average utilization duration per resource to determine the average cost of that resource for each procedure.

### RESULTS

The total costs of ablation were \$3,826, which was 75% of the \$5,088 cost for TACE, and 18% of the \$20,747 cost of Y-90. The cost for an ablation increased from \$3,288 to \$4,245 to \$4,461 for one vs. two vs. three lesions treated. The cost for a TACE increased from \$5,051 to \$5,296 for non-selective (lobar) vs. selective TACE. Consumables were the greatest cost contributor across all three procedures and accounted for 63% of ablation, 58% of TACE, and 91% of Y-90 costs. A single consumable accounted for a substantial portion of the overall procedure cost, namely ethiodized oil for TACE (30%), Y-90 resin microspheres for Y-90 (81%), and the probe for ablation (41%). Multidisciplinary tumor clinic cost was \$334 per patient, driven entirely by personnel.

#### CONCLUSION

Using a bottom-up costing approach, ablation costs are significantly less than those of TACE and Y-90 despite the increased utilization of non-curative therapies in the Medicare population.

### **CLINICAL RELEVANCE/APPLICATION**

A HCC bundled payment model may improve treatment utilization and use of potentially curative treatments. However, true costs of care need to be evaluated to accurately determine financial risk.

#### VI270-SD-WEB8 Radiomics Analysis to Predict Progression-Free Survival for Patients of RFA by Using Deep Learning in Contrast-Enhanced Ultrasound

Station #8

Participants

Fei Liu JR, MD, MD, Beijing, China (*Presenter*) Nothing to Disclose Dan Liu, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose Kun Wang, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Manxia Lin, MD, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose Xiaoyan Xie, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose Jie Tian, PhD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

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### PURPOSE

To develop and validate an deep learning (DL) based radiomics method for predicting progression-free survival (PFS) of radiofrequency ablation (RFA) accurately based on contrast-enhanced ultrasound (CEUS).

### **METHOD AND MATERIALS**

Two hundred and fourteen patients were enrolled respectively (training cohorts: 149, validation cohorts: 65), who received CEUS within one week before RFA. DL-based radiomics model was developed and validated to predict the probability of PFS. Harrell's concordance index (C-index) was used to quantify the prediction performance. Kaplan-Meier survival curve was applied to show the stratification of PFS. An individualized prediction model incorporating the radiomics signature and clinical variables was proposed for the prediction of PFS, accompanied with calibration and decision curve analysis.

### RESULTS

The C-index of the proposed model was 0.754 and 0.725 in training and validation cohorts, respectively. The radiomics signature was significantly associated with PFS (P<0.05 for two cohorts). The individualized model, which incorporated the age, PLT and radiomics signature, showed good discrimination as well, with good calibration result (P>0.05). Decision curve analysis confirmed the radiomics model's clinical utility.

### CONCLUSION

Using CEUS cines data, our developed DL-based radiomics model showed excellent prediction performance for PFS of RFA. This noninvasive radiomics model may be used to identify patients who are more likely to benefit from RFA before treatment and optimize the clinical strategy.

# **CLINICAL RELEVANCE/APPLICATION**

DL-based radiomics analysis can predict PFS of RFA with CEUS cines and distinguish who could benefit more from RFA to optimize the clinical decision making.

# VI141-ED- Percutaneous Omental Biopsies: A Safe and Non-Surgical Method in Evaluation of Abdominal Disease WEB9

Station #9

Participants Varun Chaudhry, MBBS, Delhi, India (*Abstract Co-Author*) Nothing to Disclose Vivek Saxena, MD, New Delhi, India (*Abstract Co-Author*) Nothing to Disclose Amit K. Sahu, MBBS, MD, New Delhi, India (*Presenter*) Nothing to Disclose

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# **TEACHING POINTS**

1. Evaluation of etiology of omental thickening in ascites of unknown origin. 2. Demonstrate histopathological findings in a series of patients.

### **TABLE OF CONTENTS/OUTLINE**

Materials and methods A retrospective search of all patients who underwent omental biopsies was done from Feb 2011 to January 2019.A total of 153 patients were reviewed, out of which, three patients were lost to follow up,therefore were excluded from the study.150 patients were finally enrolled into the study.110/150 patients were biopsied using CT and USG guidance combined, while 40/150 patients underwent biopsy using USG guidance .Biopsies were done using 18 G needle .The number of new malignancies diagnosed by omental / peritoneal biopsies were also recorded. Data analysis:Sensitivity, specificity, positive and negative predictive values were calculated .Biopsy result was positive for disease in 144 / 150 (96. %) patients. Four patients were negative on biopsy. 3/150 patients with negative biopsy result were found to hematomas, which resolved on subsequent scans.Thus, in the entire group,the sensitivity was 97.29 % (144/158); Conclusion USG-guided biopsy of the omentum is a safe and effective procedure. A thickened omentum can serve as an easily accessible site for biopsy, especially in patients who have ascites of unknown etiology and in those with a history of previous malignancy.







# SSM20

# Neuroradiology (Vascular, Non-Stroke)

Wednesday, Dec. 4 3:00PM - 4:00PM Room: S502AB



AMA PRA Category 1 Credit ™: 1.00 ARRT Category A+ Credit: 1.00

# Participants

Alexander M. McKinney IV, MD, Minneapolis, MN (*Moderator*) CEO, VEEV, Inc Daniel M. Mandell, MD, PhD, Toronto, ON (*Moderator*) Nothing to Disclose Luca Saba, MD, Cagliari, Italy (*Moderator*) Nothing to Disclose

### Sub-Events

# SSM20-01 Intracranial Aneurysms In Hereditary Hemorrhagic Telangiectasia

Wednesday, Dec. 4 3:00PM - 3:10PM Room: S502AB

Participants

Matias J. Rodriguez, MD, CABA, Argentina (*Presenter*) Nothing to Disclose Manuel S. Perez Akly, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose Florencia Conde, MD, Ciudad Autonoma de Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose Dan Dardik, MD, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose Cristina H. Besada SR, MD, PhD, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose

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# PURPOSE

Hereditary hemorrhagic telangiectasia (HHT) is an autosomal dominant disease induced by mutation of genes involved in angiogenesis' regulation, around 10-20% of patients may have cerebral vascular malformations. Intracranial aneurysms (ICA) are acquired vascular lesions, with prevalence of 3-5% in general population. HHT has not been specifically linked to ICA. Our purpose is to describe the frequency of ICA in population with HHT diagnosis in a reference center.

# **METHOD AND MATERIALS**

We performed a cross sectional study. We included patients with HHT who had performed an angiographic study: MR angiography, CT angiography or digital angiography from 2010 to 2018, with available images for interpretation. We recorded the location, the geometric characteristics and the presence of other cerebral vascular malformations. We evaluated the result of genetic test when available and it's association with ICA.

# RESULTS

We included 151 patients with an angiographic studies, 96 female and 55 male. The average age was 47,7 years old (SD 18,3). We found 24 ICA in 22 (14,5%) patients. The location of aneurysms were: middle cerebral artery 7/24 (29,2%) ophthalmic artery 5/24 (26,1%), intracavernous carotid artery 3/24 (12,5%), posterior communicating artery 3/24 (12,5%), anterior communicating artery 2/24 (8,3%), 1/24 (4,2%) in basilar tip and 1/24 (4,2%) anterior cerebral artery. The mean diameter of ICA was 3,4mm (SD 1.18mm). Genetic test was available in 65 patients, we found ICA in 9 of them. No statistical association was found between the presence of ICA and genetic mutations. We found cerebral AVMs in 43 patients (28,5%), in this subgroup 12 patients also had ICA, (association between both vascular malformations p=0,004). The odds ratio of having both ICA and cerebral AVMs was 4,2 (CI 95%=1,6-11,4)

# CONCLUSION

We found a frequency of ICA in HHT (14,5%). This finding may be related to arterial wall disorders induced by known genetic mutations in this disease. According to this findings, the risk of having an ICA increases approximately 3 to 5 times in patients with HHT compared to general population and its presence is associated with cerebral AVMs.

# **CLINICAL RELEVANCE/APPLICATION**

There is an increased risk of having an intracranial aneurysm in patients diagnosed with HHT. This is important because it requires increasing suspicion in this patients for the diagnosis and treatment of the aneurysms.

# SSM20-02 Readmission and Retreatment after Elective Treatment of Unruptured Cerebral Aneurysm: A Nationwide Readmission Database Analysis

Wednesday, Dec. 4 3:10PM - 3:20PM Room: S502AB

Participants Pedram Golnari, MD, Chicago, IL (*Presenter*) Nothing to Disclose Pouya Nazari, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose Roxanna M. Garcia, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose Hannah K. Weiss, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose Sameer A. Ansari, MD,PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose Ali Shaibani, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose Matthew B. Potts, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose Michael C. Hurley, MBBCh, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose Babak S. Jahromi, MD,PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Mortality rates following treatment of unruptured cerebral aneurysm (UA) have decreased over the past decades, which may be due to use of modern microsurgical and endovascular techniques as well as overall increased volumes of UA treatment. However, treatment of UA harbors a small but finite risk, and resulting readmission and retreatment rates have not been well described.

#### **METHOD AND MATERIALS**

Adult patients who underwent elective coiling or clipping of UA were extracted from the Nationwide Readmission Database spanning 2010 to 2015. Primary diagnosis for non-elective readmission within 30 and 90 days were identified and readmission and retreatment rates for coiling vs clipping were compared. To calculate 30 and 90-day readmission and retreatment rates, we included patients within the first 11 and 9 months of each year, respectively. Poisson regression was performed using generalized estimating equations and adjusted risk ratio (aRR)s were obtained for factors associated with 30 and 90 day readmission and retreatment. The adjusted model included terms for patient- and hospital-specific factors, comorbidity scores and disease severity.

### RESULTS

Of 61,894 UA patients treated and discharged alive, 5.98% and 8.99% patients were readmitted and 0.14% and 0.33% patients were retreated within 30 and 90 days, respectively. The most common primary diagnoses for readmission within 30 and 90 days, respectively, was ischemic or hemorrhagic stroke (16.13%, 21.82%). The 30 and 90-day readmission rate for coiling vs clipping was 4.87% vs 8.68% (p<0.001) and 7.82% vs 11.87% (p<0.001), respectively (figure). The 30 and 90-day retreatment rates for coiling vs clipping were 0.18% vs 0.04% (p<0.001) and 0.37% vs 0.22% (p=0.007), respectively. Patients undergoing clipping had a higher adjusted risk of 30 and 90 day retreatment (aRR=0.33; 95%CI, 1.49-1.90; p<0.001) and aRR=1.40; 95%CI, 1.27-1.54; p<0.001) but a lower adjusted risk of 30 day retreatment (aRR=0.33; 95%CI, 0.12-0.89; p=0.029) than patients having coiling.

#### CONCLUSION

The most common primary diagnoses for 30 and 90 day non-elective readmission after treatment of UA is stroke. Readmission rates are higher for clipping, but retreatment rates are higher for coiling.

### **CLINICAL RELEVANCE/APPLICATION**

Patients undergoing clipping of UA have higher readmission rates but lower retreatment rates. These data may help patients and clinicians in selection of treatment modality for UA.

### SSM20-03 Management of Tiny Unruptured Intracranial Aneurysms: A Cost-Effectiveness Analysis

Wednesday, Dec. 4 3:20PM - 3:30PM Room: S502AB

Participants

Xiao Wu, New Haven, CT (*Presenter*) Nothing to Disclose Ichiro Ikuta, MD,MMedSc, Milford, CT (*Abstract Co-Author*) Nothing to Disclose Dheeraj Gandhi, MBBS, MD, Baltimore, MD (*Abstract Co-Author*) Research Grant, Stryker Corporation Research Grant, Medtronic plc Pina C. Sanelli, MD,MPH, Manhasset, NY (*Abstract Co-Author*) Nothing to Disclose Ajay Malhotra, MD, Stamford, CT (*Abstract Co-Author*) Nothing to Disclose

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### PURPOSE

To evaluate the effectiveness, costs and incremental cost of routine treatment (aneurysm coiling) versus 3 different strategies for imaging surveillance in relation to no preventive treatment or routine follow-up of tiny UIAs.

#### **METHOD AND MATERIALS**

A decision-analytic model-based cost-effectiveness analysis was constructed using inputs from the medical literature. Five different management strategies for tiny unruptured intracranial aneurysms (UIAs) were evaluated - annual magnetic resonance angiography (MRA) screening, biennial MRA screening, MRA screening every 5 years, coiling and follow-up and, no treatment or preventive follow-up. Markov decision model for lifetime rupture was constructed from a societal perspective per 10,000 patients with incidental, tiny UIAs. Outcomes were assessed both in terms of cost and quality-adjusted life years (QALYs). Incremental cost-effectiveness ratio (ICER) and net monetary benefit (NMB) for each strategy were evaluated. Probabilistic, one-way, and two-way sensitivity analyses were performed.

### RESULTS

The base-case calculation shows no treatment or preventive follow-up to be the most cost-effective strategy. Among the imaging follow-ups, MRA every 5 years is the best strategy with the next highest effectiveness. The conclusion remains robust in probabilistic and one-way sensitivity analyses. No routine follow-up remains the optimal strategy when the annual growth rate and rupture risk of growing aneurysms are varied. When the annual rupture risk of non-growing UIAs is <2.1%, no follow-up is the optimal strategy. If annual rupture risk is >2.1%, coiling should be performed directly.

### CONCLUSION

Given the current literature, no preventive treatment or imaging follow-up is the cost-effective strategy in patients with aneurysms <=3 mm, resulting in better health outcomes and lower healthcare spending. More aggressive imaging surveillance for aneurysm growth or preventive treatment should be reserved for patients with high risk of rupture.

### **CLINICAL RELEVANCE/APPLICATION**

Civen our findings we need to critically evaluate the annronriateness of our current clinical practices and notentially determine

specific guidelines to reflect the most effective management strategy for patients with incidental, tiny UIAs.

# SSM20-04 Multi-Modal Convolutional Neural Networks with 2D and 3D Information Can Improve It's Sensitivity and Specificity for Detecting Cerebral Aneurysms in MR Angiography

Wednesday, Dec. 4 3:30PM - 3:40PM Room: S502AB

Participants

Yuki Terasaki, Chiba, Japan (*Presenter*) Nothing to Disclose Hajime Yokota, MD, Chiba, Japan (*Abstract Co-Author*) Nothing to Disclose Ryuna Kurosawa, Chiba, Japan (*Abstract Co-Author*) Nothing to Disclose Hiroki Mukai, Chiba, Japan (*Abstract Co-Author*) Nothing to Disclose Shoma Yamauchi, Chiba, Japan (*Abstract Co-Author*) Nothing to Disclose Joji Ota, Chiba, Japan (*Abstract Co-Author*) Nothing to Disclose Takuro Horikoshi, MD, Chiba, Japan (*Abstract Co-Author*) Nothing to Disclose Takashi Uno, Chiba, Japan (*Abstract Co-Author*) Nothing to Disclose Yasukuni Mori, Chiba, Japan (*Abstract Co-Author*) Nothing to Disclose Hiroki Suyari, Chiba, Japan (*Abstract Co-Author*) Nothing to Disclose

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### PURPOSE

Convolutional neural networks (CNN) with two-dimensional inputs for detecting cerebral aneurysm in magnetic resonance angiography (MRA) images have been proposed. The CNN can archive high sensitivity, although its outputs contain a large number of false positives. Various efforts for reducing false positives were implemented so far, but techniques applying three-dimensional information have not been reported. The purpose of this study was to develop multi-modal CNN taking advantage of both 2D and 3D information, and to investigate the performance improvement of aneurysms detection. As the 2D and 3D streams extract different features from inputs, we hypothesized multi-modal CNN could obtain new feature representations different from CNN with 2D input only.

# METHOD AND MATERIALS

This study included 142 aneurysms (mean size, 4.1 mm  $\pm$  1.7 [standard deviation]; range, 1.3 - 9.7 mm) in 125 patients (76 men and 49 women; mean age, 67.6 years; range, 13 - 86 years). MRA were acquired with 81 1.5-T and 44 3.0-T MRI units, respectively. Two radiologists delineated volumes of interests (VOI) of each aneurysm on MRA with consensus. Multi-modal CNN with two streams, 2D and 3D CNNs was developed. Maximum intensity projection (MIP) images around VOI were input into 2D CNN, and a box containing VOI was directly used as the input voxel of 3D CNN. 4-fold cross validation was performed to calibrate generalization ability of the model. The new model was compared with conventional CNN with only 2D input using free-response receiver operating characteristic (FROC) analysis.

### RESULTS

The average sensitivities of the 2D CNN and multi-modal CNN to detect aneurysms were 92.4% and 95.2% in eight positive candidates. Although the best sensitivity of 2D CNN was 92.4% at 6.7 false positives per image (FPI), multi-modal CNN achieved the same sensitivity as above at 5.7 FPI. In particular, the number of true positives increased at the middle cerebral artery using the proposed model.

### CONCLUSION

Multi-modal CNN using 3D appearance information in addition to conventional 2D shape information improved sensitivity and specificity for detecting cerebral aneurysms compared with conventional CNN with 2D input only.

### **CLINICAL RELEVANCE/APPLICATION**

Adding an auxiliary three-dimensional information can improve sensitivity and specificity of convolutional neural networks-based system for detecting cerebral aneurysms in MR angiography.

# SSM20-05 Increased Diagnostic Accuracy of Giant Cell Arteritis Using Three-Dimensional Fat-saturated Contrast-Enhanced Vessel-Wall Magnetic Resonance Imaging at 3 Tesla

### Wednesday, Dec. 4 3:40PM - 3:50PM Room: S502AB

Participants

Guillaume Poillon, MD, Paris, France (*Presenter*) Nothing to Disclose Adrien Collin, Paris, France (*Abstract Co-Author*) Nothing to Disclose Cecile Pinson, MD, Rouen, France (*Abstract Co-Author*) Nothing to Disclose Ygal Benhamou, Paris, France (*Abstract Co-Author*) Nothing to Disclose Gaelle Clavel, Paris, France (*Abstract Co-Author*) Nothing to Disclose Frederique Charbonneau, Paris, France (*Abstract Co-Author*) Nothing to Disclose Catherine Vignal, Paris , France (*Abstract Co-Author*) Nothing to Disclose Thomas Sene, Paris, France (*Abstract Co-Author*) Nothing to Disclose Julien Savatovsky, MD, Saint Mande, France (*Abstract Co-Author*) Nothing to Disclose Emmanuel Gerardin, MD, Rouen Cedex, France (*Abstract Co-Author*) Nothing to Disclose Augustin Lecler, MD, Paris, France (*Abstract Co-Author*) Nothing to Disclose

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### PURPOSE

To compare the diagnostic accuracy of 3D versus 2D Contrast-Enhanced Vessel-Wall (CE-VW) MRI in the diagnosis of GCA.

### **METHOD AND MATERIALS**

This prospective two-center study was approved by a national research ethics board and included 79 patients (51 GCA and 28 non-GCA) from December 2014 to October 2017. Two neuroradiologists, blinded to clinical data, individually analyzed 2D and 3D CE-VW MRIs separately and in random order. Discrepancies were resolved by consensus by a third neuroradiologist. The primary judgment criterion was the presence of GCA-related inflammatory changes, determined by arterial wall thickening and mural enhancement of extracranial arteries. Secondary judgment criteria included inflammatory changes of intracranial arteries and the presence of artifacts. A McNemar's test was used to compare 2D to 3D CE-VW MRIs.

### RESULTS

3D CE-VW was significantly more sensitive and specific than 2D CE-VW when showing inflammatory change of extracranial arteries: 80% versus 70% (p= 0.03) and 100% versus 85% (p= 0.04), respectively. 3D CE-VW showed higher sensitivity when detecting inflammatory changes of intracranial arteries: 20% versus 8% (p=0.01).Interobserver agreement was excellent for both 2D and 3D CE-VW MRI: K = 0.84 and 0.82 respectively. There was a negative correlation between CE-VW MR diagnostic accuracy and a longer corticosteroids-MRI delay with an optimal threshold of 3 and 5 days for 2D and 3D CE-VW respectively.

### CONCLUSION

3D CE-VW MRI supported more accurate diagnoses of GCA than 2D CE-VW. MRI should be performed as soon as possible, ideally before or within the first five days after corticosteroid therapy.

# CLINICAL RELEVANCE/APPLICATION

3D Contrast-enhanced Vessel-wall Magnetic Resonance Imaging is a highly precise non-invasive tool that might compete for time to complete a temporal artery biopsy when Giant Cell Arteritis is suspected.

# SSM20-06 Diagnostic Accuracy of Routine Non-Contrast MRI Sequences for Dural Venous Sinus Thrombosis

Wednesday, Dec. 4 3:50PM - 4:00PM Room: S502AB

### Participants

Minako Azuma, Miyazaki, Japan (*Abstract Submitter*) Nothing to Disclose Yoshiyuki Watanabe, MD, PhD, Suita, Japan (*Abstract Co-Author*) Research Grant, Canon Medical Systems Corporation; Research Grant, Dai Nippon Printing Co, Ltd; Speakers Bureau, General Electric Company Yoshihito Kadota, Miyazaki, Japan (*Abstract Co-Author*) Nothing to Disclose Zaw Aung Khant, Miyazaki, Japan (*Abstract Co-Author*) Nothing to Disclose Youhei Hattori, Miyazaki, Japan (*Abstract Co-Author*) Nothing to Disclose Toshinori Hirai, MD, PhD, Miyazaki, Japan (*Presenter*) Research Grant, Bayer AG

### PURPOSE

To determine what routine non-contrast MR imaging (MRI) sequence or combination of MRI sequences is most useful for the diagnosis of dural venous sinus thrombosis (DVST).

# METHOD AND MATERIALS

This multicenter study included 81 DVST patients (39 men, 42 women; age range 20-91 years; mean age 50 years) who underwent routine non-contrast 1.5- or 3T MRI within 14 days of digital subtraction angiography (DSA), contrast-enhanced MR venography, and/or CT venography. The controls were 243 age- and sex-matched individuals without DVST. They also underwent routine 1.5- or 3T MRI before- or within one month after DSA. The DVSTs were located in the transverse-, sigmoid-, and/or superior sagittal sinus. Three independent, blinded observers separately evaluated T1-, T2-, diffusion-, T2\*-, and susceptibility-weighed images (T1WI, T2WI, DWI, T2\*WI, and SWI) and FLAIR images for the presence or absence of DVST. The area under the receiver operating characteristics curve (AUC) was calculated for each MRI sequence. Fleiss  $\kappa$  statistics were applied to assess interobserver agreement. Univariate and multivariate analyses were performed to evaluate the predictive value of the sequences.

### RESULTS

The overall accuracy for the diagnosis of DVST was 0.592 for T1WI, 0.914 for T2WI, 0.874 for FLAIR, 0.871 for DWI, 0.792 for T2\*WI, and 0.673 for SWI. T2WI and DWI were most predictive of DVST [odds ratio (OR): 41.0; 95% confidence interval (CI) 7.8 - 216.3 and OR 75.1; 95% CI 15.6 - 361.6, respectively]. The combined use of T2WI and DWI yielded significantly better diagnostic performance than each sequence alone (p<0.05); the AUC was 0.802 (95% CI, 0.749 - 0.856). Interobserver agreement was good for T1WI ( $\kappa$ =0.681), T2WI ( $\kappa$ = 0.795), FLAIR ( $\kappa$ =0.719), and T2\*WI ( $\kappa$ =0.745). It was moderate for DWI ( $\kappa$ = 0.600) and fair for SWI ( $\kappa$ = 0.351).

# CONCLUSION

Among the examined routine non-contrast brain MRI sequences, the combined use of T2WI and DWI was the most predictive of DVST.

# **CLINICAL RELEVANCE/APPLICATION**

Routine non-contrast brain MRI sequences, especially T2WI and DWI, were useful for evaluating DVST.





# SSM25

# Vascular/Interventional (Mixed Oncology/Embolization Science)

Wednesday, Dec. 4 3:00PM - 4:00PM Room: S403B



AMA PRA Category 1 Credit ™: 1.00 ARRT Category A+ Credit: 1.00

### Participants

Paul M. Haste, MD, Indianapolis, IN (*Moderator*) Research support, Boston Scientific; Consultant, Boston Scientific Claire Kaufman, MD, Salt Lake City, UT (*Moderator*) Nothing to Disclose

### Sub-Events

# SSM25-01 Novel Performance Descriptor for Contrast-Free Ultrasound Microvascular Imaging Based on Spatio-Temporal Correlation of the Doppler Ensemble

Wednesday, Dec. 4 3:00PM - 3:10PM Room: S403B

Participants Rohit Nayak, PhD, Rochester, MN (*Presenter*) Nothing to Disclose Mostafa Fatemi, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose Azra Alizad, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose

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### PURPOSE

Despite effective clutter filtering, presence of motion in ultrasound microvascular imaging (USMI) can lead to incoherent integration of the Doppler ensemble (DE), resulting in poor blood flow visualization. A motion corrupted DE can lead to over- or underestimation of blood vessels [1], resulting in misleading diagnosis without any indication or forewarning. We hypothesize that the proposed spatiotemporal correlation matrix as a reliable indicator of coherency of the DE to (1) determine in real-time if the acquired DE is corrupted by motion, (2) identify frames in the DE that needs motion correction (MC) or rejection, and (3) determine the efficacy of MC of *in vivo* patient data, where ground truth is unavailable.

### **METHOD AND MATERIALS**

We conducted in vivo USMI on 10 thyroid nodules -- prone to motion due to its proximity to the pulsating carotid artery. Thyroid displacements were estimated using normalized 2D cross-correlation and were motion corrected [1]. The pixels associated with the thyroid nodule in the DE were rearranged in the Casorati form and their correlation matrices were estimated [2]. [1] Non-contrast agent based small vessel imaging of human thyroid using motion corrected power Doppler imaging. Scientific Reports, 2018. [2] Non-invasive Small Vessel Imaging of Human Thyroid Using Motion-Corrected Spatiotemporal Clutter Filtering. UMB, 2019.

# RESULTS

Visualization of the blood vessel substantially improved upon MC (Fig.1a-d). Correspondingly, the mean correlation of the DE (e,f) increased by 33 % upon MC, which is important for coherent integration of the DE [2]. Further, the frames 1580 - 1848 displayed relatively lower correlation even after MC, which indicated out-of-plane motion that cannot be motion corrected, and thus should be rejected prior to integration of the DE. Further, a mean-correlation-image estimated using overlapping 3x3 kernels was useful in assessing the quality of USMI, and in identifying regions that lacked visualization of the blood flow signal due to incoherency of the DE.

### CONCLUSION

These preliminary results were encouraging for large-scale in vivo validation.

# **CLINICAL RELEVANCE/APPLICATION**

Non-invasive, contrast-free USMI could be invaluable in detection and monitoring of diseases and cancerous masses. This technology addresses a key issue of obtaining robust, real-time feedback on if the absence of microflow signal in USMI is accurate and quantifies its degree of trustworthiness.

# SSM25-02 Comparison of High-Resolution Cone-Beam CT and Multi-Detector Computed Tomography for Abdominal Post-Embolization Imaging: Effect on Image Quality, Workflow, Radiation Dose, and Accuracy of Lesion Volumetry

Wednesday, Dec. 4 3:10PM - 3:20PM Room: S403B

Participants

Leona Alizadeh, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose Thomas J. Vogl, MD, PhD, Frankfurt, Germany (*Presenter*) Nothing to Disclose Moritz H. Albrecht, MD, Charleston, SC (*Abstract Co-Author*) Speaker, Siemens AG Richard D. Maeder, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To assess latest-generation intraprocedural cone-beam computed tomography (CBCT) versus multi-detector computed tomography (MDCT) after conventional transarterial chemoembolization (cTACE), regarding visualization of ethiodized oil distribution, imagequality, effective-dose, and tumor volumetry in patients with hepatic malignant tumors.

### METHOD AND MATERIALS

114 patients (64 female, mean age 57  $\pm$ 14 years) who had undergone TACE followed by CBCT and MDCT of the upper abdomen were included. Image quality scores were compared for both efficacy and complications and overall image quality between CBCT and MDCT images by two blinded readers using 4-point Likert-scales. Lesion volume was measured in both modalities and compared to values from pre-interventional T2-weighted MRI. In addition, we performed effective dose measurements for CBCT and two MDCT protocols using an anthropomorphous phantom.

### RESULTS

CBCT outperformed MDCT in terms of efficacy and complications (mean score,  $3.2\pm0.7$  versus  $2.6\pm0.4$ , p=0.01X). Overall image quality was inferior for CBCT (mean score,  $2.8\pm0.7$  versus  $3.1\pm0.4$  for MDCT, p<0.001). The 4-second CBCT protocol showed a higher mean effective dose of 4.7 mSv compared to MDCT, we measured 2.5 mSv with a scan-length of 22.6 cm and 2.1 mSv for a shorter length of 17.3 cm, corresponding to the shorter CBCT field-of-view. No significant differences were found regarding volumetry of malignant lesions compared to MRI (mean volume on CBCT, 26.98 ± 17.43 mm2 and on MDCT: 26.75 ± 16.00 mm2, p=0.661).

### CONCLUSION

Latest-generation CBCT facilitate sufficient image quality levels for the performance of this procedure in the post-interventional assessment in patients undergoing TACE at higher, yet acceptable effective dose levels compared to MDCT, while potentially improving the patient safety and clinical workflow. Both CBCT and MDCT can be robustly used for volumetric measurements.

# CLINICAL RELEVANCE/APPLICATION

Latest CBCT may be preferentially chosen to MDCT for post lipiodol TACE evaluation as image quality, worklfow and treatment safety benefit from having an intraprocedural feedback, while giving the ability to immediately adjust therapy and react to complications if necessary.

# SSM25-03 Survival after Local Therapies for Stage IA/B Renal Cancer: Subgroup Analysis Based on Tumor Histology

Wednesday, Dec. 4 3:20PM - 3:30PM Room: S403B

# Participants

Johannes Uhlig, Goettingen, Germany (*Presenter*) Nothing to Disclose Hyun S. Kim, MD, New Haven, CT (*Abstract Co-Author*) Boston Scientific Corporation; Galil Medical Ltd ; Sirtex Medical Ltd

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### PURPOSE

To assess the effectiveness of local ablation techniques and surgical resection for treatment of stage IA/B renal cell cancer (RCC).

# METHOD AND MATERIALS

The 2004-2015 National Cancer Database was searched for stage IA/B RCC. Inclusion criteria were clear cell or papillary RCC, surgical resection (partial or radical nephrectomy), radiofrequency/microwave ablation (RFA/MWA) or cryoablation (CRA), age > 18yo, and complete follow up. RFA/MWA, CRA and surgical resection patients were 1:1:1 propensity score matched to account for confounders, separately for each histology. Overall survival (OS) was compared in the matched cohorts using Kaplan-Meier plots, log-rank tests, and Cox proportional hazards models.

# RESULTS

162,640 patients met inclusion criteria: n=153,729 receiving surgical resection (94.5%), n=5,574CRA (3.4%) and n=3,337 receiving RFA/MWA (2.1%). Ablation patients were older, had more comorbidities and were more likely treated at academic centers for smaller diameter papillary RCCs. After multivariable adjustment, overall survival was comparable for papillary RCC and clear cell RCC (HR=0.97, 95% CI: 0.93-1.01, p=0.13). After propensity score matching, two separate cohorts with balanced distribution of patient- and tumor-related confounders were obtained (ccRCC n=6,168; papillary RCC n=1,899). For papillary RCC, OS was comparable for CRA and surgical resection (survival difference p=0.86; 1-year OS: 98 vs 98%; 3-year OS: 91 vs 90%; 5-year OS: 83 vs 83%), but inferior for RFA/MWA (p=0.024; 1-year OS: 97%: 3-year OS: 84%; 5-year OS: 76%). For ccRCC, OS was superior following surgical resection compared to both CRA and RFA/MWA (p<0.001). No statistically significant OS difference was evident comparing CRA and RFA/MWA in ccRCC patients (p=0.523).

### CONCLUSION

Utilization of ablation versus resection for stage IA/B RCC varies with patient and tumor characteristics. There is evidence that tumor histology may affect ablation effectiveness, with higher survivals observed for CRA in papillary RCCs.

# **CLINICAL RELEVANCE/APPLICATION**

In stage IA/B papillary RCC, CRA shows comparable survival to surgical resection and superior outcomes over RFA/MWA. CRA may be considered as preferential ablation technique in these cases.

# SSM25-04 Image-Guided Percutaneous Thermal Ablation of Gynecologic Cancer Metastasis: A 10-Year Experience of Patient Survival, Technique Efficacy, and Safety Profile

Wednesday, Dec. 4 3:30PM - 3:40PM Room: S403B

# Participants

Frank Yuan, MD, Alhambra, CA (*Presenter*) Nothing to Disclose Sindy Wei, MD, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose Gottfried Konecny, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose Sanaz Memarzadeh, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose Robert D. Suh, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose David S. Lu, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose David S. Lu, MD, Los Angeles, CA (*Abstract Co-Author*) Consultant, Medtronic plc Speaker, Medtronic plc Consultant, Johnson & Johnson Research Grant, Johnson & Johnson Consultant, Bayer AG Research Grant, Bayer AG Speaker, Bayer AG Steven S. Raman, MD, Santa Monica, CA (*Abstract Co-Author*) Consultant, Johnson & Johnson; Consultant, Bayer AG; Consultant, Merck & Co, Inc; Consultant, Amgen Inc; Consultant, Profound Medical Inc

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### PURPOSE

To assess the safety and efficacy of percutaneous thermal ablation treatment of metastatic GYN cancers.

### **METHOD AND MATERIALS**

With IRB exemption and HIPAA compliance, we derived a study cohort of 42 consecutive women with metastatic GYN cancers treated with radiofrequency or cryogenic ablation from over 2800 ablations performed from 1/30/2001-1/11/2019. All efficacy parameters were reported according to the 2014 International Working Group on Image-guided Tumor Ablation. The technical success rate was defined as complete ablation of the targeted tumor on post-intervention imaging. Primary effectiveness was defined as the percentage of tumors successfully eradicated during the initial course of treatment. Secondary effectiveness was defined as successful eradication by repeated ablation of local tumor progression after complete necrosis was achieved. Major complications were defined as those necessitating unplanned hospitalization, prolonging hospital stay, or additional interventions.

### RESULTS

In our study cohort of 42 women (mean age 59.3) with 126 metastatic lesions, the median follow-up was 9 months (range 1- 4022 days). The primary tumor types that were treated are ovarian (stage I-IV), endometrial (stage I, III, IV), uterine (stage II-IV), cervical (stage IB), and vaginal (stage II-III) cancers. Liver, lungs, kidney, peritoneum, lymph nodes, and abdominal soft tissues were targeted sites of metastasis. After the initial ablation session, 92.1% (n= 116/126) of the patients achieved complete tumor necrosis confirmed by contrast-enhanced MRI or CT. On follow-up scans, 7.9% (n= 8) of the previously ablated lesions developed local progression, which resulted in the primary treatment effectiveness of 94.7% (n= 107/113). Five lesions underwent repeated ablation due to local tumor progression with a mean size of 2.78 (SEM +/- 1.16; range 1.5 - 7.4 cm). Of these lesions, 4/5 achieved complete tumor eradication ensuing secondary effectiveness of 80%. Overall technique effectiveness was 94.1% (111/118). The median overall survival from first ablation was 22 months (49 - 4240 days) and the 1, 3, 5, & 10-year survival were 62.9%, 35.7%, 5.7% & 2.9%. The major complication rate was 4.8%.

### CONCLUSION

In the largest reported series, thermal ablation was safe and effective for local control of metastatic GYN cancers.

# **CLINICAL RELEVANCE/APPLICATION**

Image guided thermal ablation achieved excellent local control of metastatic GYN lesions.

# SSM25-05 Adaptive Suppression of Time Gain Compensated (TGC) Noise Bias for Contrast-Free Ultrasound Microvascular Imaging

Wednesday, Dec. 4 3:40PM - 3:50PM Room: S403B

Participants

Rohit Nayak, PhD, Rochester, MN (*Presenter*) Nothing to Disclose Mostafa Fatemi, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose Azra Alizad, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose

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### PURPOSE

Recent advances in contrast-free ultrasound microvascular imaging (USMI) has considerably improved the sensitivity of detecting blood flow. However, suppression of tissue clutter exposes the ramp-shaped time-gain-compensated (TGC) noise bias that noticeably degrades the visualization of the flow signal [1]. We hypothesize that background equalization of USM images based on the noise bias estimated from the entire clutter-filtered singular value (SV) spectrum can considerably improve the visualization of blood vessels, compared to currently existing techniques [1].

# METHOD AND MATERIALS

We conducted *in vivo* experiments on 20 patients with suspicious breast lesions. Its efficacy in imaging deeper organs (6-10 cm) was tested through imaging of hepatic and renal microvasculature in 4 healthy volunteers. All USM images were acquired using a clinical ultrasound scanner, implemented with ultrafast imaging, and singular value decomposition (SVD) based spatio-temporal clutter filtering. The TGC-based noise bias was estimated from the clutter filtered Doppler ensemble based on its local spatio-temporal correlation combined with low rank matrix estimation, which was subsequently used for background suppression of USM images.

### RESULTS

USM images obtained after clutter filtering were corrupted with ramp-shaped TGC noise bias that increased with depth. The noise bias signal was visible in both superficial breast lesions (<3.5 cm) and deep-seated hepatic and renal (4-9 cm) USM images. The noise equalized USM images obtained using the proposed technique substantially improved the visualization of the blood flow signal [Fig. 1]. The noise bias in the background equalized USM images (b,d,f) were ~ 0dB, invariant of depth, which otherwise varied over 14 dB (a,c,e), respectively.

# CONCLUSION

The preliminary results demonstrate the ability of using the proposed technique to improve the visualization of small vessel blood flow in contrast-free USMI. 1.Song, Noise Equalization for Ultrafast Plane Wave Microvessel Imaging.TUFFC 2017.

# CLINICAL RELEVANCE/APPLICATION

Non-invasive, contrast-free ultrasound microvascular imaging can be clinically invaluable in early detection and monitoring of angiogenesis in cancerous masses. This technology addresses a key issue of improving the detection of the blood flow signal in USMI, which are poorly visualized at increased depth due to signal attenuation and TGC based amplification of channel noise.

# SSM25-06 The Clinical Outcome of Utilizing Prophylactic Covered Stent in Patients with Sentinel Hemorrhage After Pancreaticoduodenectomy

Wednesday, Dec. 4 3:50PM - 4:00PM Room: S403B

Participants Yuan-Mao Lin, MD, Taipei, Taiwan (*Presenter*) Nothing to Disclose Ethan Y. Lin, MD, Sugar Land, TX (*Abstract Co-Author*) Nothing to Disclose Rheun-Chuan Lee, MD, Taipei, Taiwan (*Abstract Co-Author*) Nothing to Disclose

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# PURPOSE

To evaluate the clinical outcomes of prophylactic covered stent placement of common hepatic artery (CHA) in patients with sentinel hemorrhage (SH) after pancreaticoduodenectomy (PD) without positive image finding.

# METHOD AND MATERIALS

Between July 2006 and September 2018, 27 patients (mean age, 61.3 y) with SH after PD underwent prophylactic covered stent placement of CHA (n = 18) or conservative treatment (n = 9) without positive image finding were enrolled in this retrospective study. All patients received CT angiography (n = 11) or digital subtraction angiography (n = 25) before the treatment. Overall survival, clinical outcome and complications were compared between the groups. Clinical success was defined as sustained cessation of hemorrhage; failure was defined as requiring additional management. Chi-square analysis and Kaplan-Mayer curve were used to analyze each group's result.

### RESULTS

The clinical success rates were 55.5 % (5/9), and 88.8% (16/18) (p < .05) in conservative treatment and covered stent groups, respectively. The covered stent group had superior overall survival than conservative group (p < .05). In conservative group, delayed massive hemorrhage occurred in four patients: two died of recurrent bleeding with gastroduodenal artery pseudoaneurysm within sixteen days, and two had intraluminal hemorrhage within five days. In the covered stent group, one had inferior pancreaticoduodenal artery pseudoaneurysm one day after the placement of covered stent, and one patient had recurrent bleeding due to duodenal ulcer within 14 days. A late complication of stent related pseudoaneurysm was observed in one patient eight months after the procedure. There was no stent thrombosis, bile duct necrosis, or intrahepatic artery injury observed on follow-up CT.

# CONCLUSION

The prophylactic covered stent placement of CHA can be performed safely and reduced delayed massive hemorrhage and mortality in most patients with SH after PD without positive image finding.

### **CLINICAL RELEVANCE/APPLICATION**

The prophylactic covered stent placement of CHA can be performed safely and reduced delayed massive hemorrhage and mortality in most patients with SH after PD without positive image finding.





# SSM26

# Vascular/Interventional (Liver Cancer Basic Science)

Wednesday, Dec. 4 3:00PM - 4:00PM Room: S403A



AMA PRA Category 1 Credit ™: 1.00 ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

# Participants

Nadine Abi-Jaoudeh, MD, Orange, CA (*Moderator*) Research collaboration, Koninklijke Philips NV; Research collaboration, Teclison Cherry Pharma Inc; Research support, SillaJen, Inc; Intellectual property and Owner, Bruin Biosciences Inc D. T. Johnson, MD, PhD, South San Francisco, CA (*Moderator*) Inventor, Thunar Medical, Inc

### Sub-Events

# SSM26-01 Comparison Between HSV-TK Gene Therapy and Oncolytic Virotherapy for Radiofrequency Hyperthermia-Enhanced Treatment of Orthotopic Hepatic Cancer

Wednesday, Dec. 4 3:00PM - 3:10PM Room: S403A

### Awards

### **Trainee Research Prize - Fellow**

Participants Shanshan Gao, Seattle, WA (*Presenter*) Nothing to Disclose Jingjing Song Jr, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose Xiaolin Wang, MD, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose Fu Xiong, PhD, MD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose Spencer M. Cheng, Woodinville, WA (*Abstract Co-Author*) Nothing to Disclose Feng Zhang, MD, Seattle, WA (*Abstract Co-Author*) Nothing to Disclose Xiaoming Yang, MD, PhD, Mercer Island, WA (*Abstract Co-Author*) Nothing to Disclose

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# PURPOSE

To compare the efficacies between intratumoral herpes simplex virus-thymidine kinase (HSV-TK)/ganciclovir (GCV) gene therapy and oncolytic virotherapy for image-guided radiofrequency hyperthermia (RFH)-enhanced treatment of orthotopic liver cancer.

# METHOD AND MATERIALS

Luciferase-labeled rat hepatocellular carcinoma (HCC) cells and 36 rats with orthotopic HCCs were treated in 6 groups: (1) combination therapy with oncolytic viruses (T-VEC) plus RFH; (2) T-VEC alone; (3) HSV-TK/GCV gene therapy plus RFH; (4) gene therapy alone; (5) RFH alone; and (6) saline. For in-vitro experiments, confocal microscopy, MTS assay and bioluminescence optical imaging were used to evaluate cell viabilities and proliferation. For in-vivo validation, HSV-TK or T-VEC were directly infused into HCC masses through a multi-modal perfusion-thermal RF electrode under imaging guidance, followed by RFH at 42 °C for 30 minutes. For gene therapy groups, GCV was intraperitonially administrated daily for 14 days. Optical imaging and ultrasound imaging were used to follow up bioluminescence signal and size changes of tumors, followed by pathology confirmation.

### RESULTS

Confocal microscopy showed the significant decreases of cell viabilities and bioluminescence signal intensities in the combination therapy of HSV-TK with RFH or T-VEC with RFH, compared to other monotherapy groups (n=6/group, P <.05). Ultrasound and optical imaging showed that both combination therapies of HSV-TK or T-VEC with RFH caused decreases of average tumor volume and bioluminescence signal intensity, compared to groups with monotherapy (n=6/group, P <.05). However, no statistically significant differences were found between the two combination therapy groups. Pathology examination with apoptosis analysis further confirmed these imaging findings.

# CONCLUSION

Both intratumoral HSV-TK/GCV gene therapy and oncolytic virotherapy combined with RFH have the synergistic therapeutic effect on hepatic cancers, but no efficacy difference was found between these two combination therapies, which indicates RFH-enhanced oncolytic virotherapy is favorable for managing hepatic cancers, since the oncolytic virus, T-VEC, has been approved by FDA for human cancer treatment.

# **CLINICAL RELEVANCE/APPLICATION**

RFH-enhanced oncolytic virotherapy is favarable for hepatic cancers, since the oncolytic virus, T-VEC, has been approved by FDA for human cancer treatment.

# SSM26-02 Yttrium-90 Radioembolization as a New Treatment for Brain Cancer: Proof of Concept in a Canine Spontaneous Brain Tumor Model

### Participants

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# PURPOSE

To evaluate Yttrum-90 (Y90) radioembolization (RE) as a minimally invasive treatment for brain cancer in a canine model.

# METHOD AND MATERIALS

Three healthy research dogs (R1-R3) and two patient dogs with spontaneous intra-axial brain tumors (T1-T2) underwent transarterial RE with Y90 glass microspheres. Both tumors enhanced on pre-treatment MRI and were compatible with high-grade glioma. Y90RE was performed on research dogs from unilateral MCA, PCA or ICA while both dogs with tumors were treated from the ICA. Post-treatment Y90 PET/CT was performed along with serial, weekly neurological exam by a veterinary neurologist. One month after treatment, a post-treatment MRI was obtained on all animals.

### RESULTS

Average absorbed-dose for dogs R1-R3 calculated from Y90 PET/CT were: 20.2±2.8 Gy to the whole treated hemisphere, 52.5±23.5 Gy to the perfused tissue region and doses to the basal ganglia/thalamus ranging from 10.2-67.2 Gy depending on the treated territory. Dog T1 received 8.4 Gy to uninvolved brain and 35.0 Gy to tumor, while dog T2 received 13.2 Gy to uninvolved brain and 115.2 Gy to tumor. Transient changes in neurological exam lasting between 1-3 weeks before resolution were found in dogs R1, R2 and T1 and included unilateral delayed proprioception, postural reaction, decreased facial sensation and vision. Post-treatment MRI on dogs R1-R3 demonstrated absence of cortical atrophy or microinfarction. At 1-month post-therapy, MRI of dog T1 showed an 83% reduction in tumor volume, resolution of perilesional edema and falx shift as well as absence of cortical atrophy was not appreciated in either tumor bearing animal. T1 and T2 are currently clinically asymptomatic with an unremarkable neurologic exam and are scheduled for repeat MRI imaging at 3 months post-therapy.

# CONCLUSION

Y90RE is technically feasible in a canine model. Critical normal brain structures tolerated up to 67.2Gy with complete resolution of symptoms. A favorable dosimetric distribution with increased uptake in tumor is possible even with hemispheric (ICA) treatment. Initial clinical outcomes are positive, however, additional data on safety and efficacy is required.

# CLINICAL RELEVANCE/APPLICATION

Y90 radioembolization has shown initial promise in the treatment of spontaneous brain tumors in a canine model.

# SSM26-03 Prognostic Significance of Pretreatment Inflammatory Markers in Uveal Melanoma Liver Metastases Undergoing Hepatic Chemoperfusion

Wednesday, Dec. 4 3:20PM - 3:30PM Room: S403A

# Participants

Johannes M. Ludwig, MD, Dusseldorf, Germany (*Presenter*) Nothing to Disclose Nicola Spieker, MD, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose Axel Wetter, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose Benedikt M. Schaarschmidt, MD, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose Johannes Haubold, MD, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose Michael Forsting, MD, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose Jens M. Theysohn, MD, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose Jens M. Theysohn, MD, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose Jens M. Theysohn, MD, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose Jens A. Drescher, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose Ophelia 4. Drescher, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose Heike Richly, Essen, Germany (*Abstract Co-Author*) Nothing to Disclose

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# PURPOSE

To evaluate inflammatory markers (CRP, neutrophil to lymphocyte ratio (NLR), platelet to lymphocyte ratio (PLR) and systemic inflammatory index (SII)) as a pretreatment prognostic factors in patients with unresectable uveal melanoma liver metastases undergoing a structured transarterial hepatic chemoperfusion (THC) protocol.

# METHOD AND MATERIALS

56 patients (median age: 61 years, 44% male) were retrospectively assessed. A median of 3 (range: 1-11) THC sessions were performed with melphalan replaced by Fotemustin when progressing. Inflammatory markers were calculated as follows: SII: (platelets/nl  $\times$  neutrophils/nl)/ (lymphocytes/nl), PLR: (platelets/nl)/(lymphocytes/nl), NLR: (neutrophils/nl)/(lymphocytes/nl).

Kaplan-Meier for median overall survival in months (OS;95%CI) and Cox Proportional Hazard Model for uni- (UVA) & multivariate (MVA) analyses (Hazard ratio;95%CI) were performed.

# RESULTS

Median OS of the study cohort was 7.7 (6.3-10.9) months. Overall survival was prolonged for lower values of CRP (non-elevated: 13.5; 7.2-20,6 vs. elevated: 5.2; 3.9-7.7; p=.0003), PLR (<150: 15.8; 6.4-. versus >150: 7; 4.7-8.2, p=.003), SII (<1000: 11; 7.2-20.6 versus >1000: 5.6; 3.9-7.8, p=.0005) and NLR (<3.5: 11.1; 7,1-20.6, vs.>3.5: 6.3; 3.5-7.8, p=.004). MVA confirmed non-elevated CRP (0.37; 0.17-0.78; p=.008) and PLR <150 (0.39; 0.13-0.95p=.038) as independent predictors for longer overall survival. Combining significant values from in MVA improves survival prediction: Patients with non-elevated CRP and low PLR survived the longest (median not reached) vs. patients with either CRP or PLR elevation (11,1; 7-13.5) vs. elevated CRP and PLR (4.8; 3.4-7.5), p<.0001. Difference between each group was statistically significant in UVA.

### CONCLUSION

Pretreatment inflammatory markers (CRP, NLR, PLR, SII) play a prognostic role in patient survival with uveal melanoma liver metastases treated with THC. Utilizing pretreatment CRP and PLR as independent predictors may help to identify patients potentially profiting from therapy.

# CLINICAL RELEVANCE/APPLICATION

Inflammatory markers play a pivotal role in predicting overall survival and may provide information on treatment effectiveness and to estimate life expectancy. This can help informed clinical treatment decision making and is of great value for patients and their relatives to set expectations regarding transarterial hepatic chemoperfusion as treatment option for patients with uveal melanoma liver metastases.

# SSM26-04 Comparison of Parallel and Crossed Placement of Multiple Radiofrequency Electrode in the Treatment of Liver Tumor: An Animal Experiment

Wednesday, Dec. 4 3:30PM - 3:40PM Room: S403A

Participants

Kun Zhao, Beijing, China (*Abstract Co-Author*) Nothing to Disclose An-Na Jiang, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Wei Yang, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Song Wang, Beijing, China (*Presenter*) Nothing to Disclose Zhong-Yi Zhang, PhD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Kun Yan, BS, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

# PURPOSE

The purpose of this study was to investigate the effect of parallel and crossed needle placement with radiofrequency ablation in liver.

### **METHOD AND MATERIALS**

The experiment was performed in ex vivo bovine liver with the radiofrequency generator (Celon) and two electrode needles (200T30). Parallel and crossed needle placements were designed in our experiment. The electrode needles were placed in the shape of '=' in the parallel group and in the shape of 'x' in the crossed group. The ablation zones were compared when the shortest distances of the electrodes (2cm, 2.5cm, 3cm) or the output powers (20W, 25W, 30W) were different.(n=6 for each group). At 2 hours after ablation, the gross pathological specimens were stained with TTC. The long-axis diameter and the short-axis diameter were measured and the coagulation area of ablation zones were compared.

### RESULTS

When 25W power was applied and the shortest distances of the electrodes were 2cm, 2.5cm and 3cm, the ablation zones in the two groups were quasi-circular and increased with distance. When the shortest distances were fixed, there was no significant difference in the coagulation area between the two groups (2cm: 4.6x3.7cm vs. 4.8x3.9cm, P=0.369; 2.5cm: 4.8x4.3cm vs.5.0x4.5cm, P=0.661; 3cm: 5.0x4.5cm vs. 5.3x4.6cm, P= 0.339). When the shortest distance was 3.5cm, the coagulation zone could not be fused and was lobulate-shaped. When the shortest distance was 2.5cm and the outputs were 25W and 30W, the coagulation areas were quasi-circular and did not increase with higher power. There was no significant difference. (25W: 4.8x4.3cm vs. 5.0x4.5cm, P=0.452; 30W: 5.1x4.5cm vs. 5.1x4.7cm, P= 0.894). When the output was 20W, the coagulation zone could not be fused in parallel group, while an effective coagulation area was produced in the crossed group (4.4x3.9cm).

### CONCLUSION

The traditional opinion is that the crossed placement of electrodes was limited in coagulation area. Our study showed that the ablation zone of the two groups were similar when the shortest distance was the same and the maximum distance no more than 3cm. When the output was reduced, the fusion effect of coagulation area in crossed group was better than that in parallel group. These data provided helpful information for the design of needle placement in radiofrequency ablation of liver tumors.

# **CLINICAL RELEVANCE/APPLICATION**

Radiofrequency ablation is one of the most widely used techniques in tumor ablation.

# SSM26-05 A Novel Approach to Liver-Directed Therapy for Metastatic Well-Differentiated Neuroendocrine Tumor: Efficacy of Concurrent Everolimus with Hepatic Transarterial Bland Embolization (EveroEmbo)

Wednesday, Dec. 4 3:40PM - 3:50PM Room: S403A

Participants

Riham H. El Khouli, MD,PhD, Nicholasville, KY (*Abstract Co-Author*) Nothing to Disclose Gaby E. Gabriel, MD, Lexington, KY (*Presenter*) Nothing to Disclose Harit Kapoor, MD, Lexington, KY (*Abstract Co-Author*) Nothing to Disclose Ahmed H. Ragab, MBBCh, Alexandria , Egypt (*Abstract Co-Author*) Nothing to Disclose

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M. Elizabeth Oates, MD, Lexington, KY (Abstract Co-Author) Nothing to Disclose
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# PURPOSE

Liver-directed embolization have been the mainstay for locoregional metastatic tumor control. There continues to be considerable controversy around the optimal protocol. Recent studies suggested long-term hepatotoxicity of transarterial radioembolization (TARE). RADIANT-3 and -4 reported Everolimus resulting in median progression-free survival (PFS) of 11 months, while TAE resulted in median hepatic PFS (hPFS) of 15 months. TAE induces ischemic cell injury, yet ischemia- induced activation of vascular endothelial growth factor (VEGF) leads to neovascularization, a known cause of resistance. Everolimus is an mTOR kinase inhibitor shown to inhibit the response of vascular endothelial cells to stimulation by VEGF. Everolimus is typically held 2-4 weeks before and after embolization to minimize toxicity. We hypothesize that the concurrent use of Everolimus with TAE (EveroEmbo) would result in prolonged local liver tumor control compared to either therapy alone.

# **METHOD AND MATERIALS**

Review of all consecutive patients who underwent EveroEmbo between 9/2016 and 12/2018 at the ------. Inclusion criteria included systemic Everolimus for >= 1 month before embolization. For median hPFS analysis, only patients with > 12 months post-TAE imaging were included. An independent radiologist reviewed all baseline and subsequent post-therapy imaging and assessed liver-specific treatment response according to RECIST 1.1 criteria

### RESULTS

63 EveroEmbo procedures in 38 consecutive patients were performed. 58% (22/38) were females while 42% (16/38) were males, with mean age of  $57.8 \pm 12.8$  years. Only 40 procedures had sufficient post-procedural imaging to apply RECIST 1.1. Imaging showed 82.5% with partial response and 17.5% with stable disease; no patient had disease progression. The percentage change in liver tumor burden was -46.3% + 18.3%. Among the 63 EveroEmbo procedures, 21 had > 12 months follow-up imaging; no patients progressed to date and their median hPFS was 17 months.

### CONCLUSION

Concurrent EveroEmbo is a promising approach for local hepatic disease control with a median hPFS of 17 months. Longer follow-up is needed to assess the true median hPFS in metastatic well-differentiated NETs.

### **CLINICAL RELEVANCE/APPLICATION**

Concurrent EveroEmbo resulted in partial response in 82.5% of patients with a mean of 46% reduction in tumor burden and 17 months median hPFS. To date, none of our patients have evidence of disease progression

# SSM26-06 The Inhibiting Effect of All-Trans Retinoic Acid on Liver Cancer Stem-Like Cells after Insufficient RF Ablation

Wednesday, Dec. 4 3:50PM - 4:00PM Room: S403A

Participants

Song Wang, Beijing, China (*Presenter*) Nothing to Disclose Jing-tao Liu, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Hao Wu, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Wei Yang, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Hai-bo Han, PhD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose An-Na Jiang, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Xiu-mei Bai, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Kun Yan, BS, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Yan-hua Zhang, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

### For information about this presentation, contact:

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# PURPOSE

To investigate the role of tumor stem-like cells (TSCs) in recurrent HCC after insufficient RFA and the effect of combination treatment with all-trans retinoic acid (ATRA) in human HCC models.

### **METHOD AND MATERIALS**

Methods: First, the self-renew ability of HepG2 cells was assessed in vitro at 37°C or 42°C. Second, mice bearing HepG2 liver adenocarcinomas were randomized into two groups: (a) no treatment, (b) treatment with insufficient RFA. Tumor size were monitored every 2 days and mice was sacrificed when the tumor was 2cm in diameter. Flow cytometry was used to analyze the percentage of CD133+ and CD326+ cells from the tissue samples of the two groups. Third, HepG2 mice were randomized into four groups: (a) RFA followed by IP ATRA (10mg/kg), (b) RFA followed by IP ATRA (20mg/kg), (c) RFA followed by IP ATRA (40mg/kg), (d) RFA alone. The tumor sizes at day 20 were compared among different groups by analysis of variance. Additionally, pathological staining, western blot and flow cytometry were used for analysing the TSCs and tumor apoptosis. Fourth, the subsequently transplanted formation rate of TSCs was evaluated.

# RESULTS

First, in vitro, HepG2 cells which incubated at 42°C water bath displayed significantly higher sphere-forming efficiency compared with the cells incubated at 37°C ( $43\pm6\%$  vs 8.7 $\pm3\%$ , p<0.01). In vivo, the HepG2 tumor model after insufficient ablation grew up faster compare with no treatment group(p=0.021), and the percentage of CD133+ cells (39.3%) and CD326+ cells (42.7%) was higher than no treatment group (17.1%, 18.4%). The combination of ATRA and RFA decreased the tumor sizes at day 20 with different doses (0mg/kg: 774.2 $\pm$ 158.6mm3 vs 10mg/kg: 369.7 $\pm$ 106.5mm3 vs 20mg/kg: 152.8 $\pm$ 113.7mm3 vs 40mg/kg:143.3 $\pm$ 94.8mm3, Overall P<0.001). The combination of RFA and ATRA had the best survival outcome compare with RFA group. In addition, the combined treatment with ATRA showed less TSCs and more intensive cell apoptosis compared to RFA alone. The transplanted formation rate of TSCs after combination treatment was lower than no treatment group(P<0.001).

# CONCLUSION

TSCs might had close relationship to the recurrent HCC after RFA. ATRA could significantly improve the effect of RFA, partially attributed to ATRA effectively induced differentiation of TSCs.

# **CLINICAL RELEVANCE/APPLICATION**

Combining with ATRA could enhance the effects of RFA and reduce a part of promention of recurrent HCC involved in the TSCs after insufficient RFA.





# RC601

# **Pulmonary Vascular Imaging**

Thursday, Dec. 5 8:<u>30AM - 10:00AM Room: S103CD</u>



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

# Participants

Ioannis Vlahos, MRCP, FRCR, Houston, TX (Moderator) Director, Grayscale Ltd; Co-owner, Grayscale Ltd

# LEARNING OBJECTIVES

1) Highlight practical applications, best current practice, and state of the art multimodality CT and MRI practice with regards to pulmonary vascular imaging. 2) Review acute and chronic pulmonary embolism, pulmonary hypertension, and pulmonary arteriovenous malformations.

# Sub-Events

# RC601A Imaging of Acute Pulmonary Embolism

Participants

Ioannis Vlahos, MRCP, FRCR, Houston, TX (Presenter) Director, Grayscale Ltd; Co-owner, Grayscale Ltd

# LEARNING OBJECTIVES

1) Overview current imaging strategies and key facts in acute pulmonary embolism imaging. 2) Provide an update on current issues and challenges in acute pulmonary embolism imaging.

# RC601B Imaging of Chronic Pulmonary Embolism and Pulmonary Hypertension

Participants

Elsie Nguyen, MD, Toronto, ON (Presenter) Nothing to Disclose

# LEARNING OBJECTIVES

1) Review the classification of pulmonary hypertension. 2) List CT and MRI features of PH. 3) Describe imaging characteristics of chronic pulmonary embolism.

# RC601C Imaging of Pulmonary Arteriovenous Malformations

Participants Kristopher W. Cummings, MD, Scottsdale, AZ (*Presenter*) Nothing to Disclose

# LEARNING OBJECTIVES

1) Explain the role MDCT plays in the evaluation of suspected hereditary hemorrhagic telangiectasia. 2) List the most important information provided by MDCT for management of pulmonary arteriovenous malformations.

# RC601D Pulmonary MRA: Practical Applications

Participants

Christopher J. Francois, MD, Madison, WI (Presenter) Departmental research support, General Electric Company;

# For information about this presentation, contact:

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# LEARNING OBJECTIVES

1) Identify roles for magnetic resonance angiography (MRA) in imaging patients with pulmonary artery disease, particularly on the use of MRA in pulmonary embolism. 2) Describe techniques and protocols for robust, clinical pulmonary MRA. 3) Summarize the evidence supporting the use of pulmonary MRA for pulmonary embolism.

# ABSTRACT

1) Pulmonary MRA is appropriate for imaging patients suspected of having pulmonary embolism who have contra-indications to CTA, particularly those in whom avoiding iodinated contrast (due to allergy or decreased renal function) or minimizing radiation exposure (younger patients) would be beneficial. 2) Current, commercially available MRA sequences that take advantage of newer parallel imaging techniques help ensure consistent pulmonary MRA in a clinical setting in under ten minutes. 3) Although older, multi-center studies using MRA techniques and protocols suggested pulmonary MRA may not be accurate enough for routine clinical use, more recent studies using commercially available accelerated image acquisition techniques indicate that pulmonary MRA is effective in identifying clinically significant pulmonary embolism.







# RC610

# Abdominal Doppler: What You Need to Know

Thursday, Dec. 5 8:30AM - 10:00AM Room: E351



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

# Sub-Events

# RC610A Ultrasound Evaluation of the Aorta and Mesenteric Arteries

Participants Leslie M. Scoutt, MD, Essex, CT (*Presenter*) Speaker, Koninklijke Philips NV

# For information about this presentation, contact:

leslie.scoutt@yale.edu

# LEARNING OBJECTIVES

1) Discuss the role of ultrasound in screening for abdominal aortic aneurysms and following endograft repair. 2) Describe the ultrasound appearance of aortic and superior mesenteric artery dissections. 3) Discuss the role of ultrasound in the evaluation of mesenteric ischemia.

### ABSTRACT

This presentation will review the role of ultrasound in evaluation of common aortic and mesenteric artery pathology. The focus will be on how and why to screen for abdominal aortic aneurysms and the evolving role of ultrasound in the follow up of endograt aortic repair. The role of ultrasound in the evaluation of clinically suspected aortic dissections and in the evaluation of mesenteric ischemia will also be described. More unusual aortic and mesenteric vascalar pathology as well as mimics will also be briefly presented as challenge cases.

# RC610B Liver/TIPS Doppler

Participants

Mark E. Lockhart, MD, Birmingham, AL (*Presenter*) Author, Oxford University Press; Author, Reed Elsevier; Editor, John Wiley & Sons, Inc; Deputy Editor, Journal of Ultrasound in Medicine

# LEARNING OBJECTIVES

1) To gain an understanding of normal Doppler appearance of hepatic vessels. 2) To gain an understanding of the sonographic appearance of common liver diseases. 3) To review the normal and abnormal Doppler criteria related to TIPS shunts.

# ABSTRACT

This lecture will initially review basic Doppler concepts related to the liver and cover basic appearance of liver vessel flow. It will then describe the Doppler appearance of the most common hepatic disease processes and their sonographic appearance. Finally, the lecture will depict several examples of abnormalities associated with TIPS shunts and their Doppler criteria for diagnosis.

# RC610C Renal Doppler

Participants

Deborah J. Rubens, MD, Rochester, NY (Presenter) Nothing to Disclose

# For information about this presentation, contact:

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# LEARNING OBJECTIVES

1) Discuss the applications of Doppler US in renal vascular as well as parenchymal disease. 2) Review the critical technical parameters which enable accurate diagnoses. 3) Highlight the important pitfalls in renal Doppler imaging.

### ABSTRACT

This presentation will explore the use of Doppler ultrasound in the assessment of the kidney and its vascular supply. Doppler technique will be reviewed with particular attention to artifacts and pitfalls which may enhance or detract from diagnostic efficacy. The role of ultrasound imaging in assessment of acute as well as chronic renal dysfunction will be addressed. The performance of Doppler ultrasound will be highlighted regarding vascular stenosis and occlusion, parenchymal perfusion, and diagnosis of renal masses and stones. Doppler techniques to avoid false negative and false positive studies will be emphasized. Surgical emergencies will be highlighted and the role of correlative imaging with CT, MR and/or angiography will be presented.

# RC610D Understanding Hepatic Transplants: Not Just Chopped Liver

Participants

# For information about this presentation, contact:

# jonathan.kirsch@yale.edu

### LEARNING OBJECTIVES

1) Gain an understanding of the indications and contraindications for liver transplant. 2) Know the relevant post-operative anatomy for orthotopic liver transplant. 3) Be able to recognize and diagnose common vascular, biliary, and parenchymal complications related to the liver transplant in the postoperative period.

### ABSTRACT

Liver transplantation has become the treatment of choice and standard of care for end-stage liver disease. As liver transplants become more commonly seen outside specialized academic centers, it becomes imperative to be familiar with the imaging related to liver transplantation. This talk will review the indications and contraindications of liver transplant, the post-operative anatomy seen for orthotopic liver transplants, and review the imaging findings of common post-operative vascular, biliary, and parenchymal complications that can be seen.





# RC612

# Vascular Series: CT Angiography-New Techniques and Their Application

Thursday, Dec. 5 8:30AM - 12:00PM Room: S405AB



AMA PRA Category 1 Credits ™: 3.00 ARRT Category A+ Credits: 3.50

FDA Discussions may include off-label uses.

### Participants

Jill E. Jacobs, MD, New York, NY (*Moderator*) Nothing to Disclose W. Dennis Foley, MD, Milwaukee, WI (*Moderator*) Nothing to Disclose Russell H. Angle, MD, Potomac, MD (*Moderator*) Nothing to Disclose

### Sub-Events

# RC612-01 Relationship between Contrast Dose and Radiation Dose in CTA

Thursday, Dec. 5 8:30AM - 9:00AM Room: S405AB

Participants

Mannudeep K. Kalra, MD, Lexington, MA (Presenter) Research Grant, Siemens AG; Research Grant, Riverain Technologies, LLC;

# For information about this presentation, contact:

mkalra@mgh.harvard.edu

# LEARNING OBJECTIVES

1) Understand scan factors that affect both radiation dose and intravenous contrast administration in CT angiography (CTA). 2) Understand how scan factors should be adjusted to reduce radiation dose and/or contrast volume for CTA. 3) Understand how CT technology affects radiation dose and contrast media administration in CTA.

### ABSTRACT

NA

# RC612-02 The Utility of Test Bolus for Improving Low Iodine Dynamic 4D CTA in the Diagnosis of Lower Extremity Peripheral Vascular Disease

Thursday, Dec. 5 9:00AM - 9:10AM Room: S405AB

Participants

Terri J. Vrtiska, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose Yong Lee, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose Nikkole Weber, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose Ahmed Halaweish, PhD, Rochester, MN (*Abstract Co-Author*) Employee, Siemens AG Irene Duba, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose Eric E. Williamson, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose Shuai Leng, PHD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose Cynthia H. McCollough, PhD, Rochester, MN (*Abstract Co-Author*) Research Grant, Siemens AG Joel G. Fletcher, MD, Rochester, MN (*Abstract Co-Author*) Grant, Siemens AG; Consultant, Medtronic plc; Consultant, Takeda Pharmaceutical Company Limited; Grant, Takeda Pharmaceutical Company Limited; ; Akitoshi Inoue, MD, PhD, Higashioumi, Japan (*Presenter*) Nothing to Disclose

### For information about this presentation, contact:

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### PURPOSE

To determine the diagnostic accuracy of low iodine 4D dynamic CTA (4D CTA) with a test bolus in lower extremity peripheral vascular disease (PVD).

### **METHOD AND MATERIALS**

68 pts with suspected PVD underwent dynamic 4D CTA of the lower extremities with 40mL Iohexol 350 using either fixed delay (of 13 sec, n=34) or with test bolus (10 cc of Iohexol 350, n=34). Subsequent conventional CTA using a weight-base protocol served as the reference standard. 4D-CTA exams ( $\pm$  test bolus) consisted of 11 low-radiation-dose acquisitions. A vascular radiologist interpreted thin temporally-resolved MIPs (tMIPs) of each lower extremity, a dynamic series displaying the 4D temporal runoff, and thick tMIPs with and without calcium removal. For each lower extremity, arterial stenoses in each of 7 vascular segments was compared to conventional CTA, and was graded as <50%, 50 -70%, >70% or occluded.

### RESULTS

Runoff to the level of the ankle was observed for 76% (26/34) patients using 4D CTA with fixed delav compared to 97% (33/34)

with test bolus. In patients with runoff to the ankle, overall accuracy for peripheral vascular disease (requiring identical stenosis grading per segment) was 89.6% (326/364; 95% CI: 86 - 95%) for 4D CTA with fixed delay compared to 94.0% (355/378; 95% CI: 91 - 96%) using the test bolus. For stenosis > 70%, 4D CTA demonstrated a sensitivity of 90.3% (56/62; 95% CI: 86 - 95%) with a fixed delay and 90.4% (104/115; 95% CI: 82 - 98%) with a test bolus. For patients with runoff to the ankle, 4D temporal runoff images provided useful information about asymmetrical or collateral flow in 5/26 cases (19.2%) and in 9/32 cases (28.1%), respectively, with one technical failure to generate temporally resolved images in the test bolus arm. Thick tMIPs, with calcium displayed or removed, were only helpful in 15% (4/26) cases with fixed delay, but were helpful in the majority of patients with test bolus 63% (20/32).

### CONCLUSION

Using a test bolus, low iodine dynamic 4D-CTA results in high accuracy for the prediction of PVD. It increases the number of patients with runoff to the ankles compared to fixed delay techniques, and provides additional information about asymmetric and collateral flow.

# **CLINICAL RELEVANCE/APPLICATION**

Low iodine dynamic 4D CTA results in accurate prediction of significant peripheral vascular disease, with a test bolus improving runoff to the ankles and providing additional temporal information compared to fixed delay techniques.

# RC612-03 Reduced Contrast Agent Volume and Radiation Dose Using a Heartrate-Dependent Scanning Protocol in Computed Tomography Angiography (CTA) of Lower Extremity Artery for Patients with Diabetes

Thursday, Dec. 5 9:10AM - 9:20AM Room: S405AB

Participants Peiji Song, Liaocheng , China (*Presenter*) Nothing to Disclose Nan Wang, Liaocheng , China (*Abstract Co-Author*) Nothing to Disclose Wenbo Guo, Liaocheng , China (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To evaluate the feasibility of a personalized CT scanning protocol that was tailored to patients' heart rate for lower extremity CTA of diabetic patients.

### **METHOD AND MATERIALS**

A total of 40 diabetic patients who need to undergo lower extremity CTA were prospectively randomized into two groups (patients with vascular occlusion were excluded). For each patient in Group A (n = 20), a total of 70 mL contrast agent (Iopamidol 370) was injected with a rate of 3 mL/s. By monitoring the distal end of bilateral superficial femoral artery, the CTA scan was manually triggered according to the patient's heart rate (HR): HR > 80 bmp, the CTA was triggered manually 25-28 seconds after the injection of contrast agent and initiated automatically with a delay of 6 s; HR = 60-80bmp, trigger time was 30-33 s with a delay of 8 s; HR<60bmp, trigger time was 35-38 s with a delay of 10 s. For each patient in Group B (n = 20), a total of 85 mL contrast agent (Iopamidol 370) was injected with a rate of 3 mL/s. The routine auto-trigger protocol was applied by setting the distal abdominal aorta threshold as 180 HU. All CTAs were performed on a 16-cm wide-detector CT (Revolution CT, GE).The CT values of the bilateral femoral arteries, the superficial femoral artery, the popliteal artery, the anterior and posterior tibial arteries and the evaluated the image quality using a 5-point scale (1-unassessble to 5-excellent) and the image quality was compared using chi-square test. Radiation doses were also recorded and compared using t-test.

### RESULTS

No difference was found between the two groups in either of the CT values(Ps > 0.05, Table1). Subjective ratings of image quality were not statistically different( X2=1.086, P = 0.896, Table 2). The radiation dose was significantly lower in Group A than in Group B (7.1 mSv vs. 8.1 mSv, t = 2.162, P = 0.037).

# CONCLUSION

By adopting a heart-rate dependent protocol, the radiation dose and contrast medium dose were both reduced in lower extremity CTA for patients with diabetes, while the image quality was remained comparable to those acquired with routine CTA protocol.

# **CLINICAL RELEVANCE/APPLICATION**

The personalized, heart-rate dependent CTA protocol can reduce the use of contrast medium and the radiation dose. This is especially beneficial for patients with diabetes who have potential renal insufficiency.

# RC612-04 Automatic Detection of Aortic Dissection Using Contrast X-Ray Computed Tomography (CT)

Thursday, Dec. 5 9:20AM - 9:30AM Room: S405AB

Participants

Arkadiusz Sitek, PhD, Cambridge, MA (*Presenter*) Employee, IBM Corporation Yiting Xie, Cambridge, MA (*Abstract Co-Author*) Employee, IBM Corporation Mark Bronkalla, BSC, MBA, Hartland, WI (*Abstract Co-Author*) Employee, IBM Corporation Benedikt Graf, PhD, Cambridge, MA (*Abstract Co-Author*) Employee, IBM Corporation Manikanta Srikar Yellapragada, New York, NY (*Abstract Co-Author*) Nothing to Disclose

### For information about this presentation, contact:

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### PURPOSE

Aortic dissection is a serious event associated with a high mortality. Untreated death rates of 40% on initial presentation and increase >1% per hour have been reported (Ann Emerg Med. 1996;28:278-288). Improvement in survival is dependent on rapid diagnosis in emergency department (ED). CT with contrast is frequently used for diagnosis of aortic dissection in ED. We have

developed a fully automatic approach to detect aortic dissection on volumetric CT image. This can be used to worklist prioritization in order to expedite the diagnosis and treatment. The worklist can be that of the PACS and /or a notification within the EMR. The algorithm examines CT volumes and if dissection found alerts radiologist or other parties that the study needs immediate attention/review.

### **METHOD AND MATERIALS**

The method consists of two steps. In the first, a machine learning algorithm was used to determine a centerline of aorta in each CT volume. Eight hundred CT volumes obtained from various public sources were used to train the centerline algorithm. Based on the centerline we extracted N transverse to aorta centerline image patches encompassing the detected outermost perimeter of the aorta plus a margin along the extent of the aorta in the field of view. These patches formed image sequence that was used as input to recurrent neural network and used for classification of the presence of a dissection. Classification algorithm was trained and validated using a retrospective multi-institution, multi-vendor set 695 CT volumes. There were 319 contrast CT scans without dissection and a set of 376 contrast CT scans with dissection, 80/20 split was used for training/testing. Studies that were used as positive for dissection were selected based on positive findings in the radiology reports. The set was different than data used to train algorithm for finding the centerline.

#### RESULTS

Fully automated algorithm achieved performance of 0.982 (95% CI: 0.955-0.998) of area under ROC curve (AUC) for detection of dissection in contrast CT studies.

### CONCLUSION

The detection of aortic dissection and prioritization of the study for formal reading can now be automated with high accuracy. The detection of this relatively rare (<1:10000 studies) but deadly malady without inducing high false positive indications is now possible. This functionality can then be integrated into the clinical workflow: whether triggering an earlier, prioritized read by a staff radiologist, off-loading the study to a teleradiology practice or notifying the ED attending physician.

### **CLINICAL RELEVANCE/APPLICATION**

The algorithm has the potential to significantly decrease the time to diagnosis and therefore treatment of aortic dissection in ED and is critical for facilities without in-house 24-hour radiologist reading coverage.

# RC612-05 Dual-energy and Low kVp CTA

Thursday, Dec. 5 9:30AM - 10:00AM Room: S405AB

Participants

Shuai Leng, PHD, Rochester, MN (Presenter) Nothing to Disclose

### For information about this presentation, contact:

leng.shuai@mayo.edu

#### **LEARNING OBJECTIVES**

Assess impact of low kVp on image quality and radiation dose in CTA. 2) Select appropriate kVp for CTA exams to achieve optimal diagnosis at lowest radiation dose. 3) Understand basic principles of dual energy CT and various technical implementations.
 Understand dual energy processing methods and various types of dual energy images in CTA.

# RC612-06 Roles for CTA in Interventional Radiology

Thursday, Dec. 5 10:30AM - 11:00AM Room: S405AB

Participants

Jonathan J. Keung, MD, Bethesda, MD (Presenter) Nothing to Disclose

# LEARNING OBJECTIVES

1) Identify the uses of CT angiography in interventional radiology. 2) Describe pertinent CT angiographic findings associated with pre-procedural planning for intervention. 3) Compare pre-procedural CT angiographic findings with intraprocedural angiographic findings.

# RC612-07 Quantitative Evaluation of a Feasibility Using Dynamic CTA for Diagnosis of Lower Legs Muscle Ischemia

Thursday, Dec. 5 11:00AM - 11:10AM Room: S405AB

Participants

Da-Ming Zhang, MD, Beijing, China (*Presenter*) Nothing to Disclose Xueyan Zhou, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose Zhengyu Jin, Beijing, China (*Abstract Co-Author*) Nothing to Disclose Xiaobing Fan, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

### For information about this presentation, contact:

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### PURPOSE

To quantitatively evaluate lower leg muscle ischemia using dynamic computed tomographic angiography (CTA) and compare with clinical standard CTA diagnosis outcome.

#### **METHOD AND MATERIALS**

The study was HIPPA compliant and approved by our IRB. Patients (n=35) with known peripheral arterial occlusive disease were

enrolled. Dynamic CTA (dyn-CTA) of calves (9 phases,  $2.5s \times 5$  cycles,  $5s \times 4$  cycles, 70 kVp, 80 mAs, 30 mL Iopromide) was performed first. 5 minutes later, a standard runoff CTA (s-CTA) of lower extremity was performed. Runoff score was given for s-CTA. For each of four lower leg artery segments, a score of '0' is assigned for vessel with <20% stenosis, '1' for 21-49% stenosis, '2' for 50-99% stenosis, '2.5' for a vascular occlusion less than half of its length, and '3' for an occlusion greater than half of the length. The score for the popliteal artery is multiplied by 3 and 1 is added before adding all 4 vessel scores together. Dyn-CTA muscle signal intensity as function of time (S(t)) was analyzed between the 10th to 80th slices. For each pixel, a sum of S(t) was calculated between 2.5 to 10 s, and then sorted from low to high. Top 25th, 10th, and 5th percentile of pixels were used to calculate the average S(t). Quantitative kinetic parameters, E1(initial enhancement), Epeak(peak enhancement), and SER(signal enhancement ratio) were calculated for average S(t): E1=(S1-S0)/S0, Epeak=(Speak-S0)/S0, and SER=(S1-S0)/(Slast-S0), where S0, S1, Speak and Slast is baseline, the 1st, the peak, and the last signal intensity, respectively.

# RESULTS

Based on s-CTA diagnosis, all legs were divided into a normal group (n=22) with each vessel segment score <=1 and runoff score <=7; and an abnormal group with ischemia (n=48). On average, the E1 and Epeak for normal group were significantly higher than abnormal group, but not for the SER. There were weak correlations between runoff scores and E1 (Epeak). The ROC analysis between the two groups had area under the curve of 0.77 for E1 (25%).

### CONCLUSION

There were significant differences between normal and ischemic leg muscle for quantitative kinetic parameters calculated from dyn-CTA.

### **CLINICAL RELEVANCE/APPLICATION**

There is clinical potential application of quantitative analysis of lower extremity dyn-CTA for diagnosis of muscle ischemia besides the vessel anatomical illustration.

# RC612-08 3D Morphologic Features for Predicting Late Adverse Events in Uncomplicated Type B Aortic Dissection

Thursday, Dec. 5 11:10AM - 11:20AM Room: S405AB

Participants

Lewis D. Hahn, MD, Stanford, CA (*Presenter*) Research Consultant, Arterys Inc Gabriel Mistelbauer, Vienna, Austria (*Abstract Co-Author*) Research Grant, cool IT GmbH Kai Higashigaito, MD, Zurich, Switzerland (*Abstract Co-Author*) Nothing to Disclose Anna M. Sailer, MD,PhD, West Hollywood, CA (*Abstract Co-Author*) Nothing to Disclose Martin J. Willemink, MD,PhD, Mountain View, CA (*Abstract Co-Author*) Research Grant, American Heart Association; Research Grant, Koninklijke Philips NV; Consultant, Arterys Inc Martin Koci, MD, Prague 5, Czech Republic (*Abstract Co-Author*) Nothing to Disclose Craig Miller, Stanford, CA (*Abstract Co-Author*) Research collaboration, Edwards Lifesciences Corporation Research collaboration, Abbott Laboratories Research collaboration, Medtronic plc Michael Fischbein, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose Deminity Eleisobarane MD. Stanford, CA (*Abstract Co-Author*) Nothing to Disclose Deminity Eleisobarane AC

Dominik Fleischmann, MD, Stanford, CA (Abstract Co-Author) Research Grant, Siemens AG

# PURPOSE

Predicting the risk of late adverse events (LAE) in patients with uncomplicated Type B aortic dissection is highly desired for optimizing treatment strategy. Morphologic risk factors extracted from imaging data are almost universally 2D measurements such as maximum aortic diameter and cannot capture the complex geometry of aortic dissection. We sought to identify 3D quantitative features of aortic dissection and explore their relationship with LAE.

### **METHOD AND MATERIALS**

CT angiograms from the initial hospitalization of 41 patients with uncomplicated type B aortic dissection were retrospectively identified and manually segmented into true lumen, false lumen, and background voxels (TeraRecon). Patients were followed for a median of 1501 days (IQR 648-2224). 18 LAE - predominantly driven by aneurysm formation >55mm - were observed during the study period. Centerlines of the true lumen (TL), false lumen (FL), aorta, and dissection flap were extracted from the segmentation masks using a sequential thinning skeletonization technique. Centerlines were determined by approximating the longest paths with 3D cubic B-splines. For each centerline, physical length, tortuosity, and parameters related to curvature and torsion were obtained using the Frenet-Serret formulas. Volume of the TL and FL were calculated. In total, 35 3D parameters were extracted. Maximum aortic diameter was also measured for comparison. Cox regression analysis was used to evaluate associations between candidate morphologic features and the occurrence of LAE after considering the correlations among variables.

# RESULTS

Univariate analyses showed that multiple features were associated with LAE including TL, FL, and aortic centerline tortuosity (all p<0.05). A multivariable model with conventional maximum aortic diameter and all non-correlating features with p<0.15 showed that only true lumen tortuosity was independently associated with LAE (HR 7.8 [95% confidence interval 1.0-480.8], p=0.04).

### CONCLUSION

Our results suggest that currently unexploited 3D morphologic features extracted from imaging date such as true lumen tortuosity may be independent predictors of LAE in patients with initially uncomplicated type B aortic dissection.

### **CLINICAL RELEVANCE/APPLICATION**

This work demonstrates the feasibility of deriving 3D morphologic parameters of type B aortic dissection and finds an association between true lumen centerline tortuosity and late adverse events.

# RC612-09 Advanced Visualization of Peroneal Artery Perforators Prior to Autologous Transplantation in Head and Neck Surgery by Dual-Energy CT and Multiplanar Vessel Unfolding

Thursday, Dec. 5 11:20AM - 11:30AM Room: S405AB

# Participants

Matthias S. May, MD, Erlangen, Germany (*Presenter*) Speakers Bureau, Siemens AG Matthias Wetzl, Erlangen, Germany (*Abstract Co-Author*) Nothing to Disclose Wolfgang Wust, MD, Erlangen, Germany (*Abstract Co-Author*) Speakers Bureau, Siemens AG Rafael Heiss, Erlangen, Germany (*Abstract Co-Author*) Speakers Bureau, Siemens AG Christoph Treutlein, Erlangen, Germany (*Abstract Co-Author*) Nothing to Disclose Markus Kopp, Erlangen, Germany (*Abstract Co-Author*) Speakers Bureau, Siemens AG Michael Uder, MD, Erlangen, Germany (*Abstract Co-Author*) Nothing to Disclose

### For information about this presentation, contact:

matthias.may@uk-erlangen.de

### PURPOSE

Our aim was to improve pre-surgical visualization of peroneal artery perforators prior to fibula osteomyocutaneus flap for mandible reconstruction.

### **METHOD AND MATERIALS**

CT angiography of the lower limbs was performed in 33 patients using dual-energy acquisitions from a third generation dual-source CT and a high iodine flux (7 ml/sec, 350 mg/ml). Low monoenergetic reconstructions (40keV) were automatically reconstructed from the scanner and used for semi-automatic centerline labeling of the peroneal artery and its' perforators on a post-processing console using a vascular workflow. Multiplanar unfolding was done using a prototype software application. Image quality was evaluated as vessel contrast and vessel continuity using a five point Likert scale in comparison to standard dual energy reconstructions (mixed images).

# RESULTS

Vessel contrast was rated high or very high in 92 % of all patients in the 40 keV reconstructions and in 69% of the mixed images. Multiplanar vessel unfolding was successful in all patients. Mean number of slices was substantially reduced using vessel unfolding (3) compared to maximum intensity projections (13) or standard multiplanar reconstruction (35) in coronal plane. Continuity was rated high or very high in more than 90% of all vessels using 40 keV reconstructions and significantly lower in the mixed images.

### CONCLUSION

Low monoenergetic reconstructions allow for very good representation of small perforator vessels of the peroneal artery. Multiplanar vessel unfolding is feasible and considerably eases and improves the visualization for pre-surgical planning.

# **CLINICAL RELEVANCE/APPLICATION**

Best reproduction of peroneal perforator vessels prior to fibula osteomyocutaneus flap for mandible reconstructioncan be obtained with vessel unfolding and virtual monoenergetic reconstructions from Dual-Energy CT acquisitions.

# RC612-10 CTA Artifacts and Post-Processing

Thursday, Dec. 5 11:30AM - 12:00PM Room: S405AB

### Participants

Elliot K. Fishman, MD, Owings Mills, MD (*Presenter*) Institutional Grant support, Siemens AG; Institutional Grant support, General Electric Company; Co-founder, HipGraphics, Inc





# RCA51

# How to Prepare 3D Models to Develop Multi-material 3D Printed Vascular Phantoms (Hands-on)

Thursday, Dec. 5 8:30AM - 10:00AM Room: S401AB



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

# Participants

Ciprian N. Ionita, PhD, Buffalo, NY (*Moderator*) Grant, Canon Medical Systems Corporation; Ciprian N. Ionita, PhD, Buffalo, NY (*Presenter*) Grant, Canon Medical Systems Corporation; Kelsey N. Sommer, East Amherst, NY (*Presenter*) Nothing to Disclose

# LEARNING OBJECTIVES

1) Learn how to simplify complex vascular trees in order to create a 3D printed phantom with manageable flow conditions. 2) Learn how to use multiple objects for multimaterial 3D printing. 3) Learn how to create vessel wall structures. 4) Learn how to add support structure to allow facile use of the phantom in a bench-top simulation.

# ABSTRACT

Development of 3D printed vascular models can be challenging since it involves more complex 3D mesh manipulations following standard segmentation. For example, imaging procedures such as CT angiography can provide vessel geometry and vascular disease morphology such as vascular atherosclerosis. These 3D structure are essential but not sufficient to develop a 3D printed model which could be used for flow simulations and endovascular procedures simulations. In this hands-on session we will show how to manipulate post-segmentation a coronary tree in order to develop a flow phantom. We will use a MeshMixer which is a freeware available for download for all users. A 3D coronary geometry which includes an atherosclerotic plaque will be available for the user. Using this geometry the attendants will go through the steps of creating the model.





# SSQ20

# Vascular/Interventional (Lymphatic, AVM, and Venous Interventional Radiology)

Thursday, Dec. 5 10:30AM - 12:00PM Room: S503AB



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

# Participants

Nikunj R. Chauhan, MD, Cleveland, OH (*Moderator*) Nothing to Disclose Roshni A. Parikh, MD, Kirkwood, MO (*Moderator*) Nothing to Disclose

### Sub-Events

# SSQ20-01 Comparison of Indocyanine Green Lymphangiography and Magnetic Resonance Lymphangiography for Planning Lymphaticovenous Anastomoses

Thursday, Dec. 5 10:30AM - 10:40AM Room: S503AB

Participants

Francesco Gentili, MD, Siena, Italy (*Presenter*) Nothing to Disclose Francesco G. Mazzei, MD, Siena, Italy (*Abstract Co-Author*) Nothing to Disclose Gabriele Lucii, Siena, Italy (*Abstract Co-Author*) Nothing to Disclose Paolo Gennaro, Siena, Italy (*Abstract Co-Author*) Nothing to Disclose Federico Zerini, Siena, Italy (*Abstract Co-Author*) Nothing to Disclose Luca Volterrani, Siena, Italy (*Abstract Co-Author*) Nothing to Disclose Maria Antonietta Mazzei, MD, Siena, Italy (*Abstract Co-Author*) Nothing to Disclose

### For information about this presentation, contact:

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# PURPOSE

Lymphedema is a prevalent disease, often misdiagnosed, without a defined gold standard treatment. However supermicrosurgical lymphaticovenular anastomosis (LVA), where collecting lymphatic vessels are anastomosed to a cutaneous vein under surgical microscopy, is demonstrated a valid treatment alternative of lymphedema compared to compression treatment. The purpose of this study is to compare two dynamic imaging modalities employed to study the lymphatic system, Magnetic Resonance Lymphangiography (MRL) and Indocyanine Green Lymphangiography (IGL), evaluating their role for planning LVA treatment in patients with lymphedema.

# METHOD AND MATERIALS

We conducted a retrospective study of 32 patients (26 women) with a mean age of 38 years (range 18-73) enrolled from January 2014 to December 2018; 20 out of 32 were affected by lower limb lymphedema with 6 cases of primary lymphedema; 84% of them have a disease stage >=II. All the patient underwent IGL and MRL, by injecting different contrast medium into interdigital web spaces, between 18 and 72 hours before LVA supermicrosurgical treatment. In each patient we rated the number of lymphatic vessels visualized, considering the region of forearm for the upper limb and the leg for the lower limb. Student's t-test was applied.

# RESULTS

All patients completed both the diagnostic examinations without any significant complications. A statistically significant difference (p<0.05) was found between the number of lymphatic vessels identified on the leg/forearm (34 on IGL vs 70 on MRL and 82 on IGL vs 26 on MRL, considering affected and healthy limbs respectively). In particular dermal backflow in advanced lymphedema seems to hinder lymphatic vessels detection on IGL. Conversely, on healthy limbs, MRL hardly identify lymphatics, because of their fast lymphatic flow, that limited contrast medium detection by MR sequences.

# CONCLUSION

Both MRL and IGL are dynamic diagnostic modalities that permit an effective evaluation of lymphatic vessels anatomical and functional status in extremities lymphedema. They may be considered complementary in the preoperative planning for identyfing suitable functional lymphatic vessels for LVA treatment.

# **CLINICAL RELEVANCE/APPLICATION**

MRL and IGL are two complementary imaging modalities for the surgical planning of LVA treatment.

# ssQ20-02 Ear Arteriovenous Malformation Management

Thursday, Dec. 5 10:40AM - 10:50AM Room: S503AB

### For information about this presentation, contact:

### info@yakesvascularmalformationcenter.com

### PURPOSE

To determine the efficacy of Ethanol Endovascular Repair of Ear Arteriovenous Malformation (AVMs).

# **METHOD AND MATERIALS**

14 patients (9 female, 5 males; age range 6-39 years; mean age: 22 years) with ear AVMs presented for therapy. Two patients had failed prior embolizations (PVA/coils/nBCA/steroids) and 2 patients had other therapies (laser/excisions/grafting). All presented with a grossly enlarged painful ear, and 5 patients had intermittent bleeding. All patients underwent transcatheter and direct puncture ethanol treatments. (86 procedures).

#### RESULTS

All 14 patients were cured of their AVM at long-term follow-up (mean follow-up: 52 months). One patient had transient partial VII nerve palsy. Two patients had minor blisters and ear injuries that healed on the outer tragus. The longest follow-up demonstrating cure was 12 years.

### CONCLUSION

Ethanol endovascular repair of Ear AVMs can achieve cures in this vexing lesion that previously was treated with resection of the ear and with high recurrence rates. This series documents long-term cures of AVMs of the ear and scalp that were not treatable by endovascular approaches as previously documented in the world's literature. Permanent treatment of the auricular AVMs is documented and no recurrence occurred in any patient. Only one article is published (group from Shanghai, China) emulating this technique.

### **CLINICAL RELEVANCE/APPLICATION**

This series documents long-term cures of AVMs of the ear and scalp that were not treatable by endovascular approaches as previously documented in the world's literature.

# SSQ20-03 An Alternative Method for Adrenal Venous Sampling in Cases in which Right Adrenal Vein Sampling is Difficult

Thursday, Dec. 5 10:50AM - 11:00AM Room: S503AB

Participants

Akira Yamamoto, MD, Kurashiki, Japan (*Presenter*) Nothing to Disclose Takeshi Fukunaga, Kurashiki, Japan (*Abstract Co-Author*) Nothing to Disclose Mitsuru Takeuchi, MD, PhD, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose Hiroki Nakamura, Kurashiki, Japan (*Abstract Co-Author*) Nothing to Disclose Akihiko Kanki, MD, Kurasiki, Japan (*Abstract Co-Author*) Nothing to Disclose Atsushi Higaki, MD, Kurashiki, Japan (*Abstract Co-Author*) Nothing to Disclose Tsutomu Tamada, MD,PhD, Kurashiki, Japan (*Abstract Co-Author*) Nothing to Disclose

### For information about this presentation, contact:

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### PURPOSE

Catheterization of the right adrenal vein (rt.AdV) to obtain blood samples can often be difficult, reducing the feasibility of adrenal venous sampling (AVS). The aim of present study was to investigate whether blood sampling from the IVC at its juncture with the rt.AdV can be an alternative method to sampling of blood directly from the rt.AdV.

### **METHOD AND MATERIALS**

This study included 44 patients diagnosed with primary aldosteronism (PA) in whom AVS with adrenocorticotropic hormone (ACTH) was performed for a local diagnosis of the lesion, resulting in a diagnosis with idiopathic hyperaldosteronism (IHA) (n=24), and patients diagnosed with unilateral aldosterone-producing adenoma (APA) (n=20; rt.APA=8, lt.APA=12) who had improved PA postoperatively. In addition to regular blood sampling, blood was also sampled from the IVC at its confluence with the rt.AdV, as the substitute rt.AdV [S-rt.AdV]. The local diagnostic performance with the conventional lateralized index (LI) and the Modified LI ((Lt.AdV A/C ratio) / (S-rt.AdV A/C ratio)) using S-rt.AdV was compared to examine the utility of the Modified LI.

### RESULTS

Both conventional LIs of rt.APA ( $23.3\pm25.8$ ) and lt.APA ( $7.0\pm5.3$ ) were significantly higher than that of IHA ( $1.8\pm2.5$ ) (p=0.003 and p<0.001). Modified LI of rt. APA ( $0.4\pm0.4$ ) were significantly lower than those of IHA ( $1.4\pm0.7$ ) (p<0.001) and lt.APA ( $3.5\pm2.0$ ) (p<0.001). Modified LI of lt.APA were significantly higher than those of IHA (p<0.001) and rt.APA (p<0.001). The results of ROC curve analysis for diagnostic performance of conventional LI was area under the curve (AUC) of 0.90 in unilateral APA, whereas modified LI was AUC of 0.92 in rt.APA and 0.81 in lt.APA. Sensitivity and specificity to diagnose unilateral APA using conventional LI were 95% and 83% in threshold value was set at 1.9, and to diagnose rt.APA and lt.APA using modified LI were 87% and 75%, and 94% and 94% in threshold values were set at 0.7 and 2.2 respectively.

### CONCLUSION

Modified LI has the potential to be an alternative method for rt.AdV sampling in cases in which rt.AdV sampling is difficult. Modified LI is an extremely simple procedure, it might complement conventional AVS.

### **CLINICAL RELEVANCE/APPLICATION**

Modified LI using blood sampled from the IVC at the juncture of the right adrenal vein, which can be done easily in such patients, is a potentially useful clinical method.

# Abnormal Pulmonary Lymphatic Perfusion in Patients with Plastic Bronchitis and Non-Traumatic Chylothorax on Dynamic Contrast-Enhanced Magnetic Resonance Lymphangiography and Thoracic Duct Catheterization Suggesting a Common Etiology

Thursday, Dec. 5 11:00AM - 11:10AM Room: S503AB

Cathal O'Leary, MBBCh, Philadelphia, PA (*Presenter*) Nothing to Disclose Gregory J. Nadolski II, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose Maxim Itkin, MD, Bala Cynwyd, PA (*Abstract Co-Author*) Stockholder, ControlRad Systems, Inc Consultant, ControlRad Systems, Inc

# For information about this presentation, contact:

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### PURPOSE

To evaluate imaging findings of dynamic contrast-enhanced magnetic resonance lymphangiography (DCMRL) and thoracic duct catheterization (TDC) in patients with lymphatic plastic bronchitis and nontraumatic chylothorax.

# METHOD AND MATERIALS

This is a retrospective review of 33 patients (M/F = 15/18, median age 59 years) who presented in our institution with plastic bronchitis (n=20) or nontraumatic chylothorax (n=13). DCMRL was performed following US-guided administration of gadoliniumbased contrast material into the groin lymph nodes. Time resolved contrast-enhanced dynamic lymphangiography and post contrast steady state 3-D IR FLASH sequences were performed. Intranodal lymphangiography with oil based iodinated contrast and TDC were subsequently performed.

### RESULTS

DCMRL demonstrated the thoracic duct (TD) and abnormal pulmonary lymphatic perfusion (APLP) in 19/20 plastic bronchitis patients. Corresponding findings were seen on TDC. In 1/20 patients with non-visualization of TD on DCMRL, TDC showed delayed filling of TD with APLP. DCMRL demonstrated the TD and APLP in 11/13 non-traumatic chylothorax patients. TDC showed corresponding findings in 11/13. In 1/13 patients, DCMRL demonstrated TD with no APLP, however, APLP was seen on TDC. In 1/13 patients, the TD was not seen on DCMRL but APLP was visualized on TDC.

### CONCLUSION

Lymphatic imaging (DCMRL / TDC) demonstrated abnormal pulmonary lymphatic perfusion in all patients with plastic bronchitis and non-traumatic chylothorax. In both entities, imaging findings were strikingly similar suggesting a common etiology. We hypothesize that the clinical presentation depends on the proximity of abnormal lymphatic vessels to the pleural cavity, resulting in chylothorax; or bronchial surface, resulting in plastic bronchitis. DCMRL offers a sensitive, minimally invasive diagnostic alternative to TDC in demonstrating the TD and abnormal pulmonary lymphatic flow in the majority of cases. In cases with negative DCMRL, there was a slow progression of contrast from the inguinal area to the TD. Extension of DCMRL imaging duration in cases of TD non-visualization is suggested as a technical modification.

### **CLINICAL RELEVANCE/APPLICATION**

Abnormal pulmonary lymphatic perfusion can result in severe morbidity and mortality. DCMRL provides a minimally-invasive dynamic evaluation of the lymphatic system that can further our understanding of the mechanism of pulmonary lymphatic perfusion syndromes

# SSQ20-05 Investigation of Hepatic Venous Anatomy and Its Variations in Donors of Our Population Using 320 Slice Computed Tomography Before Live Donor Liver Transplantation

### Thursday, Dec. 5 11:10AM - 11:20AM Room: S503AB

Participants

Belqees Y. Faiz, FRCR, MBBS, Islamabad, Pakistan (*Presenter*) Nothing to Disclose Laiba Masood, MBBS, Rawalpindi, Pakistan (*Abstract Co-Author*) Nothing to Disclose Samina Akhtar, MBBS, Islamabad, Pakistan (*Abstract Co-Author*) Nothing to Disclose Rashed Nazir, MBBS, Islamabad, Pakistan (*Abstract Co-Author*) Nothing to Disclose Atif I. Rana, MBBS, Islamabad, Pakistan (*Abstract Co-Author*) Nothing to Disclose Abu Bakar Hafeez, MBBS, Islamabad, Pakistan (*Abstract Co-Author*) Nothing to Disclose

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### PURPOSE

To delineate details of hepatic venous drainage with its variation and details of accessory hepatic veins in live donor liver transplant (LDLT) donors.

# METHOD AND MATERIALS

After IRB approval a retrospective study was conducted, analyzing 106 potential liver donors from hospital database from January 2013 to December 2016. CT scans were obtained using Toshiba acquilon 320 slice CT scanner, transferred and reviewed on Vitrea Enterprise 7.7 by two radiologists. Quantitative assessment of hepatic veins was done in which mean caliber of hepatic veins, main venous drainage of segment IV, presence of accessory hepatic veins, their number and calibers, along with their distance from inferior vena cava (IVC) was assessed. Data analysis was done using SPSS version 21 and results were complied.

### RESULTS

Out of 106 donors, conventional hepatic venous anatomy with three hepatic veins was seen in 99 subjects. 7 showed more than three main hepatic veins. Out of these 6 showed two left hepatic veins (LHV) and 1 showed a small right hepatic vein (RHV). Mean calibers of RHV, middle hepatic vein (MHV) and LHV were 14.5, 9.9 and 9.5 mm respectively. Classic segment IV drainage from both

MHV and LHV was in 79 donors (74.5%). Segment IV was mainly drained by MHV and LHV in 19 (17.9%) and in 8 (7.5%) it was mainly from LHV. 69 subjects had accessory hepatic veins with caliber of 5 mm or more. Out of these 36 cases (33.9%) had single accessory hepatic vein while 17 (16%) had two or more accessory hepatic veins. The results showed that caliber of RHV in donors having single accessory vein was larger than in those donors having two or more accessory hepatic veins, 9.57 mm +/- 1.87 vs 8.21 mm +/- 1.73, p =0.007.

# CONCLUSION

Multidetector CT with image post processing, allows accurate identification of areas at risk for venous congestion and devascularization. Presence of accessory hepatic veins or variation in main hepatic veins may influence surgical planning with regard to the extent of hepatic resection or the need for vascular reconstruction including PTFE grafts, allowing surgeon to prepare well in time and anticipate the possible alterations in surgical management.

### **CLINICAL RELEVANCE/APPLICATION**

Image aquisition on multidetector CT with post processing on Vitrea beautifully delineates hepatic venous anatomy in this pilot study which will provide a guideline to the radiologists and surgeons aspiring to start liver transplant program at their centers.

# SSQ20-06 Pre-Interventional Determination of the Right Renal Vein to Right Adrenal Vein Distance Reduces Procedure Time and Contrast Agent Exposure during Adrenal Vein Sampling

Thursday, Dec. 5 11:20AM - 11:30AM Room: S503AB

Participants

Clemens Spink, Hamburg, Germany (*Presenter*) Nothing to Disclose Maxim Avanesov, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose Gerhard B. Adam, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose Alexander Lenz, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose Johannes M. Salamon, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose Lennart Well, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose Bjoern Schoennagel, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose Prank Oliver G. Henes, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose Peter Bannas, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To reduce procedure time and contrast agent exposure during adrenal vein sampling (AVS) by pre-interventional determination of the right renal vein (RRV) to right adrenal vein (RAV) distance.

# METHOD AND MATERIALS

20 patients were included in this study undergoing AVS. The RRV-RAV-distance was determined for 10 patients (study group) in CT and MRI pre-interventionally. During AVS a radiopaque planning ruler was placed underneath each patient. The RRV was probed and delineated by injection of contrast agent. Probing of the RAV was then focused at the height of the pre-interventionally determined RRV-RAV-distance. The angiographically measured RRV-RAV-distance was then correlated with the cross-sectional-derived pre-interventional distances. Procedural parameters such as fluoroscopy time, contrast agent, cumulative air kerma (AK), and cumulative dose area product (DAP) were compared to a control group of 10 patients undergoing conventional AVS without pre-interventional measurement using two-tailed t-tests.

### RESULTS

The angiographic RRV-RAV-distance of 4.2 $\pm$ 0.7 cm (95%-CI: 3.7-4.8 cm) was 0.5 $\pm$ 0.4 cm lower than cross-sectional-derived measurements of 4.7 $\pm$ 0.8 cm (95%-CI: 4.2-4.9 cm) and showed a good correlation (r=0.852, 95%-CI: 0.4335-0.9683; p<0,01). Fluoroscopy time (48 $\pm$ 19 vs. 22  $\pm$ 11 min, p<0.001) and contrast agent (235 $\pm$ 88 vs. 142  $\pm$ 44 ml, p<0.001) of the study group were significantly decreased by 56% and 39%, respectively. Radiation doses of AK (1429 $\pm$ 1683 vs. 960 $\pm$ 843 mGy, p=0.44) and DAP (242 $\pm$ 256 vs. 158 $\pm$ 151 Gycm2, p=0.38) were decreased by 32% and 34%, however without reaching statistical significance.

### CONCLUSION

Pre-interventional estimation of the RRV-RAV-distance reduces procedure time and contrast agent exposure during adrenal vein sampling.

### **CLINICAL RELEVANCE/APPLICATION**

Pre-interventional planning before AVS does not only reduce radiation and contrast agent dose during intervention, it could also benefit younger colleagues in training complex angiographic interventions.

# SSQ20-07 Diagnosis and Management of Thoracic and Shoulder Arteriovenous Malformations

Thursday, Dec. 5 11:30AM - 11:40AM Room: S503AB

### Participants

Wayne F. Yakes, MD, Englewood, CO (Presenter) Nothing to Disclose

### For information about this presentation, contact:

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# PURPOSE

To determine the efficacy of Endovascular Repair of Thoracic and Shoulder Arteriovenous Malformations (AVMs). Previous reports have documented the utter futility of Onyx, Coils, and nBCA and amputation of the extremity was required.

#### **METHOD AND MATERIALS**

13 patients (9 female, 4 male) presented for repair of shoulder and thoracic AVMs. 3 patients had extension of AVM to the supraclavicular and axillary areas. 3 patients had multiple AVMs. 7 patients had previous failed therapies (embo: PVA/coils/gelfoam;

Onyx, nBCA; surgeries: excisions/arterial bypass Left subclavian Axillary, Brachial, and Radial). All patients underwent ethanol endovascular AVM repair; 4 patients had additional coil embolizations (132 treatments). Patient age range 18-76 years; mean age 36.

### RESULTS

12 patients are cured at long-term arteriographic follow-up (follow-up 22 - 192 months; mean follow-up: 42 months). 1 patient with bilateral shoulder AVM and multiple other AVMs therapy is on-going. Complications include 2 patients with minor superficial bilisters, 1 patient with transient left radial nerve injury with complete recovery and 1 patient with clot embolus to hand, Rx with urokinase w/distal 3rd phalanx removed. Thus, major complications were 2/132 procedures, 1 being transient. 1 patient at 27-year arteriographic follow-up remains cured.

### CONCLUSION

A JVIR report of shoulder AVM endovascular repair documented total failure of the current approaches even when coupled with shoulder quadrant amputation whereby recurrence was universal. These authors stated that shoulder AVMs were not possible to treat. This report documents that cure of these difficult lesions is possible with ethanol endovascular approaches and direct puncture approaches. No other publications in the world literature documents cure of AVMs in this anatomy consistently. Long-term cures are noted with the use of ethanol, and ethanol and coils to successfully treat these complex, problematic lesions. A low major complication rate is noted. This patient series finally documents a curative procedure for this daunting lesion.

### **CLINICAL RELEVANCE/APPLICATION**

Long-term cures are noted with the use of ethanol, and ethanol and coils to successfully treat these complex, problematic lesions. A low major complication rate is noted.

# SSQ20-08 The Retrograde Vein Approach as a Curative Treatment Strategy for Yakes Type I, IIb AVMs, Type IIIa AVMs, and Type IIIb AVMs

Thursday, Dec. 5 11:40AM - 11:50AM Room: S503AB

Participants

Wayne F. Yakes, MD, Englewood, CO (Presenter) Nothing to Disclose

For information about this presentation, contact:

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#### PURPOSE

To evaluate the role of Retrograde Vein and Direct Puncture Retrograde Vein Endovascular Repair of Large Peripheral AVMs.

### **METHOD AND MATERIALS**

Eighty-seven patients (45 males, 42 females; age: 14 - 72, mean age: 27 years) presented for repair of AVMs involving head and neck, shoulder, chest wall, intra-thoracic, abdominal, renal, pelvic, buttock, and extremities. Ethanol and ethanol/coils were the embolic agents used. Retrograde transvenous catheterizations and vein direct puncture retrograde vein approaches were used in all patients.

### RESULTS

Eighty-five of 87 patients are cured at long-term follow-up (f/up: 14 months to 138 months; mean: 42 months) and 2 patients' therapy is on-going. Complications include 1 pelvic AVM post-Rx small bleed not requiring transfusion; 1 pelvic AVM coils eroded into bladder wall removed uneventfully via trans-urethra endoscopy; 2 infections treated with antibiotics; 2 patients' coils superficially eroded and uneventfully removed; and 1 patient subcutaneous hematoma removed (7/87 patients; 8% minor complications).

### CONCLUSION

Retrograde vein and direct puncture vein access and embolization of AVMs in many anatomic locations have proven curative at long-term f/up of AVMs in multiple anatomic locations with a low complication rate. Reproducible and consistent results of this technique have been reported only in 3 publications in the world's literature: by Yakes (1990), Jackson (1996) and Cho (2008). In the Yakes AVM Classification System, these approaches can routinely effect AVM cures in Yakes Types I, IIa, IIIa, and IIIb.

### **CLINICAL RELEVANCE/APPLICATION**

Retrograde vein and direct puncture vein access and embolization of AVMs in many anatomic locations have proven curative at long-term f/up of AVMs in multiple anatomic locations with a low complication rate.

# SSQ20-09 Facilitating Successful Adrenal Venous Sampling with Pre-Procedural CT to Localize the Right Adrenal Vein and Intra-Procedural CT to Verify Correct Catheter Placement

Thursday, Dec. 5 11:50AM - 12:00PM Room: S503AB

Participants

Meesha K. Khatker, Houston, TX (*Abstract Co-Author*) Nothing to Disclose Rony Avritscher, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose Kyle M. Jones, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose Mouhammed Amir Habra, Houston, TX (*Abstract Co-Author*) Nothing to Disclose Paul H. Graham, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose Nancy Perrier, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose Steven Y. Huang, MD, Houston, TX (*Presenter*) Nothing to Disclose

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PURPOSE

Adrenal venous sampling (AVS) is associated with failure rates as high as 30-40% due to difficulties in cannulating the right adrenal vein (RAV). Our purpose was: (1) to evaluate the accuracy of pre-AVS computed tomography (CT) imaging to localize the RAV and (2) to assess whether intra-procedural CT imaging would improve success rates of RAV catheterization.

# METHOD AND MATERIALS

A total of 100 AVS procedures on 85 patients with primary aldosteronism from 2000 to 2018, were included in this retrospective study. Successful cannulation of the RAV and left adrenal vein (LAV) was defined by a selectivity index > 3. Comparison of RAV location on pre-AVS CT and during AVS was performed if the RAV was identified on pre-AVS CT and RAV sampling during AVS yielded a SI > 3. Using the spine as a stationary reference, the location of the RAV was compared between the pre-AVS CT and fluoroscopic images acquired during AVS. AVS procedures were also classified according to whether intra-procedural CT (i.e. C-arm CT) was used and success rates of successful RAV cannulation were compared (Fisher's exact test).

### RESULTS

Concomitant identification of the RAV on pre-AVS CT and successful RAV catheterization during AVS occurred in 48 (56.5%) of 85 patients. The RAV was located at the same spinal level in 20 patients (41.7%) and within two-thirds of a vertebral body level in 43 patients (89.6%). Intra-procedural CT was used in 39 of 100 procedures (Figure 1). Successful cannulation of the RAV occurred in 35 of 39 (89.7%) procedures in which intra-procedural CT was used compared to 39 of 61 (63.9%) procedures in which intra-procedural CT was used (P=0.0047). A reformatted image (attached) obtained during an intra-procedural CT scan with the catheter tip in the RAV and contrast injected through the catheter demonstrates opacification of the right adrenal gland indicating successful RAV cannulation. Successful cannulation of the LAV occurred in 99 of 100 (99%) procedures, and intra-procedural CT was not used to delineate the location of the LAV.

# CONCLUSION

Pre-AVS CT imaging can be used to predict the location of the RAV during AVS. Intra-procedural CT imaging during AVS significantly improves rates of successful RAV catheterization.

# **CLINICAL RELEVANCE/APPLICATION**

Successful cannulation of the right adrenal vein can be improved with adjunctive use of intra-procedural CT imaging during adrenal venous sampling for diagnosis of primary hyperaldosteronism.





# VIS-THA

# Vascular Interventional Thursday Poster Discussions

Thursday, Dec. 5 12:15PM - 12:45PM Room: VI Community, Learning Center

# VA

AMA PRA Category 1 Credit ™: .50

**FDA** Discussions may include off-label uses.

# Participants

Claire Kaufman, MD, Salt Lake City, UT (Moderator) Nothing to Disclose

# Sub-Events

# VI218-SD- Classification of Geniculate Arterial Patterns with Implications for Interventional Radiologist THA1

Station #1 Participants Maziar Sighary, MD, New York, NY (*Presenter*) Nothing to Disclose Abin Sajan, Brooklyn, NY (*Abstract Co-Author*) Nothing to Disclose James P. Walsh, MD, Brooklyn, NY (*Abstract Co-Author*) Nothing to Disclose

Samuel Marquez, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

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# PURPOSE

Geniculate Artery Embolization (GAE) has demonstrated efficacy in alleviating knee pain associated with osteoarthritis. A thorough understanding of the classical anatomy and variations in branch patterns are essential in order to optimize target therapeutic selective embolization. We plan to anatomically review the geniculate arteries (GA) as there is a lack of detailed anatomy in the literature most notably at the cadaveric level.

# METHOD AND MATERIALS

A mixed sex sample of medically embalmed donor bodies from 3 medical schools were utilized for this study. 102 cadaveric limbs were dissected for gross anatomical appearance, presence of the descending genicular artery (DGA), recurrent tibial artery (RTA) and all 5 main branches off the popliteal artery including the superior lateral genicular artery (SLGA), superior medial genicular artery (SMGA), middle genicular artery (MGA), inferior lateral genicular artery (ILGA) and inferior medial genicular artery (IMGA). The location of origin, diameter of vessels and variation in patterns were documented using a Neiko 01409A electronic Vernier digital caliper with an accuracy to 1/10 of a mm.

# RESULTS

96 limbs were adequately preserved and reviewed. Results showed the establishment of 7 specific arterial patterns off the popliteal artery of which the highest statistical frequency was revealed to be 2 superior and 2 inferior geniculate branches with the middle emanating from, and supplying the medial side of the popliteal fossa. 4 limbs demonstrated independent DGA trunks off the femoral artery. The origin of the SMGA (47.0 mm) was the furthest from the reference line, followed by SLGA (40.2 mm), MGA (22.2), IMGA (-0.8), and ILGA (-6.5).

# CONCLUSION

This quantitative study documents the GA patterns in a large sample size of donor bodies in order to establish a baseline of variation permitting a navigational guide for interventionist performing GAE. Results showed the establishment of 7 specific arterial patterns. Understanding of the variations is essential in targeting embolization and reducing complications associated with non-target embolization. We propose a new classification system for the Geniculate Artery branching patterns in order to help in reducing these risks.

# **CLINICAL RELEVANCE/APPLICATION**

During Geniculate Artery Embolization knowledge of the most common vascular anatomy and variations in branching is essential for safe embolization, good clinical practice, and optimal outcomes.

# VI219-SD- Doppler-Based Renal Perfusion Variations After Fenestrated/Branched Endovascular Repair and THA2 Post-Operative Renal Function Outcomes

### Station #2

Participants David E. Timaran Montenegro, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose Marilisa Soto Gonzalez, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose Mitri Khoury, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose Carlos Timaran, Dallas, TX (*Abstract Co-Author*) Consultant, Cook Group Incorporated Consultant, Getinge AB Consultant, W. L. Gore & Associates, Inc
### david\_timaran@yahoo.com

# PURPOSE

To assess parenchymal renal perfusion changes, as determined by variations on Doppler Resistance index (RI), after fenestrated/branched endovascular aortic aneurysm repair (F-BEVAR) and the impact of RIs variations on renal perioperative outcomes and renal function deterioration after F-BEVAR in patients with chronic kidney disease (CKD).

# **METHOD AND MATERIALS**

A total of 102 patients who underwent F-BEVAR between 2015-2018 for suprarenal, juxtarenal, and type I-IV TAAAs were included. All procedures were performed using investigational customized and off-the-shelf devices under physician-sponsored investigational device exemptions. Post-operative acute renal failure (ARF) and CKD were defined using RIFLE criteria and CKD staging system (stage >3, GFR <60 ml/min/1.73m2), respectively. For those without baseline CKD, renal decline was defined as a drop in GFR <60 mL/min/1.73m2. For patients with baseline renal dysfunction, GFR decline > 20% or progression in CKD stage was considered as renal decline. RI was calculated as follows: RI=(Peak Systolic Velocity-End Diastolic Velocity)/ Peak Systolic Velocity. Renal parenchymal Doppler assessment was performed at upper and lower pole inter lobar arteries. Mean RI was calculated for each kidney. Highest RI was used for analysis.

# RESULTS

CKD was present in 83 patients (45%). Median pre-operative RI was 0.68 (Interquartile range [IQR], 0.65-0.71). Post-operative ARF was diagnosed in 27 patients (14.5%). Renal Doppler ultrasound within 30 days demonstrated a significant increase RI compared to baseline (0.71 IQR-0.65-0.74) (p=0.01). Peri- operative RI variations, however, did not demonstrate association with the occurrence of ARF (0.2). At a median follow-up period of 12 months (IQR 6-23 months), RI was higher compared to baseline (0. 72 IQR, 0.68-0.75) (p=0.02). Renal decline was observed in 32 patients (31%). Among patients with history of CKD, RI was higher than in patients without CKD (p=0.02). Follow-up RI variations, however, were not associated with renal function decline (p=0.1).

# CONCLUSION

ARF and renal function decline are common after FEVAR especially in patients with previous CKD. Similarly, renal perfusion variations occurred after F-BEVAR with increased RIs. Renal perfusion changes, however, are not associated with renal function decline.

# **CLINICAL RELEVANCE/APPLICATION**

Renal function deterioration is common after F-BEVAR. However, post-operative renal perfusion variations are not associated to function decline. Reasons may be related to intrinsic renal disease.

#### VI220-SD-THA3 MR-Guided Focused Ultrasound (MRgFUS) Compared to the Main Current Therapeutic Approaches for the Treatment of Uterine Fibroids: MR-Guided Focused Ultrasound (MRgFUS) Compared to the Main Current Therapeutic Approaches for the Treatment of Uterine

Station #3

Participants Giulia Alfieri, MD, Rome, Italy (*Presenter*) Nothing to Disclose Andrea Leonardi, MD, Roma, Italy (*Abstract Co-Author*) Nothing to Disclose Alessandro Napoli, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Roberto Scipione, MD, Terracina, Italy (*Abstract Co-Author*) Nothing to Disclose Susan Dababou, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Carlo Catalano, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

To prospectively evaluate clinical outcome of Magnetic Resonance Focused Ultrasound (MRgFUS), Uterine Artery Embolization (UAE) and Surgery for Symptomatic Uterine Fibroid

# METHOD AND MATERIALS

600 symptomatic uterine fibroids underwent pre-treatment MR evaluation in order to assess myoma characteristics. 202 (34%) were considered eligible to MRgFUS and treated with ExAblate-InSightec 2100 system, while 398 resulted ineligible and were directed toward other therapeutic strategies. Of these, 137 underwent to UAE, 143 to myomectomy and 61 to hysterectomy. Clinical outcome was evaluated comparing pre-treatment Symptoms Severity Score (SSS) with post-treatment SSS at 3-month and 12-month follow-up. Data concerning number and type of complications, days of hospitalization and days of convalescence were also collected and compared

# RESULTS

SSS mean reduction at 3 and 12-months was of 27,4% and 56,3%, respectively, for MRgFUS group; 48,7% and 56,9% for UAE group; 69,8% and 67,1% for myomectomy group; 96,6% and 94,5% for hysterectomy group. MRgFUS group demonstrated fewer complications (4 patients, 2,0%), while the major adverse events rate was reported in UAE group (33 patients, 25,4%). All MRgFUS patients were treated in outpatient setting, while mean days for hospitalisation and convalescence for other groups were respectively 3,4±2 and 11,7±9 days for UAE group; 4,1±2 and 16,9±12 days for myomectomy group; 4,5±1 and 24,6±14 days for hysterectomy group

# CONCLUSION

Clinical efficacy of MRgFUS for uterine fibroids treatment is comparable to UAE but slightly lower than myomectomy. However, MRgFUS is feasible in an outpatient setting and adverse events rate is significantly lower than other therapeutic strategies

# **CLINICAL RELEVANCE/APPLICATION**

MRgFUS treatment has clinical efficacy comparable to UAE but lower than myoectomy for the treatment of uterine fibroids. MRgFUS has an advers events rate significantly lower than UAE and myoectomy.

# VI248-SD- Inpatient Placement of a Subcutaneous Venous Access Ports is Not a Risk Factor for Port Infection THA4

Station #4

Participants Mohammad-Kasim H. Fassia, BS,MS, Grand Rapids, MI (*Presenter*) Nothing to Disclose James Moroney, Grand Rapids, MI (*Abstract Co-Author*) Nothing to Disclose Jordan Castle, MD, Belmont, MI (*Abstract Co-Author*) Nothing to Disclose James J. Morrison, MD, Grand Rapids, MI (*Abstract Co-Author*) Nothing to Disclose

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#### PURPOSE

Inpatient placement of subcutaneous venous access ports has been associated with increased risk of both short-term (< 30 day) and long-term infectious complications. Streamlining of patient care at our institution has lead to an increase in inpatient referrals for port placement. The purpose of this study was to determine if patients who were admitted to the hospital at the time of port placement were at increased risk of port infection compared to patients who underwent port insertion as an outpatient procedure.

# METHOD AND MATERIALS

All ports placed by the interventional radiology department at a single institution in 2018 were identified (N = 892) and retrospectively analyzed. Data were collected regarding the patient's status at time of insertion (inpatient/outpatient), indication for port placement, and the indication for port removal. Infections were defined as clinically suspected port pocket infection or culture positive bacteremia which resulted in antibiotic treatment and/or port removal.

## RESULTS

Over the study period, a total of 892 ports were placed by one of 13 attending interventional radiologists. Median patient age was 62 (range: 19 to 91). Of these ports, 751 were inserted in the outpatient setting and 141 placed on inpatients. The most common indication for port placement was solid organ malignancy (146 outpatient, 38 inpatient), followed by hematologic malignancy (26 outpatient, 11 outpatient) and poor peripheral access (5 outpatient, 1 inpatient). The most common indication for port removal was therapy completion (70 outpatient, 7 inpatient) followed by infection (16 outpatient, 7 inpatient). In 118 patients the port was still implanted at the time of death. No statistically significant difference in the port infection rate was observed between ports placed in the inpatient setting versus the outpatient setting (p = 0.89).

#### CONCLUSION

Inpatient status at the time of port insertion does not increase the risk of infectious complication of a subcutaneous venous access port.

# **CLINICAL RELEVANCE/APPLICATION**

Inpatient placement of subcutaneous venous access ports do not increase the risk of port infection

# VI245-SD- Biodegradable versus Multiple Plastic Stent Implantation in Benign Biliary Strictures: A Systematic THA6 Review and Meta-Analysis

Station #6

Participants Goncalo G. Almeida, Coimbra, Portugal (*Presenter*) Nothing to Disclose Paulo Donato, MD, Coimbra, Portugal (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Benign biliary strictures arise mostly from iatrogenic injuries during surgical procedures and various inflammatory causes. Endoscopic placement of multiple plastic stents is often regarded as the first-line therapy, albeit not without limitations. Biodegradable biliary stents present a novel therapeutic option aimed at overcoming these shortcomings. The purporse of this work is to analyze and compare long-term stricture resolution rates between biodegradable and multiple plastic biliary stent implantation in patients with benign biliary strictures, regardless of etiology.

# **METHOD AND MATERIALS**

A systematic review of original articles was conducted on MEDLINE, EMBASE and The Cochrane Library databases. Additional studies were identified by manually searching through article references. Randomized controlled trials, cohort studies and case series regarding biodegradable biliary stent and/or multiple plastic stent use in the bile duct for strictures of benign etiology were selected. Articles were excluded according to predefined criteria. Two authors independently extracted the articles using predefined data fields. Any disagreements between authors on study selection were resolved by consensus.

### RESULTS

3 studies for biodegradable stent (n = 133) and 6 for multiple plastic stent technique (n=441) met the inclusion criteria. The overall success rate (defined as no stricture recurrence during follow-up) for biodegradable biliary stent implantation was 83% (95% confidence interval [CI], 0.76-0.89), compared to 84% (95% confidence interval [CI], 0.78-0.89) in the multiple plastic stent group.

# CONCLUSION

The insertion of biodegradable biliary stents in the treatment of benign biliary strictures does not seem to be inferior to multiple plastic stents in maintaining long-term biliary duct patency.

### **CLINICAL RELEVANCE/APPLICATION**

Biodegradable biliary stents (BDBS) are a safe and viable option in the treatment of benign biliary strictures (BBS) arising from various etiologies, which may provide a more patient-friendly and possibly cost-effective alternative to multiple plastic stents (MPS), whilst exhibiting low complication rates. However, these findings are greatly limited by the total lack of RCTs and low

number of published studies regarding the use of BDBS for BBS.

# VI246-SD- Combined CT-Guided Biopsy with Tissue Examination and Outer Cannula Washing Cytology: THA7 Technique and Outcomes

#### Station #7

Participants Fumiyasu Tsushima, Hirosaki , Japan (*Presenter*) Nothing to Disclose Shinya Kakehata, Hirosaki, Japan (*Abstract Co-Author*) Nothing to Disclose Soichiro Tatsuo, Hirosaki, Japan (*Abstract Co-Author*) Nothing to Disclose Shou Maruyama, Hirosaki, Japan (*Abstract Co-Author*) Nothing to Disclose Hiromasa Fujita, Hirosaki, Japan (*Abstract Co-Author*) Nothing to Disclose Hiroyuki Miura, MD, Hirosaki, Japan (*Abstract Co-Author*) Nothing to Disclose Shuichi Ono, MD, PhD, Hirosaki, Japan (*Abstract Co-Author*) Nothing to Disclose Shingo Kakeda, Hirosaki City , Japan (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

We aimed to retrospectively examine the effectiveness of the combined use of outer cannula washing cytology and histology in CTguided tissue-core biopsy. Here, we report the results of this approach.

### **METHOD AND MATERIALS**

At our hospital, 95 patients (mean age, 68 [range, 33 to 84] years; 59 males and 36 females; 63 Thoracic, 24 abdominal, 6 musclockeletal region) were diagnosed between June 2016 and March 2019. As a biopsy needle, we used FINECORE 18 G 100 mm (Toray Medical Doctor Japan). While the inner needle was washed with formalin and submitted for tissue examination, the washing solution inside the outer cannula was submitted for cytodiagnosis.

#### RESULTS

In 94 patients, we successfully performed the procedure without any serious complications. In 80 patients, we observed malignant findings in histopathology or cytodiagnosis. Although two cases were negative for histological diagnosis and cytological examination, they were malignant after that. Remaining thirteen other cases were benign. Of note, we obtained only cytological malignant findings in the five patients. The sensitivity of the cutting-needle histological biopsy were 91%(75/82), of histology and cytology were 98%(80/82), respectively.

# CONCLUSION

In CT-guided biopsy, outer cannula washing cytology can be helpful for diagnosis in addition to conventional histopathology. Our combined approach is effective and useful for the diagnosis of malignant tumors.

#### **CLINICAL RELEVANCE/APPLICATION**

Malignancy can be diagnosed despite histodiagnosis being negative. Our approach with cytodiagnosis does not increase the physical burden on patients.

#### VI247-SD-The Utility of Test Bolus for Improving Low Iodine Dynamic 4D CTA in the Diagnosis of Lower Extremity Peripheral Vascular Disease

Station #8

Participants Terri J. Vrtiska, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose Yong Lee, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose Nikkole Weber, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose Ahmed Halaweish, PhD, Rochester, MN (*Abstract Co-Author*) Employee, Siemens AG Irene Duba, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose Eric E. Williamson, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose Shuai Leng, PHD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose Cynthia H. McCollough, PhD, Rochester, MN (*Abstract Co-Author*) Research Grant, Siemens AG Joel G. Fletcher, MD, Rochester, MN (*Presenter*) Grant, Siemens AG; Consultant, Medtronic plc; Consultant, Takeda Pharmaceutical Company Limited; Grant, Takeda Pharmaceutical Company Limited; ;

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# PURPOSE

To determine the diagnostic accuracy of low iodine 4D dynamic CTA (4D CTA) with a test bolus in lower extremity peripheral vascular disease (PVD).

# METHOD AND MATERIALS

68 pts with suspected PVD underwent dynamic 4D CTA of the lower extremities with 40mL Iohexol 350 using either fixed delay (of 13 sec, n=34) or with test bolus (10 cc of Iohexol 350, n=34). Subsequent conventional CTA using a weight-base protocol served as the reference standard. 4D-CTA exams (± test bolus) consisted of 11 low-radiation-dose acquisitions. A vascular radiologist interpreted thin temporally-resolved MIPs (tMIPs) of each lower extremity, a dynamic series displaying the 4D temporal runoff, and thick tMIPs with and without calcium removal. For each lower extremity, arterial stenoses in each of 7 vascular segments was compared to conventional CTA, and was graded as <50%, 50 -70%, >70% or occluded.

#### RESULTS

Runoff to the level of the ankle was observed for 76% (26/34) patients using 4D CTA with fixed delay compared to 97% (33/34) with test bolus. In patients with runoff to the ankle, overall accuracy for peripheral vascular disease (requiring identical stenosis grading per segment) was 89.6% (326/364; 95% CI: 86 - 95%) for 4D CTA with fixed delay compared to 94.0% (355/378; 95% CI: 91 - 96%) using the test bolus. For stenosis > 70%, 4D CTA demonstrated a sensitivity of 90.3% (56/62; 95% CI: 86 - 95%) with

a fixed delay and 90.4% (104/115; 95% CI: 82 - 98%) with a test bolus. For patients with runoff to the ankle, 4D temporal runoff images provided useful information about asymmetrical or collateral flow in 5/26 cases (19.2%) and in 9/32 cases (28.1%), respectively, with one technical failure to generate temporally resolved images in the test bolus arm. Thick tMIPs, with calcium displayed or removed, were only helpful in 15% (4/26) cases with fixed delay, but were helpful in the majority of patients with test bolus 63% (20/32).

# CONCLUSION

Using a test bolus, low iodine dynamic 4D-CTA results in high accuracy for the prediction of PVD. It increases the number of patients with runoff to the ankles compared to fixed delay techniques, and provides additional information about asymmetric and collateral flow.

# **CLINICAL RELEVANCE/APPLICATION**

Low iodine dynamic 4D CTA results in accurate prediction of significant peripheral vascular disease, with a test bolus improving runoff to the ankles and providing additional temporal information compared to fixed delay techniques.

#### VI143-ED-THA9 When It's Not a Deep Venous Thrombosis (DVT): A Pictorial Review of Alternate Causes of Swollen Limb or Pain in 'Rule-Out' DVT Exams

Station #9

#### Awards Certificate of Merit

Participants

Kenneth S. Zurcher, MD, Phoenix, AZ (*Presenter*) Nothing to Disclose Nirvikar Dahiya, MD, Phoenix, AZ (*Abstract Co-Author*) Nothing to Disclose Andrew P. Sill, MD, Phoenix, AZ (*Abstract Co-Author*) Nothing to Disclose Scott W. Young, MD, Phoenix, AZ (*Abstract Co-Author*) Nothing to Disclose Meghan G. Lubner, MD, Madison, WI (*Abstract Co-Author*) Grant, Koninklijke Philips NV; Grant, Johnson & Johnson; Maitray D. Patel, MD, Paradise Valley, AZ (*Abstract Co-Author*) Nothing to Disclose

# **TEACHING POINTS**

1. Extremity ultrasound exams are frequently ordered to exclude a diagnosis of deep vein thrombosis (DVT). While Doppler ultrasound represents an excellent diagnostic test for DVT, a wide variety of non-DVT pathology exists that may be incidentally found or can result in overlapping physical exam findings that prompt a 'rule-out DVT' ultrasound study. 2. Radiologists should be aware of these non-DVT etiologies and their corresponding sonographic features on studies that are otherwise 'negative' for DVT. 3. This educational exhibit will provide a pictorial review of this differential, which can be categorized into: vascular, traumatic, malignant, or extravascular fluid-based etiologies.

# **TABLE OF CONTENTS/OUTLINE**

1. Brief summary of DVT and extremity DVT ultrasound ordering patterns 2. Explore non-DVT pathology and corresponding ultrasound findings that in some cases prompt DVT ultrasound assessment 3. Vascular: thrombophlebitis, retained fibrin sheath, pseudoaneurysm or fistula. 4. Traumatic: achilles tear, tennis leg, intramuscular hematoma, Morel-Lavallee lesion 5. Extravascular fluid: subcutaneous edema, popliteal cyst, post-surgical seroma 6. Malignancy 7. Miscellaneous: Cellulitis, lymphadenopathy, muscle hemia, tenosynovitis etc.







# VIS-THB

# Vascular Interventional Thursday Poster Discussions

Thursday, Dec. 5 12:45PM - 1:15PM Room: VI Community, Learning Center



AMA PRA Category 1 Credit ™: .50

# Participants

Claire Kaufman, MD, Salt Lake City, UT (Moderator) Nothing to Disclose

# Sub-Events

#### VI221-SD-THB1 Particle Embolization for Treatment of Acute Lower Gastrointestinal Hemorrhage is Associated with Higher Rates of Ischemic Bowel Complications: A Single-Center Retrospective Analysis

Station #1

Participants Elisabeth Seyferth, Durham, NC (*Presenter*) Nothing to Disclose James S. Ronald, MD, PhD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose Charles Y. Kim, MD, Raleigh, NC (*Abstract Co-Author*) Consultant, Medtronic plc; Consultant, Humacyte; Consultant, Galvani

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# PURPOSE

Coil embolization has emerged as the standard embolic agent for the endovascular management of lower GI bleeding, with particle embolization having theoretically higher risk of bowel ischemia and perforation but without supporting data. The purpose of this study was to analyze outcomes after particle embolization for the management of lower GI bleeding.

# METHOD AND MATERIALS

This study received IRB approval and a waiver for informed consent. Between 2004 and 2018, a total of 582 mesenteric angiograms were performed for the indication of lower GI bleeding. Of these procedures, embolization was performed for active extravasation using only microcoils in 127 procedures in 114 patients and using particles in 81 procedures in 56 patients. In general, particles were used when microcoils alone were deemed inadequate. A case-control comparison was performed by matching cases employing PVA particles versus microcoils alone, based on age, gender, and year. Clinical success was defined as no additional intervention to treat recurrent bleed and no readmission for lower GI bleed within 30 days. Patients with less than 30 days of follow up were excluded.

# RESULTS

Analysis was performed on 33 matched patients in each group. Average age was 67.8 years in the particles group and 68.0 years in the coils group. Mean follow up was 3.1 years after embolization. Clinical success was 54% in the particles group and 71% in the coils group (P=0.15). Four patients (12%) in the particles group had bowel infarction requiring surgery within 30 days after embolization, versus none in the coils group (P=0.11). Multiple embolizations in the same admission approached significance as a risk factor for bowel ischemia within 30 days (P=0.07). One patient developed a bowel stricture 283 days after embolization using particles (embolized twice).

# CONCLUSION

Particle embolization may have lower rates of clinical success and higher rates of ischemic bowel compared to coil embolization, although there is selection bias between groups given utilization criteria as well as limited sample size. Multiple embolizations in the same admission may increase risk of ischemic bowel as well.

# **CLINICAL RELEVANCE/APPLICATION**

Our results suggest that particle embolization may have a higher risk for clinically significant bowel ischemia, which may be relevant for choosing embolization material.

#### VI222-SD-THB2 A Comparison between Laparoscopic and Open Surgery Following Self-Expandable Metallic Stent Placement for Malignant Colorectal Obstruction and an Assessment of Long-Term Oncological Outcomes

# Station #2

Participants

Jinho Lee, MD, Busan, Korea, Republic Of (*Presenter*) Nothing to Disclose Jong Hyouk Yun, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose Gyoo Sik Jung, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

# PURPOSE

To compare the outcomes between single stage laparoscopic surgery and open surgery following self-expandable metallic stent (SEMS) placement in patients with malignant colorectal obstruction and to evaluate the long-term oncological outcomes of SEMS placement.

# **METHOD AND MATERIALS**

This retrospective study included 46 patients (28 men and 18 women; mean age, 67.2 years  $\pm$  10.3) who underwent SEMS placement followed by laparoscopic resection (LS group, n=31) or open surgery (OS group, n=15) for malignant colorectal obstruction between January 2009 and January 2018. The outcomes of surgery were analyzed and compared. After a mean follow-up of 38.9 months  $\pm$  31.2, recurrence-free and overall survival were estimated by using the Kaplan-Meier method, and prognostic factors were evaluated by using the Cox proportional hazard regression model.

# RESULTS

Stent placement was successful in all patients. No procedure related complications occurred. Complete expansion of the stent occurred and bowel obstruction resolved within 2 days after SEMS placement. The mean interval between SEMS placement and surgery was 11.0 days  $\pm$  6.8 (range, 3-42 days). Primary anastomosis was possible in all patients. The mean operation time in the LS group was significantly shorter than in the OS group (P = .014). The mean postoperative hospital stay was significantly shorter in the LS group than in the OS group (P = .001). Bowel perforation was detected in six patients (13.0%). During the follow-up, ten patients (21.7%) developed a recurrence: five of the six patients with bowel perforation developed a recurrence. Bowel perforation did not have an effect on overall survival (P = .893), but had a significant effect on recurrence-free survival (P = .010).

# CONCLUSION

Laparoscopic surgery following SEMS placement results in a faster recovery than open surgery for malignant colorectal obstruction. Stent-related bowel perforation is a significant predictive factor for tumor recurrence.

# **CLINICAL RELEVANCE/APPLICATION**

Laparoscopic surgery following SEMS placement results in a faster recovery than open surgery for malignant colorectal obstruction. Stent-related bowel perforation is a significant predictive factor for tumor recurrence.

#### VI223-SD-THE Clinical Characteristics and Drug Resistance of Pyogenic Liver Abscess Caused By Extended-Spectrum Beta-Lactamase-Producing Klebsiella Pneumoniae

Station #3

Participants Yue Ren, Shen Yang, China (*Abstract Co-Author*) Nothing to Disclose Zhihui Chang, BMedSc, MMed, Shenyang, China (*Presenter*) Nothing to Disclose Zhaoyu Liu, Shenyang, China (*Abstract Co-Author*) Nothing to Disclose

# PURPOSE

The proportion of extended-spectrum beta-lactamase-producing(ESBL+) is increasing year by year and has multiple drug resistance in clinically Klebsiella Pneumoniae(KP) infection.KP has become the primary pathogen of pyogenic liver abscess(PLA).This study analyzed the incidence of ESBL+KP induced liver abscess in our hospital in the past 4 years, compared the clinical features and drug resistance of patients with liver abscess caused by ESBL+ and ESBL-KP, and explored the clinical risk factors of infection ESBL+.

# **METHOD AND MATERIALS**

We retrospectively collected medical records of 122 inpatients with liver abscess from January2015 to January 2019(including 16 cases of PLA caused by ESBL+KP and 106 cases of PLA caused by ESBL- KP) The clinical characteristics and bacterial drug resistance of the two groups were compared and analyzed, and the independent risk factors of ESBL+ KP were further investigated by Logistic multivariate analysis.

# RESULTS

In ESBL+ patients, the proportion of history of biliary disorders and malignancy was significantly higher than ESBL- group.(75% vs 30.2%;p<0.05);(50% vs 12.3%;p<0.05).ESBL+ patients were associated with pulmonary infection(87.5% vs 67.9%;p<0.05), and had a higher recurrence rate (43.8%vs 9.84%;p<0.001).Multivariate analysis indicated that history of biliary disorders(odds ratio,4.145;95%confidence interval,1.139-15.085;P=0.026) and history of malignancy (odds ratio,4.282;95%confidence interval,1.227-14.939;P=0.023) were independent risk factors for the infect of ESBL+ .Both groups were sensitive to carbapenem antibiotics.However,the resistance rate of the ESBL+ group to the compound sulfamethoxazole (59% vs 4.9%;P<0.001) and aztreonam(68.8% vs 0.8%;P<0.001) was significantly higher than that of the ESBL- group.

# CONCLUSION

The proportion of ESBL+ in KPLA in not high, but the clinical symptoms of these patients are serious. A history of biliary disorders or malignancy is an independent risk factor for ESBL+ infection. ESBL+ has a high resistance rate to non-carbapenem-based antibiotics.

### **CLINICAL RELEVANCE/APPLICATION**

The mainstay of treatment remains antibiotic in combination with adequate aspiration or drainage. In the course of treatment, it is recommended to use carbapenem antibiotics in order to improve the treatment effect if the conventional antibiotics is not effectively. Be alert to ESBL+, especially patients with liver abscess who have a history of biliary tract diseases or malignant tumors.

#### VI253-SD-THB4 Retrospective Multivariate Study of the Clinical Outcomes in Patients Affected by Different Grades of Varicocele Treated using Different Endovascular Approaches

Station #4 Participants

Giampaolo Bianchi, MD, Laquila , Italy (*Presenter*) Nothing to Disclose Antonio Izzo, Laquila, Italy (*Abstract Co-Author*) Nothing to Disclose Maria Valeria Marcella Micelli, Laquila , Italy (*Abstract Co-Author*) Nothing to Disclose Pierpaolo Palumbo, MD, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose Luca Panebianco, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Marco Varrassi, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose Sergio Carducci, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose Aldo Victor Giordano, L'Aquila, Italy (*Abstract Co-Author*) Nothing to Disclose

# Carlo Masciocchi, MD, L'Aquila, Italy (Abstract Co-Author) Nothing to Disclose

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# PURPOSE

The aim of this study is to assess the clinical outcomes of patients affected by different grades of varicocele treated by retrograde scleroembolization.

# METHOD AND MATERIALS

210 patients, mean age 32 years, with left varicocele and infertility were treated. Study inclusion criteria were: grade II or III left varicocele according to Dubin classification, infertility and US diagnosis of varicocele. All the patients were divided into 2 groups according to the diameter of the left spermatic vein with a cut-off of 6mm. Group 1 (128 out of 210 patients) underwent scleroembolization using 3% Polidocanol. Group 2 (82 out of 210 patients) underwent scleroembolization using 3% Polidocanol and coiling. Median follow-up time was 3 months. Clinical examination, semen specimen and Doppler US examination were compared to follow-up data.

# RESULTS

208 patients were successfully treated. 2 patients presented intraprocedural spermatic vein rupture. Color-Doppler US examination showed an optimal resolution of reflux in testicular veins (mean value: pre-treatment 7.1 cm/s; post-treatment 1.9 cm/s). 63% of patients showed a complete resolution of varicocele. Three months follow-up semen analysis in all the patients showed an improvement in sperm motility (mean value: pre-treatment 31%; post-treatment 42%) and sperm count (mean value: 3.6 million sperm cells per ml pre-treatment; 20.9 million sperm cells per ml post-treatment).

# CONCLUSION

varicoccele embolization is minimally invasive and technically feasible procedure that improves semen quality with a high successful rate of varicoccele resolution. No differences were observed in clinical follow-up among the two groups of patients.

# **CLINICAL RELEVANCE/APPLICATION**

Two different approaches for the varicocele embolization such sclerosing agent(Polidocanol 3%) and coiling are both safe and effective. Also an improvement in patients semen quality was observed.

#### VI249-SD-THB5 Radiologic and Clinical Factors Predicting Survival Following Hepatic Arterial Infusion Chemotherapy in Advanced Hepatocellular Carcinoma

Station #5

Participants Bohyun Kim, MD, Suwon, Korea, Republic Of (*Presenter*) Nothing to Disclose Je Hwan Won, MD, Suwon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose Jinoo Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose Yohan Kwon, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose Yong Jun Jung, Suwon, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To analyze radiologic and clinical factors predicting overall survival (OS) in patients with advanced hepatocellular carcinoma (HCC) treated with hepatic arterial infusion chemotherapy (HAIC).

# **METHOD AND MATERIALS**

Between Jan 1998 to Dec 2018, 251 Barcelona Clinic Liver Cancer stage C advanced HCC patients (219 men and 32 females; mean age 53±9.8 years) were treated with high-dose HAIC (5-FU, 500 mg/m2 for 3 consecutive days and cisplatin, 60 mg/m2 on day 2). We retrospectively collected clinical data and assessed following radiologic features: macroscopic growth pattern of the tumor, arterial enhancement pattern of HCC, extent of portal vein and hepatic vein tumor thrombus, presence of extrahepatic metastasis, size of the tumor, response to the 1st session of the treatment evaluated by mRECIST, and the direction of the portal venous flow studied during the chemoport implantation. Survival curve calculation and prognostic factor analysis were performed by Kaplan-Meier method and Cox proportional hazard model.

# RESULTS

During the mean follow-up period of 7.3 months (median, 4.4 months; range, 1-60 months), 181 (72.1%) patients died. The mean OS was 11.3 months and the median OS was 5.4 months. Objective response rate (% of patients with complete response plus partial response) and disease control rate (objective response rate plus % of patients with stable disease) were 15% and 50%, respectively. Infiltrative tumor growth and rim-like arterial enhancement pattern were pre-treatment radiologic features negatively affected the OS (both p < 0.05). Response to the 1st HAIC session was significantly associated with OS, with better response showing prolonged survival. Higher level of AST, larger size of the tumor, presence of hepatic vein tumor thrombus, bile duct invasion by the tumor, and higher CTP score all negatively affected the OS (all p < 0.05).

# CONCLUSION

HAIC is a feasible treatment option for an advanced HCC. Baseline imaging features regarding tumor growth pattern and arterial enhancement profile as well as radiologic response to the 1st therapeutic session can be used to predict OS after HAIC.

# **CLINICAL RELEVANCE/APPLICATION**

Pre-/post-therapeutic radiologic features of the target tumor and clinical factors may help predict survival in advanced HCC patients treated with HAIC.

#### VI250-SD-THB6 Day-Clinic High-Intensity Focused Ultrasound (HIFU) Focal Therapy to Primary Treatment of Localized Prostate Cancer: Initial Experience of 37 Patients

# Station #6

Guilherme C. Mariotti, MD, Jundiai, Brazil (*Presenter*) Nothing to Disclose Paulo Kayano, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose Priscila M. Falsarella, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose Oliver R. Claros, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose Gustavo C. Lemos, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose Marcos R. Queiroz, MD, Barueri, Brazil (*Abstract Co-Author*) Nothing to Disclose Rodrigo G. Garcia, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose Ronaldo H. Baroni, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose Arie Carneiro, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose

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### PURPOSE

Participants

To demonstrate the safety and feasibility of HIFU focal therapy (FT) in a day-clinic setting, as a primary option of treatment of Gleason 6 or 7 (ISUP 1, 2 and 3) prostate cancers (pCa) comproved by fusion MRI-transrectal ultrasound (TRUS) fusion biopsies, in a prospective study of initial 30 patients. HIFU is a non-invasive, single shot, radiation-free therapy that use real-time image guidance, directs focused beam of ultrasound waves to thermally ablate a selected portion of prostate gland.

# **METHOD AND MATERIALS**

A single-center prospective analysis of initial 37 patients with unilateral prostate cancer candidates for FT (hemi-gland or superfocal ablation) as the primary treatment option from August 2018 to March 2019. All patients were re-evaluated by MRI and fusion prostate biopsy and only patients with unilateral disease (high volume Gleason 6 or Gleason 7), prostatic volume less than 50 cc and mild lower urinary tract symptoms were included.

## RESULTS

Thirty-seven patients were enrolled as candidates for FT based on biopsy results. Seven were excluded and underwent radical treatment due to a Gleason upgrading and 4 due to a concomitant transurethral resection of the prostate (TURP), totalizing 26 patients in our analyses. Mean prostatic volume, age, PSA and region of interest volume were: 44.7 cc, 65.1 years, 6.09 ng/dl and 0.97cm; respectively. Pre-procedure MRI showed 5.2% of patients with PIRADS 2, 15.78% with PIRADS 3, 68.42% with PIRADS 4 and 10.52% with PIRADS 5. The biopsy showed 6 patients with unilateral ISUP 1, 14 patients unilateral ISUP 2 and 6 patients with ISUP 3. Hemi-gland ablation was performed in 20 patients and super-focal ablation in 6 patients. All patients were discharged between 2 and 4 hours after the procedure. Urethral catheter was kept for 7 days. Two patients had refractory urinary retention treated with TURP. None of the patients had urinary incontinence, worsening of erectile function, bleeding, infectious complications or rectal fistulae.

### CONCLUSION

In conclusion, day clinic HIFU FT is safe and feasible as a primary option for localized and low/intermediate risk pCa, with potential clinical impact.

### **CLINICAL RELEVANCE/APPLICATION**

High-intensity focused ultrasound in a day-clinic setting is a feasible technique that has the potential to provide an alternative to radical surgery or radiation-therapy with fewer complications and similar oncological outcomes in selected patients.

#### VI251-SD-THB7 Power of Lipiodol-Enhancement in CT-Guided Biopsies of Unspecified Suspect Intrahepatic Lesions: Improvement of Accuracy and Safeness

# Station #7

Participants Marcel C. Langenbach, MD, Cologne, Germany (*Presenter*) Research Grant, Guerbet SA Thomas J. Vogl, MD, PhD, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose Amelie Buchinger, MS, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose Lajos M. Basten, Frankfurt am Main, Germany (*Abstract Co-Author*) Nothing to Disclose Renate M. Hammerstingl, MD, Frankfurt am Main, Germany (*Abstract Co-Author*) Nothing to Disclose Tatjana Gruber-Rouh, Frankfurt am Main, Germany (*Abstract Co-Author*) Nothing to Disclose

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# PURPOSE

To evaluate the power of Lipiodol in improving the rate of successful biopsies of suspect intrahepatic lesion which is often challenging in native CT-scans. Lipiodol, commonly applied in angiography for tumor embolization, might improve the success rate.

# **METHOD AND MATERIALS**

Six-hundred-seven patients (men: 358, women: 259) with unclear suspect liver lesions were retrospectively evaluated. All patients received a CT-guided liver biopsy and results were histopathological analysed. Successful punctuations were defined by positive pathological findings. Data were ascertain regarding the use of contrast media, lipiodol or common intravenous contrast, or native performance. Lesion hitting rate and influencing factors like lesion size or liver cirrhosis were insulated. Procedure was performed with the same 128-multislice CT-scanner. Correlation was calculated according to Spearman-Rho, results compared using Wilcoxon-Man-Whitney t-test and Chi-square-test. P<0.05 was considered as statistically significant.

### RESULTS

Lesion hitting rate was significantly higher using Lipiodol (78.6%) compared to native biopsy (73.2%) or the use of intravenous contrast agent (65.2%) (p=0.038). For lesions with a size <20mm, the benefit regarding the hitting rate was even higher for Lipiodol (71.2% vs 47.7% vs. 65.5%) (p=0.021). For patients with an existing liver cirrhosis in comparison of all three groups were

seen. (p=0.97). No major complications occurred during the interventions.

# CONCLUSION

Pre-puncture marking using Lipiodol in angiography increases the lesion hitting rate significantly, especially for small suspect liver lesions (<20mm), combines with a lower rate of re-biopsy and a higher safeness for the patient.

# CLINICAL RELEVANCE/APPLICATION

Pre-puncture marking of unclear intrahepatic lesions using Lipiodol increases the hitting rate and safeness of liver biopsies and is recommended for hardly detectable liver lesions in CT.

#### VI252-SD-THB8 Evaluation of Blood Pressure Variations on CTA Geometries of Abdominal Aortic Aneurysms and CTA Protocol Recommendations on Blood Pressure Measurements for Maintaining Mechanical Simulation Viability

Station #8

Participants Roland C. Aydin, MD,MS, Munich, Germany (*Presenter*) Nothing to Disclose Fabian A. Brau, MSc, Garching, Germany (*Abstract Co-Author*) Nothing to Disclose Konstantin Nikolaou, MD, Tuebingen, Germany (*Abstract Co-Author*) Advisory Panel, Siemens AG; Advisory Panel, Bayer AG; Speakers Bureau, Siemens AG; Speakers Bureau, Bayer AG Eric E. Williamson, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose Shuai Leng, PHD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose Justus E. Roos, MD, Luzern 16, Switzerland (*Abstract Co-Author*) Nothing to Disclose Roy Marcus, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose

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# PURPOSE

To assess in patients with known abdominal aortic aneurysm (AAA) undergoing clinically indicated CTA imaging the influence of blood pressure (BP) measurements for vessel diameter measurements and mechanical simulations.

# **METHOD AND MATERIALS**

50 adult patients with known AAA underwent a contrast enhanced CT of the abdomen on a 3rd generation dual source CT (SOMATOM Force, Siemens Healthcare). BP measurements were taken upon admission as per standard protocol and during imaging, as well as at home on subsequent days at the same time of day. The mean and largest differences in mean arterial pressure (MAP) were measured. The impact of these differences on the vessel diameter/volume was then analytically estimated using an idealized cylinder geometry and stiffness parameters for young (1.14 MPa) and adult aorta (2.21 MPa). Finite element analysis (FEA) was used on the actual aneurysm geometry with the largest MAP difference to model the changes predicted by the analytic estimate.

## RESULTS

The relative difference in MAP between the imaging and home setting was 10.8% (9.1mmHg), with a maximum of 23.7% (31.2mmHg), which results in an aneurysmal difference in diameter of 1 - 2.2% (3.6 - 8.2% for the maximum MAP difference). Comparing MAP during the imaging process to the measurements at hospital admission, the average relative difference was 10.6% (9.4mmHg), with a maximum of 29.5% (27.7mmHg). The resulting difference in the aneurysmal diameter/volume is 0.8-2.4% (2.5-7.9% for the maximum MAP difference). Simulation in aorta with stiffer wall properties, such as in older patients, show a 50% reduction of maximum wall displacement in the aneurysmatic section of the aorta, when compared to the more flaccid aorta in younger patients (1.5 mm vs. 3 mm, p<0.001).

# CONCLUSION

Awards

AAA-geometry derived from CTA used for diameter measurements and mechanical simulations such as FEA are sensitive to BP differences and age. A dedicated age and gender dependent AAA-simulation is warranted for rupture risk-simulation.

# CLINICAL RELEVANCE/APPLICATION

There are pronounced differences in blood pressure during the CTA imaging process and the home setting and hospital admission. Aortic aneurysm diameters can be affected by these variations.

# VI144-ED- Complications of an Ileal Conduit after Radical Cystectomy: Interventional Radiologic Management THB9

Station #9

# **Identified for RadioGraphics**

Participants Atin Goel, MBBS, Syracuse, NY (*Presenter*) Nothing to Disclose Katsuhiro Kobayashi, MD, Syracuse, NY (*Abstract Co-Author*) Nothing to Disclose Marlon P. Coelho, MD, Syracuse, NY (*Abstract Co-Author*) Nothing to Disclose Mariangeles Medina Perez, MD, Syracuse, NY (*Abstract Co-Author*) Nothing to Disclose Matthew J. Klumpp, MD, Liverpool, NY (*Abstract Co-Author*) Nothing to Disclose Mohammed Jawed, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose Sanjit O. Tewari, MD, Columbia, MO (*Abstract Co-Author*) Nothing to Disclose Tomas Appleton Figueira, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose David Pinter, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose

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1. Describe surgical techniques for and anatomy of an ileal conduit as urinary diversion following radical cystectomy. 2. Describe early and late complications related to an ileal conduit following radical cystectomy and their diagnostic work-up. 3. Discuss interventional radiologic management of complications related to an ileal conduit.

# TABLE OF CONTENTS/OUTLINE

1. Overview of current indications of an ileal conduit as urinary diversion following radical cystectomy 2. Surgical techniques for and anatomy of an ileal conduit 3. Early and late complications of an ileal conduit following radical cystectomy and their diagnostic work-up (urine leak, postoperative fluid collections, pyelonephritis, uretero-ileal anastomotic stricture, stomal stenosis, conduit stenosis, urolithiasis etc) 4. Current interventional management of complications of an ileal conduit 5. Limitations of interventional radiologic management of complications

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# RC812

# Body CT Angiography: 2019 Update

Friday, Dec. 6 8:30AM - 10:00AM Room: E351



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

# Participants

Alan H. Stolpen, MD,PhD, Iowa City, IA (*Moderator*) Nothing to Disclose Gregory Kicska, MD, PhD, Seattle, WA (*Moderator*) Nothing to Disclose

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# Sub-Events

# RC812A Thoracic CTA

Participants Gregory Kicska, MD, PhD, Seattle, WA (*Presenter*) Nothing to Disclose

For information about this presentation, contact:

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# LEARNING OBJECTIVES

1) Diagnosis of aortic dissection, intramural hematoma and aortic aneurysm. 2) To discuss imaging features that suggest prognosis in acute aortic syndromes. 3) To discuss common pitfalls in diagnosis.

# RC812B Abdominal CTA

Participants Eric E. Williamson, MD, Rochester, MN (*Presenter*) Nothing to Disclose

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# LEARNING OBJECTIVES

1) Identify common clinical indications for abdominal CT angiography, 2) Describe techniques for performing abdominal CTA, 3) Discuss how recent developments in CT have influenced these techniques and the resulting imaging findings.

# RC812C Peripheral CTA

Participants Alan H. Stolpen, MD, PhD, Iowa City, IA (*Presenter*) Nothing to Disclose

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# LEARNING OBJECTIVES

1) Identify common clinical indications for peripheral CTA. 2) Describe protocols for performing and strategies for reviewing peripheral CTA. 3) Recognize a variety of vascular pathologies. 4) Understand the strengths, weaknesses and pitfalls of peripheral CTA.





# RC852

# Carotid and Renal Doppler (Hands-on)

Friday, Dec. 6 8:30AM - <u>10:00AM Room: E264</u>



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

# Participants

Gowthaman Gunabushanam, MD, New Haven, CT (*Presenter*) Nothing to Disclose Shweta Bhatt, MD, Rochester, NY (*Presenter*) Nothing to Disclose Wui K. Chong, MD, Houston, TX (*Presenter*) Nothing to Disclose Corinne Deurdulian, MD, Encino, CA (*Presenter*) Speaker, Samsung Electronics Co, Ltd Vikram S. Dogra, MD, Pittsford, NY (*Presenter*) Nothing to Disclose Ulrike M. Hamper, MD, Baltimore, MD (*Presenter*) Nothing to Disclose Davida Jones-Manns, Owings Mills, MD (*Presenter*) Nothing to Disclose Mark E. Lockhart, MD, Birmingham, AL (*Presenter*) Author, Oxford University Press; Author, Reed Elsevier; Editor, John Wiley & Sons, Inc; Deputy Editor, Journal of Ultrasound in Medicine Nira Beck-Razi, MD, Haifa, Israel (*Presenter*) Nothing to Disclose Margarita V. Revzin, MD, New Haven, CT (*Presenter*) Consultant, Koninklijke Philips NV; ; Leslie M. Scoutt, MD, Birmingham, AL (*Presenter*) Speaker, Koninklijke Philips NV Ravinder Sidhu, MD, Rochester, NY (*Presenter*) Nothing to Disclose Sadhna Verma, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose

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# LEARNING OBJECTIVES

1) Describe the technique and optimally perform carotid Doppler ultrasound. 2) Describe the technique and optimally perform renal Doppler ultrasound. 3) Review qualitative and quantitative criteria for diagnosing abnormalities in carotid and renal ultrasound Doppler examinations.

# ABSTRACT

This hands-on course will provide participants with a combination of didactic lectures and an extended 'live' scanning opportunity on normal human volunteers, as follows: Didactic lectures (30 minutes): Carotid Doppler ultrasound: scanning technique, diagnostic criteria and interesting teaching cases. Renal Doppler ultrasound: scanning technique, diagnostic criteria and interesting teaching cases. Mentored scanning (60 minutes): Following the didactic lectures, the participants will proceed to a scanning area with normal human volunteers and ultrasound machines from different manufacturers. Participants will be able to perform live scanning with direct assistance, as needed, by faculty. Faculty will be able to offer feedback, help participants improve their scanning technique as well as answer any questions. Time permitting, faculty will also be available to answer general questions relating to all aspects of vascular ultrasound, not just limited to carotid and renal Doppler studies.





# SST07

# Neuroradiology (Vascular and Interventions)



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

### Participants

Adrien Guenego, MD, Montjoire, France (*Moderator*) Nothing to Disclose Benjamin Y. Huang, MD, MPH, Chapel Hill, NC (*Moderator*) Nothing to Disclose Jalal B. Andre, MD, Seattle, WA (*Moderator*) Research Grant, Koninklijke Philips NV Consultant, Hobbitview, Inc Research Grant, Toshiba Corporation

### Sub-Events

# SST07-01 National Trends in the Use of Initial Imaging for Carotid Stenosis in the Outpatient Setting

Friday, Dec. 6 10:30AM - 10:40AM Room: E353A

Participants Jina Pakpoor, MD, Baltimore, MD (*Presenter*) Nothing to Disclose Andrew Harris, BS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose Joseph Canner, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose Caitilin Hicks, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

The Society for Vascular Surgery currently recommends carotid artery duplex ultrasonography (DUS) as the first-line imaging modality for the diagnosis of carotid artery stenosis, and this is in keeping with Appropriateness criteria of the American College of Radiology. We sought to investigate compliance with these guidelines on a national level for the initial work-up of suspected carotid artery stenosis in the outpatient setting.

## **METHOD AND MATERIALS**

Using a national commercial claims database, we identified patients between 18-65 years old who had an outpatient visit with an associated initial diagnosis of carotid stenosis (ICD-9 433.10; ICD-10 165.2) from 2011-2016. Use of imaging was identified by Current Procedural Terminology (codes for DUS, CTA, and MRA associated with the initial outpatient visit. Trends were assessed using logistic regression analyses. Patients with any of the relevant ICD codes or CPT codes for one year prior to the encounter were excluded.

### RESULTS

Overall, 229,464 patients with a new diagnosis of carotid artery stenosis were included in the analysis (mean age 55 years, 51.2% male). The majority (95.8%) of patients received DUS as the initial imaging modality, 2.4% received CTA, 1.3% received MRA, and 0.5% had more than one study associated with the encounter. The proportion of patients receiving DUS as the only initial imaging modality decreased from 97% in 2011 to 94% in 2016 (p<0.001). The rate of patients receiving CTA as the initial imaging modality increased from 1.6% in 2011 to 4.7% in 2016 (p<0.001). Use of MRA relatively stable (1.2%-1.5%) over the course of the study period. Use of initial advanced imaging (MRA/CTA) was highest in the West region of the USA (5.5%) and lowest in the Northeast (2.0%), p<0.001.

# CONCLUSION

Our findings demonstrate that while the majority of initial imaging studies for suspected carotid artery stenosis are compliant with current recommendations from the Society of Vascular Surgery, the use of CTA is significantly increasing with time (p<0.001). Compared to DUS, CTA is associated with radiation exposure to the patient and a significantly higher imaging cost.

# **CLINICAL RELEVANCE/APPLICATION**

Further education of the outpatient provider is needed to shift the current trend of initial CTA use for carotid stenosis; in particular in the setting of increasing availability of CT technology.

# SST07-02 Identification of Patients with Carotid Stenosis Using Natural Language Processing

Friday, Dec. 6 10:40AM - 10:50AM Room: E353A

Participants Xiao Wu, New Haven, CT (*Presenter*) Nothing to Disclose Yuzhe Zhao, PhD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose Seyedmehdi Payabvash, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose Ajay Malhotra, MD, Stamford, CT (*Abstract Co-Author*) Nothing to Disclose

For information about this presentation, contact:

### PURPOSE

This study aims to develop a natural language processing (NLP) model to retrospectively retrieve patients with presence, history and severity of carotid stenosis (CS) using their ultrasound reports.

### METHOD AND MATERIALS

Ultrasound reports from our institution between January 2016 and December 2017. To process the texts, we developed a parser to divide the raw text into fields. For baseline method, we use bag of n-grams and term frequency inverse document frequency as the features and use linear classifiers. Logistic regression is performed as the baseline model. Convolution and recurrent neural networks (CNN; RNN) with attention mechanism are applied to the data set to improve the classification accuracy.

# RESULTS

We had 1,220 ultrasound reports for training, and 307 for testing, totaling to 1,527 reports. For predicting history of CS, both CNN and RNN-Attention models have a significantly higher specificity than logistic regression. In addition, RNN-Attention also has a significantly higher F1 score and overall accuracy. For predicting presence, all models achieved above 93% accuracy. RNN-attention achieved a 95.4% overall accuracy, although the difference with logistic regression is not statistically significant with. RNN-Attention has a statistically significant higher specificity than logistic regression.

# CONCLUSION

We have developed a parser to automatically segment the report text into different sections and predict history, presence and severity of CS. We have demonstrated NLP to be an efficient approach for large-scale retrospective patient identification, with wide applications in long-term follow-up of patients and further clinical research studies.

# **CLINICAL RELEVANCE/APPLICATION**

NLP is shown to be an efficient approach for large-scale retrospective patient identification, with wide applications in long-term follow-up of patients and further clinical research studies.

# SST07-04 3D-Arterial Analysis Software and CEUS in the Assessment of Severity and Vulnerability of Carotid Atherosclerotic Plaque in Comparison with CTA and Histology

Friday, Dec. 6 11:00AM - 11:10AM Room: E353A

Participants

Daniele Fresilli, Roma, Italy (*Presenter*) Nothing to Disclose Giuseppe Schillizzi, Roma, Italy (*Abstract Co-Author*) Nothing to Disclose Daniela Elia, Roma, Italy (*Abstract Co-Author*) Nothing to Disclose Carlo Catalano, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Ferdinando D'Ambrosio, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Vito Cantisani, MD, Roma, Italy (*Abstract Co-Author*) Nothing to Disclose Vito Cantisani, MD, Roma, Italy (*Abstract Co-Author*) Speaker, Canon Medical Systems Corporation; Speaker, Bracco Group; Speaker, Samsung Electronics Co, Ltd; Giorgia Polti, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Patrizia Pacini, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Olga Guiban, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Eleonora Polito, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Yana Solskaya, MD, Riga, Latvia (*Abstract Co-Author*) Nothing to Disclose Eleonora Tassone, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose Vincenzo Dolcetti, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

Nicola Di Leo, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose

### PURPOSE

To evaluate the accuracy of ultrasonographic 3D-Arterial Analysis and CEUS in assessing severity and vulnerability of carotid plaques.

# **METHOD AND MATERIALS**

134 patients were enrolled with the following criteria: (1) asymptomatic stenosis of carotid artery >70% but <100%; or (2) recent transient ischemic attack or ischemic stroke, and ipsilateral carotid stenosis >50%. All the patients underwent endarterectomy and gross and histology evaluation was performed to grade the plaque. 3D-Arterial Analysis provided a colour map to evaluate plaque vulnerability and a 3D volumetric stenosis evaluation. Its diagnostic performance has been compared to histological examination for plaque's vulnerability and to CEUS and CTA for stenosis' grading.

#### RESULTS

94 vulnerable plaques at histological examination were identified with at least one of the following criteria: fibrous cap <  $200 \mu$ m, presence of lipid core, intra-plaque haemorrhage, leukocyte recruitment or angiogenesis. 3D-Arterial Analysis software, CEUS and CTA were able to detect 84, 82 and 82 of these 94 vulnerable plaques respectively, with 89%, 87% and 87% sensitivity and 100% specificity. CTA has identified 84 severe stenosis of which 83 were correctly evaluated by 3D-Arterial Analysis software and CEUS, with a sensitivity of 88% and specificity of 100%.

# CONCLUSION

3D-Arterial Analysis software and CEUS seem effective tools to assess plaque's vulnerability and stenosis severity, providing useful information for surgery planning. Multicenter prospective evaluation is warranted to clarify the role of US multiparametric evaluation.

### **CLINICAL RELEVANCE/APPLICATION**

Pre-operative evaluation of carotid plaque is crucial for prompt follow-up or treatment. New Ultrasound diagnostic tool may open new further prospects. Multicenter prospective evaluation is warranted to clarify the role of US multiparametric evaluation

# sst07-05 Current Challenges and Accuracy of Carotid Plaque Neovascularization Grading with Contrast-

# **Enhanced Ultrasound Method**

Friday, Dec. 6 11:10AM - 11:20AM Room: E353A

Participants Andrejs Lioznovs, Riga, Latvia (*Abstract Co-Author*) Nothing to Disclose Maija Radzina, MD,PhD, Riga, Latvia (*Presenter*) Speaker, Canon Medical Systems Corporation

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## PURPOSE

One of the stroke risk factors is unstable carotid atherosclerotic plaque with ulceration, soft plaque with surface irregularity as well as presence of nevascularisation. Contrast ultrasound (CEUS) is a new noinvasive method, that can detect vasa vasorum within plaque. The purpose of the study was to analyze CEUS technique ability to confirm plaque instability in correlation with CT angiography (CTA) and histological findings and to determine methods accuracy and limitations.

# **METHOD AND MATERIALS**

Within period of 2 years a prospective study enrolled 54 patients with unstable plaque signs on ultrasound (US), all patients received baseline Duplex scanning, microvascular imaging (SMI) and contrast enhanced US with sulfur hexafluoride 1 ml followed by saline flush. CTA and histology results were used as reference standart. 32 patients underwent endarterectomy surgery. Based on CEUS results 2 groups were identified: poor (Grade 1) neovascularization and well visible (Grade2) vasa vasorum. For determination of CEUS sensitivity and specificity and limitations - two groups were compared - extensive calcified vs. soft plaques.

## RESULTS

The neovascularization was diagnosed in 27 (50%) patients by CEUS - in 12 cases (44.4%) plaques showed neovascularization grade 1 and in 15 cases (55.6%) grade 2 plaques were detected. Comparing CEUS method and results of histology statistically significant correlation was found (rs = 0,624; p = 0,002). Comparing 2 groups: soft plaques neovascularization by CEUS was diagnosed in 13 cases (48.1%) with sensitivity - 77.78%, specificity 60%, positive predictive value 77.78%, negative predictive value 60%, accuracy 76.3%; In a group with extensive calcified plaques - neovascularization was detected in 14 patients (51.9%), methods sensitivity 53.33%, specificity 37.5%, positive predictive value 61.54%, negative predictive value 30%, accuracy 47.83% regardless stenosis grade.

# CONCLUSION

CEUS is accurate method for confirmation of unstable plaque neovascularization regardless of stenosis grade well corresponding to histological results, but it cannot be recommended in cases of extensive calcinosis

# **CLINICAL RELEVANCE/APPLICATION**

CEUS is a new noninvasive method, that may facilitate early detection of unstable carotid plaque (neovascularization) and may change patient management regardless stenosis grade concept in high stroke risk. Prerequisite is informative, but inconclusive baseline Duplex US and/or CTA findings.

# SST07-06 Carotid Plaque Ulceration on Contrast-Enhanced Ultrasound: Diagnostic Accuracy Compared to Angiography

Friday, Dec. 6 11:20AM - 11:30AM Room: E353A

Participants

Ji Eun Park, Seongnam, Korea, Republic Of (*Presenter*) Nothing to Disclose Yeo Koon Kim, Seongnam-si , Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

The plaque ulceration is one of the features of plaque vulnerability and related to the risk for embolic stroke. The purpose of this study was to define the diagnostic accuracy of contrast-enhanced ultrasound (CEUS) for the carotid plaque ulceration.

# **METHOD AND MATERIALS**

This study is a retrospective case series study. Institutional review board approved the study and waived informed consent. Patients who had CEUS and carotid angiography for evaluation of carotid plaque from September 2015 to June 2018 in our institution were consecutively included in this study (184 patients, 142 males, 280 carotid arteries, age 72±8.5 years, age range 32-91 years). The time interval between angiography and CEUS was limited to within six months. Carotid arteries with prior intervention (endarterectomy and stent) were excluded. CEUS was performed in order of 1) Doppler ultrasound, 2) injection of ultrasound contrast agent (SonoVue, Bracco, Italy), and 3) CEUS. A radiologist who was blinded to clinical information reviewed the CEUS images for plaque ulceration and the degree of stenosis. A neuro-intervention radiologist reviewed the angiography images. The plaque ulceration was defined to plaque surface indentation deeper than 2mm on both CEUS and angiography. Sensitivity, specificity and diagnostic accuracy were calculated for the detection of plaque ulceration and the significant (>50%) stenosis.

# RESULTS

The prevalence of plaque ulceration was 25% on angiography. The sensitivity of CEUS for detection of plaque ulceration was 85.7% (95% confidence interval [CI]: 75.3% to 93.9%), specificity was 96.2% (95% CI: 92.6% to 98.3%), positive predictive value was 88.2% (95% CI: 79% to 93.7%), negative predictive value was 95.2% (95% CI: 91.9% to 97.2%), and the diagnostic accuracy was 93.6% (95% CI: 90% to 96.1%). The reason of false-negative cases was mainly calcification shadow on CEUS, and the false-positive cases were due to plaque surface irregularity.

# CONCLUSION

CEUS can accurately visualize carotid plaque ulceration.

The CEUS showed excellent diagnostic accuracy for carotid plaque surface evaluation.

# SST07-07 Elevated Hemoglobin A1c is Associated with Intracranial Plaque Enhancement: Novel Findings from Magnetic Resonance Imaging Study in Stroke Patients

Friday, Dec. 6 11:30AM - 11:40AM Room: E353A

Participants

Xiao Li, Shanghai, China (*Presenter*) Nothing to Disclose Beibei Sun, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose Xiaosheng Liu, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

# PURPOSE

Few study reported the association between Hemoglobin A1c (HbA1c) level and intracranial plaque vulnerability by magnetic resonance imaging (MRI). The present study of MRI-identified intracranial atherosclerotic lesions in patients with ischemic symptom therefore sought to determine the association between HbA1c level and intracranial plaque morphological and compositional characteristics and cerebral infarction severity.

# METHOD AND MATERIALS

108 patients with intracranial ischemia were recruited. All patients were stratified into high (>6.5%) and low (<6.5%) HbA1c groups and underwent both intracranial vessel wall MRI and brain MRI scans. Intracranial plaque features and intracranial ischemic lesions were assessed.

# RESULTS

More intracranial plaques ( $2.38\pm1.50$  vs.  $0.96\pm0.75$ , P=0.001), higher incidence rate of intracranial symptomatic plaque enhancement (88.24% vs. 45.95%, P=0.001), more acute cerebral infarct (50.00% vs. 25.67%, P=0.013) and more recurrent infarct (67.65% vs. 45.95%, P=0.036) were in the high as compared to the low HbA1c group. High HbA1c was the independent risk factor for the presence of intracranial symptomatic plaque enhancement [odds ratio (OR)=7.05].

# CONCLUSION

Our study suggested that an elevated HbA1c might have an adverse effect on intracranial plaque enhancement, which might induce acute cerebral infarct.

# **CLINICAL RELEVANCE/APPLICATION**

Our findings indicate that determination of HbA1c levels and characterization of intracranial atherosclerotic plaque by MR vessel wall imaging might be useful to better select proper treatment options of stroke subjects.

# SST07-08 Digital Variance Angiography Allows 50% Contrast Medium Reduction in Carotid X-Ray Angiography

### Friday, Dec. 6 11:40AM - 11:50AM Room: E353A

Participants

Viktor I. Orias, MD, Budapest, Hungary (*Presenter*) Clinical Research and Development Specialist, Kinepict Health Kft David Szollosi, MD, Budapest, Hungary (*Abstract Co-Author*) Nothing to Disclose Marcell Gyano, MD, Budapest, Hungary (*Abstract Co-Author*) Researcher, Kinepict Health Ltd. Sandor Nardai, MD,PhD, Budapest, Hungary (*Abstract Co-Author*) Nothing to Disclose Krisztian Szigeti, PhD, MSc, Budapest, Hungary (*Abstract Co-Author*) CEO, Kinepict Health Ltd Szabolcs Osvath, PhD, Budakeszi, Hungary (*Abstract Co-Author*) CEO, Kinepict Health Ltd Janos P. Kiss, MD,PhD, Budapest, Hungary (*Abstract Co-Author*) Officer, Kinepict Health Ltd Peter Sotonyi, MD,PhD, Budapest, Hungary (*Abstract Co-Author*) Nothing to Disclose Zoltan Ruzsa, MD,PhD, Budapest, Hungary (*Abstract Co-Author*) Nothing to Disclose

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# PURPOSE

In previous clinical studies Digital Variance Angiography (DVA) provided higher SNR and better image quality than Digital Subtraction Angiography (DSA). The observed quality reserve might provide opportunity for the reduction of ICM in CXA. Our aim was to evaluate the potential of DVA to reduce iodinated contrast medium (ICM) in carotid X-ray angiography (CXA).

# METHOD AND MATERIALS

Our prospective study enrolled 26 patients undergoing carotid percutaneous transluminal angioplasty between January and June 2018. Mean±SD age (years): 67.0±8.1, 23 males 67.3±8.1, 3 females 64.7±9.8. We compared the signal-to-noise ratio (SNR) of DSA and DVA image pairs obtained by a standard (100% ICM) or a low-dose (50% ICM) protocol. Visual evaluation of single DVA or DSA images was performed by specialists using a 5-grade rating scale. The quality of DSA and DVA videos was also compared. Interrater agreement was described by percent agreement and Fleiss' kappa.

#### RESULTS

DVA provided more than two-fold SNR, the median SNRDVA/SNRDSA ratio was 2.06 (100%) and 2.25 (50%). In the visual evaluation the DVA100% score ( $3.73\pm0.06$ ) was significantly higher than the DSA100% score ( $3.52\pm0.07$ , p<0.001), and the DVA50% score ( $3.64\pm0.13$ ) was also significantly higher than the DSA50% score ( $3.01\pm0.17$ , p < 0.01). There was no statistical difference between the DSA100% and DVA50% scores. Evaluators preferred DVA50% over DSA100% videos in 61 % of comparisons, the interrater agreement was 81% (Fleiss' kappa 0.35, p<0.001)

# CONCLUSION

Our data show, that DVA allows a very substantial (50%) ICM reduction in CXA without affecting the quality and diagnostic value of angiograms.

### **CLINICAL RELEVANCE/APPLICATION**

Digital Variance Angiography (DVA) is a novel medical image processing method that significantly improves the image quality of Xray angiograms compared to Digital Subtraction Angiography The quality reserve of DVA allows a substantial amount of iodinated contrast medium dose reduction in the carotid X-ray angiography setting without affecting the quality and diagnostic value of angiograms

# SST07-09 Readmission after Treatment of Symptomatic Carotid Stenosis: A Nationwide Readmission Database Analysis

Friday, Dec. 6 11:50AM - 12:00PM Room: E353A

#### Awards

### **Trainee Research Prize - Fellow**

# Participants

Pouya Nazari, MD, Chicago, IL (*Presenter*) Nothing to Disclose Pedram Golnari, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose Roxanna M. Garcia, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose Hannah K. Weiss, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose Sameer A. Ansari, MD,PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose Ali Shaibani, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose Michael C. Hurley, MBBCh, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose Matthew B. Potts, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose Babak S. Jahromi, MD,PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Carotid endarterectomy (CEA) and stenting (CAS) are two well-described methods for treating symptomatic carotid artery stenosis. However, literature on readmission after CEA and CAS is limited. We therefore utilized the Nationwide Readmission Database (NRD) to characterize the rate and causes of 30 and 90-day unplanned readmissions after CEA and CAS for symptomatic stenosis.

# **METHOD AND MATERIALS**

Data was extracted from the NRD spanning 2010 to 2015. The population consisted of adult patients who underwent CEA or CAS with a primary diagnosis of occlusion and/or stenosis of carotid artery with cerebral infarction or TIA. Non-elective readmission rates within 30 and 90 days for CEA vs CAS were compared. To calculate 30 and 90-day readmission rates, we included patients within the first 11 and 9 months of each year respectively. Poisson regression was performed using generalized estimating equations and adjusted risk ratio (aRR)s were obtained for factors associated with 30 and 90-day readmission. The adjusted model included terms for patient- and hospital-specific factors, comorbidity scores and disease severity.

## RESULTS

Of 54,704 patients treated and discharged alive, 8.0% patients were readmitted within 30 days, and 13.6%) patients were readmitted within 90 days. The 30 and 90-day non-elective readmission rate for CEA vs CAS was 7.7% vs 9.1% (p<0.0001) and 12.8% vs 17.0% (p<0.0001), respectively (figure). Patients undergoing CAS had a higher adjusted risk of non-elective 30 and 90-day readmission than patients having CEA (aRR=1.16; 95%CI, 1.09-1.23; p<0.001 and aRR=1.04; 95%CI, 1.01-1.08; p=0.024, respectively). The most common primary diagnoses for non-elective readmission within 30 and 90 days, respectively, were cerebral artery occlusion with infarct, septicemia, TIA, myocardial infarction, pneumonia, carotid artery stenosis/occlusion without infarction, and acute kidney failure.

# CONCLUSION

Common reasons for 30 and 90-day non-elective readmission after CEA or CAS for symptomatic stenosis were cerebral artery occlusion with infarct, septicemia and TIA. Adjusted risk and rates of non-elective readmission after 30 and 90 days were higher after CAS than CEA.

# **CLINICAL RELEVANCE/APPLICATION**

Patients undergoing CAS had higher risk of readmission than those undergoing CEA at 30 and 90-day post-procedure.

#### **SPECIAL NOTE**

This paper has received the Kuo York Chynn Neuroradiology Research Award. This award is funded in perpetuity by the Chynn Family Foundation. Through the Chynn Family Foundation, Emil William Chynn, MD, FACS, MBA will guide future distributions to support research in radiology.





# SST10

# Vascular/Interventional (Tumor Ablation & Biopsy)

Friday, Dec. 6 10:30AM - 12:00PM Room: E451B



AMA PRA Category 1 Credits ™: 1.50 ARRT Category A+ Credit: 1.75

FDA Discussions may include off-label uses.

# Participants

Jennifer Montgomery, MD,PhD, Cleveland, OH (*Moderator*) Nothing to Disclose Nikunj R. Chauhan, MD, Cleveland, OH (*Moderator*) Nothing to Disclose

# Sub-Events

SST10-01 Accuracy and Effectiveness of Transoral Contrast-Enhanced Ultrasound Guided Core Needle Biopsy for Oral Lesions

Friday, Dec. 6 10:30AM - 10:40AM Room: E451B

Participants Ting Wei, Chengdu, China (*Presenter*) Nothing to Disclose Man Lu, PhD, Chengdu, China (*Abstract Co-Author*) Nothing to Disclose

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# PURPOSE

To determine the accuracy and effectiveness of transoral contrast-enhanced ultrasound (CEUS) guided core needle biopsy (CNB) for oral lesions that could not be accurately identified or had a previously non-diagnostic cyto-histological biopsy.

# METHOD AND MATERIALS

A consecutive series of 29 patients (age range, 31-81 years; mean 61±12 years; 18 male and 11 female) who underwent transoral CEUS-guided CNB of oral lesions at our hospital were evaluated retrospectively. Among them, 10(34.5%) lesions were inconspicuous and 19(65.5%) patients had a previously non-diagnostic cyto-histological exam by endoscopic or surgical incisional biopsy. Transoral CEUS-guided CNB was performed by using an endocavitary transducer and needle guide device attached to the transducer shaft. The CEUS characteristics, successful biopsy rate, diagnostic performance and complications were assessed and recorded.

# RESULTS

Of the 29 lesions (median size:  $31.5\pm14.3$  mm; range: 9-58mm), 18 lesions were located in oral cavity (oral tongue (n=6), floor of the mouth (n=5), gingiva (n=5), hard palate (n=1) and lip (n=1)) and 11 lesions were located in oropharynx (base of the tongue (n=6), parapharyngeal space (n=4), and tonsil (n=1)). CEUS improved the conspicuity of target lesions and detection rate of internal liquefied necrosis comparing with transoral US (p <0.05). Successful biopsy rate was 100%. Based on the final diagnosis: 19 malignant lesions (15 squamous cell carcinomas, 2 adenoid cystic carcinomas, one mucoepidermoid carcinoma and one melanoma) and 10 benign lesions (5 inflammatory lesions, 3 pleomorphic adenomas, one schwannoma and one hematoma), the diagnostic sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy of this technique for the diagnosis of oral lesions were 94.7%, 100%, 100%, 90.9% and 96.6% respectively. No serious complications were observed.

# CONCLUSION

Transoral CEUS-guided CNB can be considered as a complementary technology for pathological diagnosis of oral lesions that could not be accurately identified or had a previously non-diagnostic cyto-histological biopsy.

# **CLINICAL RELEVANCE/APPLICATION**

Transoral CEUS-guided CNB can serve as a safe, feasible and accurate technique for pathological diagnosis and decision making of oral lesions.

# SST10-02 HighNoon CT-Guided Needle Navigation Device: Preliminary Experience

Friday, Dec. 6 10:40AM - 10:50AM Room: E451B

Participants

Siddharth S. Vijayakumar, MBBS, Chennai, India (*Presenter*) Nothing to Disclose Roy J. Santosham, MD, Chennai, India (*Abstract Co-Author*) Inventor, HigHNooN; Director, Kornerstone Pvt Ltd Bhawna Dev, MD, Chennai, India (*Abstract Co-Author*) Nothing to Disclose Ritesh Santosham, MBBS, Chennai, India (*Abstract Co-Author*) Nothing to Disclose Shanthakumar Devakaran, BSC, Chennai, India (*Abstract Co-Author*) Director, Kornerstone Devices Pvt Ltd; Managing Director, Vital Bio-Systems Pvt Ltd Azhagu Palaniappan, Chennai, India (*Abstract Co-Author*) Technical Coordinator, Kornerstone Devices Pvt Ltd

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### PURPOSE

To establish the clinical utility in terms of safety, less time consumption & practicality of high noon in simple & complex CT guided needle placement - biopsies & procedures.

# METHOD AND MATERIALS

HighNooN - Shadow based needle navigation device is used to perform high precision percutaneous CT guided needle placement. The devices is ceiling mounted and can be guided easily to area of action. Device has central camera, four sources of light at right angle to each other and a laser source which project a crosier on the patient. The device can make left to right and head to toe swinging motion.140 biopsies were performed on mannequins under Ct guidance following which detailed results were presented to the ethics committee. After approval from ethics committee 55 cases are done using HighNoon prototype.

### RESULTS

We are presenting here the results of our initial 55 patients. In these 55 Patients Average target accuracy achieved was 1mm as compared to 5mm without needle guidance device . Average manipulations done was 3%, average no of check scans was 1.24 using High Noon when compared to free hand biopsies where it was 5-10% & 0.4 - 6 respectively. Average wheel in & wheel out time was 26 mins with High noon and between 35 to 50 mins without needle guidance. Patient movement can be identified and corrected and respiratory misregisteration can be avoided using visual feedback for raddiologist & bagging anestheteist .

#### CONCLUSION

The 'High noon device 'helps to place the needle/device with precise angles of incidence from the point of entry in both axis (X & Z axis), thereby adding to accuracy, reducing the number of insertions, pain, discomfort, radiation, and complications.

# **CLINICAL RELEVANCE/APPLICATION**

WHO states that 9.6 million deaths occurred globally in 2018, 30 % increase in cancer cases is expected in 2030. As the cancer mortality is decreased by early detection -the action plan of WHO is to develop tools to help early detection.HighNooN can help in assessing the smaller lesions in easy & difficult locations to be biopsied and reach the final histopathological diagnosis leading to timely, correct treatment saving lives. Also in countries like India where tuberculosis including extra pulmonary tuberculosis mimicking malignancy is very common - deep seated mediastinal lymph nodes & vertebral lesions can be easily accessed by HighNoon alleviating the unnecessary apprehension and and initiating the correct medication .

# SST10-03 Video Augmented Reality Percutaneous Needle Intervention Decreases Radiation Dose While Maintaining Accuracy Compared to C-Arm Cone Beam CT with Fluoroscopy Overlay: A Prospective Clinical Study with a Matched Control

Friday, Dec. 6 10:50AM - 11:00AM Room: E451B

#### Participants

John M. Racadio, MD, Cincinnati, OH (*Presenter*) Institutional research agreement, Koninklijke Philips NV Neil D. Johnson, MD, Cincinnati, OH (*Abstract Co-Author*) Institutional research agreement, Koninklijke Philips NV Manish N. Patel, DO, Cincinnati, OH (*Abstract Co-Author*) Institutional research agreement, Koninklijke Philips NV Nicole Hilvert, Cincinnati, OH (*Abstract Co-Author*) Institutional research agreement, Koninklijke Philips NV Drazenko Babic, MD, Best, Netherlands (*Abstract Co-Author*) Employee, Koninklijke Philips NV Robert Homan, MSc, Best, Netherlands (*Abstract Co-Author*) Employee, Koninklijke Philips NV Jurgen Hoppenbrouwers, Best, Netherlands (*Abstract Co-Author*) Employee, Koninklijke Philips NV

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### PURPOSE

To compare navigational accuracy and radiation dose during percutaneous needle intervention for video augmented reality (AR) guidance (study group) versus c-arm cone beam computed tomography (CT) with fluoroscopy overlay (control group)

# METHOD AND MATERIALS

This is an IRB approved prospective study with a retrospective matched-control group. Matching was performed for clinical indication. Patients requiring c-arm cone beam CT and integrated fluoroscopy overlay guidance for biopsy, drainage, injection, or ablation were eligible to be prospectively enrolled for the procedure to be performed with video AR. Three interventional radiologists performed 15 video AR procedures in 11 patients. The video AR procedures were compared to an equal number of procedures and patients using c-arm cone beam CT with fluoroscopy overlay. Accuracy of needle guidance was defined as distance between the needle tip and planned anatomic target. Target depth from skin surface, fluoroscopy time, and complications were recorded. Correlation between accuracy and depth of target was assessed using Pearson correlation coefficient. Student's t-test was applied to evaluate statistical difference between groups for each continuous variable.

#### RESULTS

Age in the study and control groups was 19±6 yrs and 14±4 yrs (p<0.05), respectively. There were 6 biopsies (3 ilium, 1 femur, 1 tibia, 1 sternum) and 9 injections (4 pars interarticularis, 3 sacroiliac, 1 hip, 1 sternum) in each group. Accuracy in the study group was superior to the control group ( $2.9\pm2.3 \text{ mm vs}$ .  $5.6\pm5.0 \text{ mm}$ ) although not statistically significant (p=0.07). Fluoroscopy time was significantly lower in the study group compared to the control group ( $0.8\pm1.0 \text{ min vs}$ .  $2.1\pm2.0 \text{ min}$ , p<0.05). Target depth in the study group ( $48\pm20 \text{ mm}$ ) and control group ( $60\pm27 \text{ mm}$ ) were not statistically different (p=0.18). There was higher negative correlation between the accuracy and the depth of the anatomic target in control group compared to the study group. There were no complications in either group.

# CONCLUSION

Video augmented reality percutaneous needle intervention decreases radiation dose while maintaining accuracy compared to c-arm cone beam CT with fluoroscopy overlay.

# **CLINICAL RELEVANCE/APPLICATION**

Replacing fluoroscopy with video AR guidance decreases x-ray dose to patients and interventionalists without compromising accuracy or clinical outcome.

# SST10-04 Comparison of the Complications of Percutaneous versus Transjugular Liver Biopsies Performed at a Single Institution

Friday, Dec. 6 11:00AM - 11:10AM Room: E451B

Participants

Andrew P. Mai, Houston, TX (*Presenter*) Nothing to Disclose Peyton Cramer, BS, Houston, TX (*Abstract Co-Author*) Nothing to Disclose Anil K. Pillai, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Transjugular liver biopsy (TJLB) is safer than percutaneous liver biopsy (PLB) in patients with increased risk for hemorrhage. Few clinical studies have directly compared the complication rates between the two procedures. The aim of this study was to retrospectively review patients who underwent liver biopsy and compare the incidence of adverse events and patient factors that were associated with complications.

### **METHOD AND MATERIALS**

Institutional approval was obtained for this study. Data was collected from 158 patients diagnosed with cirrhosis that underwent non-targeted liver biopsies from January 2016 to April 2018. Information included patient demographics, coagulation status, biopsy method, operative findings, and immediate complications (<30 day). Statistical analyses with Fisher's exact test and Wilcoxon rank sum test were then performed to compare the outcomes of the two procedures.

#### RESULTS

Complications occurred in 7.3%(7/96) who underwent TJLB and included self-limiting post-operative pain (n=4, 4.2%) and major vascular complications (n=3, 3.1%) such as AV fistula and hemoperitoneum. 4.8% (3/62) of patients in the PLBs developed procedural complications including post-operative pain (n=2, 3.2%) and major vascular complications (n=1, 1.6%). The difference in complication rates between the two techniques was not statistically significant (p = 1), nor was there a clinically significant difference in patient demographics, INR, PTT, or PT between the two groups. A larger number of patients who received TJLB were on anticoagulation therapy.

# CONCLUSION

Our results show that both TJLB and PLB are safe procedures and there is no significant difference in complication rates between the two biopsy techniques. Although not statistically significant, there was a higher number of major vascular complications with TJLB biopsies. This suggests that the conventional belief of TJLB being the inherently safer approach is not necessarily true in clinical practice.

# **CLINICAL RELEVANCE/APPLICATION**

Transjugular and percutaneous liver biopsies are minimally invasive techniques that allow for hepatic tissue sampling and both are used in the diagnosis and management of cirrhosis.

# SST10-05 Power of Lipiodol-Enhancement in CT-Guided Biopsies of Unspecified Suspect Intrahepatic Lesions: Improvement of Accuracy and Safeness

Friday, Dec. 6 11:10AM - 11:20AM Room: E451B

# Participants

Marcel C. Langenbach, MD, Cologne, Germany (*Presenter*) Research Grant, Guerbet SA Thomas J. Vogl, MD, PhD, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose Amelie Buchinger, MS, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose Lajos M. Basten, Frankfurt am Main, Germany (*Abstract Co-Author*) Nothing to Disclose Renate M. Hammerstingl, MD, Frankfurt am Main, Germany (*Abstract Co-Author*) Nothing to Disclose Tatjana Gruber-Rouh, Frankfurt am Main, Germany (*Abstract Co-Author*) Nothing to Disclose

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# PURPOSE

To evaluate the power of Lipiodol in improving the rate of successful biopsies of suspect intrahepatic lesion which is often challenging in native CT-scans. Lipiodol, commonly applied in angiography for tumor embolization, might improve the success rate.

### **METHOD AND MATERIALS**

Six-hundred-seven patients (men: 358, women: 259) with unclear suspect liver lesions were retrospectively evaluated. All patients received a CT-guided liver biopsy and results were histopathological analysed. Successful punctuations were defined by positive pathological findings. Data were ascertain regarding the use of contrast media, lipiodol or common intravenous contrast, or native performance. Lesion hitting rate and influencing factors like lesion size or liver cirrhosis were insulated. Procedure was performed with the same 128-multislice CT-scanner. Correlation was calculated according to Spearman-Rho, results compared using Wilcoxon-Man-Whitney t-test and Chi-square-test. P<0.05 was considered as statistically significant.

### RESULTS

Losion hitting rate was significantly higher using Liniadal (79 604) compared to native hiensy (72 204) or the use of intravenous

Lesion nucling rate was significantly higher using Liploud (70.0%) compared to hative plopsy (73.2%) of the use of intravenous contrast agent (65.2%) (p=0.038). For lesions with a size <20mm, the benefit regarding the hitting rate was even higher for Liplodol (71.2% vs 47.7% vs. 65.5%) (p=0.021). For patients with an existing liver cirrhosis in comparison of all three groups were seen. (p=0.97). No major complications occurred during the interventions.

# CONCLUSION

Pre-puncture marking using Lipiodol in angiography increases the lesion hitting rate significantly, especially for small suspect liver lesions (<20mm), combines with a lower rate of re-biopsy and a higher safeness for the patient.

# **CLINICAL RELEVANCE/APPLICATION**

Pre-puncture marking of unclear intrahepatic lesions using Lipiodol increases the hitting rate and safeness of liver biopsies and is recommended for hardly detectable liver lesions in CT.

# SST10-06 Real-Time Intravascular Device Guidance for Procedures in the Thorax and Abdomen Using Motion-Compensated Roadmaps

Friday, Dec. 6 11:20AM - 11:30AM Room: E451B

Participants

Martin Wagner, Madison, WI (*Presenter*) Shareholder, LiteRay Medical LLC Sarvesh Periyasamy, MS, Madison, WI (*Abstract Co-Author*) Nothing to Disclose Joe F. Whitehead, BS, Madison, WI (*Abstract Co-Author*) Nothing to Disclose Michael Speidel, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose Paul F. Laeseke, MD, PhD, Madison, WI (*Abstract Co-Author*) Consultant, NeuWave Medical, Inc ; Shareholder, Elucent Medical ; Consultant, Elucent Medical ; Shareholder, HistoSonics, Inc; Consultant, HistoSonics, Inc; Shareholder, McGinley Orthopaedic Innovations, LLC; Grant, Siemens AG

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# PURPOSE

Vascular roadmaps have limited utility for intravascular procedures in the thorax and abdomen due to severe subtraction artifacts and changes in vessel shape and position caused by respiratory motion. Instead, most interventional radiologists navigate devices (eg. guidewires and catheters) without vascular overlay. This procedure is time consuming and requires experienced interventional radiologists. The purpose of this study was to test the accuracy of a recently developed system that provides real-time motioncompensated vascular overlays for device navigation.

# METHOD AND MATERIALS

The proposed system creates a dynamic motion model from contrast enhanced x-ray images acquired under free breathing conditions. During device navigation, a motion-compensated vessel roadmap is created based on respiratory motion estimations from live x-ray images. The device is extracted from the x-ray images and superimposed on the motion compensated roadmap. Alternatively, the system can apply respiratory motion compensation to the device and display a static vascular roadmap. A porcine study was conducted with 3 animals, where a real-time prototype of the system was used to navigate a guidewire within the hepatic arteries. An EM-tracking sensor was placed in different branches of the vasculature to measure motion and compare it to the deformation estimated by the proposed approach.

# RESULTS

The average difference between the measured EM-sensor motion and the estimated vessel motion was  $1.59 \pm 0.64$  mm at the detector. The Pearson correlation was 0.94 (p < 0.01). The prototype was able to display the guidewire within the correct vascular branches despite respiratory motion. In some cases, the proximal and less flexible part of the device deforms the surrounding vessels, but the distal part, most relevant for device navigation, is still displayed correctly.

## CONCLUSION

Our real-time motion compensated device guidance system provides an intuitive way to accurately navigate devices during intravascular procedures in the abdomen. This could reduce procedure times and therefore decrease risk and radiation exposure to the patient.

# **CLINICAL RELEVANCE/APPLICATION**

Real-time motion compensated roadmaps provide the device position in the vasculature during procedures in the abdomen. This could reduce procedure times and decrease radiation and risk to patients.

# SST10-07 Role of Contrast-Enhanced Ultrasound (CEUS) in the Detection of Complications Ensuing US-Guided Interventional Procedures: A Multi-Center Study

Friday, Dec. 6 11:30AM - 11:40AM Room: E451B

Participants

Giampiero Francica, MD, Castel Voltumo, Italy (*Presenter*) Research Consultant, Shenzhen Mindray Bio-Medical Electronics Co, Ltd Maria Franca Meloni, Basiglio, Italy (*Abstract Co-Author*) Nothing to Disclose Laura Riccardi, Roma, Italy (*Abstract Co-Author*) Nothing to Disclose Eugenio Caturelli, Viterbo, Italy (*Abstract Co-Author*) Nothing to Disclose Ilario De Sio, Naples , Italy (*Abstract Co-Author*) Nothing to Disclose Francesco Giangregorio, MD, Piacenza, Italy (*Abstract Co-Author*) Nothing to Disclose Fulvia Terracciano, San Giovanni Rotondo, Italy (*Abstract Co-Author*) Nothing to Disclose Maurizio Pompili, MD, Roma, Italy (*Abstract Co-Author*) Nothing to Disclose

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### PURPOSE

Aim of this study was to assess the contribution of CEUS to the detection of complications ensuing US-guided hepatic interventional procedures in field practice of 7 interventional ultrasound centers

# **METHOD AND MATERIALS**

The participating centers retrospectively selected all patients in whom CEUS detected complications after US-guided liver biopsy for diffuse liver disease or focal liver lesions (FLL) and after ablation of liver tumors over the last decade.

### RESULTS

22 patients (13 M/ 9F, median age 73 yrs.) experienced complications after 5 liver biopsies with 18g cutting needles (3 for FLL) and 17 ablations of liver tumors (16 HCC) carried out with PEI (2), MW (2), RF (13). Median size of the 20 biopsied/ablated nodules was 22.5 mm (range 15-39 mm). In 10 cases CEUS was performed at the end of ablation (2 PEI, 2 MW, 6 RF) and demonstrated 6 sub-segmental/segmental infarcts, 3 active bleedings (2 capsular tears with hemoperitoneum, 1 hemobilia), and 1 subcapsular hepatic hematoma (SHH). Only 2 patients underwent RF to achieve hemostasis. In 5 symptomatic cases CEUS was performed within 6 hours after biopsy and displayed 1 actively bleeding capsular tear with hemoperitoneum, 1 hemobilia and 3 SHHs, one of which actively bleeding. In the latter case transarterial embolization (TAE) was carried out and another patient needed blood transfusion (BT). Finally, in 7 cases CEUS was performed 24-48 hours after interventional maneuvers. In 5 symptomatic cases CEUS showed 1 actively bleeding capsular tear with hemotherax (due to actively bleeding intercostal artery), 1 pseudoaneurysm of a right arterial branch, 1 segmental infarct, 2 abscessed ablated areas; in the remaining case, routine CEUS check at 24 hours displayed 1 SHH. 5 out of 7 patients in this group were treated with TAE (2 cases), percutaneous abscess drainage (2 cases), and BT plus TAE (1 case).

# CONCLUSION

This multicenter survey highlights the potential role of CEUS in the detection of immediate and early (<6 hours) complications ensuing US-guided liver biopsy or ablation. Iatrogenic hemorrhagic complications even with active bleeding and ischemic segmental areas can be successfully demonstrated by CEUS and promptly treated if clinically needed.

# **CLINICAL RELEVANCE/APPLICATION**

CEUS should be considered as an useful tool to detect iatrogenic complications mainly of ischemic and hemorrhagic type occurring after US-guided hepatic interventional procedures.

# SST10-08 Detection of Bleeding Complications After Instituting a 1-Hour Post-Procedure Recovery Time Following Renal Transplant Biopsy

Friday, Dec. 6 11:40AM - 11:50AM Room: E451B

Participants

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# PURPOSE

To analyze the timing of major bleeding complications following renal transplant biopsy in the context of a standardized 1-hour post-procedure observation protocol.

### **METHOD AND MATERIALS**

We retrospectively reviewed the electronic medical record for 4519 consecutive US-guided renal transplant biopsies (769 women, 1055 men) from 01/01/2012 to 12/31/2017, after initiating a post-procedural protocol limited to 1 hour of routine observation, additional observation only if symptoms present at 1 hour, and subsequent patient contact within 24 hours after discharge. The development of a major bleeding complication (CTCAE Class 3 or higher) was recorded, along with all available details regarding the time course of patient symptoms and presentation.

# RESULTS

There were 11 CTCAE Class 3 complications (11/4519, 0.24%). Seven patients (7/11, 63.6%) were asymptomatic after 1 hour of observation and were discharged. Of these, two (2/11, 18.2%) were admitted after symptoms began 4-8 hours after biopsy; the remaining five (5/11, 45.5%) were admitted after developing symptoms more than 8 hours after biopsy. Four patients (4/11, 36.3%) had symptoms in the 1 hour observation period; of these, two (2/11, 18.2%) had pain combined with hemodynamic alterations, leading to hospital admission. The other 2 patients (2/11, 18.2%) had pain without hemodynamic alterations, leading to an additional hour of observation, and subsequent discharge due to successful pain control with oral analgesics; these 2 patients were later admitted when symptoms returned 4- 8 hours after biopsy.

### CONCLUSION

Major bleeding complications following US-guided renal transplant biopsy are rare, occurring in 0.24% of patients in this study, and most are not clinically apparent within 4 hours of biopsy. One-third of patients who develop significant hemorrhage have early manifestations, but approximately two-thirds of patients do not have unusual symptomatic manifestations of hemorrhage until more than 4 hours after biopsy. Almost half of all patients do not have unusual symptoms until more than 8 hours after biopsy.

# **CLINICAL RELEVANCE/APPLICATION**

A recovery protocol with only 1 hour of routine observation after uneventful renal transplant biopsy can be safely implemented when combined with routine follow-up patient contact. Requiring routine post-procedure observation for 4 hours as used at some facilities uses more resources without improving care.

# SST10-09 High-Intensity Focused Ultrasound (HIFU) Focal Therapy to Primary Treatment of Localized Prostate Cancer Using 68Ga-PSMA PET/MR as Main Guidance: Innovative Experience in 14 Patients

Friday, Dec. 6 11:50AM - 12:00PM Room: E451B

# Participants

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# PURPOSE

To identify candidates to High-intensity focused ultrasound (HIFU) focal therapy (FT) for localized prostate cancers (pCa), the following inclusion criteria are commonly used: serum PSA (<15 ng/ml), Gleason score (ISUP 1-3), multiparametric magnetic resonance imaging (mpMRI) with no extracapsular extension, no seminal vesicle invasion or pelvic lymph node disease and negative bone scintigraphy; however, to the best of our knowledge, no prior study has used 68Ga-PSMA PET/MR as the main feature to indicate and guide HIFU procedures.

# **METHOD AND MATERIALS**

A single-center prospective analysis of initial 14 patients, candidates for FT (hemi-gland or super-focal ablation) as the primary treatment option, from August 2018 to March 2019. All patients were re-evaluated by mpMRI and transrectal US/MR fusion prostate biopsy and follow-up 68Ga-PSMA PET/MR to better understand the indication of HIFU before the procedure.

#### RESULTS

Mean prostatic volume, age, PSA and region of interest volumes were: 47.9 cc, 68 years, 4.56 ng/dl and 1.1 cm; respectively. Preprocedure mpMRI showed 7.1% of PIRADS 2, 21.4% of PIRADS 3, 57.3% of PIRADS 4 and 14.2% of PIRADS 5. US-guided fusion + systematic biopsy showed 3 patients with unilateral ISUP 1, 8 patients wth unilateral ISUP 2 and 3 patients with ISUP 3. Ten patients (71.4%) had concordant findings between pre-procedure mpMRI, 68Ga-PSMA PET/MR and biopsy. Four patients (28.5%) had discordant findings, altering the treatment planning or contraindicating the procedure, for the following reasons: 2 patients had larger unilateral multifocal disease on 68Ga-PSMA PET/MR than on MRI or US-MR fusion biopsy, with need to extend the treatment area; One patient presented a smaller extent of disease in 68Ga-PSMA PET/MR than in MRI, allowing a reduction of the expected area of treatment; One patient had extensive bilateral disease in 68Ga-PSMA PET/MR that was not suspected in MRI, confirmed by biopsy, contraindicating the procedure.

# CONCLUSION

In conclusion, 68Ga-PSMA PET/MR may play a fundamental role in the indication and planning of focal ablative prostatic therapy and might be introduced in the inclusion criteria for cases indicated for HIFU.

# **CLINICAL RELEVANCE/APPLICATION**

High-intensity focused ultrasound is a promising novel technique but new diagnostic procedures, such as 68Ga-PSMA PET/MR for selection of patients and correct planning of the procedure may alter the oncological outcome and mortality.