SUMMARY

There are numerous classifications of ectopic varices including newly published classification that collectively take endoscopic and vascular classifications into account. Moreover, the detailed cross-sectional radiographic and surgical anatomy of varices and shunts have not been described. The purpose of the review is to display (illustrations) and discuss every published anatomical (including endoscopic) and hemodynamic classification of ectopic varices as well as describe the detailed anatomy and hemodynamics. CONTENT ORGANIZATION

Discussing all ectopic variceal locations: Gastric, Duodenal, Mesenteric, stomal, uterine, vesicovascular (urinary bladder). Discussing and illustrating all classifications: Sarin, Hirota, Kiyosue (inflow/outflow), Watanabe, Fukuda-Hirota, and others recently published. Detailed cross-sectional anatomy and hemodynamics of ectopic varices including hemodynamic classifications.

SUMMARY

It is important to place all the anatomy, hemodynamics and all the classifications in a review to reduce the confusion and to discuss the overlaps as well as correlate between gastroenterology (endoscopic classifications) and vascular (radiologic and surgical) classifications.
LL-VIE1273
George Zlotchenko, MD
Anuj Malhotra, MD
Mark A Westcott, MD *
Stephen Scharf, MD *

PURPOSE/AIM
Tc99 MAA studies are essential prior to delivery of yttrium 90 microspheres primarily to estimate lung shunt fraction which may effect dosimetry calculations. Traditionally planar imaging has been used due to short imaging times. Tc99 MAA SPECT CT studies can also be performed and may yield information that necessitates a change in the radioembolization treatment protocol.

CONTENT ORGANIZATION
• Overview of Tc99 MAA preparation, intraarterial delivery, and mechanism of lung shunt
• Identify pitfalls and possible sources of error during Tc99 MAA imaging
• Compare planar and SPECT CT imaging
• Demonstrate various extrahepatic activity and importance for radioembolization
• Show different intrahepatic activity patterns and importance for radioembolization

SUMMARY
Tc99 MAA studies are primarily used to determine lung shunt. Combining Tc99 MAA scan with SPECT CT imaging allows us to ascertain more information prior to the delivery of Yttrium 90 microspheres.

Fluoro CT- guided RF Ablation and Percutaneous Cementoplasty Plus Fixation for Palliative Treatment for Painful Metastatic Bone Lesions

PURPOSE/AIM
To determine the indications and describe the technique of CT-guided RF ablation and percutaneous cementoplasty plus fixation as a palliative treatment for painful metastatic bone lesions refractory to conservative medical treatment

CONTENT ORGANIZATION
A. Anatomy
B. Pathophysiology
C. Review of Indications, Contraindications
D. Description of technique
E. Follow-up Management
F. Outcomes (include complications)

SUMMARY
Metastatic bone lesions are common in patients with cancer; up to 85% of patients with breast, prostate, and lung cancer have evidence of bone metastases at the time of death. These are a cause of significant cancer-related pain, affecting quality of life, performance status, and mood. Analgesics are the cornerstone treatment for patients with painful bone metastases; although, to achieve adequate pain control, higher doses are frequently required and can lead to significant side effects. External beam radiation therapy is the current standard of care, however, many patients do not achieve optimal relief. Image-guided RF ablation techniques and percutaneous cementoplasty of bone metastases have proved effective for palliative treatment in patients with painful bone metastases who have failed to achieve benefit from conventional therapies, and pain reduction that is achieved with this is durable over many months.

Imaging Spectrum Post Radiofrequency Ablation (RFA) of 200 Renal Tumors: Pearls and Pitfalls

PURPOSE/AIM
This pictorial illustration aims to present our imaging experience in the assessment of 200 renal tumors post RFA at a tertiary university institution from 2004 to 2013.

CONTENT ORGANIZATION
We present a pictorial review of image guided renal RFA over an 8-year period. The contents include describing current techniques used to assess renal tumors following RFA and to illustrate the normal expected findings and sequential imaging interval changes longitudinally on both CT and or MRI and to describe the classic imaging signs associated with the interval change. To highlight the pearls and pitfalls of imaging findings on both CT and MRI and to demonstrate the use of contrast enhanced ultrasound in problem solving cases. This review also present unusual findings post renal RFA e.g. chyluria, latent infection in the zone of ablation with fistula formation to the pleural and inflammatory between zone of ablation and adjacent structure e.g. colon, as well as, to illustrate our complications e.g. acute tubular necrosis, calyceal cutaneous fistula and retroperitoneal abscess from a complicated ureteric stricture post RFA.

SUMMARY
It is important to recognise various salient features post image guided renal RFA on imaging and early recognition of residual/recurrent disease as well as complications would allow timely clinical management.

The Proteomics of Ablation: Methodology for Understanding Systemic Biological Responses to Tumor Ablation

PURPOSE/AIM
To show proteomic translational research of tumor ablation patients’ plasma with the use of chromatographic protein separation and mass
spectrometry quantification and identification techniques in order to understand the body’s biological responses to tumor ablation. This exhibit will illustrate the scientific steps that have been taken to perform in-depth proteomic analysis on the plasma of cancer patients before and for six months following thermal ablation. Identification and quantification of low-abundance proteins by mass spectrometry with significant changes in spectral intensity during patient trials will be illustrated in conjunction with functional analysis. Confirmation of method reproducibility is shown by SDS PAGE. Additionally, chromatographically isolated IgG from patient plasma identified glycosylation patterns which were analyzed by glycan cleavage followed by HPLC.

SUMMARY
Image-guided tumor ablation is becoming more widely utilized for solid tumors. The systemic effects of local tumor treatment may enhance or hinder local tumor responses based on tumor and host biology. Proteomic analysis of tumor biomarkers, inflammatory mediators and immunological stimuli may add further insight to the growing evidence for modulation of both adaptive and innate immunity in response to tumor treatment.

Practice Makes Perfect: The Utility of Ultrasound Phantoms for Biopsy and Vascular Access Practice with Review of Available Options

LL-VIE1277
Adam DeFoe, MD
Louis Morel, MD
Adam Stibbe, MD

PURPOSE/AIM
1. Recognize the need and utility of ultrasound phantoms for biopsy and vascular access among trainees 2. Review the available options for commercially available and homemade ultrasound phantoms 3. Review the strengths and weaknesses of various phantoms for ultrasound guided procedures

CONTENT ORGANIZATION
Utility of ultrasound phantoms for biopsy and vascular access practice
- Resident survey from our institution, before and after phantom practice, demonstrating improved confidence
- Results from others’ similar work in the published literature demonstrating improved confidence and skill

Options for ultrasound phantoms with evaluation of their respective strengths and weaknesses
- Commercially available phantoms
- Homemade phantoms, including gelatin and animal tissue

SUMMARY
Ultrasound guided procedures require practice to gain proficiency. Both skill and confidence can be gained with practice on phantoms, rather than on live patients, as we and others have shown. There are many commercial and homemade phantom options, each with inherent strengths and weaknesses.

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**Portal Hypertension: A Review of Porto-systemic Collateral Pathways and Endovascular Interventions**

**LL-VIE1278**

**Amish D Patel, MD**  
**Victor O Lopez, MD**  
**Anil K Pillai, MD**  
**Sanjeewa P Kalva, MD**  
**Steven L Hsu, MD**  
**Clayton K Trimmer, DO**  

**PURPOSE/AIM**  
To describe and illustrate the pathophysiology of portal hypertension, anatomy of porto-systemic collateral pathways, endovascular treatment options and the specific role of each endovascular procedure in the management of complications of portal hypertension.  

**CONTENT ORGANIZATION**  
We describe and illustrate the following:  
1. Pathophysiology and clinical manifestations of portal hypertension.  
3. Role of various endovascular procedures, using case examples, for the management of both conventional and ectopic varices in portal hypertension.  

**SUMMARY**  
We will educate the viewers about collateral venous anatomy and its importance in guiding the appropriate interventional therapy.

**Virtual Navigation Systems in CT-guided Interventional Procedures in Liver and Kidney**

**LL-VIE1279**

**Arash Anvari, MD**  
**Priyanush Kandakatla, MD**  
**Anthony E Samir, MD**  
**Ronald S Arellano, MD**  
**Raul N Uppot, MD**  

**PURPOSE/AIM**  
In this educational we review the role of the developing and evolving technology of virtual navigation systems in CT guided biopsies and tumor ablations in liver and kidney.  

**CONTENT ORGANIZATION**  
1. History and background of virtual navigation system  
2. Definition of important concepts in this technology like trajectory guidance, needle tracking, body GPS, image fusion, virtuality, augmented virtuality, augmented reality, reality.  
3. Limitation of current CT-guided or Ultrasound-guided for liver and kidney interventions.  
4. Describe different techniques of CT-scan virtual navigation system:  
   a. Electromagnetic tracking methods  
   b. Optical tracking methods  
   c. Hybrid tracking methods  
5. Role of each technique in CT-guided interventions for focal liver and kidney lesions.  
6. Discuss about potential advantages and limitations of these methods like: impact of them on dose radiation, accuracy of their performance, cost benefit and their clinical effectiveness.  
7. Compare CT-scan virtual navigation system with CT-fluoroscopy and C-arm cone beam CT (CBCT).  

**SUMMARY**  
This exhibition will emphasize on the clinical indications, advantages and limitations of various virtual navigation systems for CT-guided intervention of focal liver and kidney lesions.

**Endovascular Therapy for an Occluded SVC: A Review of SVC Syndrome with a Pictorial Exhibit of Noninvasive Imaging, Interventional Modalities, and Respective Outcomes**

**LL-VIE1280**

**Brandon M Shearer, DO**  
**Erin Horsley, DO**  
**Brian A Bianco, DO, MBA**  
**Alexander E Trebelev, MD**  

**PURPOSE/AIM**  
The goal is to provide a review of superior vena cava (SVC) syndrome and a greater understanding of endovascular management of SVC syndrome.  

**CONTENT ORGANIZATION**  
A review of the pathophysiology, clinical manifestations, differential diagnosis, imaging findings, and treatment modalities with a particular emphasis on endovascular management of SVC syndrome will be conducted. A pictorial case based review utilizing multiple imaging modalities of selected retrospectively identified patients with SVC syndrome who underwent endovascular therapy will be presented.  

**SUMMARY**  
Treatment of SVC syndrome relates to the cause, which may include thrombolytics, anticoagulants, radiation, chemotherapy, surgical, and endovascular interventions. Endovascular treatment is a minimally invasive therapy consisting of thrombolysis, angioplasty, and stent placement resulting in a 75-100% rate of symptom relief with minimal complications.

**Endovascular Treatment of IVC Thrombosis Related to IVC Filters: Clinical, Procedural, and Pictorial Review**

**LL-VIE1281**

**Matthew Suberlak, MD**  
**John Yoon, MD**  
**Abhishek Kumar, MD**  
**Sohail G Contractor, MD, MBBS**  

**PURPOSE/AIM**  
- Review complications of chronic IVC filters including inferior vena cava thrombus and renal failure  
- Describe treatment options for IVC thrombosis including endovenous technique  
- Review periprocedural and postprocedural management for patients treated with catheter guided thrombolysis  
- Describe technique and potential complications of mechanical thrombectomy
1) Introduction 2) Clinical Findings 3) Imaging findings 4) Treatment options 5) Endovenous technique 6) Postop management and complications

SUMMARY
IVC thrombosis is a major complications with a chronic IVC filter (> 6 month duration). Catheter guided thrombolysis can provide definitive treatment for caval thrombosis. For those patients with renal failure, direct catheter guided thrombolysis of the renal vein will often immediately improve renal function. Followup endovenous mechanical thrombectomy is an effective treatment to clear the thrombus. Postprocedural care requires admission to the ICU with close observation of pertinent labwork including fibrinogen levels. Complications include recurrent thrombosis and bleeding.
gland. 3. Review various types of nodules including sonographic characteristics which make nodules more suspicious for malignancy. 4. Discuss technique in performing fine needle aspiration of the thyroid nodule and review which parts of a thyroid nodule should be biopsied in order to provide the pathologist with adequate tissue sample.

SUMMARY
The goal of this presentation is to: 1. Provide a review for the radiologist in recommending which nodules should be closely followed up, which ones can be stated to be benign and which nodules require further evaluation by fine needle aspiration. 2. Discuss and illustrate technique in performing fine needle aspiration on a thyroid nodule.

The Thyroid Nodule Conundrum: To Biopsy or to Not Biopsy?

LL-VIE1284
Amar M Amin, MD
Pratish A Shah, MD
Eric Chen, MD
Amardeep S Johar, MD
Mary Connell, MD
Dan G Gridley, MD
Michael C Switzer, MD

PURPOSE/AIM
The purpose of this exhibit is: 1. To review the anatomy of the thyroid gland on sonography. 2. To explain which nodules should be biopsied and which ones can be left alone or followed up.

CONTENT ORGANIZATION
1. Anatomy of the thyroid gland and surrounding structures within the neck. 2. Standard sonographic protocol in evaluating the thyroid gland. 3. Review various types of nodules including sonographic characteristics which make nodules more suspicious for malignancy. 4. Discuss technique in performing fine needle aspiration of the thyroid nodule and review which parts of a thyroid nodule should be biopsied in order to provide the pathologist with adequate tissue sample.

SUMMARY
The goal of this presentation is to: 1. Provide a review for the radiologist in recommending which nodules should be closely followed up, which ones can be stated to be benign and which nodules require further evaluation by fine needle aspiration. 2. Discuss and illustrate technique in performing fine needle aspiration on a thyroid nodule.

Sharp Recanalization Techniques for Central Venous Occlusions: A Pictorial Essay

LL-VIE1285
Samir Kulkarni, MD
Yi Ju Chuang, MD
Anil K Pillai, MD
Steven L Hsu, MD

PURPOSE/AIM
1. To emphasize the important of maintaining central venous access in dialysis patients
2. To review the current techniques of sharp recanalization in the setting of central venous occlusion.

CONTENT ORGANIZATION
A. Dialysis access and options for initiation
B. Common mechanisms for central venous occlusions in hemodialysis (HD) patients
C. Importance of maintaining central venous access in HD patients
D. Review of 4 different methods for sharp recanalization with procedural steps, illustrative images depicting the anatomy with recanalization techniques, and actual case images
   a. Sharp needle recanalization
   b. Snare-assisted recanalization
   c. Balloon-assisted recanalization
   d. Rotation device (Tru-Path) assisted recanalization.

SUMMARY
1. Central venous occlusion is not uncommon in patients with end stage renal disease (ESRD) on HD
2. Loss of central venous access has a significant impact on quality of life and mortality for patients with ESRD on HD
3. There are techniques to attempt to overcome central venous occlusion and maintain access for HD, which we will review with illustrations and cases.

Three Dimensional Printing: A Highly Customizable Technology for the Rapid Fabrication of Personalized Tailored Devices

LL-VIE1290
Rahul A Sheth, MD
David S Kong, PhD
Zubin Irani, MD
Rahmi Oklu, MD, PhD

PURPOSE/AIM
Rapid prototyping methods, also known as 3D printing, are a recent technological advancement with tremendous potential for advancing personalized medical device design. 3D printing represents an additive construction method: material is added layer by layer, so that complex structures can be created without a pre-existing mold. As a result, the incremental cost of creating a new design is minimal, thereby greatly expanding the design possibilities, which in many ways are limited only by the creativity of the designer. We will summarize the methods for 3D printing, their current and potential roles in medical device design, and emphasize their particular relevance to Interventional Radiology.

CONTENT ORGANIZATION

SUMMARY
3D printing is a burgeoning fabrication technology that allows for highly customizable device design. With the ability to interpret volumetric data from cross-sectional imaging and subsequently implant devices tailored to match the imaged anatomy, Interventional Radiologists are uniquely poised to serve in the vanguard of 3D printing.

Climbing the Learning Curve: Lessons Learned with Balloon-occluded Retrograde Transvenous Obliteration (BRTO) of Gastric Varices

LL-VIE1291
Steven Steer, MD
Shain S Wallis, DO
Rajesh Patel, MD
Ablative Therapies in the Treatment of Renovascular Hypertension

PURPOSE/AIM
Hypertension remains one of the greatest public health threats facing the United States today involving 1 in 3 American adults. Percutaneous renal artery denervation using the application of radiofrequency ablation (RFA) energy has been shown to be safe, effective and durable in reducing systolic blood pressure in patients with resistant hypertension. In this exhibit, we will review the pathogenesis of renal artery denervation, compare current and emerging technologies such as irreversible electroporation (IRE) technology and propose celiac axis alcohol ablation as a viable alternative as a treatment for renovascular hypertension.

CONTENT ORGANIZATION
1. Review of the Pathogenesis of Renovascular Hypertension 2. Explore the Biological Basis of Renal Artery Denervation in the Treatment of Renovascular Hypertension. Compare and contrast RFA and IRE. 3. Celiac axis alcohol ablation as a potential alternative to renovascular hypertension. We will provide a pictorial review of the relevant neuroanatomy and their interconnections with the celiac axis.

SUMMARY
This educational exhibit will provide a comprehensive review of the biological basis and effectiveness of current and emerging ablative strategies in clinical practice. We will also provide a detailed pictorial review of the relevant neuroanatomy that play a role in renovascular hypertension.

Particle Embolization: Past, Present, Future

PURPOSE/AIM
To discuss liquid casting agents available and how they work. To discuss techniques employed when working with liquid casting agents. To discuss common complications.

CONTENT ORGANIZATION

SUMMARY
Liquid casting agents are relatively new options for embolic therapy. There are two types of such agents, adhesive and nonadhesive. With a wide range of embolic agents to choose from, standardizing the approach to agent selection simplifies the process. Determining the best embolic agent for a case depends on factors including: how large is the vessel to be embolized, should the embolized tissue remain viable after embolization, and length of time the vessel should remain occluded. Liquid casting agents are ideal for cases when tissue death is desired and vessel size is small. These agents have been applied with various pathologies and may offer some unique benefits in certain scenarios. Liquid casting agents require unique preparation techniques. Complications associated with liquid casting agents are similar to those seen with conventional embolic agents including post embolization syndrome; although there are some unique pitfalls.

Liquid Casting Agents for Embolic Therapies-Agent Options and Selection

PURPOSE/AIM
To discuss liquid casting agents available and how they work. To present criteria for agent and patient selection. To discuss techniques employed when working with liquid casting agents. To discuss common complications.

CONTENT ORGANIZATION

SUMMARY
Liquid casting agents are relatively new options for embolic therapy. There are two types of such agents, adhesive and nonadhesive. With a wide range of embolic agents to choose from, standardizing the approach to agent selection simplifies the process. Determining the best embolic agent for a case depends on factors including: how large is the vessel to be embolized, should the embolized tissue remain viable after embolization, and length of time the vessel should remain occluded. Liquid casting agents are ideal for cases when tissue death is desired and vessel size is small. These agents have been applied with various pathologies and may offer some unique benefits in certain scenarios. Liquid casting agents require unique preparation techniques. Complications associated with liquid casting agents are similar to those seen with conventional embolic agents including post embolization syndrome; although there are some unique pitfalls.

Ablative Therapies in the Treatment of Renovascular Hypertension

PURPOSE/AIM
Hypertension remains one of the greatest public health threats facing the United States today involving 1 in 3 American adults. Percutaneous renal artery denervation using the application of radiofrequency ablation (RFA) energy has been shown to be safe, effective and durable in reducing systolic blood pressure in patients with resistant hypertension. In this exhibit, we will review the pathogenesis of renal artery denervation, compare current and emerging technologies such as irreversible electroporation (IRE) technology and propose celiac axis alcohol ablation as a viable alternative as a treatment for renovascular hypertension.

CONTENT ORGANIZATION
1. Review of the Principles and Technique of RFA. 2. Discuss the relevant anatomical considerations of gastric varices and the classifications of gastrorenal shunts. 3. Discuss the indications for BRTO. 4. Describe the step-by-step interventional technique. 5. Illustrate modifications to the technique in a pictorial review.

SUMMARY
BRTO is an effective and increasingly utilized treatment for gastric varices. An understanding of indications and anatomical considerations is essential to appropriate patient selection and procedural planning. As techniques evolve, an exchange of ideas is needed to facilitate improvements to the procedure, optimize outcomes and minimize complications.
PURPOSE/AIM

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

CONTENT ORGANIZATION

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

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

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

SUMMARY

Major teaching points of this exhibit:

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

Review of Perforator Flap Imaging with High Resolution MRA

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

CONTENT ORGANIZATION
Types of Flaps:
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SUMMARY
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1. Review of different types of donor flaps used in breast and head and neck surgeries.
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An Update on Devices Currently Available to Treat Chronic Total Occlusions in the Peripheral Vasculature

PURPOSE/AIM
• To illustrate the mechanism of action of currently available intra luminal and extra luminal CTO devices.
• To illustrate the TASC 11 classification in the management of occlusive peripheral vascular disease.
• To present a brief review of literature pertaining to the success and complication of the currently available CTO devices.

CONTENT ORGANIZATION
A pictorial review of the currently available chronic total occlusion (CTO) crossing devices illustrating mechanism of action and highlighting the benefits and drawbacks of each device will be presented. We also discuss the current TASC classification and the use of CTO crossing devices within and outside the confines of the classification. A short table with a brief literature review of published data regarding the success and complication rates for each of these devices will be presented. The following devices will be profiled: 1) Crosser (Bard) 2) Tru-Path (Boston Scientific) 3) Front Runner (Cordis) 4) SafeCross (Spectranetics) 5) Excimer Laser angioplasty (Spectranetics) 6) Pioneer (Medtronic) 7) Outback (Cordis) 8) Viance (Covidien) 9) Enteer (Covidien)

SUMMARY
The above exhibit, with illustrations will educate the viewers about the currently available Chronic Total Occlusion devices; their specific indications with respect to the TASC classification and currently published data.
The Role of IR in Thyrotoxic Crisis

PURPOSE/AIM
The purpose of this exhibit is to provide a clinical and pictorial review of thyrotoxic crisis (thyroid storm). We will review published data on thyroid arterial embolization as treatment of thyrotoxic crisis, and present our own case of thyrotoxic crisis refractory to medical and surgical management that underwent thyroid arterial embolization.

CONTENT ORGANIZATION
We will review thyroid anatomy and clinical presentation and outcomes of thyrotoxic crisis, with a specific focus on multitude of etiologies. Given the mortality rate of 20-30%, which can rise up to 75% with delayed treatment, medical management is crucial. While thyroidectomy is often necessary, critically ill patients are often poor surgical candidates. Utilizing a limited number of published case reports, we will discuss thyroid arterial embolization as a treatment option for unstable patients and review our own case of a clinically unstable patient in thyrotoxic crisis who underwent thyroid embolization.

SUMMARY
Patients in thyroid storm are often unstable, which combined with poor overall prognosis, often makes them poor surgical candidates. Limited literature and our own experience suggests some patients may benefit from thyroid arterial embolization, implying interventional radiologists may play an key role in the treatment of thyroid storm.

Recognition and Management of Aortic Intussusception: Review of Literature and Case Examples

PURPOSE/AIM
The purpose of our educational exhibit is to present the imaging features of an uncommon complication of aortic dissection and to focus on the importance of its recognition during endovascular surgical treatment of aortic dissection.

CONTENT ORGANIZATION
1. Overview of aortic intussusception
   * Epidemiology
   * Pathophysiology
   * Imaging features and recognition using CT and TEE, as demonstrated by cases
2. Case presentation
   * Case summary
   * Recognition and real-time diagnosis of aortic intussusception using IVUS
   * Management strategy
3. Future directions and summary

SUMMARY
Circumferential tears of the intimal flap are uncommon. The free floating intima can fold and collapse, resulting in antegrade or retrograde intussusception. It is important to recognize the presence of an inverted and invaginated intimal flap during endovascular and surgical repair of aortic dissections associated with malperfusion. Furthermore, an incomplete tear may progress into a complete tear during endovascular instrumentation of a collapsed true lumen. Dynamic intravascular ultrasound (IVUS) allows precise diagnosis of intimal intussusception during endovascular treatment. This abnormality can also be recognized on CTA or MRA, however, the finding may be overlooked unless three-dimensional reformat is performed.

The ABC of Percutaneous Management of Pseudoaneurysms

PURPOSE/AIM
To describe the role of minimally invasive techniques for the management of pseudoaneurysms and to illustrate the spectrum of these procedures. To review the different available materials (such as coils, stent grafts or liquid embolic agents) and when to use each of them. To outline the advantages, limitations and best indications for percutaneous treatment of pseudoaneurysms.

CONTENT ORGANIZATION
A. Introduction
B. When to treat a pseudoaneurysm?
C. How to treat a pseudoaneurysm?
   1. Pretreatment assessment of a pseudoaneurysm
   2. Therapeutic options for pseudoaneurysm management

SUMMARY
The minimally invasive techniques due to their low morbidity and mortality, have increased their role in the last years for the management of pseudoaneurysms. Therefore, a proper knowledge of available endovascular materials and techniques is essential. This exhibit will review:

a. the spectrum of minimally invasive techniques
b. the percutaneous management of pseudoaneurysms
c. the advantages, limitations and best indications for percutaneous treatment of pseudoaneurysms

Endovascular Management of Acute and Subacute Abdominal Hemorrhage

PURPOSE/AIM
The aim of this exhibit is to give an overview about embolization materials and techniques - to present common and rare causes of
The Vascular Distribution of Fibromuscular Dysplasia: A Pictorial Essay

PURPOSE/AIM
To provide examples of fibromuscular dysplasia in less-commonly described vascular beds and to showcase other vascular lesions that can be seen in patients with FMD.

CONTENT ORGANIZATION
Fibromuscular dysplasia (FMD) is a non-inflammatory disease of medium sized arteries, most commonly seen in the renal arteries. With the creation of the National FMD Registry, it has become apparent that this disease is frequently present in non-renal vascular beds. In that cohort, the prevalence of FMD in carotid arteries (56%) approaches the prevalence of renal artery FMD (65%). This exhibit demonstrates the imaging and clinical manifestations of FMD in extra-renal vascular beds and its possible association with intracranial and aortic aneurysms. Case examples include: 1) Renal, carotid and intracranial FMD. 2) Bilateral renal FMD with abdominal aortic aneurysm. 3) Renal and iliac FMD with thoracic aortic aneurysm. 4) Renal FMD with an aortic dissection. 5) Mesenteric FMD. 6) Coronary FMD. 7) Vertebrobasilar FMD. 8) Renal intimal FMD.

SUMMARY
As awareness of FMD increases, we will see extra-renal FMD more often. This will increase the possible utility of screening for carotid disease and ankle-brachial indices in patients with known renal FMD. The clinical implications of these findings will remain prominent in the discussion of FMD-related complications in the future.

Interventional Radiology Management of Pediatric Vascular Malformations

PURPOSE/AIM
To provide an overview of the role of interventional radiology (IR) in the management of pediatric vascular malformations (VM).

CONTENT ORGANIZATION
- Discuss the classification of VM, which has historically been separated into two groups: hemangiomas and vascular malformations, based on their natural history, cellular turnover, and histology. The more modern classification of VM into low-, intermediate-, and high-flow malformations will be discussed.
- Outline imaging used to characterize and determine the anatomic extent of VM, including Doppler ultrasound, contrast-enhanced CT/MRI, and conventional angiography.
- Discuss syndromes associated with VM with examples of clinical and radiologic images.
- Discuss treatment principles and options of VM with an emphasis on current IR treatment methods, which include sclerotherapy, coil embolization, and/or particle embolization. A discussion of prognosis and a comparative analysis of medical, surgical, and IR treatment will be included.
- Discuss the importance of a multidisciplinary approach to VM, which involves pediatric radiology, surgery, hematology/oncology, dermatology, otorhinolaryngology, orthopedic surgery, and occupational/physical therapy.
- Key learning points.

SUMMARY
IR plays an integral role in the management of VM, which requires a multidisciplinary approach.

AtlaVasc: An Interactive Online Vascular Atlas and Interventional Radiology Review

PURPOSE/AIM
A thorough understanding of complex vascular anatomy in various imaging modalities is critical for radiologists, interventional radiologists, and other specialties. However, interactive vascular atlases are currently limited and there are few advanced online resources with an emphasis on interventions. Our aim is to review the upper and lower extremity vascular anatomy, anatomic variants, and related interventions with correlation between multiple modalities including CT, DSA, MRA, and 3D reformats.

CONTENT ORGANIZATION
The online vascular anatomy atlas will enable visitors to review anatomy by interactive scrolling through the upper extremity vasculature in 3 planes with labeled static images that highlight pertinent anatomy. Additionally, the user will be able to review relevant pathology, clinical applications and interventions at various regions of the upper and lower extremities. Self-quiz questions will be available for additional review.

SUMMARY
The Atlavasc website will be an ideal resource for reviewing vascular anatomy, pathology, and interventional procedures within the upper and lower extremities. The user will be able to scroll through vasculature in 3 planes with labeled static images that highlight pertinent anatomy with available self quizzes, links to interventional updates, links to resources and opportunities for case submission.
Intratumoral Vascular Shunting: Conduit for Circulating Tumor Cells and Their Role in Metastasis

**LL-VIE1309**

Amy R Deipol, MD, PhD
Rahmi Oklu, MD, PhD

**PURPOSE/AIM**
Metastasis is the leading cause of cancer-related deaths; understanding the factors that enable or prevent metastasis is essential in diagnosing and treating cancer. Circulating tumor cells (CTCs) initiate metastases, but must gain access to distant sites in the body.

**CONTENT ORGANIZATION**
1. Describe current knowledge of the mechanisms underlying tumoral angiogenesis. 2. Describe the pathogenesis of intratumoral vascular shunting including prevalence in various tumor types. 3. Illustrate vascular shunting in a variety of tumors including primary and metastatic liver cancers with case images from ultrasound, angiography, and nuclear medicine studies. 4. Illustrate how intratumoral vascular shunts can provide conduits for CTCs to access distant sites of metastasis.

**SUMMARY**
Intratumoral vascular shunting is likely an important etiological factor in cancer metastasis; their prevalence with respect to cancer staging is unknown. Angiogenic processes result in significant intratumoral vascular shunts that could provide conduits for CTCs to gain access to distant sites for tumor metastasis. Such shunts can be evaluated with imaging, and the extent of intratumoral shunting may be a robust marker of tumor aggressiveness and likelihood of progression.

Ghrelin Busters: A Novel Approach to Weight Loss Treatment

**LL-VIE1310**

Elizabeth J Hamilton, MD
Andrew J Gunn, MD
Richard L Hesketh, MD, PhD

**PURPOSE/AIM**
New treatments are needed to control the obesity epidemic. This exhibit will review current understandings of the physiological relationship between ghrelin and weight gain, and will explore interventions in animal models and the potential for human applications.

**CONTENT ORGANIZATION**

**SUMMARY**
Ghrelin is a hormone involved in the regulation of food intake and energy expenditure. Understanding its role in weight gain and obesity can lead to the development of new interventions. This exhibit will review the potential of ghrelin as a target for weight loss treatment.

Pathogenesis of Mycotic Aneurysms

**LL-VIE1311**

Junsung Rho, BSc
Bailin Alexander, BA
Richard L Hesketh, Anand M Prabhakar, MD
Zubin Irani, MD
Rahmi Oklu, MD, PhD

**PURPOSE/AIM**
Mycotic aneurysms are often a diagnostic challenge by cross sectional imaging. We will provide a pictorial review of varying stages of mycotic aneurysm and associate with typical blood culture results, clinical presentation and pathology findings. Mycotic aneurysms are associated with high morbidity and mortality; thus, early diagnosis is essential for best outcome. Molecular mechanisms of tissue degradation resulting from arterial wall infection will be further explored.

**CONTENT ORGANIZATION**
1. Define mycotic aneurysm and provide potential mechanisms of bacterial seeding of arterial wall 2. Review the interaction between microorganisms, arterial endothelial cells and leukocytes, with a specific focus on the balance of matrix metalloprotease activation and regulation. 3. Provide a pictorial review of mycotic aneurysms on CT or MRI and correlate with pathology findings (histology and gross images) 4. Review the treatment algorithm of mycotic aneurysms and the difficulties they present

**SUMMARY**
Mycotic aneurysms are often a diagnostic challenge by cross sectional imaging. We will provide a pictorial review of varying stages of mycotic aneurysm and associate with typical blood culture results, clinical presentation and pathology findings. Mycotic aneurysms are associated with high morbidity and mortality; thus, early diagnosis is essential for best outcome. Molecular mechanisms of tissue degradation resulting from arterial wall infection will be further explored.

Imaging of Venous Malformations: State of Art

**LL-VIE2921**

Ahmed Abdel Razek, MD
Ehab Saad, MD

**PURPOSE/AIM**
1) To review basic background and classification of venous malformations
2) To review characteristic imaging findings of venous malformations
3) To illustrate imaging findings suggestive of associated syndrome
4) To discuss methods of treatment of venous malformations

**CONTENT ORGANIZATION**
1-Update classifications of venous malformations
2-Pathogenesis, pathology, clinical presentation and biomarkers of venous malformations
3-Plain radiography, ultrasound and CT imaging findings
4-MR imaging findings of venous malformations
5-Venography and MR venography of subtypes of venous malformation
6-Imaging-based classifications and treatment implications based on venous malformation morphology
7-Imaging of syndrome associated with venous malformations
8-Interventional and imaging guided sclerotherapy of venous malformations
9-Post treatment imaging of venous malformations
Do No Harm: Minimizing Tumor Seeding after Percutaneous Intervention

LL-VIE2925
Alok B Bhatt, MD
Mittul Gulati, MD
Harshawn Malhi, MD
Katherine J Too, MD
Vinay A Duddalwar, MD

PURPOSE/AIM
1. Review the incidence of tumor tract seeding after percutaneous intervention. 2. Provide an atlas of tumor seeding resulting from different interventions. 3. Review techniques to minimize risk of tumor seeding.

CONTENT ORGANIZATION
Different interventions. 3. Review techniques to minimize risk of tumor seeding.

SUMMARY
The major teaching points of this exhibit are:
1. To be familiar radiologist with imaging appearance of venous malformations
2. To be familiar with syndromes associated with venous malformations.
3. Imaging-based classifications help to select appropriate line of treatment
4. To be familiar radiologist with interventional and imaging guided sclerotherapy of venous malformations

Interventional Oncology of the Thorax Beyond the Parenchyma: Management of Chest Wall and Pleural Disease

LL-VIE2922
Quazi Al-Tariq, MD
Robert D Suh, MD
Fereidoun G Abtin, MD

PURPOSE/AIM
To provide an evidence based review of techniques and treatment options for patients with primary and secondary neoplasms of the thorax involving the chest wall and pleural space, including a how to approach and use of adjunctive techniques.

CONTENT ORGANIZATION
General review with study data to support the use of techniques and procedures to be discussed. A how to approach with mention of pitfalls and adjunctive techniques using actual cases will be used. The section on chest wall disease will focus on the treatment of painful, osseous metastases. The section on pleural disease will focus primarily on the management of malignant pleural effusions.

SUMMARY
In addition to treating primary and secondary neoplasms of the lung, many patients will present with higher stages of disease with involvement of the chest wall and pleural space. The interventionalist must be familiar with the techniques best suited for these clinical scenarios. This presentation will focus exclusively on chest wall and pleural space disease. By offering case based examples of their use, overviews on how they should be performed, and adjunctive techniques, this presentation should better prepare one for undertaking the care of these patients.

Angiographic Patterns of TIPS Dysfunction and Interventional Approaches to Shunt Revision

LL-VIE2923
Ahmad Parviniain, BS
Benedicatta O Omene, MD
James T Bui, MD
Martha-Gracia Knuttinen, MD, PhD
Jeet Minocha, MD
Ron C Gaba, MD

PURPOSE/AIM
1. To illustrate different angiographic patterns of transjugular intrahepatic portosystemic shunt (TIPS) dysfunction. 2. To review technical and pathophysiological bases underlying different types of TIPS dysfunction. 3. To demonstrate simple and complex interventional techniques for TIPS revision, as well as angiographic indicators of successful therapy.

CONTENT ORGANIZATION
1. Case-based review of TIPS dysfunction, including thrombotic occlusion, intimal hyperplastic stenosis, portal and hepatic venous stenosis, abnormal angulation, occult pressure gradient elevation, tumor ingrowth, and insufficient or excessive shunting. 2. Overview of proper TIPS creation with emphasis on technical pitfalls and TIPS induced alterations in liver vascular physiology. 3. Case-based demonstration of approaches to shunt revision, including balloon angioplasty, stent repositioning, shunt extension, percutaneous recanalization, stiff guide wire and metal cannula supported access, parallel TIPS insertion, and shunt reduction or occlusion, with imaging hallmarks of treatment response.

SUMMARY
1. Recognize different angiographic patterns of TIPS dysfunction. 2. Understand technical errors and pathophysiological mechanisms underlying TIPS dysfunction. 3. Be familiar with basic and advanced techniques for TIPS revision, as well as indicators of procedure success.

Transjugular Intrahepatic Portosystemic Shunt Creation in Patients with Portal Vein Cavernoma: The Importance of a Recognizable Portal Vein Remnant

LL-VIE2924
Roberto Miraglia, MD
Luigi Maruzzelli, MD
Kelvin Cortis, MD, MRCS, FRCR
Angelo Luca, MD

PURPOSE/AIM
The aim of this exhibit is to evaluate the technical considerations and results of transjugular intrahepatic portosystemic shunt (TIPS) creation in patients with portal vein cavernoma and a recognizable portal vein remnant.

CONTENT ORGANIZATION
The technical considerations of TIPS creation in non-cirrhotic patients with portal vein cavernoma and complications of portal hypertension will be presented in representative cases. Special attention with be paid to imaging evaluation before TIPS, real-time sonographic guidance for puncture of the portal vein remnant using the Colapinto needle, technique for recanalization of the portal vein remnant, type and diameter of the stent, together with the results achievable as evaluated by follow-up imaging.

SUMMARY
TIPS creation in patients with portal cavernoma and a recognizable portal vein remnant is technically challenging. However, it remains a feasible and clinically effective procedure in such patients for the treatment of the complications of portal hypertension.

Do No Harm: Minimizing Tumor Seeding after Percutaneous Intervention

LL-VIE2925
Alok B Bhatt, MD
Mittul Gulati, MD
Harshawn Malhi, MD
Katherine J Too, MD
Vinay A Duddalwar, MD, FRCR

PURPOSE/AIM
1. Review the incidence of tumor tract seeding after percutaneous intervention. 2. Provide an atlas of tumor seeding resulting from different interventions. 3. Review techniques to minimize risk of tumor seeding.

CONTENT ORGANIZATION
Different interventions. 3. Review techniques to minimize risk of tumor seeding.
1. Incidence of tumor seeding after various percutaneous interventions
2. Cases, including CT and/or MRI examples of tumor seeding after:
   A. Percutaneous biopsy of pancreatic adenocarcinoma, hepatocellular carcinoma, cholangiocarcinoma, and renal cell carcinoma
   B. Percutaneous drainage including suprapubic bladder diversion, biliary drainage, and abdominal abscess drainage
   C. Ablation, including cryo and radiofrequency
3. Techniques to minimize risk of tumor seeding, including
   A. Co-axial technique
   B. Needle selection (size, side versus end cutting)
   C. Marking tract (methylene blue)

SUMMARY
Incidence of tumor seeding after percutaneous procedures is widely variable, and may be underestimated due to a reliance on self-reporting and lack of large studies. This presentation will review both the appearance of percutaneously seeded tumor resulting from a variety of interventions, as well as best practice techniques to minimize the risk of seeding.
Sample cases of these techniques imaging the aorta, renal arteries, portal vein, and peripheral arteries Future directions in noncontrast MRA
SUMMARY
While MR angiography offers the advantages of absence of ionizing radiation and nephrotoxicity over CT or catheter-based angiography, patients with severe renal insufficiency pose a challenge regardless of modality. Noncontrast MRA provides the body imager with another tool for evaluating the arterial and venous vasculature in these patients. This exhibit aims to characterize and provide examples of emerging noncontrast MRA techniques in body imaging applications.

Emerging Noncontrast MRA Techniques for the Body Imager

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

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

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

MRI-guided Focal Cryoablation of Prostate Cancer Recurrence: How We Do It

PURPOSE/AIM
To describe our approach to magnetic resonance imaging (MRI)-guided focal cryoablation of prostate cancer (PCa) recurrence. To describe our initial experience with this treatment in patients with PCa recurrence after radiotherapy.

CONTENT ORGANIZATION
In this educational exhibit, we describe step-by-step how we perform transperineal MRI-guided focal cryoablation of histologically proven PCa recurrence after radiotherapy. Also, technical details on procedure setup and equipment will be provided. Finally, we present case examples to illustrate our initial experience with this treatment.

SUMMARY
We present a feasible and safe approach to perform transperineal MRI-guided focal cryoablation in patients with recurrent PCa after radiotherapy, with promising initial results.

All Bleeding Stops Eventually: Case Studies and Evidence Based Review of Atypical Causes of Gastrointestinal Hemorrhage; What the Gastroenterologist and the Diagnostic and Interventional Radiologist Need to Know

PURPOSE
To describe our approach to magnetic resonance imaging (MRI)-guided focal cryoablation of prostate cancer (PCa) recurrence. To describe our initial experience with this treatment in patients with PCa recurrence after radiotherapy.

CONTENT ORGANIZATION
In this educational exhibit, we describe step-by-step how we perform transperineal MRI-guided focal cryoablation of histologically proven PCa recurrence after radiotherapy. Also, technical details on procedure setup and equipment will be provided. Finally, we present case examples to illustrate our initial experience with this treatment.

SUMMARY
We present a feasible and safe approach to perform transperineal MRI-guided focal cryoablation in patients with recurrent PCa after radiotherapy, with promising initial results.
Purushottam K Dixit, MD
Monzer A Chehab, MD
Matthias J Kirsch, MD
Jeremy D Handel, MD

PURPOSE/AIM
Gastrointestinal hemorrhage is a potentially life threatening condition. The majority are due to more common etiologies and managed with institutional protocols, however, less common etiologies exist in which specific management may be less well defined. Here, we present multiple atypical causes in order to make those involved in the management of these patients more cognizant of these atypical etiologies.

CONTENT ORGANIZATION
Approximately 90% of cases of gastrointestinal hemorrhage are due to typical etiologies and managed with institutional protocols[1-4]. Due to the importance of timely and unique management, however, it is crucial for the clinician, radiologist, interventionalist, and surgeon to be cognizant of atypical causes of GI bleeds. This is an exhibit of multiple atypical cases of GI hemorrhage, spanning a range of pathologic entities, from hemosuccus pancreaticus to stomal varices, in which clinical presentation, diagnosis, management, and a review of the literature are presented.

SUMMARY
Massive bleeding from the gastrointestinal tract has the propensity to be life threatening. While the endoscopist, interventional radiologist, or surgeon may be well versed in typical causes, there exist atypical causes in which management may be less well defined. Multiple case studies of these atypical etiologies are presented in order to raise awareness.

Perioperative Internal Iliac Artery Balloon Occlusion in the Setting of Placenta Accreta and Its Variants: What the Interventional Radiologist Needs to Know

LL-VIE2931
Benjamin D Karlberg, MD
Gordon K McLean, MD
Matthew S Hartman, MD
Sheri Macrino, MD

PURPOSE/AIM
- To review normal and pathologic placentation
- To provide an overview of the diagnosis and clinical significance of placenta accreta and its variants
- To describe prophylactic internal iliac artery balloon occlusion and its role in achieving hemostasis following cesarean section in the setting of placenta accreta

CONTENT ORGANIZATION
This presentation will cover the following sections:
- Overview of normal and pathologic placental attachment to the uterine wall
- Diagnosis and clinical significance of placenta accreta and its variants
- Outline of internal iliac artery balloon occlusion and its role in peri-operative hemostasis during cesarean section in the setting of placenta accreta and its variants
- Summary

SUMMARY
Placenta accreta and its variants can lead to significant morbidity and mortality as a result of postpartum uterine hemorrhage. Prophylactic internal iliac artery balloon occlusion in the setting of cesarean section functions as an adjunctive therapy to reduce intraoperative blood loss and achieve post-partum hemostasis in patients with placenta accreta and its variants. There is an ongoing need for large scale prospective, randomized studies to more adequately evaluate the efficacy of internal iliac artery balloon occlusion in the setting of placenta accreta and its variants.

Bleeding after Paracentesis: Managing Complications of Paracentesis with Attention to Critical Vascular Anatomy

LL-VIE2932
Daniel H Macarthur, MD
Salar Hakham, DO
Kevin P Daly, MD
David W Allen, MD

PURPOSE/AIM
To discuss the clinical indications and contraindications for paracentesis and how to safely perform the procedure with attention to critical vascular anatomy. Cases complicated by injury to the major anterior abdominal wall arteries will be included, focusing on the interventional radiology management. Special consideration will be given to the endovascular management of injury to the inferior epigastric artery and intercostal artery.

CONTENT ORGANIZATION
1. Discuss the clinical indications and contraindications for paracentesis. 2. How to safely perform a paracentesis to minimize risk of injury to the major anterior abdominal wall arteries. 3. Discuss the interventional radiology management of paracentesis complicated by vascular injury to the major anterior abdominal wall arteries. 4. Focus on the endovascular management of injury to the inferior epigastric artery and intercostal arteries.

SUMMARY
By viewing this exhibit, the reader will: 1. Understand the clinical indications and contraindications for paracentesis. 2. Learn how to safely perform a paracentesis. 3. Understand the interventional radiology management of paracentesis complicated by vascular injury to the major anterior abdominal wall arteries.

Review of Endovascular Intervention in Acute Deep Vein Thrombosis

LL-VIE2933
Jaskirat S Virk, MD
Robert A Lookstein, MD *
Aaron M Fischman, MD *
Edward Kim, MD *
Francis S Nowakowski, MD
Rahul S Patel, MD *

PURPOSE/AIM
1. To review the pathophysiology of deep vein thrombosis (DVT) and its acute and chronic complications, including the post-thrombotic syndrome (PTS) 2. To review the indications of thrombolysis and the various techniques to achieve thrombus removal, including the risks and benefits of each technique. 3. To discuss future directions and clinical applications

CONTENT ORGANIZATION
Controversial Issues in the Embolization of Pelvic Fractures in Haemodynamically Unstable Patients

Maurizio Cariati, MD
Francesco Petrocelli, MD
M’hamed Dahmane, MD
Paolo Rigamonti, MD
Umberto Rossi, MD

PURPOSE/AIM
To outline the optimal strategy for emergency procedures in unstable patients with pelvic fractures. To describe the techniques, limitations and complications of pelvic embolization (PE). To analyze how the injury type, patient's basal condition, and PE technique affect the outcome. To evaluate the PE results for the management of patients with multiple trauma.

CONTENT ORGANIZATION
PE plays a key role in the management of unstable patients with PF. Proximal embolization of both internal iliac arteries is the standard technique. PE complications are uncommon. One of the most feared complication is glutal necrosis, because its high morbidity and mortality. The type of fracture, embolization technique, patient hemodynamic status, and injury severity might contribute to glutal necrosis. We describe the angiographic findings after selective and nonselective PE of both internal iliac arteries. We review the collateral pathways established between contralateral iliac, iliolumbar and deep femoral arteries to prevent ischemic complications.

SUMMARY
PE is an effective technique to control arterial bleeding in patients with pelvic fractures. Complications are uncommon. Ischemic events are more likely in nonselective bilateral embolization but the severity of the injury and the patient's hemodynamic condition are other underlying causes.

Visceral Artery Arcades: What the Radiologist Needs to Know

LL-VIE2935
Marta Cufi Quintana, MD
Anna Alguersuari, MD
Eva Criado, MD
Jose Ramon Fortuno Andres, MD
Carlos Serrano Burgos, MD
J. Carlos Tortajada Bustelo, MD
Cristina Maria Spini, MD
Marta Sola, MD

PURPOSE/AIM
To review the embryology of the visceral arteries in order to understand the development of the visceral artery anastomoses and all potential collateral circulation in the case of stenosis obstruction of one or several visceral arteries.

CONTENT ORGANIZATION
Arterial vascularization of the gastrointestinal tract is a three-level system composed of the celiac trunk, and both superior and inferior mesenteric arteries. The three vessels are joined together via arterial trunk anastomoses: the arcades. The celiac trunk and the superior mesenteric artery are joined together via the intestinaloduodenal, the Kirk and the Buhler arcades. The mesenteric arteries are joined together by the Riolan and the Villemin arcades and by the marginal artery of Drummond.

SUMMARY
Vascular variants and arteriopathy are responsible for frequent stenosis/occlusion one or several digestive arterial trunks with subsequent development of collateral circulation. For such reasons, imaging and knowledge of digestive arterial anatomy is an absolute prerequisite for endovascular/surgical technique choice.
Arterial vascularization of the gastrointestinal tract is a three-level system composed of the celiac trunk, and both superior and inferior mesenteric arteries. The three vessels are joined together via arterial trunk anastomoses: the arcades. The celiac trunk and the superior mesenteric artery are joined together via the pancreaticoduodenal, the Kirk and the Buhler arcades. The mesenteric arteries are joined together by the Riolan and the Villemin arcades and by the marginal artery of Drummond.

SUMMARY
Vascular variants and arteriopathy are responsible for frequent stenosis/occlusion one or several digestive arterial trunks with subsequent development of collateral circulation. For such reasons, imaging and knowledge of digestive arterial anatomy is an absolute prerequisite for endovascular/surgical technique choice.

**Isolated Limb Infusion: The Interventional Radiologist’s Role in Treating Recurrent Limb Melanoma**

**PURPOSE/AIM**
Introduce isolated limb infusion (ILI) as a minimally invasive therapy for recurrent limb melanoma. Review ILI procedural technique, as well as the potential clinical benefits and limitations of this procedure.

**CONTENT ORGANIZATION**
- Arterial vascularization of the gastrointestinal tract
- Vascular variants and arteriopathy
- Isolated limb infusion (ILI) for recurrent limb melanoma
- ILI procedural technique
- Potential clinical benefits and limitations

**Introduction**
ILI is a minimally invasive therapy for recurrent limb melanoma. It involves the isolation of the affected limb and the delivery of a high-dose chemotherapy regimen, typically under the guidance of interventional radiologists.

**Procedure**
The procedure begins with the identification of the affected limb and the planning of the optimal ILI technique. This includes the selection of the appropriate chemotherapy regimen, the calculation of the appropriate dose to be delivered, and the planning of the endovascular/surgical technique choice.

**Technique**
The ILI technique involves the placement of an endovascular graft, which is used to isolate the limb and prevent the systemic dissemination of chemotherapy. This allows for the delivery of a high-dose chemotherapy regimen directly to the affected limb, minimizing the systemic effects of the chemotherapy.

**Benefits and Limitations**
- **Benefits:** reduced systemic toxicity, improved quality of life, and potential for disease remission.
- **Limitations:** limited to recurrent limb melanoma, potential for limb loss, and the need for skilled interventional radiologists.

**Conclusion**
ILI is a promising therapy for recurrent limb melanoma, offering a minimally invasive approach to achieving high-dose chemotherapy with improved clinical outcomes. However, it requires careful planning and execution by interventional radiologists to achieve the best possible results.

**References**

**Acknowledgments**
We would like to acknowledge the contribution of Dr. Sarah Brown and Dr. John Smith in the development of the ILI technique.

**Authors**
- Mark L Lessne, MD
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- Charles Y Kim, MD

**Correlation between MD-CT and DSA Before Percutaneous Embolization in Cystic Fibrosis Patients Affected by Massive Hemoptysis**

**PURPOSE/AIM**
The purpose of our presentation is to evaluate the diagnostic role of Multi-Detector Computed Tomography (MD-CT) in depiction of bronchial systemic arteries in cystic fibrosis patients with massive hemoptysis before digital subtraction angiography (DSA) embolization.

**CONTENT ORGANIZATION**
- The diagnostic role of MD-CT in cystic fibrosis patients
- Comparison of MD-CT and DSA for embolization
- Clinical implications of MD-CT

**SUMMARY**
Currently, MD-CT represents the gold standard in the pre-intervention imaging of cystic fibrosis patients with massive hemoptysis. MD-CT permits to plan accurately the subsequent interventional procedure of endovascular embolization, reducing procedure time and the radiation dose given to the patient.

**Correlation between MD-CT and DSA Before Percutaneous Embolization in Cystic Fibrosis Patients Affected by Massive Hemoptysis**

**PURPOSE/AIM**
The purpose of our presentation is to evaluate the diagnostic role of Multi-Detector Computed Tomography (MD-CT) in depiction of bronchial systemic arteries in cystic fibrosis patients with massive hemoptysis before digital subtraction angiography (DSA) embolization.

**CONTENT ORGANIZATION**
- The diagnostic role of MD-CT in cystic fibrosis patients
- Comparison of MD-CT and DSA for embolization
- Clinical implications of MD-CT

**SUMMARY**
Currently, MD-CT represents the gold standard in the pre-intervention imaging of cystic fibrosis patients with massive hemoptysis. MD-CT permits to plan accurately the subsequent interventional procedure of endovascular embolization, reducing procedure time and the radiation dose given to the patient.
as the literature regarding efficacy and toxicity of therapy. Define the place of ILI within the algorithm for treatment of limb melanoma and emphasize the radiologist’s role as a primary member of the multidisciplinary melanoma team.

**CONTENT ORGANIZATION**
Step by step details of the procedure, along with a graphical depiction, will be provided. Angiographic images from ILI procedures in the upper and lower extremities will be exhibited. A detailed review of the relevant efficacy and toxicity data will be discussed, including ILI response rates and toxicity estimates from the literature as well as a comparison to those data from ILP surgeries. In addition, factors that influence efficacy and toxicity, such as chemotherapy dosing, intraprocedural vasodilation, and limb volume will be addressed.

**SUMMARY**
Isolated limb infusion is an underutilized interventional procedure that may offer comparable results to surgical isolated limb perfusion while improving the toxicity profile. Interventional radiologists have the opportunity to take an active role treating recurrent limb melanomas, but must first familiarize themselves with the procedure technique, efficacy, toxicities, and the factors that may influence success of therapy.

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### Failing to Plan is Planning to Fail: Pre-procedural Planning in Percutaneous Ablations

**LL-VIE2938**

**Hilary A Brazeal, MD**
**Kathryn J Fowler, MD**
**Guillermo Gonzalez-Araiza, MD**
**Matthew M Niemeyer, MD**
**Christine O Menias, MD**
**Nael E Saad, MBCh**

**PURPOSE/AIM**
1. Outline indications for percutaneous ablation of solid organ tumors.
2. Review different ablation methods.
3. Discuss considerations for planning, how they differ by organ.
4. Discuss procedural risks and how to minimize.

**CONTENT ORGANIZATION**
1. Evidence based review of indications for ablation of solid organ tumors.
   - Tumor type
   - Co-morbidities
   - Role of percutaneous ablation in oncologic management
2. Brief background on basic principles, technique (pearls/pitfalls), and indications for:
   - Microwave ablation
   - Radiofrequency ablation
   - Cryoablation
   - Irreversible electroporation
   - Ethanol ablation
3. Pre-procedural planning:
   - Imaging work-up
   - Pertinent anatomy by organ and region
   - Medical co-morbidities and their role in treatment algorithm
   - Risk assessment based on pre-procedure labs and organ function
5. Long-term follow-up and management implications.

**SUMMARY**
Multiple methods of ablation are available to the radiologist. This exhibit reviews the biology and science behind each method, the algorithm for choosing the appropriate technique, and the essential imaging and clinical information necessary to minimize risk through effective pre-procedural planning.

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### Endovascular Management of Anticoagulation-related Spontaneous Soft Tissue Hematoma: How â€œTo Do?â€ It

**LL-VIE2939**

**Anthony Dohan, MD**
**Olivier Pellerin, MD**
**Massimiliano Di Primio, MD**
**Marc R Sapoval, MD, PhD**

**PURPOSE/AIM**
To describe the various locations of anticoagulation-related spontaneous soft tissue hematoma (SSTH) and the feeding arteries involved by this condition.
To illustrate the impact of computed tomography angiography (CTA) in the evaluation of the severity of SSTH and in planning arterial embolization.
To discuss the indications for arterial embolization of SSTH.

**CONTENT ORGANIZATION**
A. Epidemiology and impact of anticoagulant therapy
B. Anatomy and feeding arteries of mostly involved muscles
C. Potential indications for arterial embolization
D. Diagnostic Imaging with CTA and planning of arterial embolization
E. Endovascular Management
F. Outcomes

**SUMMARY**
The indications and challenges of embolization of SSTH are presented.
This exhibit will review:
- the various techniques of embolization.
- the different anatomical supplies.
- the impact of CTA in diagnosis and planning of arterial embolization.

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### Acute Non-variceal Gastrointestinal Bleeding: Imaging and Treatment

**LL-VIE2940**

**Paul E Smith, MBBS**
**Geertje D Noe, MD**
**Mark D Goodwin, BMBCh**
**Dinesh G Ranatunga, MBBS**

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1. Provide an imaging atlas of the various causes of acute non-variceal gastrointestinal (GI) bleeding
2. Review how acute non-variceal GI bleeding presents
3. Discuss the work-up of bleeding patients, and the pros and cons of various modalities
4. Discuss the management options, focusing on endovascular therapy

CONTENT ORGANIZATION
- Introduction
- Pathophysiology
- Presentation
- Work-up Diagnostic
- Imaging Management (including evidence)
- Outcomes
- Conclusion

SUMMARY
Gastrointestinal (GI) bleeding is a common cause of morbidity and mortality. Its successful management involves a multiple disciplinary approach, in which imaging plays a key role through diagnosis and endovascular therapeutic options. The spectrum of disease is diverse due to the multiple pathologies that can cause bleeding and also multiple sites from which it can occur. Imaging and endovascular intervention both play a pivotal role in the management of these patients. In this exhibit, we review the pathology, presentation and the treatment options that exist for the management of acute non-variceal bleeding.

Principles and Applications of Ultrasound Fusion with Other Cross-Sectional Imaging for the Purpose of Biopsy

LL-VIE2941
Stephanie F Coquia, MD
Katarzyna J Macura, MD, PhD *
Sheila Sheth, MD *
M. Robert Dejong *
Ulrike M Hamper, MD, MBA

PURPOSE/AIM
To discuss practical applications of ultrasound fusion with other cross-sectional imaging modalities (CT, MRI, and PET) when performing biopsies of lesions within the chest, abdomen, and pelvis.

CONTENT ORGANIZATION
1. Basic principles and requirements for fusing US to other modalities
2. Clinical applications of fusion in the biopsy of lesions in the chest, abdomen, and pelvis:
   a. Locating lesion when not initially seen on screening ultrasound
   b. Identification of a specific target lesion initially detected on other cross-sectional imaging modalities (suspicious prostate lesions on multiparametric MRI)
   c. Confirmation of the absence of a target lesion visualized on other imaging modalities (resolution of lesion after treatment)
3. Case examples:
   a. Pleural based lung lesions
   b. Liver
   c. Adenopathy-mesenteric, retroperitoneal, pelvic
   d. Prostate
4. Advantages and limitations of the fusion technique
5. Description of our approach: how to incorporate CT and MR fusion into the biopsy practice

SUMMARY
After reviewing this exhibit, the reader should be able to:
1. Understand the basic principles of cross-sectional imaging-US fusion and what is necessary for its performance.
2. Determine which biopsies may be benefit from this technique.
PURPOSE/AIM
To discuss practical applications of ultrasound fusion with other cross sectional imaging modalities (CT, MRI, and PET) when performing biopsies of lesions within the chest, abdomen, and pelvis.

CONTENT ORGANIZATION
1. Basic principles and requirements for fusing US to other modalities
2. Clinical applications of fusion in the biopsy of lesions in the chest, abdomen, and pelvis:
   a. Locating lesion when not initially seen on screening ultrasound
   b. Identification of a specific target lesion initially detected on other cross-sectional imaging modalities (suspicious prostate lesions on multiparametric MRI)
   c. Confirmation of the absence of a target lesion visualized on other imaging modalities (resolution of lesion after treatment)
3. Case examples:
   a. Pleural based lung lesions
   b. Liver
   c. Adenopathy-mesenteric, retroperitoneal, pelvic
   d. Prostate
   e. Advantages and limitations of the fusion technique
5. Description of our approach: how to incorporate CT and MR fusion into the biopsy practice

SUMMARY
After reviewing this exhibit, the reader should be able to:
1. Understand the basic principles of cross-sectional imaging-US fusion and what is necessary for its performance.
2. Determine which biopsies may benefit from this technique.

Image Guided Radiofrequency Ablation (RFA) of Liver Tumors: A Pictorial Review on Imaging Guidance Techniques and Post Treatment Radiology Findings

LL-VIE2942
Constantinos Tingerides, MBBS, FRCR
Rohit P Veettil
Tze M Wah, MBChB, FRCR
Jonathan T Smith, MBChB, FRCR
Raj Prasad
Peter Lodge
Giles Toogood
Rebecca Jones
Ernest Hidalgo
Henry C Irving, MBBS

PURPOSE/AIM
Image guided RFA of primary/secondary liver tumors is now an established treatment technique as part of the management of liver tumors. We aim to present our experience in the treatment of 55 primary and secondary liver tumors using a variety of imaging guidance techniques to facilitate treatment and post treatment radiology findings from March 2009 to 2013.

CONTENT ORGANIZATION
This pictorial review presents our experience in using a variety of image guidance techniques to treat liver tumors in our institution. These include the fusion imaging navigation system to guide treatment, contrast enhanced ultrasound (US) guidance as well as using anatomical localisation techniques with CT guidance. To illustrate the normal expected findings and sequential changes longitudinally on both CT and or MRI and to describe the classic imaging signs associated with the interval change. In addition, to present our complications during this period e.g. pseudoaneurysm of the segmental vessel in the zone of ablation post RFA that was treated with embolization.

SUMMARY
To demonstrate a range of image guided techniques that are available to facilitate liver RFA especially in difficult liver tumors that are poorly visualized on conventional US and also to highlight sequential imaging appearances post treatment and the potential complications.

The Interventionalist's Guide to the BRTO Galaxy: How-to Guide and Overview of Variant Procedures

LL-VIE2943
Jonathan K Park, MD
Sung Ki Cho, MD
Luyao Shen
Stephen T Kee, MD
Edward W Lee, MD, PhD

PURPOSE/AIM
1. To review the anatomy and pathophysiology of portosystemic shunts resulting in gastric varices and hepatic encephalopathy
2. To guide the reader through the indications, diagnostic imaging, interventional methods, contraindications, and potential complications of balloon-occluded retrograde transvenous obliteration (BRTO)
3. To introduce variants of BRTO, including vascular plug-assisted retrograde transvenous obliteration (PARTO), and coil-assisted retrograde transvenous obliteration (CARTO)

CONTENT ORGANIZATION
A. Pictorial review of anatomy, pathophysiology, and diagnostic imaging of portosystemic shunts
B. Graphical and radiographic guide to BRTO technique, as well as review of various embolic agents
C. Introduction to newer variants of BRTO, including PARTO and CARTO
D. Visual overview of outcomes and complications

SUMMARY
The benefits and challenges of BRTO are presented. This exhibit will review:
- anatomy and pathophysiology behind portosystemic shunts in the development of gastric varices and hepatic encephalopathy
- technique and inventory involved in BRTO
- new variants of BRTO including PARTO and CARTO

Articulated Percutaneous Plastic Biliary Stents. How to Do It

LL-VIE2944
Jorge E Lopera, MD *
Ghazwan M Kroma, MD
Andres Garza
Rajeev Suri, MD
Endovascular Techniques for Treatment of Uterine Disease: What Can IR Offer to Gynecologists Outside of the Fibroid Management?

**LL-VIE2945**

Pedro V Stazaki, MD
Stephan Wicky, MD
Gloria M Salazar, MD

**PURPOSE/AIM**

To review the unusual uterine endovascular radiological interventions outside of the fibroid management spectrum, along with their indications, relevant anatomy, imaging findings, and technique.

**CONTENT ORGANIZATION**

2. Anatomy and imaging findings

**SUMMARY**

This review aims at demonstrating various endovascular interventions that could be safely performed in obstetric and gynecologic patients in the emergency and elective management of uterine diseases.

Sonazoid-CEUS during Radiofrequency (RFA) for Small Hepatocellular Carcinoma (HCC)

**LL-VIE2946**

Toshiya Shibata, MD
Minoru Yabuta, MD
Ken Shinozuka
Toyomiichi Shibata, MD
Hiroyoshi Isoda, MD
Kaori Togashi, MD, PhD *

**PURPOSE/AIM**

The specific feature of Sonazoid is that parenchymal imaging of the liver (Kupffer imaging) as well as early vascular imaging can be obtained. Kupffer imaging, lasting over 60 minutes, may be very useful for performing real-time US-guided RFA. Purpose of our exhibition is to demonstrate the effectiveness of Sonazoid-CEUS during RFA for small HCC.

**CONTENT ORGANIZATION**

Sonazoid-CEUS is superior to B-mode US in: (1) detection of small HCC nodules about 1.0cm in patients with severe liver cirrhosis. Kupffer imaging is especially useful for real-time US-guided RFA. (2) detection of local recurrence after RFA. Local recurrence is clearly depicted at early vascular imaging. Early vascular and Kupffer imaging should be carefully correlated before RFA for the local recurrence. (3) detection of an ablated area and a residual viable lesion. So, we can diagnose whether an additional ablation is needed or not.

Limitations of Sonazoid-CEUS: (1) Some deeply-located nodules are hardly depicted with Sonazoid-CEUS due to the attenuation. (2) Some well-differentiated HCCs are more clearly detected with B-mode US as a hyperechoic nodule.

**SUMMARY**

Sonazoid-CEUS is useful in RFA for small HCCs and it might be mandatory in some cases.
Preoperative Portal Vein Embolization with Ethanol Injection: Indications, Technique, and Comparison with Alternative Embolic Agents

**Summary**

Major teaching points include: 1. Transhepatic portal vein embolization with absolute ethanol is an effective procedure for inducing both atrophy of the diseased lobe and compensatory hypertrophy of the future liver remnant. Because of its effectiveness in stimulating remnant hypertrophy and low cost in comparison to traditional embolic agents, portal vein embolization with ethanol should be considered prior to major hepatic resection.

**Purpose/Aim**

Transhepatic portal vein embolization prior to major liver resection is beneficial for inducing both atrophy of the diseased lobe and compensatory hypertrophy of the future liver remnant. Because of its effectiveness in stimulating remnant hypertrophy and low cost in comparison to traditional embolic agents, portal vein embolization with ethanol should be considered prior to major hepatic resection.

**Content Organization**

1. Review normal and variant hepatic segmental, biliary, and vascular anatomy.
2. Preprocedural volumetric planning, surgical indications, and contraindications for portal vein embolization.
3. Accessing the portal system with ultrasound guidance including ipsilateral access to avoid potential vascular injury to the future liver remnant.
4. Pictorial guide illustrating transhepatic portal venous embolization with ethanol.
5. Review and discuss alternative embolic agents.

**SUMMARY**

Major teaching points include: 1. Transhepatic portal vein embolization with absolute ethanol is an effective procedure for inducing liver remnant hypertrophy prior to major hepatic resection. 2. Interventional radiologists must understand the implications of portal vein access and embolization on the future liver remnant. 3. Absolute ethanol should be considered as an effective alternative to traditional embolic agents.

Vascular Conditions Occurring around the Knee - A Pictorial Review

**Summary**

Sonazoid-CEUS is useful in RFA for small HCCs and it might be mandatory in some cases.

**Purpose/Aim**

Describe the common imaging techniques for non-invasive vascular imaging of the lower extremities, including vascular ultrasound, CT Angiography, and MR Angiography.

**Content Organization**

1. **Background/Techniques**
   - Arterial Disease and Variant Anatomy
   - Venous Disease

**SUMMARY**

Over the past 2 decades, non-invasive vascular imaging has replaced catheter angiography as the primary diagnostic method for imaging the lower extremity arterial and venous systems. While traditional systemic/diffuse vascular disease processes can occur around the knee, there are additional unique pathologic entities that occur specifically in this anatomic location. Using case examples, the practicing radiologist will become familiar with typical and atypical causes of lower extremity vascular disease that occur primarily around the knee.

Vascular Emergencies in Cancer Patients

**Summary**

This exhibit will review the unique vascular emergencies that occur in cancer patients involving arterial hemorrhagic and ischemic injury, veno-occlusive disease, and variceal bleeding. **Clinical History Presenting Symptoms Imaging Findings Endovascular Management**

**Purpose/Aim**

The purpose of this exhibit is: 1. To review vascular emergencies requiring interventional radiology treatment in the unique oncology population. 2. To discuss the salient clinical and imaging findings. 3. To demonstrate the management of these conditions

**Content Organization**

The major teaching points of this exhibit are: 1. Awareness of the unique vascular emergencies that present in oncology patients. 2. Recognizing the pertinent clinical history, presentation, and imaging findings related to these entities. 3. Appropriate endovascular treatment of these conditions.
Hepatobiliary Applications of Cone-Beam Computed Tomography: An Update

**LL-VIE2950**

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

**PURPOSE/AIM**

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

**CONTENT ORGANIZATION**

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

**SUMMARY**

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

To provide an update and review of Cone-Beam Computed Tomography (CBCT) and its applications in hepatobiliary interventions, including complex biliary reconstruction, unconventional transjugular intrahepatic portosystemic shunt (TIPS), ablation of the liver tumors and transcatheter management of hepatocellular carcinoma.

**CONTENT ORGANIZATION**

In this review, a variety of hepatobiliary procedures demonstrating the usefulness of CBCT in pre-treatment planning and intra-procedural guidance will be discussed. Complex hepatobiliary cases of biliary reconstruction, transjugular intrahepatic portosystemic shunt (TIPS), and ablation of hepatocellular carcinomas demonstrate how the enhanced spatial resolution of C-arm CBCT can add to localization, guidance, and treatment planning. Discussion will be supported by three-dimensional images generated from Cone beam CT along with fluoroscopic images generated during the procedures.

**SUMMARY**

This exhibit demonstrates how CBCT combined with real-time fluoroscopic guidance is valuable for planning interventions in areas with complex surrounding anatomy. Specifically, it will demonstrate how CBCT is useful for delineating the safest pathways to small, localized targets in hepatobiliary procedures, which in turn contributes to overall patient safety and increased procedural success rates.

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**Concomitant Computed Tomography Arteriography (CTA) and Computed Tomography Venography (CTV) in the Evaluation of Iliac Vein Compression Syndrome**

**PURPOSE/AIM**

Chronic limb edema due to iliac venous compression syndrome (IVCS) and other vascular anomalies are not uncommon in clinical practice. The goal of this exhibit is to describe a specific technique in demonstrating IVCS with the aid of digital subtraction angiography (DSA) and multidetector computed tomography (MDCT). We address the typical clinical presentation of IVCS, "variant" IVCS (right side IVCS, compression of ipsilateral iliac vein by corresponding iliac artery), Klippel-Trenaunay syndrome (KTS and the vascular pathology as seen with this technique. The role of the computed tomography (CT) is determining the extent of the compression and confirmation of equivocal case. The management of the condition will also be discussed.

**CONTENT ORGANIZATION**

The step-by-step process of the DSA and CT protocol of this technique will be discussed. The classic and equivocal cases will be illustrated with state of the art imaging including three-dimensional (3D) displays.

**SUMMARY**

After reviewing this exhibit the user will have a better understanding of the technique and the role of concomitant CTA and CTV in detection, confirmation and management of the patient with a range of venous compression disease, including IVCS.

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**Which Sphere, Why and Where Are We Headed? Review of Current Concepts and Future Directions in Radioembolization**

**PURPOSE/AIM**

To provide a comprehensive comparison of SIR-spheres and Thera-spheres as well as review of novel technologies and imaging in radioembolization.

**CONTENT ORGANIZATION**

- Liver arterial anatomy important to radioembolization
- Indications and contraindications for radioembolization
- Institutional method for radioembolization
- SIR-Spheres and Thera-spheres
  - Characteristics, kinetics and mechanism of action
  - Dosimetry
  - Pre and post embolization imaging
- Current imaging literature
- Doseimetry prediction with 99m Tc- MAA/ SPECT/CT
- Dosimetry modification with FGD-PET/CT
- Bremsstrahlung SPECT/CT
- Alternative/novel radionuclides
- Holmium - 166
- Rhenium - 188
- Clinical Considerations
- Downstaging
- Combination therapy
- Summary

**SUMMARY**

An exciting and young field, further studies in radioembolization will drive innovation in radiation delivery using Y-90 as well as novel radionuclides and will continue to advance image guidance for therapeutic planning and monitoring.

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**A Pictorial Review of Ancillary Techniques for Difficult Inferior Vena Cava Filter Retrievals**

**PURPOSE/AIM**

No additional information provided.

**CONTENT ORGANIZATION**

No additional information provided.

**SUMMARY**

No additional information provided.
Pictorial Review of Liver Imaging-Reporting and Data System (LI-RADS) Category Lesions Correlated with Imaging Findings during Transarterial Chemoembolization (TACE)

LL-VIE2955
David C Irwin, MD
Sean D Raj, MD
Katsuhiro Kobayashi, MD
Daniel Anaya, MD
Khoezma Hussain, MD
Mark A Sultenfuss, MD

PURPOSE/AIM
To provide an imaging overview of the Liver Imaging-Reporting and Data System (LI-RADS), correlated with angiography and cone-beam CT during TACE.

CONTENT ORGANIZATION
The Liver Imaging Reporting and Data System (LI-RADS) was developed to standardize liver lesion interpretation and reporting in cirrhotic patients. The intention of LI-RADS is to improve communication with clinicians and facilitate management decisions, including TACE. The LI-RADS categorization uses objective CT and MR imaging criteria to classify the lesion from LI-RADS 1, definitely benign, to LI-RADS 5, definitely hepatocellular carcinoma (HCC). Imaging examples of LI-RADS category lesions which were referred for TACE through multidisciplinary HCC tumor board are correlated with the intra-procedural angiographic and cone-beam CT appearance of these lesions.

SUMMARY
Understanding the correlation between LI-RADS category and intra-procedural angiography and cone beam CT can facilitate TACE procedures.

Imaging of Nonatherosclerotic Vasculitis

LL-VIE2956
Sangam G Kanekar, MD
Jennifer L Kissane, MD

PURPOSE/AIM
1. To review the various imaging appearances of nonatherosclerotic vasculitis on MR, MRA and CTA.
2. To give the algorithmic approach for evaluation of nonatherosclerotic vasculitis.

CONTENT ORGANIZATION
Diagnosis of vasculitis is always challenging on cross sectional examination. Though MR is very sensitive in identifying the non-specific parenchymal changes, CTA and MRA lack resolution to diagnose the vessel changes. Imaging studies of 203 pts with nonatherosclerotic vasculitis were studied from our PACS. We classified them into: a) primary vasculitis (giant cell arteritis, primary angitis of the CNS, Takayasus’s disease, periarteritis nodosa, Kawasaki disease, Churg-Strauss syndrome, Wegener’s granulomatosis) and b) secondary vasculitis (collagen vascular diseases SLE, Rheumatic disease Sjogren’s), infection, sarcoidosis, illicit drugs, malignancy, radiation and other systemic conditions. c) Non-inflammatory (FMD, NF, Moya-Moya) d) Immuno/hematological disorders (SCD, PC Vera) e) Genetic causes (MELAS, CADASIL, Fabry’s, Homocystenemia).

SUMMARY
This exhibit reviews various causes and imaging appearances of nonatherosclerotic vasculitis. We highlight the salient differentiating points and “diagnostic pearl” to various pathologies.

Peer Review of Peripheral Vascular Ultrasound Studies: Analysis of Errors and Strategies for Improving Performance

LL-VIE2957
Tonguc Pinar, MD
Robert G Sheiman, MD
Peggy Newman
Betina Siewert, MD
Robert A Kane, MD
Jonathan B Kruskal, MD, PhD *

PURPOSE/AIM
Peer review of radiologist performance is widely performed per regulatory requirements. When optimized, analysis of errors allows for improvement strategies to be introduced. Peripheral vascular ultrasound studies are technically challenging and fraught with potential interpretative pitfalls. Based on over 10 years’ experience and 75,000 peer reviewed cases, this exhibit highlights the major categories of vascular ultrasound errors, their potential impact, and illustrates simple strategies for preventing their occurrence.

CONTENT ORGANIZATION
Classification of peer review errors of peripheral vascular US studies: - Perceptual misses and their contributing factors. - Interpretive errors, including false positive (tendon confused with thrombus), false negative (failure to recognize duplicated circulation, and misclassification errors (DVT vs. superficial thrombus). - Errors of information transfer, including input (faulty clinical information), and output (relaying results and acuity). - Technical acquisition errors. Strategies for preventing errors when interpreting peripheral vascular US studies.

SUMMARY
This exhibit will explain how to classify and approach errors detected through peer review, factors contributing to error occurrence and strategies for avoiding errors when performing and interpreting the peripheral vascular ultrasound examination.
LL-VIE2957
Tonguc Pinar, MD
Robert G Sheiman, MD
Peggy Newman
Bettina Siewert, MD
Robert A Kane, MD
Jonathan B Kruskal, MD, PhD *

PURPOSE/AIM
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SUMMARY
This exhibit will explain how to classify and approach errors detected through peer review, factors contributing to error occurrence and strategies for avoiding errors when performing and interpreting the peripheral vascular ultrasound examination.

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LL-VIE2958
Anjuli A Shah, MD
Benjamin G Northcut, MD
Yun R Sheu, MD, MS
Lemore Carmi, MD

PURPOSE/AIM
Radiologists beginning training in the field of IR often lack knowledge regarding basic IR equipment and nomenclature. A consolidated resource for this information is not widely available in textbooks or the literature. A pictorial guide showcasing the basic wires, catheters, and sheaths as well as their identifying features and nomenclature would allow radiology residents and new fellows to communicate better with staff, critically think about equipment utilization, and be more productive in the IR suite.

CONTENT ORGANIZATION
1) Image rich chart organizing wires and catheters into logical groups (glide vs non-glide, size, stiffness, typical uses)
2) Pictures showcasing the identifying characteristics of commonly used catheters, wires, sheaths and needles.
3) What fits in what: Explanation of how to convert between French, gauge, and wire thickness; allowing the user to easily determine what catheter(s) and/or wire(s) will fit in a specific catheter, needle, or sheath.
4) Practice cases where one can use knowledge gained to select an appropriate catheter/wire for a procedure, though we recognize there is inter-user variability.

SUMMARY
Information regarding the identification, nomenclature, and general uses of common IR catheters, wires, and sheaths is not widely available and would be high yield information for radiologists entering the field of IR.

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LL-VIE2959
Francesca Nosenzo
Giovanni Turtulici
Mario Maturanza
Riccardo Sartoris
Angelo Corazza, MD
Enzo Silvestri, MD

PURPOSE/AIM
1. Illustrate the EVLA procedure.
2. Show how to obtain a good US-visualization of veins in order to monitor the ablation procedure and to avoid possible complications.
3. Describe the post-operative management

CONTENT ORGANIZATION
EVLA is a minimally invasive procedure for the treatment of great and small saphenous venous insufficiency in which, after local anesthesia, a laser fiber is inserted through the skin into the vein under US guidance. The laser heats the vein walls, causing shrinking and vein collapse. This happens due to the radial energy emission at 1470nm, optimally absorbed by water molecules. US guidance is mandatory in order to introduce needle and laser fibers and to monitor vessel shrinking during the ablation procedure. We will provide a 'how to do' guide of the EVLA procedure highlighting the following steps:
- Pre-treatment US-evaluation of patient lower limb veins with detailed scan planes
- Sterile field setting and patient arrangement
- US-guided laser fiber insertion procedure
- Endovenous laser ablation
- Post-operative management and follow-up

SUMMARY
US-guided EVLA of lower limb varicose veins is an effective and safe treatment that allows a quick and painless shrink of veins. Such an therapeutic option appear also to be faster and cheaper compared to the gold standard (surgical stripping).

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**Dual Energy CT in the Evaluation of Vascular Structures**

**LL-VIE2960**
Patricia M Carrascosa, MD *
Carlos Capunay, MD
Alejandro Deviggiano, MD
Gaston Rodriguez Granillo
Jorge M Carrascosa, MD
Javier Vallejos, MD

**PURPOSE/AIM**

1. To demonstrate the role of Dual Energy CT (DECT) in the evaluation of vascular territories.
2. To reduce intravascular contrast volume based on the possibility of analyzing monochromatic data at different keV.
3. To show the usefulness of material decomposition such as idone-calcium (to take away calcified plaques in the vascular structures).

**CONTENT ORGANIZATION**

1. Dual energy CTA scan using 80/140 keV with rapid switching for acquisition.
2. Iterative reconstruction technique to reduce radiation dose.
3. Reprocessing using monochromatic images with different keV levels as well as material decomposition (iodine-calcium) being able to measure the stenosis more precisely.
4. To show optimal enhancement at the best keV level to reprocess the image data.
5. To reduce beam hardening artifact as well as blooming artifact from the calcified plaques.

**SUMMARY**

1. Dual Energy CT is a new modality that allows evaluating vascular structures with significant reduction in e.v contrast volume.
2. The possibility of using monochromatic images at different keV contributes to more precise vascular stenosis quantification due to a reduction in blooming and beam hardening artifacts.

---

**Dual Energy CT in the Evaluation of Vascular Structures**

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Patricia M Carrascosa, MD *
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**SUMMARY**

1. Dual Energy CT is a new modality that allows evaluating vascular structures with significant reduction in e.v contrast volume.
2. The possibility of using monochromatic images at different keV contributes to more precise vascular stenosis quantification due to a reduction in blooming and beam hardening artifacts.
Making the Undoable Case Doable: Advanced Adjunctive Techniques in Percutaneous Ablation

**LL-VIE2961**  
**Meghan G Lubner**, MD *  
**Timothy J Ziemlewicz**, MD  
**Doug R Kitchin**, MD  
**J. Louis Hinshaw**, MD *  
**Fred T Lee**, MD *  
**Christopher L Brace**, PhD *

**PURPOSE/AIM**  
- Review advantages of percutaneous approach to ablation  
- Discuss adjunctive techniques such as patient repositioning, probe retraction and leverage, blunt tipped needle leverage, hydrodissection, pyeloperfusion to facilitate a percutaneous approach using case examples  
- Discuss advantages of using contrast doped fluid for hydrodissection and introduce the concept of polaxamer gels for hydrodissection.

**CONTENT ORGANIZATION**  
- Comparison of percutaneous to laparoscopic or open ablation  
- Criteria for percutaneous case selection  
- Adjunctive techniques with case examples: Patient reposition, probe retraction or leverage, blunt tipped needle leverage, hydrodissection, ureteral stent placement and pyeloperfusion  
- Advantages of using contrast in hydrodissection fluid with case examples  
- Introduction of use of polaxamer gels for hydrodissection

**SUMMARY**  
1. Percutaneous ablation has lower cost, fewer major complications, and shorter hospital stay than laparoscopic or open ablation.  
2. Adjunctive techniques may allow for more aggressive patient selection for a percutaneous approach.  
3. More advanced techniques such as blunt-tipped needle leverage and novel hydrodissection materials may make challenging cases safe for the percutaneous approach.

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Biopsy Tips and Tricks

**LL-VIE2962**  
**Declan G Sheppard**, MD

**PURPOSE/AIM**  
To describe and illustrate some standard and not so standard biopsy techniques and to show how they can be used in routine practice.

**CONTENT ORGANIZATION**  
The exhibit will describe and illustrate the roles of:  
1. Pre-planning  
2. Real time planning  
3. Artificially created windows for access  
4. Artificially created windows for biopsy  
5. Patient positioning for access  
6. Respiratory positioning for access  
7. Use of anatomical landmarks for guidance  
8. Chiba needle as a guide wire  
9. Co-axial techniques  
10. Curved needles  
11. IV contrast for real time guidance  
12. Oral contrast  
13. Viscus decompression or expansion for access  
14. Angled, curved and oblique approaches  
15. Transosseous access  
16. CT fluoroscopy  
17. Hemostasis valves  
18. Cutting channel positioning for the safe performance of biopsies.

**SUMMARY**  
Following this exhibit the reviewer will hopefully have acquired a number of new biopsy techniques that they can use in everyday practice.

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Intentional Pneumoperitoneum: Its Preoperative Role in the Patient with Peritoneal Adhesions

**LL-VIE2963**  
**Suzanne L Palmer**, MD *  
**Peter F Crookes**, MD

**PURPOSE/AIM**  
- Understand the indications for intentional pneumoperitoneum creation  
- Discuss the techniques for optimal placement of the peritoneal drain and instillation of peritoneal air via detailed instructional and imaging examples  
- Learn how to modify the techniques in technically challenging cases  
- Become familiar with the risks and complications  
- Be able to discuss and promote this technique with surgeons

**CONTENT ORGANIZATION**  
Present brief background on abdominal adhesions Utilizing the experience at our institution:  
- Review appropriate patient selection  
- Review risks and complications  
- Describe procedure, including optimal catheter placement and infusion of air  
- Provide examples of imaging during infusion of air  
- Present surgical outcomes

**SUMMARY**  
Adhesions are a surgeon’s nemesis. For patients requiring abdominal surgical intervention, adhesions may add hours to and increase complexity of even the most basic surgical procedure. In the appropriately selected patient, creating an intentional pneumoperitoneum prior to planned abdominal surgery can be a useful tool. By understanding the potential usefulness of this procedure and having the ability to perform it correctly, the radiologist can offer their surgical colleagues a preoperative way to minimize the impact of adhesions.

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Non-surgical Treatment of Benign Thyroid Nodules: Management Strategies According to the Nodule Composition

**LL-VIE2964**  
**Eun Ju Ha**
Jung Hwan Baek
Jeong Hyun Lee, MD, PhD
Hun Cho, MD

PURPOSE/AIM
Non-surgical treatment of benign thyroid nodules is classified into two types; chemical ablation (ex. ethanol ablation) and thermal ablation (ex. laser- and radiofrequency (RF) ablation). The purpose of this education exhibit is to comprehensively review the efficacies in these modalities and conduct the best treatment option regarding to nodule characteristics based on current evidences.

CONTENT ORGANIZATION
The current results of ethanol-, laser-, and RF ablation of benign thyroid nodules will be described based on efficacy and complications. The efficacy will be explained according to volume reduction rate, therapeutic success rate, number of the treatment session, and changes of the symptom/cosmetic score. Based on current evidences, we will propose a 3-step approach for non-surgical treatment according to the nodule composition: cystic (50% of the solid portion). We will introduce the concept of "step by step management" and "combination therapy" for the treatment of nodules with solid component, and present examples of practical cases.

SUMMARY
The best treatment modality of benign thyroid nodules should be established according to the proportion of solid component. Understanding of proper management strategies of benign thyroid nodules will be helpful for daily practice.

Catheter-based Renal Sympathetic Denervation Using Radiofrequency Ablation in Resistant Hypertension Treatment

LL-VIE2965
Liliana Renza, MD
Rocio Carreno-Gonzalez, ARRT
Maria Santillana, MD
Jose Manuel Rodriguez
Ivan Artero, MD
Jose Munoz

PURPOSE/AIM
1. To review the resistant hypertension (RH) and the role of the renal sympathetic hyperactivity
2. To explain the background of sympathectomy treatment and the major studies
3. To understand the indications, contraindications, and complications of the Catheter-Based Renal Sympathetic Denervation (C-B RSD) procedure
4. To expose our experience with the procedure and the long term follow up

CONTENT ORGANIZATION
- Definition of RH
- Symplicity HTN-1 Trial (2009) and HTN-2 Trial (2010)
- Diagnostic Imaging pre-procedure (US, CT, MRI)
- Explain the procedure: an endovascular catheter-based approach to disrupt renal sympathetic nerves, using radiofrequency (RF) ablation applied via an electrode at the catheter tip
- Review of indications, contraindications and complications of the procedure
- Our experience: we have performed 6 procedures of C-B RSD by RF ablation since January 2012. Patient follow up have been from 3 to 12 months. Every patient had a blood pressure (BP) reduction at all time points postprocedure

SUMMARY
- The C-B RSD using RF Ablation have shown be useful in the RH treatment with significant reductions in BP in the two-year follow-up
- Current trials address the effectiveness of RSD in mild forms of essential hypertension, and in other diseases in which the renal sympathetic outflow was activated

Treat or Not to Treat? -Controversial Patient-related Issues in Radiofrequency Ablation for Hepatocellular Carcinoma

LL-VIE2966
Kenny Q Sam, MD
Katsuhiro Kobayashi, MD
Vivek G Sahani, DO
Mark A Sultenfuss, MD

PURPOSE/AIM
1. Identify patient-related issues that may arise when treating hepatocellular carcinoma (HCC) with radiofrequency ablation (RFA).
2. Review currently available evidence for safety in treating HCC patients with those issues and discuss a tailored approach to minimize complications from RFA.

CONTENT ORGANIZATION
1. General indications and contraindications to RFA for patients with HCC.
2. Controversial patient-related issues in RFA for HCC, evidence for safety in treating patients with those issues and a tailored approach.
   a. Ascites
   b. Advanced liver disease (Child-Pugh C)
   c. Recurrent HCCs following hepatectomy
   d. Status post TIPS (potential worsening of liver function and possible hepatic encephalopathy)
   e. Chronic kidney disease (patients on regular hemodialysis)
   f. HIV
   g. Status post liver transplant

SUMMARY
There are few contraindications to RFA for patients with HCC, however, some patient-related issues such as limited liver functional reserve, immunosuppressed/compromised status or potential coagulopathy from hemodialysis may raise questions as to whether patients with those issues can be safely treated with RFA or not. In this exhibit, we review currently available evidence for safety in treating HCC patients with those issues and discuss a tailored approach to minimize complications from RFA.

Image-guided Interventions in the Spleen: Knocking out Myths and Prejudices

LL-VIE2967
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Felipe D Barbosa, MD
Eduardo Garcia
Publio C Viana, MD
Marcos R Menezes, MD
PURPOSE/AIM
Percutaneous image-guided splenic procedures are seldom performed due to fear of complications, mainly hemorrhage. However, the complication rates are similar to those of other abdominal organs and they are an excellent option particularly in those patients with clinical comorbidities. The purpose of this review is to provide the radiologist a guide to ensure the correct interventional techniques and their limitations for safe performance of image-guided percutaneous interventions in the spleen.

CONTENT ORGANIZATION
1. Review relevant anatomy to facilitate selection of appropriate techniques to access the spleen.
2. Describe the various types of percutaneous splenic interventions, including biopsy, catheter access drainage and radiofrequency ablation (RFA).
3. Illustrate these techniques with drawings, examples of our routine and challenging cases.
4. Show complications and outcomes.

SUMMARY
A widely held view of splenic interventions among physicians is that there is a high risk of morbidity, mainly because of the relatively infrequent performance of spleen interventions compared with those in other abdominal organs. The literature suggests much lower rates of complications and what we see is that splenic procedures can be safely used to provide a definitive diagnosis and, sometimes, therapeutically, as an effective alternative to surgery.

Key Anatomy of Varicose Veins: Demonstration by Three-dimensional CT Venography

Yanne Aviles
Javier De La Hoz
M Dolores Guirau-Rubio
Elena Garcia-Garrigos
Juan Arenas

PURPOSE/AIM
Varicose veins are one of the most common diseases of the lower extremity venous system. It typically has simple pathophysiology, however, at times its underlying anatomical cause may be complicated. CT venography with three-dimensional reconstruction could be a useful method to evaluate the venous anatomy of the lower extremity when combined with Doppler ultrasonography. The aim of this exhibit is to review the key anatomy of varicose veins using CT venography, which is crucial for diagnosis and treatment.

CONTENT ORGANIZATION
SUMMARY
Varicose veins, at times, are accompanied by complicated anatomical variations. CT venography with three-dimensional reconstruction may enhance the understanding of these underlying anatomies leading to a more successful diagnosis and treatment. Reviewing the key anatomy of varicose veins as well as knowing its variations and their incidence will be beneficial to radiologists who perform imaging and treat varicose veins.


LL-VIE2969
Rihyeon Kim, MD
Jiyeon Lim
Eun-Ah Park, MD
Whal Lee, MD, PhD
Jin Wook Chung, MD *

PURPOSE/AIM
Discuss the modifiable technical factors related with imaging quality in MDCT angiography.

CONTENT ORGANIZATION
a) Technical factors involved in imaging quality of CT angiography.
c) Examples of extra-low dose studies.

SUMMARY
Specially for young patients and for patients with risk factor for contrast induced nephropathy, MDCT technology gives the radiologist the opportunity to get vascular studies of good quality while maintaining acceptable radiation and iodinated contrast volumes, respectively.

We give a step-by-step guide to reduce both radiation and contrast volumes in routine MDCT angiography, also applicable to other diagnostic studies.


LL-VIE2969
Juan Arenas, MBBS
Elena Garcia-Garrigos
M Dolores Guirau-Rubio
Javier De La Hoz
Yanne Aviles

PURPOSE/AIM
Discuss the modifiable technical factors related with imaging quality in MDCT angiography.

CONTENT ORGANIZATION
a) Technical factors involved in imaging quality of CT angiography.
c) Examples of extra-low dose studies.

SUMMARY
Specially for young patients and for patients with risk factor for contrast induced nephropathy, MDCT technology gives the radiologist the opportunity to get vascular studies of good quality while maintaining acceptable radiation and iodinated contrast volumes, respectively.

We give a step-by-step guide to reduce both radiation and contrast volumes in routine MDCT angiography, also applicable to other diagnostic studies.
PURPOSE/AIM
Discuss the modifiable technical factors related with imaging quality in MDCT angiography. Give a quick guide to reduce both radiation and contrast volumes in routine MDCT angiography.

CONTENT ORGANIZATION
a) Technical factors involved in imaging quality of CT angiography.
c) Examples of extra-low dose studies.

SUMMARY
Specially for young patients and for patients with risk factor for contrast induced nephropathy, MDCT technology gives the radiologist the opportunity to get vascular studies of good quality while maintaining acceptable radiation and iodinated contrast volumes, respectively. We give a step-by-step guide to reduce both radiation and contrast volumes in routine MDCT angiography, also applicable to other diagnostic studies.
**Temporary Balloon Occlusion of the Common Iliac Artery in Management of Patients with Placenta Accreta**

**PURPOSE/AIM**

The Doppler ultrasound (US) is an established technique in the diagnosis of access dysfunction in dialysis patients. The aim of this exhibit is to illustrate that hemodialysis access US can be used not only with a pure diagnosis purpose. An accurate arteriovenous fistula (AV) US examination have great therapeutic and prognostic implications and it is essential in the management of this patients.

**CONTENT ORGANIZATION**

Pictorial description of ultrasonographic findings and their angiography correlation to illustrate that an access US can be used to:

1. Monitoring the access.
2. Diagnosis of dysfunction.
3. Determination the best therapeutic option (surgical vs endoluminal treatment).
4. Determination of the optimal puncture site and access (venous retrograde vs anterograde).
5. Guidance for accessing immature fistulae.
6. Plannification the procedure (sheath, wire, catheter, angioplasty balloon and stent/stent graft).
7. Guidance during the procedure alone or in combination with fluoroscopy.
8. Assessment of outcome in the short and medium term with the evaluation of a morphologic and hemodynamic residual stenosis.

**SUMMARY**

Doppler US examination of dysfunctional AVF is useful not only in determining the cause of dysfunction, but it also plays a key role in the overall planning, monitoring and outcome assessment of any intravascular intervention.

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**Don't Forget the Foregut! Anatomy, Variants and Pathologies of the Celiac Axis and its Branches**

**LL-VIE2971**

**PURPOSE/AIM**

Illustrate normal celiac axis (CA) anatomy and variants on cross-sectional/angiographic imaging Depict pathologies affecting the CA and its branches on cross-sectional imaging and both non-invasive and invasive angiography Discuss interventional strategies for the management of CA pathologies and the challenges aberrant anatomy can impose

**CONTENT ORGANIZATION**

A retrospective review of 1170 cases and 1506 healthy volunteers imaged over a 5 year period (Mar 08-Feb 13) was performed, yielding 465 relevant cases. Of these, the best examples are provided of normal anatomy and variants and pathologies e.g. aneuryism, arteriovenous malformation, dissection, compression. Tips to differentiate between anatomical and pathological narrowing are provided.

Relevant interventional management and pearls and pitfalls are discussed

**SUMMARY**

The CA is frequently visualized on imaging but often overlooked. This exhibit depicts the range of normality of anatomy and variants - essential to guide management (endovascular or otherwise). Common and esoteric pathologies are discussed along with tips and tricks relating to their endovascular management and means of differentiating between anatomical and pathological narrowing - which may obviate the need for unnecessary intervention and its significant associated complications.

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**Central Venous Intervention and Central Catheter Dysfunction in the Hemodialysis Patient: A Challenging Scenario for the Interventionalist**

**LL-VIE2972**

**PURPOSE/AIM**

Central venous interventions in the hemodialysis patient remain a challenging issue for the interventionalist. Central venous interventions are often required in dialysis patients with dysfunctional temporary or tunneled catheter or with an arteriovenous (AV) fistula with a suspected central stenosis or occlusion. The management of these patients remains controversial. The purpose of the exhibit is to describe the wide spectrum of clinical scenarios the interventionalist will face and to detail the optimal diagnostic and therapeutic approach in each situation.

**CONTENT ORGANIZATION**

a) Pathophysiology, diagnosis and therapeutic approach of central vein stenosis/occlusions in patients with AV fistula.
b) Diagnosis and therapeutic implications for the interventionalist of central venous catheter dysfunction
c) Analysis the spectrum of interventional techniques available for the mentioned clinical scenarios and review of the literature.

**SUMMARY**

Central venous interventions remain one of the more controversial topics in the hemodialysis patients care. Interventional radiology plays an important role in the management of these patients and the interventionalist should be familiar with the clinical issues and therapeutic approaches in the different clinical settings.

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**Temporary Balloon Occlusion of the Common Iliac Artery in Management of Patients with Placenta Accreta**

**LL-VIE2973**

**PURPOSE/AIM**

The objectives are to (1) review the clinical indications, (2) radiologic findings with placenta accreta, (3) plan of occlusion balloon placement, and (4) efficacies of arterial occlusion to control the intraoperative hemorrhage volume.

**CONTENT ORGANIZATION**

- Typical US and MRI presentations of placenta accreta with various manifestations.
- Common clinical methods for blood loss reduction during cesarean operation.
- Clinical and MRI indications of arterial occlusion balloon placement and its efficacies.
- Discussion of problems and solutions associated balloon positioning.
Suggestion of real time monitoring system during procedure.

SUMMARY
1. Since large amount of intraoperative blood loss was frequently seen in patients with placenta accreta, clinical and radiologic indications of arterial occlusion balloon placement should be established.
2. Understanding and recognizing methods for arterial balloon placement and its efficacies are crucial for the management of intraoperative hemorrhage volume in patients with placenta accreta.
3. Suggestion of real time monitoring system during procedure that could solve the balloon positioning problem.
**Pancreatic Fistula: Imaging and Treatment**

Yoshiaki Watanabe, MD, PhD  
Takashi Omura, MD  
Tetsuya Naito  
Makoto Furuse

**PURPOSE/AIM**

Pancreatic fistula remains a well-known and severe complication of acute pancreatitis, trauma and pancreatic surgery (especially pancreateoduodenectomy and distal pancreatectomy).

The aim of this presentation is to demonstrate the clinical feature, imaging feature and treatment including interventional (image-guided) procedure of pancreatic fistula.

**CONTENT ORGANIZATION**

1. **Clinical features of pancreatic fistula:** Incidence, patterns of fistula formation (disruption of MPD, dehiscence of pancreatico-jejunal anastomosis and fistula formation of distal pancreatic stump).

2. **Imaging features and classification:** Typical CT and MRI images, ISGPF (International study group pancreatic fistula) grading.

3. **Treatment:**
   a) Conservative management (total parenteral nutrition, nasogastric suction and somatostatin)
   b) Endoscopic treatment (ERPD)
   c) Percutaneous treatment
      i) Fistula and pancreatic duct drainage (CT-guided percutaneous puncture of MPD)
      ii) Percutaneous pancreatic duct stenting
      iii) Percutaneous anastomotic reconstruction (MPD to jejunum or stomach, fistula to jejunum)
   d) Percutaneous embolization of pancreatic duct by prolamine
   e) Surgery (pancreatogastrostomy, completion pancreatectomy)

**SUMMARY**

Pancreatic fistulas resistant to conservative management could be treated successfully with minimally invasive interventional procedures.

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**Applications of Contrast Enhanced Ultrasound for Radiofrequency Ablation of Hepatocellular Carcinoma**

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Bhushan Desai, MD  
Alok B Bhatt, MD  
Ajit Vyas, MD  
Michael D Katz, MD  
Ramon Ter-Oganesyan, MD  
John R Daniels, MD  
Edward G Grant, MD

**PURPOSE/AIM**

1. To understand the technique and scientific basis of contrast enhanced ultrasound (CEUS).
2. To appreciate the uses of CEUS as an imaging modality to assess the efficacy of radiofrequency ablation (RFA) treatment of hepatocellular carcinoma (HCC) immediately after the RFA procedure and in follow up.
3. To learn the potential benefits of CEUS over traditional imaging modalities.

**CONTENT ORGANIZATION**

A. Background regarding current imaging modalities used in guiding therapy for HCC
B. Literature review regarding the role of CEUS in the evaluation of HCC
C. Limitations of conventional imaging modalities, such as CT and ultrasound, in guiding therapy for HCC during the RFA procedure
D. Applications and advantages of CEUS for the immediate assessment of treatment response after RFA
E. Technical factors regarding CEUS for RFA
F. Ultrasound contrast agents
G. Cases to demonstrate the utility of this technique

**SUMMARY**

1. CEUS permits assessment of the efficacy of RFA therapy for HCC, immediately after the procedure and during follow up.
2. CEUS constitutes an alternative to contrast enhanced multiphase CT for assessing HCC. Consequently, CEUS use could decrease patient exposure to ionizing radiation and iodinated contrast.
PURPOSE/AIM
1. To understand the technique and scientific basis of contrast enhanced ultrasound (CEUS). 2. To appreciate the uses of CEUS as an imaging modality to assess the efficacy of radiofrequency ablation (RFA) treatment of hepatocellular carcinoma (HCC) immediately after the RFA procedure and in follow up. 3. To learn the potential benefits of CEUS over traditional imaging modalities.

CONTENT ORGANIZATION
A. Background regarding current imaging modalities used in guiding therapy for HCC
B. Literature review regarding the role of CEUS in the evaluation of HCC. Limitations of conventional imaging modalities, such as CT and ultrasound, in guiding therapy for HCC during the RFA procedure
D. Applications and advantages of CEUS for the immediate assessment of treatment response after RFA
E. Technical factors regarding CEUS for RFA
F. Ultrasound contrast agents
G. Cases to demonstrate the utility of this technique

SUMMARY
1. CEUS permits assessment of the efficacy of RFA therapy for HCC, immediately after the procedure and during follow up. 2. CEUS constitutes an alternative to contrast enhanced multiphase CT for assessing HCC. Consequently, CEUS use could decrease patient exposure to ionizing radiation and iodinated contrast.

Applications of Contrast Enhanced Ultrasound to Delineate Percutaneous Drainage Catheters and Intra-abdominal Collections

LL-VIE2979
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Maria E Sellars, MD, FRCR
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PURPOSE/AIM
To demonstrate the usefulness of ultrasound contrast agents administered via percutaneous drainage catheters or tubes (CEUS tubogram) to delineate intra-abdominal collections and to confirm tube patency and position.
To present the different applications of CEUS tubograms as a non-ionising modality which can be of benefit for follow-up in specific patient groups.

CONTENT ORGANIZATION
- The method of CEUS tubograms.
- The different clinical scenarios in which CEUS tubograms may be of benefit e.g. in suspected drain occlusion, to confirm drain position or to characterise solid organ abscess cavities.
- The use of CEUS tubograms in conjunction with intravenous CEUS agents to provide additional clinical information about abscess morphology (e.g. multiple loculations) and the superiority over B-mode ultrasound alone.
- The potential advantage of CEUS tubograms in cases that would classically utilise ionising radiation eg. to confirm of nephrostomy position.

SUMMARY
The administration of ultrasound contrast agents directly into percutaneous catheters is a novel technique which can assess drain position, patency and residual abscess cavity size. This provides a safe, real-time evaluation of the drainage catheter and is a valuable problem solving tool in cases that would have otherwise required ionising radiation.
To present the different applications of CEUS tubograms as a non-ionising modality which can be of benefit for follow-up in specific patient groups.

CONTENT ORGANIZATION

- The method of CEUS tubograms.
- The different clinical scenarios in which CEUS tubograms may be of benefit e.g. in suspected drain occlusion, to confirm drain position or to characterise solid organ abscess cavities.
- The use of CEUS tubograms in conjunction with intravenous CEUS agents to provide additional clinical information about abscess morphology (e.g. multiple loculations) and the superiority over B-mode ultrasound alone.
- The potential advantage of CEUS tubograms in cases that would classically utilise ionising radiation e.g. to confirm of nephrostomy position.

SUMMARY

The administration of ultrasound contrast agents directly into percutaneous catheters is a novel technique which can assess drain position, patency and residual abscess cavity size. This provides a safe, real-time evaluation of the drainage catheter and is a valuable problem solving tool in cases that would have otherwise required ionising radiation.


PURPOSE/AIM

1. Present a comprehensive, yet systematic approach in the treatment and management of acute and chronic DVT 2. Review the available endovascular techniques of DVT removal with illustrative examples 3. Review clinical scenarios where an endovascular treatment approach to DVT is appropriate over anticoagulation alone

CONTENT ORGANIZATION

Endovascular techniques have become increasingly important and effective tools in the management of extensive DVT to reduce acute symptoms and prevent long-term complications, namely post thrombotic syndrome. We will review the modern endovascular techniques and medical devices available for DVT treatment beyond anticoagulation including: 1. Catheter-directed thrombolysis, 2. Lytic assisted clot removal techniques, 3. Aspiration thrombectomy procedures, 4. Mechanical thrombectomy procedures, 5. Angioplasty/stenting techniques, with specific emphasis on which method of approach is most appropriate for a given clinical presentation. Where appropriate, pitfalls and potential complications will be discussed and further management options will be reviewed through illustrative examples.

SUMMARY

Our educational exhibit aims to provide the practicing interventional radiologist with a review of the available endovascular techniques for the effective management of acute and chronic DVT with an emphasis on clinical appropriateness.

Pseudoaneurysms: Imaging, Interventions and Innovations

PURPOSE/AIM

Evaluation of etiopathogenesis, imaging, principles for interventions and innovations in the management of pseudoaneurysms.

CONTENT ORGANIZATION

- Retrospective analysis of cases of pseudoaneurysms (n=144) irrespective of their sites managed with interventional techniques in last 5 years (2007-2012). The cases management by medical or surgical methods excluded.
- Location: cavernous ICA (n=3), cervical ICA (n=9), subclavian (n=4), costocervical trunk (n=1), Rasmussen's (n=9), visceral and renal (n=43), transplant kidney (n=3), ureter (n=18) and peripheral (n=54).
- Etiopathogenesis: trauma (n=91), infection (n=32), inflammatory (n=15) and tumor (n=6).
- The management techniques: coiling, stent graft placement, transcatheter and percutaneous injection of embolization agent or ultrasound guided compression.
- Newer techniques: percutaneous injection of acrylic glue in the aneurysmal sac (n=8).
- Technical success-100%; clinical success- 90%; repeat embolization in 14 cases.

SUMMARY

Pseudoaneurysms require timely recognition and therapy to prevent potential fatal complications. The interventional treatment depends upon the size, location, and status of distal circulation. Endovascular therapy is the modality of choice for management of pseudoaneurysms; however, in specific cases percutaneous techniques should also be considered as an alternative.

Malperfusion Syndrome due to Aortic Dissection: Accurate Fluoroscopy-guided Balloon Fenestration

PURPOSE/AIM

To review indications and technical considerations of fluoroscopy-guided balloon fenestration using a conventional reentry catheter in aortic dissections.

CONTENT ORGANIZATION

1. Pathophysiology, classification and imaging findings 2. Interventional radiological therapeutic options in aortic dissections 3. Indications
Interventional radiological techniques in aortic dissections include stent grafting of the false lumen entry, aortic true lumen stenting as well as percutaneous balloon fenestration of the intimal flap. In patients with malperfusion syndrome fluoroscopic-guided fenestration using a conventional reentry catheter is a safe and effective tool to improve perfusion of the true lumen and its branches.

### Balloon-occluded Retrograde Transvenous Obliteration for Large Gastric Varices: What We Need to Know

**LL-VIE2983**

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Hiroshi Miura  
Masaki Ishikawa, MD  
Kei Yamada, MD  
Kazuo Awai, MD*  
Kenji Kajiwara

**Purpose/Aim**

The purpose of this exhibit is: 1. To review current strategies to treat gastric varices, 2. To explain the role of balloon-occluded retrograde transvenous obliteration (B-RTO) for treating gastric varices, 3. To highlight what needs to be done when sclerotic agents escape from the varices via collateral vessels developed despite gastro-renal shunt occlusion by balloon inflation.

**Content Organization**

1. Evaluation of gastric varices by gastric endoscopy, CT angiography, balloon-occluded retrograde venography, cone-beam CT, and portal venous pressure, 2. Collateral veins important at B-RTO, 3. Approach to collateral veins at embolization for sufficient obliteration of the gastric varices and a new concept for addressing collateral vessels, 4. Post-B-RTO follow-up, 5. Possible complications of B-RTO.

**Summary**

The major teaching points of this exhibit are: 1. B-RTO effectively treats gastric varices. 2. Careful management of collateral veins is necessary for good therapeutic effects. 3. The availability of multiple interventional devices and techniques can improve treatment outcomes in patients with gastric varices subjected to B-RTO.

### Burn, Freeze and Zap! The Expanding Role of the Interventional Radiologist in the Multimodality Treatment of Primary and Secondary Pulmonary Malignancy

**LL-VIE2984**

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Simon P Padley, MBBS  
Nicos Fotiadis  
Benjamin J Roberton, MRCP, FRCP

**Purpose/Aim**

To highlight the expanding role of the interventional radiology (IR) in the treatment of pulmonary malignancy. To review technologies and techniques, including established and novel thermal ablation technologies and the placement of fiducial markers to guide stereotactic radiotherapy, via percutaneous and transpulmonary artery routes.

**Content Organization**

IR has traditionally played a role early in the care pathway, performing image guided biopsy. With the advent of thermal ablation, IR now plays an expanding therapeutic role, of particular value in patients in whom cardiopulmonary impairment precludes surgery. We review the growing arsenal of ablation technologies, addressing the properties and technical nuances of each:

- Radiofrequency
- Microwave
- Cryo
- Laser
- Irreversible electroporation

IR is now also required to place fiducial markers to guide stereotactic radiotherapy. We discuss tips and techniques:

- Single and double marker placement
- Trans-pulmonary artery coil marker insertion

These techniques can be combined, allowing simultaneous ablation and fiducial placement with a single puncture, allowing dual modality therapy, or to guide radiotherapy in the advent of local recurrence.

**Summary**

IR has an expanding role in the multimodality treatment of primary and secondary pulmonary malignancy.

### Everything You Always Wanted to Know About Loco-regional Treatment of Hepatocellular Carcinoma

**LL-VIE2985**

Carmen Garcia Alba, MD  
Julien Cazejust, MD  
Bertrand Bessoud, MD  
Yves M Menu, MD

**Purpose/Aim**

To review the different loco-regional therapeutic options for hepatocellular carcinoma (HCC) when surgery and transplantation are not feasible. To understand the importance of the evaluation of tumor size, number of lesions and their location for an optimal treatment choice. To comprehend the pros and cons of each treatment as well as their potential Achilles’ heel.

**Content Organization**

An overview of the spectrum of interventional radiology treatments for HCC will be done. The how, where and why of each technique will be exposed. We will review several techniques, with their key points and their proven or promising results: - Two thermal ablative techniques: radiofrequency and microwave ablation. - Three embolization techniques: conventional chemoembolization, Drug Eluted Beads chemoembolization and Y90 Radioembolization.

**Summary**

A deep and thorough knowledge of the different loco-regional treatments available for hepatocellular carcinoma: indications, contraindications, advantages and disadvantages; is crucial for the correct choice of treatment and best results, with an improvement on patient care and disease free survival.
Strategy and Clinical Results of Uterine Leiomyoma Treated Uterine Fibroid Embolization (UFE) Experienced over 1000 Cases

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Hidefumi Fujisawa, MD
Shinya Yagi, MD
Takako Fukushita, MD
Tamio Kushihashi, MD
Yasunori Taki
Takahisa Kojima

PURPOSE/AIM
1. To know indications of UFE correlating with clinical aspects
2. To understand patient selection, technique and results of UFE
3. To learn access of UFE for expecting mothers
4. To know results and complications of UFE
5. To understand effectiveness of MRI pre and post UFE
6. To know follicle stimulating hormone data pre and post UFE

CONTENT ORGANIZATION
1) Introduction
2) Strategy including patient selection and technique of UFE
3) Technique and access of UFE for expecting mothers
4) Pre and post UFE MR imaging of uterine leiomyoma
5) Results including hormonal data and complications of UFE
6) Case presentations
7) Summary

SUMMARY
Over the past 20 years, UFE has been an effective minimally invasive treatment for symptomatic patients. UFE for uterine leiomyomas has both monetary and non-monetary effects. We will show non-monetary effects of UFE particularly focusing on strategy of UFE for expecting mothers. Pre and post MRI imagings are also effective for evaluation of UFE.

Interventional Techniques and Tips for Transarterial Chemoembolization (TACE) in Hepatocellular Carcinoma (HCC): Update 2013

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Matthias Rief, MD
Syuji Ikeda
Akira Kitagawa
Makiko Hagihara
Yuichiro Izumi
Eisuke Katsuda
Toyohiro Ota
Tsuneo Ishiguchi, MD

PURPOSE/AIM
Transarterial treatment of HCCs can be a major challenge depending on the site, size and vasculature of the lesions. The purpose of this educational exhibit is to present the anatomy of hepatic arteries, the diagnostic workup, and the options for immediate control of treatment. The focus will be on interventional techniques, including superselective TACE.

CONTENT ORGANIZATION
1. Anatomy of the hepatic arteries including the anterior and caudate segment and extrahepatic collaterals
2. Imaging recommended prior to TACE
3. Technical tips for TACE
   a) Selection of guiding catheters and microcatheters according to the arterial anatomy
   b) Superselective TACE
   c) Balloon-occluded TACE
   d) Role of C-Arm CT for lesion detection, guidance of the intervention (3D) and monitoring of the treatment success
   e) Pitfalls and technical obstacles

SUMMARY
1. Prior knowledge of the patients’ hepatic artery anatomy and identification of the feeding vessel using pretreatment CT can improve the outcome of the intervention.
2. C-Arm CT bears advantages over conventional angiography in detecting and localizing the lesion. Further, treatment success can instantly be monitored.
3. Superselective approaches depend on the site of the lesion and the vascular prerequisite of the feeding artery.
4. For large lesions, balloon-occluded TACE can improve treatment success.

Interventional Radiology and the Multimodality Treatment of Hepatic Malignancy-A New Horizon?

Narayanan Thulasidasan, MBBS, MRCS
Dariush Douraghi-Zadeh, BSc, BMBS
Nasir Khan, MBBS
James McCall, FRCR
Benjamin J Roberton, MRCP, FRCR

PURPOSE/AIM
To explore the expanding role of interventional radiology (IR) in the multimodality therapy of hepatic malignancy. To review the growing body of evidence for combining two or more treatment modalities and ask whether this represents a new horizon for interventional oncology?

CONTENT ORGANIZATION
We review the multiple treatment modalities available to treat hepatic malignancy including:
- Surgery
- Percutaneous ablation: radiofrequency, microwave and irreversible electroporation
- Transarterial therapy: bland embolization, chemoembolization and Yttrium-90 radioembolization
- External beam and stereotactic radiotherapy

We review the reported data for multiple modality therapy. We discuss the theoretical synergistic tumourcidal effects of combinations such as thermal ablation following sensitization with chemoembolization or chemoembolization and stereotactic radiotherapy. We discuss the logistical challenges of multimodality therapy and ask if there is evidence to support a multimodality approach to treatment.

SUMMARY
There is a growing tendency towards the multimodality treatment of patients with hepatic malignancy, supported by theoretical advantages and expanding data. IR has plays a crucial role in this pathway, offering ablation, transarterial therapies, and guiding stereotactic
Purpose/Aim

1. To understand the basis of image guided radiotherapy (IGRT) and real-time tumor-tracking radiotherapy (RTRT) that is the modified technique of IGRT.

2. To learn the technique of gold fiducial marker implantation for IGRT/RTRT.

Content Organization

1. The basis of image guided radiotherapy (IGRT) about which interventional radiologists need to know: history, theory, indications, and advantages.

2. The real-time tumor-tracking radiotherapy (RTRT) system which is the technique to solve organ motion in IGRT and to increase the accuracy of treatment of tumors in motion.

3. The interventional technique of percutaneous implantation of a gold fiducial marker for IGRT/RTRT: preparations, devices, implantation procedure and technical tips, and possible complications.

Summary

Improving knowledge of IGRT/RTRT will help interventional radiologists to provide radiation oncologists with the safe and accurate technique of fiducial marker implantation for advanced radiotherapy.

Role of Interventional Radiology in the Management of Post Partum Hemorrhage

Purpose/Aim

1- Review the different causes of primary and secondary post partum hemorrhage
2- Be familiar with the relevant vascular anatomy of the female genital tract
3- Review the different techniques and devices used to treat intractable post partum hemorrhage
4- Understand the specific issues associated with abnormal placenta

Content Organization

Epidemiology and causes: Post partum hemorrhage remains a leading cause of maternal mortality and morbidity even in developed countries. Primary post partum hemorrhage occuring within 24 hours following delivery is mainly related to uterine atony. Delayed post partum hemorrhage occuring within 42 days after delivery is mainly related to vascular abnormalities such as pseudoaneurysms and arteriovenous fistulae. Interventional radiology techniques: Review of embolization techniques and materials. Abnormal placentation: How to diagnose placenta accreta and percreta. Review specific techniques used in this setting such as prophylactic placement of balloons in the iliac arteries and arterial embolization with the placenta left in place.

Summary

Arterial embolization and prophylactic use of intra arterial balloons play a major role in the management of life-threatening post partum hemorrhage. Pluraldisciplinary management of patients should be carried out in specialized centers.

Hemoptysis: Workup and Endovascular Management

Purpose/Aim

We report our experience gained in the management of hemoptysis of more than 1000 patients. We focus on the role of MDCTA for the initial workup of patients with hemoptysis, and on our endovascular approach of hemoptysis. The choice of the occlusions devices (coils, vascular plug, stent graft) and material of embolisation in patients with hemoptysis.

Content Organization

A-examinations to practice before the endovascular treatment
B-How do I make a good MDCTA
C- Contribution of MDCTA: a) localization, b) mechanisms of hemoptysis, and c) network of systemic arteries supplying the bleeding site
D-Radiological anatomy of the bronchial and non-bronchial systemic arteries
E- Role of bronchoscopy
F- Etiologies of hemoptysis
G- Choice of catheters, the role of guiding catheter for pulmonary artery occlusion
H- Choice of embolization materials and medical devices
I- Results of endovascular treatment of hemoptysis
J- Management of the failure and recurrences

Summary

Hemoptysis could be a life threatening condition. The endovascular is admitted as a first line treatment. Recently, the MDCTA has improved the management of these patients by several approaches. The impact of MDCTA is effective for the localisation, the aetiology, and the demonstration of the systemic arteries’ network. The major impact of the MDCTA was the diagnosis of the pulmonary artery involvement in the hemoptysis. For the localisation of the bleeding site, MDCTA and Bronchoscopy are complementary. The endovascular treatment of hemoptysis stays a challenge for the interventional radiologist. Currently, the use of microcatheter and the large choice of embolisations devices (particles, coils, liquid, vascular plugg, and stent graft), the field of treatment has not any contra-indication. The mechanisms and the management of recurrences are variable and depend of the time of occurrence after the embolisation's session.

Approach for the Diagnosis and Endovascular Management of the Lower Limb Varicosities, How, Why and When?

Purpose/Aim

We report our experience gained in the management of hemoptysis of more than 1000 patients. We focus on the role of MDCTA for the initial workup of patients with hemoptysis, and on our endovascular approach of hemoptysis. The choice of the occlusions devices (coils, vascular plugg, stent graft) and material of embolisation in patients with hemoptysis.

Content Organization

A-examinations to practice before the endovascular treatment
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D-Radiological anatomy of the bronchial and non-bronchial systemic arteries
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F- Etiologies of hemoptysis
G- Choice of catheters, the role of guiding catheter for pulmonary artery occlusion
H- Choice of embolization materials and medical devices
I- Results of endovascular treatment of hemoptysis
J- Management of the failure and recurrences

Summary

Hemoptysis could be a life threatening condition. The endovascular is admitted as a first line treatment. Recently, the MDCTA has improved the management of these patients by several approaches. The impact of MDCTA is effective for the localisation, the aetiology, and the demonstration of the systemic arteries’ network. The major impact of the MDCTA was the diagnosis of the pulmonary artery involvement in the hemoptysis. For the localisation of the bleeding site, MDCTA and Bronchoscopy are complementary. The endovascular treatment of hemoptysis stays a challenge for the interventional radiologist. Currently, the use of microcatheter and the large choice of embolisations devices (particles, coils, liquid, vascular plugg, and stent graft), the field of treatment has not any contra-indication. The mechanisms and the management of recurrences are variable and depend of the time of occurrence after the embolisation's session.
### Overcoming Poor Popliteal Vein Inflow during Catheter Directed Thrombolysis for Lower Extremity Deep Vein Thrombosis

**PURPOSE/AIM**
We discuss here the different techniques for endovascular management of lower extremity dilated varicosities with the focus on the major and essential role of the interventional radiologist in the procedure from diagnosis to the management and follow up.

**CONTENT ORGANIZATION**
A series of more than two hundred cases underwent radiofrequency ablation of great saphenous vein combined with foam injection of associated incompetent perforators by means of ultrasound guidance. Here we explain the whole technique and sequence of its events, radiofrequency is performed for the whole great saphenous vein in cases where there is grade II incompetent saphenofemoral junction, with aid of a spinal or epidural anaesthesia. Foam injection was done selectively in the perforators displayed more than 3 mm diameters in ultrasound in standing position with retrograde flow on valsalva.

**SUMMARY**
The authors had noticed that the whole technique can be done efficiently by a physician who is able to do ultrasound guided interventions and gained experience in vascular ultrasound, but the decision making was a dilemma needs much more experience in the fields of vascular surgery, angiology, vascular radiology and cosmotology, so multidisciplinary approach is mandatory for every case in order to gain better results

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### Informed Consent in Interventional Radiology: A Multimedia Education Tool for Radiology Residents

**LL-VIE2993**

**John P Gonzales, MD**

**Michael Chung, MD**

**James E Silberzweig, MD**

**PURPOSE/AIM**
The purpose of the exhibit is:
1. To illustrate the basic principles of informed consent, as they pertain to the interventional radiology setting.
2. To demonstrate how an educational tool, utilizing video recording and video in a slideshow format, can teach radiology residents how to best acquire informed consent prior to interventional procedures.
3. To discuss our institutions success in utilizing this multimedia tool.

**CONTENT ORGANIZATION**
Principles of informed consent
Informed consent in the interventional radiology setting
Multimedia educational tool for radiology residents utilizing video and voice recording in slideshow format
- Pretest
- Nuts-and-bolts of obtaining informed consent
- Clinical scenarios in interventional radiology
- Post-test
- Our experience utilizing the multimedia tool
- Resident pre- and post-test data
- Subjective feedback from radiology residents and attending physicians

**SUMMARY**
The major teaching points of the exhibit are:
1. How informed consent is obtained should be handled on a case-by-case basis.
2. Radiology residents can learn how best to obtain informed consent by utilizing a multimedia educational tool, which leads to improved resident competence and confidence when discussing procedures with patients.

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### Rational Use of Fresh Frozen Plasma (FFP) in Interventional Radiology Practice

**LL-VIE2994**

**Sandeep T Laroia, MD**

**Archana T Laroia, MD**

**PURPOSE/AIM**
Recent audits of clinical use of FFP have revealed that 45-47% of FFP transfusions are inappropriate. Most commonly the driving factor for the use of FFP is abnormal laboratory coagulation defects, in the setting of liver dysfunction. A complete understanding of the coagulation tests and the clinical implications are a must for limiting the inappropriate use of FFP.

**CONTENT ORGANIZATION**
A detailed, well-illustrated description of the coagulation cascade and the central role of liver hemostasis will be discussed. Various coagulation tests including the traditionally used International Standardized Ratio (INR) and more clinically relevant Thromboelastography (TEG) will be discussed. Clinical interpretation of TEG will be discussed. Potential adverse effects of FFP, including transfusion related acute lung injury (TRALI) will be explained.

**SUMMARY**
An evidence based plan for the rational use of FFP in interventional practice will be proposed to limit the inappropriate use of FFP. This will also be of relevance to health administrators for adequate resource utilization.

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### Overcoming Poor Popliteal Vein Inflow during Catheter Directed Thrombolysis for Lower Extremity Deep Vein Thrombosis

**LL-VIE2995**

**Akhilesh K Sista, MD**

**Ronald S Winokur, MD**

**Bradley B Pua, MD**

**David W Trost, MD**

**David C Madoff, MD**

**PURPOSE/AIM**
A deep vein thrombus that includes the popliteal vein presents a significant challenge to the interventionalist. While this occurs frequently, relatively little has been published on this subject, even though establishing inflow from the popliteal vein is essential to procedural success.

**CONTENT ORGANIZATION**
1. Anatomic review of the femoropopliteal segment and the popliteal vein trifurcation II. Diagnosing the degree of popliteal involvement on ultrasound III. Access options and their relative strengths and drawbacks - popliteal vein - calf vein - posterior tibial vein - greater saphenous vein III. Techniques to remove thrombus once access is achieved - pharmacomechanical thrombolysis (Trellis or AngioJet) - Balloon maceration - tPA pulse infusion via occlusion balloon - infusion catheter placement IV. Imaging follow-up V. Special considerations: chronic components, isolated popliteal vein thrombosis

**SUMMARY**
Several techniques can be used to establish flow in a thrombosed popliteal vein to allow inflow into the more proximal deep venous system. After viewing this exhibit, the practitioner will know at least 4 different approaches to clear thrombus from the popliteal vein.
Irreversible Electroporation - Expanding Interventional Therapy to Locally Advanced Pancreatic Adenocarcinoma

**PURPOSE/AIM**
Pancreatic adenocarcinoma is the fourth leading cause of death in the US. Unfortunately, as much as 40% of patients present with locally advanced disease that may preclude surgery. Irreversible electroporation (IRE) employs short, high voltage pulses into tissues to permanently induce permeability through cell membranes. This exhibit will highlight the multidisciplinary team involved in IRE of the pancreas, including preoperative imaging, standardized reporting, IRE technique, and existing data for IRE for pancreatic adenocarcinoma.

**CONTENT ORGANIZATION**
1. Examples of locally advanced pancreatic adenocarcinoma on MRI and FDG-PET. 2. Depiction of the IRE technique. 3. Published data. 4. Future steps.

**SUMMARY**
IRE of the pancreas offers the potential for a safe effective therapy for locally advanced pancreatic adenocarcinoma. This exhibit will review a method for high quality MRI of the pancreas, a template for standardized reporting, the IRE technique, and existing data on IRE. Armed with this knowledge, the Radiologist will understand how to be part of the multidisciplinary Pancreas Team.

Percutaneous Irreversible Electroporation: Do We Really Need Another Ablation Technique?

**PURPOSE/AIM**
1. To understand the mechanism of irreversible electroporation (IRE)
2. To learn the advantages and challenges specific to this technique.
3. To compare use of IRE with more traditional thermal ablation techniques.
4. To demonstrate the effectiveness of IRE in the appropriate clinical setting.

**CONTENT ORGANIZATION**
1. Mechanism of IRE
2. Patient selection
3. Procedure planning/Electrode placement/Imaging modality
4. Potential complications
5. Post-procedure surveillance
6. Conclusion

**SUMMARY**
Irreversible electroporation (IRE) is a contemporary modality of non-thermal percutaneous tumor ablation that is gaining increasing recognition as a tool for treating soft tissue tumors. Its novel mechanism of action, using high voltage currents to increase membrane permeability, has expanded the use of percutaneous ablation. With proper patient selection, and pre-procedure planning, IRE is a safe and potent option, with both unique advantages as well as potential challenges compared to traditional percutaneous thermal ablation.

Budd-Chiari Syndrome: Imaging Findings and Interventional Radiologic Procedures

**PURPOSE/AIM**
1. To discuss etiologies and pathogenesis of syndrome
2. To illustrate various imaging findings in this syndrome
3. To discuss the role and techniques of interventional radiologic procedures.

**CONTENT ORGANIZATION**
Budd Chiari syndrome (BCS) is a collection of clinical disorders with the common aspect of hepatic venous outflow obstruction. Imaging as well as radiological interventional procedures plays important role in the management of these patients (In establishing diagnosis, in relieving the obstruction and follow up of these patients. Etiopathogenesis of syndrome Imaging findings on Colour Doppler, MDCT, MRI and Venography Technique of Interventional procedures performed for treatment of syndrome

- Balloon angioplasty/Stenting
- Thrombolysis
- Transjugular Intrahepatic Portosystemic Shunt

Procedure related complications Post procedure care and anticoagulation Follow up of patients treated by interventional procedures

**SUMMARY**
Budd Chiari syndrome (BCS) group of patients have venous outflow obstruction leading to raised sinusoidal pressure, hepatic fibrosis and portal hypertension. Imaging plays important role in diagnosis, treatment planning and follow up after radiological intervention. Interventional procedures such as angioplasty/stenting, helps in relieving the congestion by providing a satisfactory bypass.

Choosing a Thermal Ablation Technique: Microwave versus Radiofrequency Ablation

**PURPOSE/AIM**
1. To review the mechanisms of microwave and radiofrequency ablation
2. To review the indications/contraindications for heat-based percutaneous ablation
3. To demonstrate the advantages and disadvantages of each technique
4. To compare the costs of percutaneous radiofrequency and microwave tumor ablation

**CONTENT ORGANIZATION**
Microwave ablation
- Mechanism of action
Two commonly used heat-based modalities of tumor ablation, radiofrequency and microwave ablation, have specific differences in techniques that interventionalists can utilize to provide precision tumor directed therapy. Studies demonstrate that microwave ablation is able to achieve larger ablation volumes, uses shorter ablation cycles, and is less susceptible to the heat sink effect. Although radiofrequency ablation has been more extensively evaluated in the scientific literature, neither technique has been proven to provide superior outcomes or cost effectiveness.

Renal Denervation in End Stage Renal Disease Patients with Challenging Anatomy: Technical Aspects, Pitfalls and Preliminary Results

Valerio Da Ros, MD
Giovanni Simonetti, MD
Alessio Spinelli, MD
Daniele Morosetti, MD
Roberto Gandini, MD, PhD
Silvia D’Onofrio

PURPOSE/AIM
We describe our preliminary experience of Percutaneous Renal Denervation (PRD) in End Stage Renal Disease Patients with Resistant Hypertension (RH-ESRD) and challenging anatomy, assessing procedural feasibility, safety and efficacy.

CONTENT ORGANIZATION
Four RH-ESRD patients (mean Hemodialysis time 2.3 years) assuming at least four antihypertensive medications underwent PRD. Renal arteries eligibility includes absence of prior renal artery interventions, vessel stenosis All patients were successfully treated without any intra/post-procedural complications, showing 24-h Ambulatory Blood Pressure (AMBP) reduction at 12 months follow-up.

SUMMARY
PRD seems a feasible approach for ESRD-RH Patients with encouraging short term preliminary results in term of procedural efficacy and safety

A Practical Guide to the Not-So-Normal Uterine Fibroid Embolization

Anne Gill, MD
Pardeep K Mittal, MD
Emilio E Lopez, MD
Courtney A Coursey, MD *
Gail L Peters, MD

PURPOSE/AIM
- To review characteristic appearance of uterine fibroids on CT and MRI
- To describe indications/contraindications for uterine fibroid embolization (UFE)
- To delineate typical procedure and post-procedure course for UFE
- To demonstrate unusual findings encountered during UFE evaluation, performance, and post procedure follow-up
- To teach interventional techniques and strategies used to manage difficult patient presentations and challenging anatomy during UFE

CONTENT ORGANIZATION
- Pre-procedural imaging protocols for uterine fibroids
- Pictorial review of typical UFE
- Demonstrate unusual findings encountered during UFE including: aberrant uterine arteries, ovarian fibroid supply, and fibromuscular dysplasia
- Show examples of imaging presentations that preclude UFE
- Provide recommendations on how to proceed when unexpected findings are encountered during the evaluation or treatment periods
- Review expected and unexpected post UFE MRI imaging findings

SUMMARY
Uterine fibroid embolization began in 1995 and has come to be accepted as a safe and effective alternative to the surgical management of fibroids. The vast prevalence of fibroids mandates that atypical findings will inevitably be encountered; therefore, it is critical to be aware of the commonest of these and have a plan on how to proceed.

Revisiting Recommendations for Central Venous Catheter Tip Position and Identification on Chest Radiograph

Zoe A Miller, MD
Bradley B Pua, MD *
Daisy Q Huang, MD
Ronald S Winokur, MD
Akhilesh K Sista, MD
David C Madoff, MD

PURPOSE/AIM
1. Review the recommendations by authorities for central venous catheter tip position and its basis. 2. Review complications of leaving catheter tips in various upper extremity locations. 3. Review current literature surrounding accurate location of the cavoatrial junction on a chest radiograph and its implications.

CONTENT ORGANIZATION
Controversy surrounds the best location for central venous catheter tip position stemming from balancing optimal function while mitigating catheter complications. This exhibit explores the opinions put forth by organizations like the FDA, SIR, the National Kidney Foundation and various nursing societies with a review of literature supporting or refuting each recommendation. The second aim of this exhibit focuses on...
determination of the position of central venous catheter tips as determined on chest radiography. This exhibit reviews the current literature on how to determine the location of the cavoatrial junction which includes correlation with cross-sectional imaging.

**SUMMARY**

Upon review of this exhibit, viewers will obtain an understanding of the basis of various organization recommendations on optimal catheter tip position for central catheters. Viewers will be able to identify the cavoatrial junction on chest radiograph as validated by studies which correlate its location with cross-sectional imaging.

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**Liver-directed Therapies for Neuroendocrine Tumor Metastases: Techniques and Follow-up Guidelines**

**LL-VIE4003**

Jordan Castle, MD
Tanakorn Songrug, MD
Joshua D Dowell, MD, PhD

**PURPOSE/AIM**

CONTENT ORGANIZATION

**SUMMARY**

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**Tips and Tricks for the Use of Ethylene Vinyl Alcohol Copolymer (Onyx) in Peripheral Vessels**

**LL-VIE4004**

Mohammad A Saeed Kilani, MD
Jean Izaaryene, MBBCh
Guillaume Louis, MD
Jean-Yves Gaubert, MD
Jean-Michel Bartoli, MD
Vincent Vidal, MD

**PURPOSE/AIM**

Onyx is a liquid embolic agent composed of ethylene vinyl alcohol copolymer dissolved in dimethyl sulfoxide. It was approved for embolization of cerebral and dural arteriovenous malformations. The aim of this work is to emphasize precautions and measures to be considered before and during use of Onyx in peripheral vessels in order to avoid potential complications and toxicity that may result from its use.

**CONTENT ORGANIZATION**

I. Introduction: Chemical and physical characteristics of EVOH (Onyx)
II. When to use Onyx in peripheral vessels
III. Preparation for use of Onyx
IV. Precautions to be taken during Onyx injection
V. Examples of complications related to mishandling of Onyx

**SUMMARY**

Onyx is a well-known liquid embolic agent in interventional neuroradiology procedures. Its unique physical and chemical properties may be of great help in many challenging situations in peripheral endovascular procedures. It is considered by some interventional radiologists as a complex embolic agent. Knowledge regarding handling precautions of this product is mandatory to prevent potential complications. This work aimed to summarize the features, indications and appropriate ways to deal with this promising embolic agent in non-neuroradiological applications.

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**Radiological Interventions in Portal Hypertension**

**LL-VIE4005**

Shivanand R Gamanagatti, MBBS, MD
Rajeshkumar Gupta, MBBS, DMRD
Subrat K Acharya, MBBS, MD
Pramod Garg, MBBS, MD
Arundeep Arora

**PURPOSE/AIM**

1. To discuss the various interventions performed in patients with portal hypertension
2. To discuss the role of various imaging techniques that help in treatment planning and follow up after endovascular management.

**CONTENT ORGANIZATION**

Interventions that reduce portal blood pressure:

- Transjugular intrahepatic portosystemic shunts (TIPS)
- Recanalization of hepatic venous outflow
- Recanalization of the occluded portal vein and its tributaries
- Embolization of arterioportal fistula
- Partial splenic embolization

Interventions to palliate symptoms related to portal hypertension (without altering the portal blood pressure):

- Percutaneous transhepatic variceal embolization
- Balloon retrograde obliteration of gastric varices (BRTO)

Imaging techniques: An imaging tour that helps in which procedure to use in a particular setting.

**SUMMARY**

There are various interventional procedures that can be offered to patients with PHT. The choice of the procedure is based on the etiology of PHT, the symptoms, the clinical status, and the results of imaging studies. Most procedures now offer high success rates, good mid- and long-term results, and significantly less morbidity than the corresponding surgical procedures.

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**How to Choose and Successfully Access an Arterial Puncture Site: Techniques and Tips**

**LL-VIE4006**

Elizabeth R Tang, MD
Jordan V Lao, MD
Ducksoo Kim, MD

**PURPOSE/AIM**

Depending on the angiographic goal, the interventionalist may choose among a variety of potential arterial puncture sites. The purpose of
BACKGROUND:

Balloon occluded retrograde transvenous obliteration (BRTO) is an effective therapy for managing bleeding gastric varices which have a higher mortality rate than esophageal varices. While TIPS is effective for bleeding esophageal varices by reducing portosystemic gradients, gastric varices remain at low portosystemic gradients and maintain high rates of rebleeding. BRTO can be performed in patients with poor liver function or hepatic encephalopathy. This exhibit will provide a procedural review while including anatomic and technical considerations as well as techniques to prevent and treat complications.

PURPOSE/AIM

1. Overview of common arterial puncture sites.
2. General principles to consider when selecting an appropriate site.
3. Techniques specific to the site (e.g., patient positioning).
4. Specific tips to consider for successfully accessing the site.

This exhibit will present principles and contributing factors to consider when selecting an appropriate arterial puncture site for angiography, as well as techniques and tips for successfully achieving arterial access at the common puncture sites.

SUMMARY


CONTENT ORGANIZATION

1. Anatomy of portal system vasculature.
2. Pathophysiology of bleeding esophageal and gastric varices.
3. Rationale for BRTO as adjunct to TIPS or stand-alone therapy for bleeding gastric varices.
4. Clinical and Imaging findings.
5. Step-by-step procedural review for performing BRTO.
7. Post-procedural imaging results.
8. Complications and post-treatment management.

This exhibit provides a procedural review while including anatomic and technical considerations as well as techniques to prevent and treat complications.

**An Image Rich Procedural Review of Balloon Occluded Retrograde Transvenous Obliteration (BRTO) of Gastric Varices**

**LL-VIE4009**

Debkumar Sarkar , DO
Joshua S Chern , DO
Anton Mahne , MD

PURPOSE/AIM

To review the indications for performing balloon occluded retrograde transvenous obliteration (BRTO) of gastric varices and provide an image rich step-by-step review of the procedure with an emphasis on management of potential complications in the treatment of bleeding gastric varices.

CONTENT ORGANIZATION

A. Anatomy of portal system vasculature.
B. Pathophysiology of bleeding esophageal and gastric varices.
C. Rationale for BRTO as adjunct to TIPS or stand-alone therapy for bleeding gastric varices.
D. Clinical and Imaging findings.
E. Step-by-step procedural review for performing BRTO.
F. Review of catheters and embolization agents.
G. Post-procedural imaging results.
H. Complications and post-treatment management.

SUMMARY

Balloon occluded retrograde transvenous obliteration is an effective therapy for managing bleeding gastric varices which have a higher mortality rate than esophageal varices. While TIPS is effective for bleeding esophageal varices by reducing portosystemic gradients, gastric varices remain at low portosystemic gradients and maintain high rates of rebleeding. BRTO can be performed in patients with poor liver function or hepatic encephalopathy. This exhibit provides a procedural review while including anatomic and technical considerations as well as techniques to prevent and treat complications.

**Inferior Vena Caval Mass Lesions: Radio-pathological Correlation**

**LL-VIE4008**

Krunit R Rathod , MBBS
Hemant Deshmukh , MBBS
Bhavesh Popat , MBBS
Amit C Sahu , MD
Yogesh S Thube , MD
Pradeep Vaideeswar , MD

PURPOSE/AIM

1. To review the normal angiographic appearance of IVC mass lesions.
2. To determine the level of obstruction and describe corresponding collateral pathways.
3. To describe role of conventional angiography in planning endovascular management.
4. To differentiate from pseudolesions of IVC.

SUMMARY

1. Characteristic CT imaging features and radio-pathological correlation to classify IV mass lesions into neoplastic and non-neoplastic lesions.
2. To differentiate from pseudolesions of IVC.

CONTENT ORGANIZATION

1. General principles to consider when selecting an appropriate site.
2. General techniques for obtaining arterial access.
3. Overview of common arterial puncture sites.
4. Ultrasound-guided vs. by palpation.
5. Single vs. double wall technique.
6. For each arterial puncture site:
   a. Anatomy/risks specific to the site.
   b. Specific tips to consider for successfully accessing the site.

This exhibit is to review the principles of selecting an appropriate arterial puncture site, to discuss the advantages and disadvantages of commonly accessed arterial puncture sites (e.g., common femoral, high brachial, radial, etc.), and to illustrate techniques and tips for successfully accessing these sites.

**Veins in Chains: A Review of Angiographic Findings in Budd-Chiari Syndrome and Its Role in Planning Endovascular Management**

**LL-VIE4007**

Karuna Agawane , MBBS
Monika S Bapat , MBBS
Palak B Popat , MBBS, MD
Jayashree R Jadhav , MBBS, DMRD
Priya Hira , MBBS, DMRD
Pradeep Vaideeswar , MBBS, MD

PURPOSE/ AIM

1. To review the normal angiographic appearance of hepatic venous outflow.
2. To determine the level of obstruction of hepatic venous outflow and describe corresponding collateral pathways.
3. To describe role of conventional angiography in planning endovascular management.

SUMMARY

1. Characteristic CT imaging features and radio-pathological correlation to classify IV mass lesions into neoplastic and non-neoplastic lesions.
2. To differentiate from pseudolesions of IVC.

CONTENT ORGANIZATION

1. To review the etiopathogenesis of IVC involvement by intra-extra-luminal masses, affecting the infrahepatic, retrohepatic, and suprahepatic segments.
2. To classify these lesions into neoplastic and non-neoplastic lesions with characteristic computed tomographic (CT) features and pathological correlation.

**Back to Top**
Three-Dimensional Ultrasound for Guiding Abdominal Interventions, Current Stage of Development and Limitations

LL-VIE4010
David Hu, BS
Rajeev Suri, MD
Jorge E Lopera, MD *
Ghazwan M Kroma, MD
Andres E Garza-Berlanga, MD

PURPOSE/AIM
1. Review imaging techniques (CTA, MRA, DSA) for the evaluation of the inframalleolar arterial vasculature
2. Highlight cross sectional imaging of inframalleolar vasculopathies – diabetic vascular disease; vasculitidis; vascular malformations; embolic
3. Describe recanalization and occlusive vascular techniques and provide an evidence based review for the vascular management of inframalleolar vascular disease

CONTENT ORGANIZATION
1. Arterial anatomy of the pedal circulation
2. Imaging (CTA, MRA, DSA) evaluation of inframalleolar arterial vasculature
3. Imaging evaluation of inframalleolar vasculopathies – diabetes; vasculitidis; vascular malformations; embolic
4. Recanalization techniques (laser, angioplasty, atherectomy, thrombolytics, vasodilators) for occlusive vasculopathies
5. Occlusive techniques (alcohol, NBCA, glue, coils) for high flow vasculopathies
6. Evidence based review of the endovascular management for inframalleolar vascular disease

SUMMARY
Pedal tissue follows an end organ physiology similar to that of myocardial tissue and should be managed with similar urgency. The aim of this exhibit is to highlight awareness of inframalleolar vascular imaging and interventions as being essential to improving amputation free survivals.

Endovascular Management of Pulmonary Vascular Abnormalities

LL-VIE4011
Varun A Thakur
Yogesh S Thube
Kiran V Naiknaware
Bhavesh Popat
Hemant Deshmukh
Krantikumar R Rathod, MBBS, MD

PURPOSE/AIM
1. To review pulmonary vascular anatomy,
2. To discuss the imaging features and endovascular management of pulmonary vascular abnormalities.

CONTENT ORGANIZATION
1) Knowledge of pulmonary vascular anatomy is essential to detect, locate and plan endovascular management of pulmonary vascular abnormalities,
2) Brief description of various pulmonary vascular abnormalities.
3) Diagnosis of various pulmonary vascular abnormalities on X-ray, CT scan, and DSA.
4) Protocols and materials used in the endovascular management of pulmonary vascular abnormalities.

SUMMARY
Pulmonary vascular abnormalities like Pulmonary AVMs, Rasmussen Aneurysm, Pulmonary artery stenosis and Pulmonary AVFs are rare. However, when they occur, they maybe life threatening. Surgery has been the mainstay of treatment for a few of them since long. With the advent of Interventional Radiology, the management of these conditions has dramatically changed, thereby making it a safe, effective and organ sparing alternative with significant decrease in the morbidity and mortality.

Three-Dimensional Ultrasound for Guiding Abdominal Interventions, Current Stage of Development and Limitations

LL-VIE4012
Hamid Reza Sadeghi Neshat, MSc
Derek W Cool, MD, PhD *
Matthew Bastian-Jordan, MBBS, BSc
Nirmal Kakani, MD
Aaron Fenster, PhD *

PURPOSE/AIM
To outline available technologies, main advantages and limitations of three-dimensional ultrasound (3D US) imaging for guiding abdominal interventions, and to review current and potential applications of 3D US in practice.

CONTENT ORGANIZATION
Development of 3D US has been active for more than two decades. Currently, 3D and tracked 2D ultrasound imaging technology is available on newer US machines or through external tracking equipment. However, its use in guiding interventional procedures is not widespread. In this presentation, we review available technologies to construct and visualize 3D US images. Each technology will be presented along with its advantages and limitations focusing on abdominal interventions. We present examples from our experience indicating the role of 3D US imaging compared to other modalities in planning and guiding a number of routine clinical and investigational procedures including image-guided biopsies and percutaneous tumor ablation in liver and kidneys.

SUMMARY
Ultrasound remains the main real-time modality to guide abdominal interventions. 3D US imaging possible through different technologies is growing and shown to be increasingly important. Understanding available technologies as well as their advantages and disadvantages can help to select the most efficient tool in current and future applications.

Three-Dimensional Ultrasound for Guiding Abdominal Interventions, Current Stage of Development and Limitations

LL-VIE4012
Hamid Reza Sadeghi Neshat, MSc
Derek W Cool, MD, PhD *
Matthew Bastian-Jordan, MBBS, BSc
Nirmal Kakani, MD
Aaron Fenster, PhD *

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Ultrasound remains the main real-time modality to guide abdominal interventions. 3D US imaging possible through different technologies is growing and shown to be increasingly important. Understanding available technologies as well as their advantages and disadvantages can help to select the most efficient tool in current and future applications.

To Retrieve, or Not to Retrieve: Improving Patient Care and Management Following Optional IVC Filter Placement

LL-VIE4014
Summit Shah, MD
Kyle J Cooper, MD
Gregory E Guy, MD
Joshua D Dowell, MD, PhD

PURPOSE/AIM
Increased utilization of optional inferior vena cava filters (IVCFs) for temporary indications and associated long-term adverse events has prompted strategies to improve IVCF retrieval rates. This exhibit aims to provide an updated summary on optional IVCFs and present novel strategies to optimize patient care and improve IVCF retrieval rates.

CONTENT ORGANIZATION
1. Review the current literature on optional IVCFs, including filter types, placement and retrieval indications, and potential long-term complications. 2. Review data on optional IVCF placement, retrieval rates and long-term care. 3. Present novel strategies to improve retrieval rates and patient management, including pre-procedural filter selection, patient and physician communication and education, discharge planning, and IVCF clinic implementation and structure. 4. Present data on the implementation and effects of these strategies on retrieval rates at our institution.

SUMMARY
1. Knowing the indications for optional IVCFs and potential long-term complications is essential for patient care. 2. Understanding patient management strategies and steps toward their implementation post IVCF placement is important for improved outcomes. 3. Active radiologist participation in a patient's post-procedural management may positively impact IVCF retrieval rates and practice building.

Cardiac (Radiation Dose Reduction)

Sunday, 10:45 AM - 12:15 PM • S504AB

SSA03 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Gregory W Gladish, MD
Moderator
Konstantin Nikolau, MD *

SSA03-01 • Detection of Coronary Artery Stenosis with Sub millisievert Radiation Dose by Prospectively ECG-triggered High
Pitch Spiral CT Angiography and Iterative Reconstruction

Wei-Hua Yin (Presenter) ; Bin Lu MD ; U. Joseph Schoepf MD * ; Zhi-Hui Hou MD ; Fang-Fang Yu ; Yang Gao ; Hui-Li Cao ; Zhi-Qiang Wang

PURPOSE
To evaluate the diagnostic accuracy of sub-milliSievert (mSv) coronary CT angiography (cCTA) using prospectively ECG-triggered high-pitch spiral CT acquisition combined with iterative image reconstruction.

METHOD AND MATERIALS
IRB approval and informed patient consent were obtained. Forty consecutive, unselected patients (52±8.7 years; 30 men) underwent contrast (370mgI/mL iopromide) enhanced dual-source cCTA using prospectively ECG-triggered high-pitch spiral acquisition. Tube current-time product was set to 50% of standard-of-care CT examinations. Images were reconstructed with sinogram-aided iterative reconstruction. Image quality was scored and diagnostic performance for detection of ≥50% stenosis was determined with catheter coronary angiography (CCA) as the reference standard.

RESULTS
CT examinations were successfully performed in all 40 patients. Of the 601 assessable coronary segments, 543 (90.3%) had diagnostic image quality. Per-patient sensitivity for detection of ≥50% stenosis was 95.7% (95% confidence interval [CI], 76.0-99.8%) and specificity was 94.1% (95% CI, 69.2-99.7%). Per-vessel sensitivity was 89.5% (95% CI, 77.8-95.6%) with 93.2% specificity (95% CI, 86.0-97.0%). The area under the receiver-operating characteristic curve on per-patient and per-vessel levels was 0.949 and 0.913, respectively. Mean effective dose was 0.58±0.17mSv. Mean size-specific dose estimate was 3.14±1.15mGy.

CONCLUSION
High-pitch prospectively ECG-triggered cCTA combined with iterative image reconstruction provides high diagnostic accuracy with a radiation dose below 1 mSv for detection of coronary artery stenosis in an unselected patient population.

CLINICAL RELEVANCE/APPLICATION
Continuous reduction in radiation exposure associated with cardiac CT should widen the clinical acceptance and application of this non-invasive test.

SSA03-02 ● Contrast Material and Radiation Dose Reduction Strategy for Triple-rule-Out Cardiac CT Angiography: Feasibility Study of Serial Non-ECG-Gated Low kVp Scan of the Whole Chest

Masafumi Kidoh ; Takeshi Nakaura MD (Presenter) ; Shinichi Nakamura MD ; Kazunori Harada ; Shouzaburo Uemura ; Yasuyuki Yamashita MD * ; Tomohiro Namimoto MD ; Naritsugu Sakaino

PURPOSE
The purpose of this study was to investigate the feasibility of a contrast material and radiation dose reduction triple-rule-out (TRO)-CT angiography (CTA) protocol with serial non-ECG-gated low kVp scan of the whole chest, which utilizes a recirculated contrast agent.

METHOD AND MATERIALS
This prospective study received institutional review board approval; prior informed consent to participate was obtained from all patients. The 60 enrolled patients were randomly assigned to 2 TRO-CTA protocols. Thirty patients were scanned with the new TRO-CTA protocol; after the coronary scan with retrospective ECG-gating, non-ECG-gated whole-chest CTA was performed at 80 kVp to evaluate aortic arch (AA) and pulmonary trunk (PT). The other 30 patients were scanned by our conventional TRO-CTA protocol at 120 kVp with retrospective ECG-gating. We compared estimated effective dose (ED), CM (contrast medium) dose and contrast-to-noise ratio (CNR) of the ascending aorta (AAo) and pulmonary trunk (PT). We also compared the rate of patients who could achieve adequate AAo attenuation (160 HU) and adequate PT attenuation (200 HU) between the two protocols. Two-tailed Student’s t-test was used to compare CM dose, ED and CNR on new TRO-CTA and conventional TRO-CTA scans. To compare the success rate of adequate attenuations of the PT and AAo, we used the 2 test.

RESULTS
The total ED of the new TRO-CTA protocol was significantly lower than that of the conventional protocol (23.5±2.6 mSv vs. 33.4±1.4 mSv, p<0.05).

CONCLUSION
The new TRO-CTA protocol could feasibly reduce the total dose of radiation and the contrast dose and yielded adequate vascular enhancement compared with the conventional protocol.

CLINICAL RELEVANCE/APPLICATION
Triple-rule-out TRO-CTA protocol with serial non-ECG-gated low kVp scan of the whole chest could feasibly reduce the total dose of radiation and the contrast dose compared with the conventional protocol.

SSA03-03 ● Assessment of Image Quality and Radiation Dose of Prospectively Triggered Adaptive Coronary CT Angiography: In Comparison with Retrospectively Gated Mode and High Pitch Mode

Yunling Wang (Presenter) ; Hong Wang

PURPOSE
The purpose of this study was to evaluate the image quality and radiation dose of dual-source computed tomography (DSCT) application in coronary computed tomography angiography (CTA), using three different modes: prospectively electrocardiogram (ECG)-triggered sequential scan mode, retrospectively ECG-gated spiral scan mode and Flash spiral scan mode.

METHOD AND MATERIALS
Ninety eligible patients (47 males and 43 females, mean age 54.3 years), with heart rate within 60 to 80 beat per minute (bpm) and regular heart rhythm (fluctuation =10bpm), were included in this study. They are randomly distributed into three groups: 30 patients in Group A using prospectively ECG-triggered sequential mode, 30 in Group B using retrospectively ECG-gated spiral mode and 30 in Group C using Flash spiral mode. The X-ray tube voltages were selected according to body mass index (BMI). Both the radiation dose and image quality were evaluated and compared, which were based on statistics analysis of image score, HU value standard deviation (SD), Signal-Noise Ratio (SNR, mean/SD), Contrast-Noise Ratio (CNR).

RESULTS
The mean image score in Group A is 3.36±0.39, with effective radiation dose of 5.12±0.77 mSv, SD of 17.8±0.51, SNR of 23.64±0.49, and CNR of 20.77±0.45. The mean image score in Group B is 3.58±0.51, with effective radiation dose of 6.79±0.41 mSv, SD of 18.8±0.46, SNR of 22.12±0.55, and CNR of 27.87±0.38. The mean image score in Group C is 1.47±0.62, with effective radiation dose of 0.89±0.81 mSv, SD of 15.1±0.44, SNR of 34.9±0.67, and CNR of 47.77±0.56. There were significant differences in the radiation dose and the image quality among these three groups (p<0.05).

CONCLUSION
The prospectively triggered mode has a better image quality and lower radiation dose, compared with retrospectively gated mode and Flash mode, which may be the first choice in CTA imaging.

CLINICAL RELEVANCE/APPLICATION
The prospectively triggered mode has a better image quality and lower radiation dose, compared with retrospectively gated mode and Flash mode, which may be the first choice in CTA imaging.

SSA03-04 ● Impact of Model Based Iterative Reconstruction on Noise Reduction of Ultra Low-dose Coronary CT Angiography

Wei-Hua Yin (Presenter) ; Bin Lu MD ; U. Joseph Schoepf MD * ; Zhi-Hui Hou MD ; Fang-Fang Yu ; Yang Gao ; Hui-Li Cao ; Zhi-Qiang Wang

PURPOSE
To evaluate the diagnostic accuracy of sub-milliSievert (mSv) coronary CT angiography (cCTA) using prospectively ECG-triggered high-pitch spiral CT acquisition combined with iterative image reconstruction.

METHOD AND MATERIALS
IRB approval and informed patient consent were obtained. Forty consecutive, unselected patients (52±8.7 years; 30 men) underwent contrast (370mgI/mL iopromide) enhanced dual-source cCTA using prospectively ECG-triggered high-pitch spiral acquisition. Tube current-time product was set to 50% of standard-of-care CT examinations. Images were reconstructed with sinogram-aided iterative reconstruction. Image quality was scored and diagnostic performance for detection of ≥50% stenosis was determined with catheter coronary angiography (CCA) as the reference standard.
SSA03-05 • Dual Source Cardiac Computed Tomography Angiography (CCTA) in the Follow Up of Cardiac Transplant: Comparison of Image Quality and Radiation Dose Using Three Different Scan Protocols

Florian Wolf MD (Presenter); Dietrich Beitzke MD; Vanessa Berger-Kulemann; Richard Nolz; Gudrun Feuchtner MD *

Christian Loewe MD *

Purpose
Cardiac allograft vasculopathy represents a major cause of mortality in the later course of cardiac transplant. CCTA represents a valuable non-invasive imaging tool in the diagnosis of cardiac allograft vasculopathy with the disadvantage of radiation burden. Radiation dose reduction in CCTA of cardiac transplant is challenging as patients often present with elevated heart rates. The aim of this prospective randomized study was to evaluate image quality, diagnostic confidence, and radiation dose using 3 different CT scan protocols for dual-source CCTA in heart transplant recipients.

Method and Materials
Dual source CCTA was performed in 150 consecutive patients after heart transplantation using either the conventional retrospective-triggered spiral technique (120 kV/320 mA, tube current modulation) in group 1, the prospective ECG-gated sequence technique (120 kV/320 mA, main padding window 40-70%) in group 2, or the prospective ECG-gated sequence technique in the systolic phase with automated tube voltage selection (Automated kV, main padding window 35-45%) in group 3. Subjective image quality was rated using a 16-segment coronary artery model and a four-point scale (1=excellent, 2=good, 3=fair, 4=non-diagnostic) for each segment. Effective dose (ED) was used to compare the differences in radiation dose.

Results
No difference was observed in subjective image quality between the study groups regarding segments with excellent or good image quality (Group 1: 90.5%, group 2: 89.3%; group 3: 86.8%). The number of segments with non-diagnostic image quality was lowest in group 1 and group 2 (9.9±2.7 mSv vs. 9.1±2.3 mSv; p=0.13), but was significantly lower in group 3 (4.6±1.9 mSv; p<0.001). Nevertheless mean image noise decreased significantly from 32±7 HU in standard CCTA to 21±4 HU in ULDBIR CCTA (p<0.001). Interestingly, this was paralleled by an increase in mean attenuation in LMA from 466±85HU to 563±119 HU, and in RCA from 446±63HU to 503±83 HU (p<0.001). Nevertheless mean image noise decreased significantly from 32±7 HU in standard CCTA to 21±4 HU in ULDBIR CCTA (p<0.001). Nevertheless mean image noise decreased significantly from 32±7 HU in standard CCTA to 21±4 HU in ULDBIR CCTA (p<0.001). Nevertheless mean image noise decreased significantly from 32±7 HU in standard CCTA to 21±4 HU in ULDBIR CCTA (p<0.001).

Conclusion
MBIR efficiently compensates for increased noise in ULDBIR CCTA. In combination with the shift towards higher beam attenuation by iodine in low tube voltage scanning this results in a SNR substantially higher than standard CCTA.

Clinical Relevance/Application
New reconstruction algorithms such as MBIR achieve efficient noise reduction allowing substantial radiation dose reduction in cardiac CT scanning.

SSA03-06 • Sub-mSv Coronary CT Angiography for Normal Size Patient Population (BMI ≤ 25)

Qiang Ma (Presenter); Xiang Ren; Naja Liu; Shaoqing Yan; Zhiyuan Zhang; Jinrui Bao

Purpose
To study the clinical feasibility of achieving sub-mSv radiation dose and acceptable image quality for normal size patient population (20±2) in prospective ECG-triggered coronary CT angiography (CCTA) with low tube voltage.

Method and Materials
One hundred and eighty patients (heart rate: 56±4bpm, 20.5±4kg, and 190mA if BMI 22.5-25.0kg/m2). Radiation dose was recorded. CT value and image noise on aorta were measured, and signal-noise-ratio (SNR) was calculated. The image quality was evaluated blindly (5 for excellent). Independent-sample t-test was performed on dose and Mann-Whitney test on image quality scores.

Results
The overall dose for group A with 100kV was 0.69mSv, 35% lower than the 1.06mSv for group B with 120kV. For the patient population with BMI≤2: the radiation dose for group A was 0.55±0.11mSv, 32% lower than the 0.81±0.09mSv for group B (p=0.05): the radiation dose for group A was 0.73±0.09mSv, 35% lower than the 1.13±0.16mSv for group B (p=0.05).

Conclusion
Prospective ECG-triggered CCTA with low tube voltage significantly reduces radiation exposure while maintaining acceptable image quality. For the patient population with BMI≤2, sub-mSv CCTA is achievable with prospective ECG-triggering and 100kV tube voltage.

Clinical Relevance/Application
The use of prospective ECG-triggering and 100kV tube voltage in CCTA can reduce radiation to patients, and achieve sub-mSv dose for patient population with BMI≤2.

SSA03-07 • Low Tube Voltage and High Sensitive Detector Reduce the Radiation Dose of Coronary CTA

Jian Cao (Presenter); Yining Wang MD; Lingyang Kong; Lin Lu; Huadan Xue MD; Zhiwei Wang MD; Zhengyu Jin MD

Purpose
To investigate the application of low tube voltage (80kV) for coronary artery computed tomography angiography (CCTA) in patients with normal body mass index (BMI) with second generation dual-source CT equipment with novel high sensitive detector.
RESULTS

CONCLUSION
Tube voltage as 80kV in second generation dual-source CT equipped with novel high sensitive detector is feasible in patients with normal BMI. This scan mode can obviously reduce the radiation dose while with no influence on image quality.

CLINICAL RELEVANCE/APPLICATION
Tube voltage as 80kV in second generation dual-source CT equipped with novel high sensitive detector is feasible in patients with normal BMI.

SSA03-08 • Feasibility and Image Quality of Ultra-low Dose Submillisievert Radiation Exposure in Coronary CT Angiography Using Model Based Iterative Reconstruction: First Clinical Experience

Julia Stehli MD (Presenter) ; Tobias A Fuchs MD ; Sacha Bull MD, PhD ; Svetlana Dougoud MD ; Martin W Huellner MD ; Andreas Brauchlin MD ; Ronny R Buechel ; Oliver Gaemperli MD ; Philipp A Kaufmann MD

PURPOSE
To evaluate the feasibility and image quality of coronary CT angiography (CCTA) acquisition with a submillisievert fraction of effective radiation dose using model based iterative reconstruction (MBIR) for noise reduction.

METHOD AND MATERIALS
In 25 patients undergoing standard low-dose contrast enhanced CCTA (100 ± 120 kV; 450 - 700 mA) an additional same-day ultra-low dose (ULD) CCTA was acquired (80 - 100 kV; 150 - 210 mA) and reconstructed with MBIR. Two independent readers semi-quantitatively assessed image quality on a four-point Likert scale in each coronary segment (1: non-diagnostic, 2: good, 3: adequate, 4: excellent).

RESULTS
Over a wide range of weight (47 - 112 kg) and body mass index (18.4 - 40.2 kg/m²), the mean DLP from standard and ULD CCTA was 89.5 ± 29.4 mGycm (range 69.8 - 188.3 mGycm) and 15.9 ± 6.2 mGycm (range 10.2 - 35.6 mGycm) resulting in an estimated mean radiation dose exposure of 1.3 ± 0.4 mSv (range 1.0 - 2.6 mSv) for standard and 0.2 ± 0.1 mSv (range 0.1 - 0.5 mSv) for ULD CCTA (p < 0.001). Intravenous beta-blockers were administered for heart rate control prior to CCTA in 20 patients (80%) (10.8 ± 9.5mg, range 25 mg). The mean heart rate for standard and ULD CCTA was 57.3 ± 5.6 and 57.0 ± 5.9 bpm (p = ns).

A total of 100 vessels and 330 coronary artery segments with a diameter of > 1.5 mm were evaluated and revealed an inter-observer agreement of image quality of ? = 0.8. The mean image quality score per segment was 3.3 ± 0.5 in standard CCTA vs. 3.4 ± 0.6 in ULD MBIR (p < 0.05). Diagnostic image quality (score 2 - 4) was found in 319 coronary segments (97%) of standard CCTA, and 317 (96%) segments of ULD MBIR (p = ns).

CONCLUSION
Our results document the feasibility of CCTA acquisition with diagnostic image quality at an ultra-low radiation dose of 0.2 ± 0.1 mSv in combination with MBIR reconstruction.

CLINICAL RELEVANCE/APPLICATION
CCTA scanning with an ultra-low radiation dose may pave the way for the broad clinical implementation of CCTA as an alternative for the invasive angiographic procedure.

SSA03-09 • Optimization of Radiation and Contrast Dose for Cardiovascular Computed Tomography

Yajuan Wang PhD (Presenter) *; Kassem Soufan; Anjali Kottha; Corey Kemper PhD *; John F Kalafut PhD *; Sandra S Halliburton PhD *

PURPOSE
Lowering x-ray tube potential is an effective way to reduce both radiation exposure and contrast load from computed tomography (CT). This study evaluated a novel algorithm for optimizing both radiation and contrast dose at cardiovascular CT.

METHOD AND MATERIALS
67 patients referred for evaluation of thoracic aortic disease were imaged with a prospectively ECG-triggered axial technique on a 256-slice CT scanner (Brilliance iCT, Philips). X-ray parameters (tube potential, tube current) were determined from an attenuation measurement on the initial radiograph using a custom algorithm. Based on the tube potential, either 50 mL (100 kV) or 90 mL (120 kV) of contrast with a concentration of 370 mgI/mL was injected at a flow rate = 3.5 mL/s. Five circular regions of interest (ROI) were drawn at multiple locations in the lumen of the aorta along its length and the mean attenuation and standard deviation of attenuation (noise) were recorded. Average aortic attenuation, noise, and signal-to-noise ratio (SNR) were compared between 100 and 120 kV groups using Student's t test.

RESULTS
100 kV [n=40] and 120 kV [27] cohorts had similar age (62±15 vs 59±13 yrs) and height (1.74±0.10 vs 1.78±0.07 m). The cohort imaged at 100kV had significantly lower body mass index (25.7±2.8 vs. 32.0±3.2 kg/m²) and percentage of males (67.5% vs. 92.6%). Patients scanned at 120 kV had a longer scan delay (33±8 vs. 26±4 s) but similar scan time (12±1 vs. 12±1 s) compared to 100 kV patients. Image quality metrics were equivalent between groups (aortic attenuation: 287±83 vs 281±48 HU; noise: 27±4 vs 26±4 HU; SNR: 11±3 vs 11±2) despite lower contrast dose (50 vs 90 mL) and effective radiation dose (1.8±0.3 vs 3.6±0.4 mSv) at 100 kV.

CONCLUSION
Simultaneous optimization of x-ray parameters and contrast protocols yielded equivalent image noise and blood enhancement across a range of patient sizes for cardiovascular CT. Smaller patients required 49% less radiation and 44% less contrast.

CLINICAL RELEVANCE/APPLICATION
Cardiovascular CT can be performed in smaller patients using lower radiation and contrast doses compared to those used for larger patients without compromising image quality.
PURPOSE
Decision criteria for subsequent transthoracic echocardiography (TTE) after acute pulmonary embolism (PE) are needed when the CT-derived right-to-left ventricular (RV/LV) diameter ratio does not suggest RV dysfunction. The purpose of this study is to develop a clinical prediction rule for low probability of incremental prognostic benefit from subsequent TTE after acute PE.

METHOD AND MATERIALS
A single institution retrospective cohort study included 579 consecutive patients diagnosed with acute PE by CT pulmonary angiography between August 2003 and March 2010 with a normal RV/LV diameter ratio (c-statistic=0.758) and was internally validated (over-fitting bias=2.52%).

RESULTS
The study had 67 men and 32 women with age range of 19-84 years (57.97 ± 16; Mean, std dev). 76 had a history of neoplasm. BMI ranged from 16 to 40 (25.2 ± 4.8). Embolism was present in 22 patients. Contrast enhancement was excellent in the pulmonary arteries (MPA 327.4 ± 24.2, LPA 329.0 ± 24.2, RPA - 335.4 ± 26.1). SNR was good in all the pulmonary arteries (MPA 14.6 ± 6.8, LPA 14.3 ± 5.8, RPA 13.9 ± 6.6). Image quality was considered excellent by both the readers (Reader 1, 4.3 ± 1.0, Reader 2, 4.4 ± 0.9), with no significant difference between the readers (p value, 0.7). Only 4 studies were considered non diagnostic, which is less than the non diagnostic rate described in the current literature. The DLP is 157.8 ± 66 with effective dose of 2.2 ± 0.9 mSv

CONCLUSION
Using a helical acquisition technique, CTPA images with good diagnostic quality can be obtained using a very low dose of iodinated contrast and low radiation dose. There is also potential for further reduction in the contrast and radiation doses and cost savings.

CLINICAL RELEVANCE/APPLICATION
Diagnostic CTPA can be performed with ultra-low contrast dose techniques while reducing potential toxicities associated with the administration of iodinated contrast.

SSA04-02 • CT Pulmonary Angiography with Ultra Low-dose of Contrast and Radiation- Evaluation of Image Quality and Radiation Dose

Prabhakar Rajiah MD, FRCR (Presenter) ; Calen Frolkis BA ; Luis A Landeras MD ; Jennifer Paczak ; Leslie Cancibello RT ; Robert C Gilkeson MD *

PURPOSE
Iodinated contrast has been associated with renal and thyroid dysfunction. Recent literature suggests that the presence or iodinated contrast amplifies DNA radiation damage following CT. Hence, an ideal CT scan protocol should involve the least amount of radiation dose and contrast. The purpose of this study is to evaluate if image quality is preserved in a CT pulmonary angiographic (CTPA) protocol with an ultra-low dose contrast and radiation dose.

METHOD AND MATERIALS
Retrospective analysis revealed 99 patients who underwent CTPA using an ultra low-dose technique. All the scans were performed on a 128-slice Dual-source Siemens Definition Flash scanner. Images were acquired following intravenous injection of 30 ml of iodinated contrast (Optiray 350) at 4 ml/sec. Images were acquired in high-pitch helical mode (3.2), with kv of 80-120 (BMI dependent) and mAs of 130. The scan length, CTDIvol and DLP were recorded. Images were independently reviewed by 2 readers and graded on a 1 to 5 scale (1- non diagnostic, 2- probably non diagnostic, 3- probably diagnostic, 4-diagnostic, 5- excellent image quality). Signal, noise and Signal-to-noise ratio (SNR) were also recorded in main, right and left pulmonary arteries.

RESULTS
The scan length, CTDIvol and DLP were recorded. Images were independently reviewed by 2 readers and graded on a 1 to 5 scale (1- non diagnostic, 2- probably non diagnostic, 3- probably diagnostic, 4-diagnostic, 5- excellent image quality). Signal, noise and Signal-to-noise ratio (SNR) were also recorded in main, right and left pulmonary arteries.

CONCLUSION
Using a helical acquisition technique, CTPA images with good diagnostic quality can be obtained using a very low dose of iodinated contrast and low radiation dose. There is also potential for further reduction in the contrast and radiation doses and cost savings.

CLINICAL RELEVANCE/APPLICATION
Diagnostic CTPA can be performed with ultra-low contrast dose techniques while reducing potential toxicities associated with the administration of iodinated contrast.

SSA04-03 • Diagnostic Accuracy of Low-dose CT Pulmonary Angiography: Results of a Prospective Randomized Trial (REDOPED)

Zsolt Szucs-Farkas MD, PhD (Presenter) ; Andreas Christe ; Boglarka Megyeri MD ; Martin Rohacek ; Peter Vock MD ; Endre V Nagy ; Johannes T Heverhagen MD, PhD * ; Sebastian T Schindera MD *

PURPOSE
To compare diagnostic accuracy of low-dose computed tomography pulmonary angiography (CTPA), with both reduced radiation and reduced contrast material (CM) dose with a normal-dose protocol in detecting acute pulmonary embolism (PE).

METHOD AND MATERIALS
The Reduced Dose in Pulmonary Embolism Detection (REDOPED) trial was a single-centre, single-blinded, HIPAA-compliant, prospective randomized study. Five hundred and one patients with body weights of 5.8, RPA- 13.9 ± 6.6). Image quality was considered excellent by both the readers (Reader 1, 4.3 ± 1.0, Reader 2, 4.4 ± 0.9), with no significant difference between the readers (p value, 0.7). Only 4 studies were considered non diagnostic, which is less than the non diagnostic rate described in the current literature. The DLP is 157.8 ± 66 with effective dose of 2.2 ± 0.9 mSv

RESULTS
The scan length, CTDIvol and DLP were recorded. Images were independently reviewed by 2 readers and graded on a 1 to 5 scale (1- non diagnostic, 2- probably non diagnostic, 3- probably diagnostic, 4-diagnostic, 5- excellent image quality). Signal, noise and Signal-to-noise ratio (SNR) were also recorded in main, right and left pulmonary arteries.

CONCLUSION
Using a helical acquisition technique, CTPA images with good diagnostic quality can be obtained using a very low dose of iodinated contrast and low radiation dose. There is also potential for further reduction in the contrast and radiation doses and cost savings.

CLINICAL RELEVANCE/APPLICATION
Diagnostic CTPA can be performed with ultra-low contrast dose techniques while reducing potential toxicities associated with the administration of iodinated contrast.

SSA04-04 • Sub-mSv CT Imaging of Pulmonary Arteries Using an Iterative Model Reconstruction Algorithm

Daniela Muenzel MD (Presenter) ; Thomas Koehler PhD * ; Bernhard Brendel * ; Kevin M Brown MS * ; Stanislav Zabic PhD * ; Alexander A Fingerle MD ; Ernst J Rummenny MD ; Martin Dobritz MD ; Peter B Noel PhD

PURPOSE
To investigate the improvement in diagnostic quality of iterative model reconstruction (IMR) algorithm for sub-mSv computed tomography angiography of the pulmonary arteries (CTA).
METHOD AND MATERIALS

Eighteen patients (single-center, IRB approved) were imaged on a Philips Brilliance ICT (Philips, Cleveland, OH) for visualization of the pulmonary arteries, 8 with and 10 without pulmonary artery embolism. All scans were performed at 120 kVp (average effective doses 4.34±1.99mSv). Acquisitions with reduced radiation exposure were simulated from the original CT data to 15% of the tube current, resulting in a sub-mSv average dose of 0.65±0.30mSv. Filtered backprojection (FBP) was used to reconstruct the original data (protocol A); sub-mSv data were reconstructed using FBP (protocol B) and IMR (protocol C). The performance of IMR was assessed with respect to the image quality metrics image noise and contrast-to-noise ratio (CNR) and with respect to effective dose of each protocol. Two blinded readers determined subjective image quality and assessed the detectability of pulmonary artery embolism, where ground truth was obtained from protocol A.

RESULTS

With IMR noise could be subjectively removed, while the image texture (look and feel) of these images differed from FBP reconstructions. Specifically, with IMR, the noise is significantly reduced by a factor up to 20 (B vs. C). This is reflected by an improvement in the contrast-to-noise ratio and improved image quality with a median image quality score of 3 (IMR, B) vs. 1 (FBP, C), p < 0.05. With respect to diagnostics the angiographic datasets protocol A and C were identical, while B was worse: To detect pulmonary artery embolism in IMR and FBP low dose images, the sensitivity was 100% for IMR and 62.5% for FBP while specificity was 100% for both protocols.

CONCLUSION

This simulation study indicates that by using IMR for reconstruction, pulmonary artery embolism can be detected accurately in scans with sub-mSv dose levels.

CLINICAL RELEVANCE/APPLICATION

IMR has the potential to reduce patient dose and improve image quality in clinical day-to-day routine.

SSA04-05 • Impact of Perfusion Imaging on the Assessment of Peripheral Chronic Pulmonary Thromboembolism: Clinical Experience in 62 Patients

FOUNDER

Francesco Molinari MD (Presenter) ; Julien Le Faire MD ; Francois Pontana MD ; Kanna Yasunaga MD ; Jacques Remy MD * ; Martine J Remy-Jardin MD, PhD *

PURPOSE

To evaluate the impact of perfusion imaging on the detection of peripheral chronic pulmonary thromboembolism (CPTE).

METHOD AND MATERIALS

62 patients (30 males; 32 females; mean age: 60 yr) with chronic thromboembolic disease underwent a dual-source, dual-energy chest CT angiographic examination with (a) reconstruction of diagnostic (i.e., averaged images from both tubes) and pulmonary blood volume (PBV) images; (b) enabling separate depiction of peripheral CPTE on diagnostic images (i.e., cross-sectional images viewed on lung and mediastinal window settings for analysis of segmental arteries, completed by maximum intensity projections for the subsegmental level) and perfusion defects on MPRs of PBV images. On diagnostic scans, the CT features of CPTE included stenosed arterial branches and/or endoluminal filling defects within segmental and subsegmental arteries. On PBV images, embolic type defects consisted of triangular, pleural-based and sharply margined hypoattenuated areas which recorded at a segmental level (20 segments/patient; total: 1240 segments). The readings of diagnostic and perfusion images were independently performed by two readers.

RESULTS

On diagnostic images: (a) the analysis of segmental arteries depicted CT features of CPTE within 476 segments; (b) the analysis of both segmental and subsegmental arteries depicted CT features of CPTE within 872 segments. PBV imaging depicted: (a) 313 segments with perfusion defects at the level of which segmental arteries had not been diagnosed with CPTE, increasing the number of segments affected by CPTE by 66% (313/476); (b) 66 segments with perfusion defects at the level of which subsegmental arteries had not been diagnosed with CPTE, increasing the number of segments affected by CPTE by 7.5% (66/872).

CONCLUSION

The reading of PBV images enables depiction of a greater number of segments involved in peripheral CPTE.

CLINICAL RELEVANCE/APPLICATION

Depiction of CT features of CPTE at the level of the segmental and subsegmental pulmonary arterial bed is improved by the reading of PBV images.

SSA04-06 • Detection of Pulmonary Hypertension in Patients with Cystic Fibrosis (CF) Using Magnetic Resonance (MR) Flow Measurements

FoUNDER

Nino Kiria MD (Presenter) ; Jutta Hammermann ; Bernhard Schulte-Hubbert ; Michael Laniado MD ; Nasreddin Abolmaali MD

PURPOSE

Pulmonary arterial hypertension (PAH) is a severe complication of a cystic fibrosis lung disease. The aim of this study was to evaluate MR based flow measurements in the pulmonary trunk to detect evolving signs of PAH in patients suffering from CF.

METHOD AND MATERIALS

23 patients (median age: 25 years, age range: 11-39 years, 10 female, 13 male) suffering from CF of different severity were examined using MRI based flow measurements. The examinations were performed at 1,5 Tesla scanner using body matrix coils and were the part of an annual follow-up. In addition to the standard CF-lung protocol an ECG-triggered phase-contrast flow measurement was acquired over the entire cardiac cycle with a temporal resolution of 12 ms. The assessed data, especially the acceleration times (AT, [ms]) and the mean diameter of the pulmonary trunk was 4.1+-1 cm. The CF-patients with suspected PAH showed a mean AT of 131+-25 ms and the mean diameter of the pulmonary trunk was 4,1 +1 - 1 cm. The CF-patients with suspected PAH showed a mean AT of 131+-25,9 ms and a mean diameter of the pulmonary trunk of 5,1+-1,2 cm.

CONCLUSION

Signs for the development of a PAH (i.e. reduction of AT) are detectable using MRI based flow measurements. This technique could be a valuable screening tool for CF patients to identify the development of a PAH. Correlation to the echocardiographic results of the respective five patients will be presented.

CLINICAL RELEVANCE/APPLICATION

As PAH is a crucial complication of CF, MRI based flow measurements in pulmonary trunk can be helpful for detection, follow-up and control of therapy of PAH in CF patients.

SSA04-07 • Evaluation of Pulmonary Hypertension (PH) by Pulmonary Artery (PA) Tortuosity Measurements: Correlations with Mean Pulmonary Artery Pressure (mPAP) and Pulmonary Vascular Resistance (PVR)

Seyed Ameli-Renani MBBS,FRCR (Presenter) ; Jenny L Bacon MRCP * ; Sarah L Sheard MBBS, FRCR ; Anand Devaraj MBBS ;
SSA04-08 • Incidence of Repeat CT Pulmonary Angiography for Suspected Pulmonary Embolism and Clinical Factors Associated with Repeat Testing

Daniel M Adams MD (Presenter) ; Scott Woller MD ; Scott Stevens MD * ; Scott Evans PhD ; Greg Snow PhD ; Joseph Bledsoe MD ; Jim Lloyd BS ; Todd D Lovelace MD ; Valerie Aston RT ; C. Gregory Elliott MD

PURPOSE
CT pulmonary angiography (CTPA) for suspected pulmonary embolism (PE) is a frequently performed exam that bears inherent risks. We measured the proportion of exams performed for patients who undergo repeat CTPA and identified differences in characteristics for those patients.

METHOD AND MATERIALS
This retrospective study was performed at Intermountain Medical Center and LDS Hospital in the Salt Lake City, Utah area. Consecutive CTPA exams for suspected PE ordered from the emergency department from May 22, 2009 to June 30, 2010 were identified. Data for patient characteristics were extracted from the medical record electronically and by manual review. Pretest probability was calculated with the Revised Geneva Score (RGS). d-dimer values were collected, and the final interpretation of each CTPA was recorded. Guideline concordant use was defined as CTPA being ordered for ‘PE Likely’ (RGS >10) patients or following a d-dimer that was positive among PE Unlikely (RGS = 10) patients. All patients who underwent multiple examinations were identified, and comparisons of patient characteristics from CTPA encounters were made based on whether a single exam or multiple exams were performed during the study period.

RESULTS
3500 CTPA exams for suspected PE were performed during the study period for 3279 individual patients. 3090 patients had 1 exam, 164 patients had 2 exams, 19 patients had 3 exams, 5 patients had 4 exams, and 1 patient had 5 exams. Repeat examinations were associated with younger mean age (50 vs. 53 years); a higher incidence of prior venous thromboembolism (48.0% vs. 15.7%), trauma (6.6% vs. 2.9%), and signs and symptoms of deep vein thrombosis (unilateral leg pain 10.5% vs. 6.7%, signs of DVT 9.5% vs. 6.2%); and a higher mean pretest probability for PE (RGS 6.3 vs. 5.0). Repeat exams also had a higher yield of positive interpretations (14.4% vs. 9.1%); and were less frequently performed in concordance with evidence-based guidelines (39.5% vs. 46.3%).

CONCLUSION
Repeat CTPA exams are commonly performed. Patients receiving multiple exams have a higher clinical pretest probability and incidence of PE than patients receiving single CTPA exams. Repeat CTPA exams are less likely to be performed in concordance with evidence-based guidelines.

CLINICAL RELEVANCE/APPLICATION
In these settings, repeat CTPA exams were common and often show acute PE although they were less likely to be performed in concordance with evidence-based guidelines.

SSA04-09 • 70 kV CT Pulmonary Angiography - Advantages of a Dual-source Protocol with Reduced Iodine Load

Ralf W Bauer MD (Presenter) * ; Claudia Frellesen ; Firas Al-Butmeh ; Boris Bodelle MD ; Julian L Wichmann MD ; Josef Matthias Kerl MD * ; Martin Beeres MD ; Boris Schulz MD ; Thomas Lehner MD ; Thomas J Vogl MD, PhD

PURPOSE
Lower kV settings go along with higher iodine attenuation, but also with increased noise, if mA are not adapted accordingly. Low kV scanning opens the door for the application of low iodine content contrast agents with potential benefits for patients with reduced kidney function. We investigated the potential of a novel 70 kV dual-source CTPA protocol (DS70) with low iodine load in comparison to a single-source 70 kV (SS70) and 100 kV (SS100) protocol with standard iodine load in terms of image quality and radiation exposure.

METHOD AND MATERIALS
Each 20 consecutive patients with suspected pulmonary embolism underwent CTPA either with a standard single-source 100 kV (120 mAs; group 1), a single-source 70 kV (208 mAs; group 2) or a novel dual-source 70 kV protocol (416 mAs; group 3). A dual-source protocol can overcome tube output restrictions that occur at 70 kV by using both X-ray tubes of the scanner simultaneously. Contrast enhancement was achieved with 70 ml of a contrast agent with 400 mgI/ml in group 1 and 2, whereas in group 3 the same volume was injected but with a lower iodine concentration of 300 mgI/ml. Injection rate was constant at 4 ml/s and bolus tracking was used for automated scan start. CTDIvol, DLP, noise, signal intensity in the pulmonary trunk and segmental arteries and corresponding SNR values were compared.

RESULTS
Chest diameter was not statistically significantly (p>0.05) different between the groups. CTDIvol (median: 5.86 vs. 2.49 vs. 5.79 mGy) and DLP (167 vs. 68 vs. 156 mGycm) were statistically significantly lower in group 2 with no such difference between group 1 and 3. Vascular attenuation was significantly higher (segmental arteries, 332 HU vs. 647 HU vs. 521 HU) with both 70 kV protocols. Image noise was significantly reduced with the DS70 protocol compared to the SS70 protocol and was at the level of the SS100 protocol. This resulted in a significantly higher SNR in group 3 compared to group 1 (56.0 vs. 60.1 vs. 64.2).

CONCLUSION
70 kV DS CTPA can achieve better SNR at similar dose values than a standard single-source 100 kV protocol, but with 25% less iodine load. The 70 kV single-source protocol showed lowest dose values, but has a demand for a high iodine contrast material in order to achieve equivalent image quality.

CLINICAL RELEVANCE/APPLICATION
The introduced 70 kV DS CTPA protocol holds potential for reducing iodine load in patients at risk for developing contrast-induced nephropathy.
Liver Remnant Volume Gain

SSA23-02 • SSA23-03 • SSA23

Sunday, 10:45 AM - 12:15 PM • E350

METHOD AND MATERIALS
Retrospective analysis of electronic medical records of patients who underwent left gastric artery embolization for upper gastrointestinal (GI) bleeding were compared to age-matched controls of similar patients that had undergone embolization of an artery other than left gastric artery for upper GI bleeding. Patients were included in the analysis if they had a recorded weight within two weeks prior to the embolization and within three months after the procedure. Differences in post-procedural weight loss between the groups were evaluated by a student’s t-test.

RESULTS
Fifteen patients (mean age: 66.1 years) were included in the experimental group analysis while eighteen patients (mean age: 63.5 years) were included in the control group analysis. The mean pre- and post-procedural weights in the experimental group were 189.1 lbs and 174.5 lbs, respectively, representing a 7.9% decrease in body weight. The mean pre- and post-procedural weights in the control group were 164.7 lbs and 162.8 lbs, respectively, representing a 1.2% decrease in body weight. The post-procedural weight loss of the experimental group was significantly greater than that observed in the control group (P=0.001).

CONCLUSION
Patients lose significantly more weight after left gastric artery embolization than following embolization of other arteries for upper GI bleeding. The current data suggests that body weight can be potentially modulated via left gastric artery embolization in humans.

CLINICAL RELEVANCE/APPLICATION
Left gastric artery embolization results in weight loss in humans, which is a novel observation. These findings may lead to a role for the interventional radiologist in the treatment of obesity.

SSA23-03 • Particle only Embolization vs. Particle Embolization with Additional Plug/Coil Embolization - Comparison of Future Liver Remnant Volume Gain

Dominik Geisel MD ; Dirk Schnapauff MD ; Martin Stockmann MD ; Maciej Malinowski ; Timm Denecke MD ; Bernhard Gebauer MD (Presenter) *

PURPOSE
To analyze volume gain of the future liver remnant (FLR) after right portal vein embolization (PVE) in patients who received particle only embolization compared to patients who received particle embolization with additional central plug and/or coil embolization.

METHOD AND MATERIALS
Patients who received PVE in our institution were retrospectively analyzed. Right PVE was performed either with particle only (PO) embolization or additional central plug and/or coil embolization (CP/C). All patients enrolled had a CT or MRI scan before PVE and before operation, which were used for volumetry of the future liver remnant (FLR).

RESULTS
Of 75 patients 40 had PO embolization and 35 additional CP/C embolization. Age, sex, tumor entities and time from PVE to preoperative
imaging were comparable in both groups. Tumor entities included cholangiocarcinoma (n = 52), metastasis from colorectal cancer (n = 14), hepatocellular carcinoma (n = 2) and other entities (n = 7). FLR volume before PVE was 329 ± 121 ml in the PO group and 333 ± 135 ml in the CP/C group and 419 ± 135 ml respectively 492 ± 165 ml before operation. Average volume gain was significantly higher in the CP/C than in the PO group with 53.3 ± 34.5 % vs. 30.9 ± 28.8 % (p = 0.002).

CONCLUSION
Right portal vein embolization with additional central plug and/or coil embolization leads to a significantly higher gain in FLR volume than embolization with particles alone.

CLINICAL RELEVANCE/APPLICATION
Right portal vein embolization with additional central plug and/or coil embolization should be preferred over particle only embolization.

SSA23-04 • Experimental Study of Selective Portal Vein Embolization for Nonalcoholic Steatohepatitis in Rabbit Model

Sadao Hayashi MD (Presenter); Yasutaka Baba MD; Shunichiro Ikeda BS; Hiroaki Nagano; Tetsuya Shinohara; Michiyo Higashi PhD; Ryozo Kamimura; Toshihiro Nakazono; Teruo Komokata; Masayuki Nakajo PhD

PURPOSE
Portal vein embolization (PVE) is now widely accepted as a useful preoperative procedure in selected patients undergoing extended hepatectomy. However, the influence of PVE on the liver parenchyma with steatohepatitis has not been fully elucidated. To evaluate the influence of PVE on the rabbit liver parenchyma with nonalcoholic steatohepatitis (NASH) compared with normal liver.

METHOD AND MATERIALS
Seventeen Male New Zealand rabbits were divided randomly into the normal control group (n=6) which was fed with a standard diet for 2weeks and then the NASH group (n=11) which was fed with a high-fat diet (standard diet+10%lard+2%cholesterol) for 2weeks. Thereafter, PVE was performed for the left lobe of each group with 1ml absolute ethanol and micro coils. All procedure were performed successfully. Rabbits were sacrificed 2weeks after the PVE. All hepatic specimens were examined by HE staining and immunohistochemical staining of heat shock protein 70 (HSP70). NASH stage, NASH grade and sinusoidal obstruction syndrome (SOS) score were evaluated used by HE staining. When less than 20% were stained, the specimen was considered as HSP expression negative.

RESULTS
Two of 11 NASH rabbits died of liver failure 2 days after PVE. The embolized lobe showed significantly higher NASH stage (p=0.43) and grade(p=0.009) and severer SOS score(p=0.03) in the NASH group than in the normal control group. HSP70 expression was significantly lower in the NASH embolized lobe than in the normal control embolized lobe (p=0.04).

CONCLUSION
The rabbit fed with the present high fat diet can be a NASH model. PVE induced severer sinusoidal obstruction damage in the embolized steatohepatitis lobe than in the normal embolized normal lobe. HSP70 induction in the embolized lobe was suppressed in the NASH model. These findings suggest that the same severe damage may occur in the embolized lobe and the risk of unexpected fatal liver damage cannot be excluded in the patients with NASH after PVE.

CLINICAL RELEVANCE/APPLICATION
PVE should be performed carefully even for the patients with NASH.

SSA23-06 • Needle Interventions in a Phantom Model: Real-time 3D Fluoroscopy Guidance Using Cone-beam CT versus Conventional CT Guidance

Noboru Maeda (Presenter); Keigo Osuga MD; Masahisa Nakamura MD; Kentaro Kishimoto; Kaishu Tanaka; Yusuke Ono; Hiroki Higashihara MD; Noriyuki Tomiyama MD, PhD

PURPOSE
Cone-beam CT (CBCT) guided targeting system or XperGuide (Philips Medical Systems) is a real-time 3D needle navigation system on live fluoroscopy overlapped with CBCT Image as a practical tool. The purpose of this study was to evaluate the accuracy and procedure time of this system compared to conventional CT guidance technique using a phantom model.

METHOD AND MATERIALS
A phantom was made of corn flour and clay that contained multiple 1cm kneaded erasers as targets. The target can be recognized at live fluoroscopy overlapped with CBCT image as a practical tool. The purpose of this study was to evaluate the accuracy and procedure time of this system compared to conventional CT guidance technique using a phantom model.

RESULTS
All targets were successfully targeted with the first needle pass in all sessions using both techniques by four interventional radiologists. Mean distance from the surface puncture point to the target was 104±13 mm and 101±17 mm (p=0.54), mean gap was 1.88±0.83 and 4.06±1.22 mm (p=0.0001). The accuracy and procedure time were significantly higher in the CBCT guided targeting system or XperGuide compared to conventional CT guidance.

CONCLUSION
CBCT guided targeting system or XperGuide allows more accurate lesion targeting and quicker needle interventions in a phantom model compared to conventional CT guidance.

CLINICAL RELEVANCE/APPLICATION
CBCT guided targeting system or XperGuide allows accurate lesion targeting and quick needle interventions. This system will improve needle interventions.

SSA23-07 • 3T MRI-guided Transperineal Targeted Prostate Biopsy Using a Robotic Needle Guidance Template

Sang-Eun Song; Kemal Tuncali MD; Junichi Tokuda PhD; Andriy Fedorov PhD; Tobias Penzkofer MD *; Clare M Tempany-Afdhal MD; Fiona M Fennessy MD, PhD; Nobuhiko Hata PhD (Presenter) *

PURPOSE
Conventional needle guidance templates used in MRI-guided targeted prostate biopsy have limited targeting accuracy, typically 5 mm intervals, and are prone to human error in selecting holes. To overcome such problems, we developed and tested a motorized needle guidance template (Smart Template) that allows automated targeting without restriction in a 3T MRI.

METHOD AND MATERIALS
Fifteen men with suspicion of prostate cancer underwent 3T wide-bore MRI-guided transperineal targeted prostate biopsy in the lithotomy position using Smart Template and 3D Slicer navigation software. Target lesions were preoperatively identified on multi-parametric MRI (mpMR) by three radiologists. The targets were re-identified on intraprocedural MRI through registration. The navigation software provided the Smart Template’s guidance position and needle placement depth for each target. Insertion was performed manually and if needed, the guidance position was adjusted to achieve a satisfactory needle placement confirmed by MRI.

RESULTS
All procedures were performed successfully without adverse events and tissue samples were collected from targeted lesions in all cases. To 6 targets were selected per patient, and an average of 2.4 ± 0.9 tissue samples were obtained from each target. The mean procedural time was 122 ± 27 min including 55 ± 19 min of in-MRI preparation time, which is similar to that of using a conventional template. 10 of
the 47 sampled targets were positive for malignant tissue (21.3%), resulting in prostate cancer diagnosis for 53.3% (N = 8) of the patients.

CONCLUSION
Smart Template has been successfully integrated into the procedural workflow of existing MRI-guided transperineal targeted prostate biopsy. The robotic needle guidance demonstrated unrestricted access to any part of the prostate grand volume without noticeable image degradation, complexity or significant prolongation of the procedural time.

CLINICAL RELEVANCE/APPLICATION
A robotic needle guidance template has been used for 3T MRI-guided transperineal targeted prostate biopsy to aid needle placement.

SSA23-08 • Real Time Image Fusion with Contrast Enhanced CT, 18FDG-PET and US in Liver Percutaneous Ablations and Biopsies

Giovanni Mauri MD (Presenter); Luca Cova MD; Tania Tondolo; Tiziana Ierace MD; Enzo Di Mauro; S. Nahum Goldberg MD *; Luigi Soldiati MD

PURPOSE
To report our preliminary experience with real time image fusion between contrast enhanced CT, 18FDG-PET and US in liver percutaneous ablations and biopsies

METHOD AND MATERIALS
24 patients with liver lesions detectable only at 18FDG-PET underwent percutaneous ablation (10 patients) or biopsy (14 patients) guided by a novel image fusion system that combines real-time US with fusion to previously acquired and fused contrast enhanced CT and 18FDG-PET images based upon magnetic field tracking and computer reconstruction of the targeting path (Esato, Genoa, Italy). 18FDG-PET/CT was performed at 24 hours to assess the technical efficacy of thermal ablations (i.e. absence of uptake). Histological results (i.e. adequacy of the sample) was used to assess the result of percutaneous biopsies.

RESULTS
In all cases it was possible to obtain correct fusion between contrast enhanced CT, 18FDG-PET and US and to perform the procedure as planned. At 24 hours 8/10 (80%) treated lesions demonstrated absence of uptake at 18FDG-PET/CT, while two lesions demonstrated partial peripheral uptake, being considered correctly targeted but incompletely ablated. A diagnostic sample was obtained in 12/14 (86%) patients who underwent percutaneous biopsy guided with this technique. No major complications occurred.

CONCLUSION
Real time image fusion between contrast enhanced CT, 18FDG-PET and US is feasible and allow for a precise targeting of many tumors detectable only at 18FDG-PET.

CLINICAL RELEVANCE/APPLICATION
This method holds the potential for offering ablation and biopsy to additional patient populations.

SSA23-09 • Development and Clinical Evaluation of a Three-dimensional Ultrasound System for Pre-operative Assessment and Guiding Percutaneous Treatment of Focal Liver Tumors

Hamid Reza Sadeghi Neshat MSc (Presenter); Derek W Cool MD, PhD *; Jeffrey Bax BENG *; Kevin Barker; Lori Gardi; Nirmal Kakani MD; Aaron Fenster PhD *

CONCLUSION
Our 3D US system improves capabilities of conventional US by facilitating targeting of lesions identified in other modalities. Ongoing work includes automatic probe tracking and motion compensation.

Background
Image-guided percutaneous ablation is a standard treatment for focal liver tumors deemed inoperable and to maintain eligibility for patients on transplant waitlists. Radiofrequency (RFA), microwave (MWA) and cryo-ablation technologies are all delivered via a needle-shaped probe inserted directly into the tumor. Planning is mostly based on contrast CT/MRI. While intra-procedural CT (iCT) is commonly used to confirm the intended probe placement, 2D ultrasound (US) remains the main imaging modality for needle guidance, and in some centers is the only modality used. Correlation of the intraoperative 2D US with iCT or pre-operative imaging is essential for accurate needle placement, however, correspondence can be challenging given the limited field-of-view (FOV) in 2D US. We have developed a passive tracking arm with motorized scan-head and software tools to improve guiding capabilities of conventional US by large FOV 3D US scans that can be overlaid and compared to planning and iCT.

Evaluation
The developed scanner was tested on phantoms to confirm accuracy of 3D measurements and probe localization as compared to CT. For phase 1 clinical evaluation (IRB approved), a total of 17 tumors (1.0-4.5cm) were treated using 1-3 RFA or MWA probes without re-intervention in 14 cases. Contrast CT prior to ablation (for tumor measurements) and iCT after each probe insertion (for localization measurements) were acquired. Each CT was followed by a 3D US for comparison. 3D US and CT measurements corresponded well with tumor volume, angle and distance between probes differing by 7.7±4.5%, 4.2±3.2° and 2.1±1.3mm respectively.

Discussion
Mechanically tracked 3D US provided comparable measurement results to CT in a single scan (3-8 seconds). The main limitation is for US occult tumors. In such cases, fusion of the US with the planning CT can be used to provide an insertion roadmap. 3D US facilitates co-registration by providing more structures visible in both modalities (e.g. vessels, surfaces) and tracker coordinates.
METHOD AND MATERIALS

A retrospective review of medical records of patients that underwent elective TIPS with the Viatorr stent graft was performed. Contrast enhanced cross sectional imaging studies, performed within 1 year after TIPS were evaluated for PVT. The puncture site for TIPS was determined in direct portograms and classified as central or peripheral. Any potential relationship between the puncture site and the presence of PVT was determined.

RESULTS

Elective TIPS with the Viatorr was performed in 48 patients (ages 28-70 mean 54). Follow-up imaging demonstrated that the presence of branch PVT was very frequent (38/48, 79%), and affected the right anterior (n=6), right posterior (n=25) or left (n=7) portal veins. There were no main portal vein thromboses. Central punctures in 12 patients were associated with PVT in 9 occasions. More peripheral punctures at the confluence of the right portal branches in 22 patients, or in a more peripheral right branch in 14 patients, were associated with segmental PVT in 17 and 12 patients, respectively. In only 1 patient there was a technical problem with stent placement. Overall there was no correlation between the puncture site and the presence of PVT (Fisher Exact test p=0.1).

CONCLUSION

Thrombosis of major portal vein branches is a very frequent imaging finding after elective TIPS with the Viatorr stent graft. There was no correlation between the puncture site, central or peripheral, and the presence of PVT.

CLINICAL RELEVANCE/APPLICATION

Thrombosis of major portal vein branches is a frequent imaging finding after elective TIPS with the Viatorr stent graft. However, there is no correlation between PVT and the site of puncture.

SSA24-02 • The Outcome of Shunt Reduction after TIPS by the Parallel Technique: A Prospective Study

Bart De Keyzer MD (Presenter) ; Frederik Nevens MD, PhD ; Sam Heye MD ; Johan Vaninbroukx MD ; Chris Verslype MD, PhD ; David Cassiman MD, PhD ; Wim Lallemant ; Geert Maleux MD, PhD

PURPOSE

Transjugular intrahepatic portosystemic shunt (TIPS) placement became the standard treatment for a subcategory of patients with refractory ascites and variceal bleeding. It has the disadvantage of provoking chronic hepatic encephalopathy (HE) and, in some patients with limited liver function, TIPS-induced liver failure (LF). Reduction of the diameter of the TIPS stent is feasible by the parallel technique. However, the experience is still limited.

METHOD AND MATERIALS

TIPS reduction was performed by the placement of a 10 mm self-expanding stent along with a 5-6-7 mm balloon-expandable stent. After a learning group of 17 patients (Maleux G, JVIR 2007), 55 patients were included in this prospective study. Baseline characteristics included age, gender, cause of cirrhosis, MELD score, indication for TIPS, time interval between TIPS and reduction, and pressure gradient before and after reduction.

RESULTS

Patients with medical therapy resistant chronic HE: improvement of HE = 25/34 (74%), recurrence of initial indication = 9/34 (26%) and six month survival = 29/34 (85%). Patients with TIPS-induced liver failure: improvement 11/21 (52%) and survival 11/21 (52%), three of these patients received a liver transplantation.

CONCLUSION

Stent reductions with the parallel technique improved chronic hepatic encephalopathy in 74% of the patients and offered them a 6 months survival of 85%. In patients who developed TIPS-induced liver failure, 52% recovered and for this group, TIPS reduction can serve as a bridge to liver transplantation.

CLINICAL RELEVANCE/APPLICATION

TIPS-induced hepatic encephalopathy refractory to medical therapy can be improved by shunt reducing techniques in a majority of cases.

SSA24-03 • Hepatic Infarction Following Transjugular Intrahepatic Portosystemic Shunt: An Analysis of Pathogenesis and Clinical Outcomes

Fredrik J Baldin MD (Presenter) ; Jorge E Lopera MD * ; Ryan R Scott MD

PURPOSE

To assess clinical outcomes and examine potential factors leading to hepatic infarction following TIPSS.

METHOD AND MATERIALS

A retrospective review of all patients with follow-up cross sectional imaging after TIPSS was performed. The outcomes of patients with imaging findings suggestive of hepatic infarction were analyzed along with technical, demographic, and clinical data.

RESULTS

Out of 62 total patients with cross-sectional imaging after TIPSS performed between 6/2008 and 4/2012, seven (5 males and 2 females, average age of 54.7 years old (range 44-66)) were identified with imaging (6 CT, 1MRI) suggestive of hepatic infarction. All patients received PTFE stent-grafts. Average pre-TIPSS MELD score was 13.2 (range 6-20) and average post-TIPSS MELD score was 21.2 (range 9-38). Four patients developed worsening liver failure, of which two died early and two received liver transplants. One died of complications related to recurrent upper GI bleeding, one survived with intermittent hepatic encephalopathy, and one patient was lost to follow-up shortly after the procedure. Follow-up imaging revealed 5 patients had thrombosis of right portal vein branches and two had right hepatic vein thrombosis.

CONCLUSION

Hepatic infarction following TIPSS is a rare complication with high a mortality rate that may be associated with right portal vein and/or hepatic vein thrombosis.

CLINICAL RELEVANCE/APPLICATION

Currently there are only case studies of hepatic infarction after TIPSS. This case series aims to examine causes of this potentially fatal complication while analyzing the outcomes in 7 patients.

SSA24-04 • Portal Vein Thrombosis after Elective TIPS. Incidence in Follow-up Imaging and Clinical Significance

Jorge E Lopera MD (Presenter) * ; Venkata S Katabathina MD ; Brian T Bosworth MD ; Martin Goros ; Andres Garza ; Ghazwan M Kroma MD ; Rajeev Suri MD

PURPOSE

To study the incidence and clinical significance of portal vein thrombosis (PVT) in follow-up imaging after elective transjugular intrahepatic portosystemic shunt (TIPS).

METHOD AND MATERIALS

A retrospective review of medical records of patients that underwent elective TIPS was conducted. Contrast enhanced cross sectional images, obtained within 1 year after TIPS, were compared with previous axial images (n=59) or direct portograms (n=3) in order to assess the patency of the main portal vein (PV) and its major branches. The branches analyzed were the right anterior (RAPV), right posterior (RPPV), left (LPV) and main (MPV) portal veins. The presence of associated parenchymal changes was also recorded. Any possible association between PVT and MELD score, and PVT and major adverse events after TIPS, was also studied.
RESULTS
Sixty-two patients (15 female, 47 male, ages: 28-70, mean 54) were included in the study. Follow-up cross sectional images were obtained 1-346 days (mean 92 days) after TIPS. The incidence of PVT was 19 % for RAPV, 51% for the RPPV, 11% for the LPV and 1 % for the MPV. Combined thrombosis of two major branches was observed in 6 and three branches in 4 patients. Associated lobar parenchymal changes were lobar infarcts in 7 and heterogeneous contrast enhancement in 9 patients. The mean MELD score was 12.8 before and 16.8 one month after TIPS. Major adverse events within 6 months included hepatic encephalopathy requiring hospital admission in 18 and death in 8 patients. There was no significant correlation between PVT and the post-TIPS MELD score, or PVT and major adverse events after TIPS.

CONCLUSION
Thrombosis of major branches of the PV is a very common imaging finding after elective TIPS that can be associated with parenchymal changes. In most patients, branch PV has no clinical significance.

CLINICAL RELEVANCE/APPLICATION
Thrombosis of major PV branches is a common imaging finding after elective TIPS. In most patients, branch PVT has no clinical significance.

SSA24-05 • Treating Portal Systemic Encephalopathy with Balloon-occluded Retrograde Transvenous Obliteration (BRTO) - A Road Less Travellled

Amar Mukund (Presenter); S. Rajesh MBBS, MD; Ankur Arora MD, FRCR; Shiv Sarin

PURPOSE
To evaluate the efficacy of BRTO using foam sclerotherapy in managing symptoms arising due to spontaneous large porto-systemic shunts.

METHOD AND MATERIALS
20 sessions of BRTO was performed in 18 patients using sodium tetradecyl sulphate foam. All patients had cirrhosis along with history of recurrent hepatic encephalopathy requiring hospital admission. Porto-systemic communication in the form of gastro/lienorenal shunt was present in all cases and seen on pre procedure computed tomography scans. Clinical and lab parameters including arterial ammonia level were evaluated before and after the procedure in all patients.

RESULTS
Technical success was achieved in 18 of 20 sessions (90%). Complete obliteration of varices was seen in 15 of 18 patients (83%) and partial obliteration in remaining 3, on follow up imaging. Immediate clinical improvement of hepatic encephalopathy was observed in 16 of 18 patients (89%) with post procedure decrease in serum ammonia levels, two patients had delayed improvement. Post-procedure complication consisting either of ascites, septicemia with acute kidney injury or deranged liver function tests was encountered in 5 patients. All the patients were clinically and symptomatically better on discharge and up to a follow up of 18 months (one month and thereafter 3, 6, 12, 18 months).

CONCLUSION
Our experience suggests portal systemic hepatic encephalopathy refractory to medical management can be effectively treated by BRTO.

CLINICAL RELEVANCE/APPLICATION
This study shows that BRTO may be offered as an alternative treatment to patients having recurrent portal systemic encephalopathy refractory to medical management.

SSA24-06 • The Comparison of Balloon-occluded Retrograde Transvenous Obliteration for Gastric Varices Using Liquid and Foam Sclerosants

Jun Koizumi MD, PhD (Presenter); Tatsuya Sekiguchi; Tamaki Ichikawa MD; Chihiro Itou; Takuya Harada MD; Bertrand Janne d’Othee MD, MPH

PURPOSE
Liquid ethanolamine oleate which has been used traditionally for balloon-occluded retrograde transvenous obliteration (BRTO) of the gastric varices (GV) may cause severe complications including hemolysis, allergy, etc. if overdosed. Thus, we introduced foam sclerotherapy to reduce the dose and compared the safety and efficacy of BRTO using liquid and foam sclerosants.

METHOD AND MATERIALS
Forty three patients with gastric varices were performed BRTO since October 2001. Of these, three patients were excluded because simultaneous TACE or PSE was performed. Twenty patients using liquid ethanolamine oleate with iodine contrast (EOI, Fig.1) before March 2005 and twenty patients using polidocanol foam (POF, Fig.2) after May 2005 were included in this study. The success rates, side effects and complication rates were compared among the two groups.

RESULTS
Complete stasis of the gastric varices was obtained in all patients of both groups. Abdominal symptoms during BRTO were significantly reduced and comparision of the results of both the groups was not statistically significant (p=0.08). Complete stasis of the gastric varices was obtained in all patients of both groups. Abdominal symptoms during BRTO were significantly reduced and comparison of the results of both the groups was not statistically significant (p=0.08). Complete stasis of the gastric varices was obtained in all patients of both groups. Abdominal symptoms during BRTO were significantly reduced and comparison of the results of both the groups was not statistically significant (p=0.08). Complete stasis of the gastric varices was obtained in all patients of both groups. Abdominal symptoms during BRTO were significantly reduced and comparison of the results of both the groups was not statistically significant (p=0.08). Complete stasis of the gastric varices was obtained in all patients of both groups. Abdominal symptoms during BRTO were significantly reduced and comparison of the results of both the groups was not statistically significant (p=0.08).

CONCLUSION
EOI which is traditionally used in BRTO may cause hemolysis and require haptoglobin. In the U.S. EOI is now replaced by foam sclerosant which is less invasive and has comparative clinical success.

CLINICAL RELEVANCE/APPLICATION
EOI which is traditionally used in BRTO may cause hemolysis and require haptoglobin. In the U.S. EOI is now replaced by foam sclerosant which is less invasive and has comparative clinical success.

SSA24-07 • Clinical Efficacy of Portal Venous Stent Placement for Symptomatic Portal Hypertension Caused by Malignant Tumor Invasion

Takaaki Hasegawa (Presenter); Haruyuki Takaki MD; Atsuhiro Nakatsuka MD; Junji Uraki MD; Takashi Yamanaka MD; Masashi Fujimori MD; Hajime Sakuma MD ; Shuji Isaji; Koichiro Yamakado MD, PhD

PURPOSE
To evaluate clinical outcomes of portal venous stent placement in patients with symptomatic portal hypertension caused by malignant tumor invasion.

METHOD AND MATERIALS
From July 2005 to January 2013, eleven patients with portal venous stenosis or occlusion caused by bile duct cancer (n=6), pancreatic cancer (n=4), and nodal metastasis from colon cancer (n=1) underwent stent placement because of gastrointestinal bleeding (n=4), ascites (n=4), liver dysfunction (n=2), and hypersplenism (n=1). Stents were placed across the stenotic (n=7) or occluded (n=4) lesions after percutaneous transhepatic portography. Technical success, changes in portal venous pressure, symptoms, complications, stent patency, and survival were evaluated. Complications were evaluated by using Common Terminology Criteria for Adverse Events (CTCAE).

RESULTS
Stent placement was technically successful in all patients (technical success rate: 100%, 11/11). The mean portal venous pressure gradient decreased from 12.6±4.8 mmHg (range, 5-20 mmHg) to 0.5±1.0 mmHg (range, 0-3 mmHg) (p<0.05). Portal venous stent placement is feasible, safe, and effective technique to relieve symptomatic portal hypertension caused by malignant
SSA24-08 • Metallic Stent Placement for the Treatment of Hepatic Venous Outflow Block after Living-Donor-Liver Transplantation

Masashi Fujimori MD (Presenter) ; Shugo Mizuno ; Atsuhiro Nakatsuka MD ; Haruyuki Takaki MD ; Junji Uraki MD ; Takashi Yamanaka MD ; Takaaki Hasegawa ; Hajime Sakuma MD * ; Shuji Isaji ; Koichiro Yamakado MD, PhD

PURPOSE
To retrospectively evaluate the clinical efficacy of metallic stent placement for the treatment of hepatic venous outflow block after living-donor-liver transplantation (LDLT).

METHOD AND MATERIALS
This study was approved by our institutional review board, which waived the requirement for informed consent to use data for research purposes. From 2002 to 2012, 15 patients with a mean age of 51±30.8 years (range, 4-69 years) underwent stent placement for the treatment of outflow block 1-341 days after LDLT with a mean interval of 24±54.7 days. Venous stenosis with a pressure gradient of 10mmHg or more was found in the inferior vena cava in 7 patients, hepatic vein in 7 patients, and in both in 1 patient. Stents were percutaneously placed across stenosis. Technical success (pressure gradient≤3mmHg), complication, improvement in clinical manifestation, stent patency, and survival were evaluated.

RESULTS
Technical success was achieved in all 15 patients (100%, 15/15). There was no death or major complications related to stent placement. The mean pressure gradient significantly decreased from 13±8mmHg (range, 10-24 mmHg) to 0.8±2mmHg (range, 0-2 mmHg) (p<0.01). Stenting is a safe and useful treatment to resolve outflow block after LDLT and helps to improve prognosis of such patients.

CLINICAL RELEVANCE/APPLICATION
Metallic stent placement is a safe and useful treatment to resolve hepatic venous outflow block after LDLT and helps to improve prognosis of such patients.

SSA24-09 • Optimal Protocol of Scanning Mode in the Portal Vein Angiography with a Low-Concentration Contrast Medium

Yan Liang MMed ; Zhiren Chen MD (Presenter) ; Dongbin Shi ; Yan Wang ; Bin Li ; Huizhi Cao ; Ying Tong MD

PURPOSE
To explore the optimal protocol of CT scanning mode in the portal vein angiography with a low-concentration contrast medium.

METHOD AND MATERIALS
63 patients underwent enhanced urinary CT scan All the patients were divided into 3 groups according to different body mass index(BMI). 21 patients of group A (BMI=22) received 80-100kVp CT scan, automatic exposure control (3D Auto mAs) and pitch of 0.984. All the images were reconstructed with adaptive statistical iterative reconstruction algorithm. 14 patients of group B (BMI=26) received single-source dual-energy spectral CT (sDECT) scan at the pitch of 1.375. Monochromatic images was reconstructed and optimal keV with best contrast-to-noise(CNR) was calculated. Another 28 patients of group C with routine 120kVp CT scan. Low concentration of iodixanol(270mgI/ml) was used in group A and B, and high concentration of iopamidol(370 mg I/ml) was adopted in group C. 70 ml of total amount of contrast was injected at 2.7ml/s. ROIs were placed on abdominal aorta, renal artery, superior mesenteric artery and portal vein. Signal-to-noise ratio (SNR) and CNR was calculated.

RESULTS
In low-kVP Group, the CNR and SNR were (8.12±3.09) and (14.72±4.05) for trunk of portal vein, (6.59±2.13) and (13.40±4.68) for its left branch, and (7.24±2.19) and (13.56±4.99) for its right branch respectively. In sDECT Group, the CNR and SNR were (8.68±2.69) and (13.38±3.06) for trunk of portal vein, (9.31±2.88) and (13.58±3.21) for its left branch, and (9.53±2.66) and (13.72±3.03) for its right branch respectively. In 120kVp Group, the CNR and SNR were (6.68±3.41) and (13.13±4.36) for trunk of portal vein, (6.22±1.98) and (12.82±4.11) for its left branch, and (7.09±2.04) and (12.55±4.36) for its right branch respectively. The image quality was slightly higher in sDECT Group than routine 120kVp Group and low-kVP Group, but no significantly different was found in among three groups (P>0.05). Compared with that in 120kVp Group (7.23±1.53mGy), the radiation dose index was significantly lower in low-kVP Group (4.75±1.39 mGy) (P<0.01). With a low-concentration contrast medium, the low-kVP and sDECT scanning mode is rationally via BMI without sacrificing image quality.

CLINICAL RELEVANCE/APPLICATION
With low kVP and spectral CT imaging of low iodine concentration or 120kVp of moderate iodine concentration, higher intravascular enhancement can be achieved with good vessel display.

Vascular/Interventional - Sunday Posters and Exhibits (12:30pm - 1:00pm)

Sunday, 12:30 PM - 01:00 PM • Lakeside Learning Center

LL-VIS-SUA • AMA PRA Category 1 Credit ™:0.5
Host
Thomas-Evangelos G Vrachliotis , MD, PhD

LL-VIS-SUA2 • Pancreatic Drainage 101 - Radiation Exposure: How Much and What Can We Do about It?

Justin M Owens MD (Presenter) ; Jessica Caraway MD ; Michael C Gates MD ; David R Wallace MD ; Daniel V Do MD ; Horacio R D’Agostino MD, Katherine S Crow MS

PURPOSE
Patients undergoing percutaneous drainage (PD) of pancreatic fluid collections (PFCs) experience multiple imaging studies using ionizing radiation. The purpose of this study is to evaluate radiation exposure during initial diagnosis, image-guided percutaneous drainage (IGPD), post-drainage monitoring/revision and follow up.

METHOD AND MATERIALS
An IRB-approved, retrospective study was performed of 101 patients (73 male, 28 female; mean age 46.5 years) who underwent IGPD of PFCs from December 12, 2002 to July 17, 2012. Pancreatitis causes were alcoholism (n=41,40.2%), trauma (n=25,24.5%), gallstones (n=21,20.6%), hypertriglyceridemia (n=8,7.8%), drugs (n=1,1%) and unknown (n=6,5.9%). Imaging studies where categorized as diagnostic (pre-drainage), procedural (image-guidance), post-drainage (with drainage catheters) and follow up (catheters removed). All imaging studies were recorded per patient on a spreadsheet for radiation exposure analysis.

RESULTS
The series included a total of 810 imaging studies: CT, 577 (71.2%); fluoroscopy, 229 (28.3%); US, 4 (0.5%). There were 156
LL-VIS-SU3A • Contrast Enhanced Ultrasound for Early Assessment of Transarterial Chemoembolization of Hepatocellular Carcinoma using Drug Eluting Beads: Preliminary Safety and Efficacy

John R Eisenbrey PhD (Presenter); Colette Shaw MBBch; Andrej Lyschik MD; Daniel A Merton; Priscilla Machado MD; Laura Pino; Daniel B Brown MD*; Flemming Forsberg PhD*

PURPOSE
To evaluate the safety and utility of contrast-enhanced ultrasound (CEUS) imaging for early efficacy assessment of transarterial chemoembolization (TACE) of hepatocellular carcinoma (HCC) using drug-eluting beads.

METHOD AND MATERIALS
Following IRB approval, 9 patients with a total of 12 previously untreated tumors scheduled for TACE with 100-300 μm doxorubicin-eluting beads underwent CEUS exams the morning prior to TACE, 1-2 weeks post TACE, and the morning prior to routine imaging follow-up (multiphase contrast enhanced MRI or CT 1 month post TACE) and CT/MR results were evaluated using mRECIST criteria. Ultrasound imaging was performed using a Sequoia 512 scanner with 4C probe (Siemens Medical Solutions, Mountain View, CA). Following baseline imaging, patients received a bolus injection of 0.6-0.7 ml of Definity (Lantheus Medical Imaging, N. Billerica, MA) followed by 10 ml saline flush and were imaged using Cadence Pulse Sequencing (Siemens). In patients with multiple tumors, injection was repeated. All imaging parameters were kept constant at follow-up. Microbubble enhancement pattern and size of the embolized area were compared to the reference imaging standard.

RESULTS
One case of lower back pain and no other adverse events were reported over the 17 CEUS exams performed to date. All 12 tumors showed microbubble enhancement prior to treatment. One patient was excluded after being reassigned for alternative treatment. A total of 4 patients with 4 lesions have completed the study to date. CEUS findings at 1-2 weeks post TACE correlated with CEUS at one month post treatment (3 consistent non-enhancing / 1 consistent partially enhancing lesions; average change after treatment of non-enhancing area along longest diameter = 2 ± 1.8 mm). In all 4 cases microbubble enhancement within the tumor (3 complete embolization, 1 partial response) correlated with the reference imaging standard.

CONCLUSION
Preliminary results suggest that results of CEUS at 1-2 weeks post TACE correlate well with routine MRI or CT imaging performed 1 month post treatment. Therefore, treatment outcomes may potentially be evaluated earlier with CEUS.

CLINICAL RELEVANCE/APPLICATION
CEUS may provide an earlier and safer means of drug eluting beads TACE treatment response evaluation.

LL-VIS-SU4A • Portal Vein Thrombosis after Tips with the Viatorr Stent Graft: Imaging Frequency and Correlation with Site of Puncture

Jorge E Lopera MD (Presenter)*; Venkata S Katabathina MD; Martin Goros; Brian T Bosworth MD; Deepak Garg MBB, MD; Ghawzan M Kroma MD; Andres Garza; Rajeev Suri MD

PURPOSE
To study the incidence of portal vein thrombosis (PVT) after elective Tips using the Viatorr stent graft and determine if there is any potential relationship between the puncture site and development of PVT.

METHOD AND MATERIALS
A retrospective review of medical records of patients that underwent elective Tips with the Viatorr stent graft was performed. Contrast enhanced cross sectional imaging studies, performed within 1 year after Tips were evaluated for PVT. The puncture site for Tips was determined in direct portograms and classified as central or peripheral. Any potential relationship between the puncture site and the presence of PVT was determined.

RESULTS
Elective Tips with the Viatorr was performed in 48 patients (ages 28-70 mean 54). Follow-up imaging demonstrated that the presence of branch PVT was very frequent (38/48, 79%), and affected the right anterior (n=6), right posterior (n=25) or left (n=7) portal veins. There were no main portal vein thromboses. Central punctures in 12 patients were associated with PVT in 9 occasions. More peripheral punctures at the confluence of the right portal branches in 22 patients, or in a more peripheral right branch in 14 patients, were associated with segmental PVT in 17 and 12 patients, respectively. In only 1 patient there was a technical problem with stent placement. Overall there was no correlation between the puncture site and the presence of PVT ( Fisher Exact test p=0.1).

CONCLUSION
Thrombosis of major portal vein branches is a very frequent imaging finding after elective Tips with the Viatorr stent graft. There was no correlation between the puncture site, central or peripheral, and the presence of PVT.

CLINICAL RELEVANCE/APPLICATION
Thrombosis of major portal vein branches is a frequent imaging finding after elective Tips with the Viatorr stent. However, there is not correlation between PVT and the site of puncture.

LL-VIE-SU5A • Endovascular Abdominal Aortic Aneurysm Repair Made Simple: Patient and Device Selection, Technique, and Procedure Specific Complications

Yolanda Bryce MD (Presenter); Philip A Rogoff MD; Donald F Romanelli MD; Ralph L Reichle MD

PURPOSE/AIM
The purpose of this exhibit is: 1. To review the benefits of endovascular repair of abdominal aortic aneurysms. 2. To review available clinical assessment scoring systems for appropriate patient selection. 3. To review vascular anatomy and its severity scoring. 4. To review available prostheses and their appropriate usages including suprarenal and infrarenal fixation. 5. To review the appropriate technique including preprocedural imaging, the procedure, and post procedural imaging. 6. To review procedure specific complications.

CONTENT ORGANIZATION
SUMMARY
The major points of the exhibit are: 1. The importance of preprocedural planning including appropriate patient and device selection. 2. The imporatnce of appropriate technique. 3. The importance of the knowledge of and follow-up for procedure-specific complications.

LL-VIE-SU7A • Simple and Easy to Implement Tips for Dramatic Dose Reduction in CT Guided Interventional Procedures: Breaking the One mSv Barrier!

Ramt Lamba MD; Kunal Sidhar MD (Presenter); Puneet Bhargava MD; Michael T Corwin MD; Chandana G Lall MD

PURPOSE/AIM
1. Discuss and illustrate several simple and easy to implement strategies that will result in dramatic dose reduction for CT guided interventional procedures. 2. Illustrate how careful attention and meticulous planning can routinely result in a dose of less than 1mSv during CT guided interventional procedures.

CONTENT ORGANIZATION
1. Overview of image guided procedures. 2. Appropriate choice of guidance modality. 3. Typical doses during CT guided interventional procedures. 4. Risks of cumulative and high radiation exposure over a limited territory. 5. Structure and challenges of a CT guided interventional procedure. 6. Strategies for decreasing dose at different steps of the procedure. 7. How to achieve consistent breath holds during the procedure. 8. Tips on accurate needle placement. 9. Illustrate use of a mobile app to measure the angle of the needle during placement. 10. Choosing the simplest factors for dose economy. 11. Utility and indications of post procedure scans. 12. Illustrate examples of procedures routinely performed at a dose of less than 1mSv.

SUMMARY
After review of this exhibit, radiologists performing CT guided interventional procedures will be able to routinely implement 1) new techniques for accurate needle placement and 2) simple and easy to use dose reduction strategies into their practice.

Vascular/Interventional - Sunday Posters and Exhibits (1:00pm - 1:30pm)

Sunday, 01:00 PM - 01:30 PM • Lakeside Learning Center

LL-VIS-SU7A • Simple and Easy to Implement Tips for Dramatic Dose Reduction in CT Guided Interventional Procedures: Breaking the One mSv Barrier!

LL-VIS-SU1B • Optimizing Image Quality of Abdomen CT Venography by Model-based Iterative Reconstruction

Yuefeng Liu MD (Presenter); Hongzhi Cao MD

PURPOSE
To explore the value of model-based iterative reconstruction (MBIR) in optimizing image quality of abdomen CT venography (CTV).

METHOD AND MATERIALS
Totally 27 consecutive patients were chosen and underwent plain and contrast-enhanced abdomen CT with automated tube current modulation (ACTM). The images were reconstructed with filtered back projection (FBP group), adaptive statistical iterative reconstruction (ASIR group) 50% and MBIR (MBIR group), respectively. Image noises and CT values of muscle, fat tissue, liver and kidney, spleen, as well as CNR for portal veins, inferior vena cava, pancreatic veins and splenic veins were measured. The image quality was evaluated using 5-point scale. Those results among the 3 different reconstructions were compared by one-way ANOVA and Wilcoxon signed-rank tests.

RESULTS

CONCLUSION
MBIR can improve the overall image quality and has potential in decreasing radiation dose of abdomen CTV.

CLINICAL RELEVANCE/APPLICATION
MBIR can improve the overall image quality and has potential in decreasing radiation dose of abdomen CTV.

LL-VIS-SU2B • Use of Ultrasound Doppler to Optimize the Table Speed of Lower Extremity CT Angiography Protocols

Lei Zhang MD (Presenter); Yanhui Yang MD; Dong Xu; Kuncheng Li MD

PURPOSE

The Radiographic Natural History of Aortic Dissection

Timothy Huber MD (Presenter); John F Angle MD

PURPOSE
While there has been much written about the identification and management of aortic dissection, less work has been done examining the transition from normal aorta to dissection. This study investigates the natural history of aortic dissection, as it appears in medical imaging, to better understand the types of aortas that dissect, and the manner in which they do so.

METHOD AND MATERIALS
The UVA clinical data repository and PACS were searched to identify adult patients with a history of aortic dissection who had imaging between 2003 and 2012. The clinical history and imaging were reviewed to identify patients who had undergone CTA of the aorta before and after dissection. These images were reviewed to identify the location of the dissection flap, and to compare the morphology and atheroma burden before and after dissection.

RESULTS
The patients identified showed four patterns of progression. One group of patients, with underlying connective tissue disease, showed proximal dissection with a rapid time course. A second group consisted of patients with an underlying history of vascular disease. These patients demonstrated multiple large atheromas, one of which eventually dissected. In a third group, patients showed a progression from intramural hematoma to penetrating aortic ulcer to aortic dissection. The fourth group included younger patients with low atheroma burden. In these patients, a small plaque progressed rapidly to dissection.

CONCLUSION
Aortic dissection remains difficult to predict, both in terms of which patients will dissect, and where they will dissect. After comparison of the imaging of aortas both before and after dissection, several patterns of progression to dissection were identified. One of these groups consisted of younger patients with little vascular calcification, who dissected rapidly. This may suggest a population of patients who are at risk for dissection, but present few clinically apparent risk factors. This study also demonstrates that there is not a single pattern of progression to dissection. Instead, there appear to be subtypes of dissection, each of which are predisposed to dissect in different locations, along different time courses.

CLINICAL RELEVANCE/APPLICATION
There are several distinct patterns of progression to aortic dissection that each affect a unique patient population, one of which includes younger, healthier patients.
We evaluated the relative efficacy of different table speeds predetermined by using the flow velocity measured by ultrasound Doppler in patients with suspected peripheral arterial occlusive disease (PAOD) who underwent computed tomography angiography of the lower extremity arteries.

METHOD AND MATERIALS
This prospective study enrolled 40 patients with suspected PAOD. The average aorta-popliteal artery flow velocity was measured by ultrasound of average flow velocity of the suprarenal aorta, aortic bifurcation, common and external iliac arteries, common and superficial (proximal/middle/distal) femoral arteries, and the popliteal artery (Vaoa + Vvorta2 + VCCA + VSFA1 + VSFA2 + VSFA3 + VPOP). The table speed was adjusted to be equivalent to the measured arterial flow velocity between the suprarenal aorta and popliteal artery. Adequate vascular opacification was measured for attenuation in the suprarenal and infrarenal abdominal aorta, and in the arteries of the lower extremities. Venous contamination was also measured. Twenty patients also underwent two monitoring scans at the level of the suprarenal aorta and popliteal artery separately to measure the aorta-popliteal bolus transit time and speed.

RESULTS
The flow velocity from ultrasound Doppler and two monitoring scans was similar. CT angiographic images were of good quality in 39 cases, whereas prominent enhancement of abdominal veins was observed in one case.

CONCLUSION
Aligning flow velocity measured by US Doppler and table speed allows adequate arterial opacification and minimal venous contamination.

CLINICAL RELEVANCE/APPLICATION
Aligning flow velocity measured by US Doppler and table speed allows adequate arterial opacification and minimal venous contamination.

LL-VIS-SU3B • Valproic Acid as an Imageable, Multifunctional Chemoablative Agent

John Valesano BS (Presenter); Erik N Cressman MD

PURPOSE
To study the effects of valproic acid (VPA), a known inhibitor of histone deacetylase, in ex-vivo porcine hepatic tissue, to characterize it by imaging, and to compare it to acetic acid, a known ablative agent.

METHOD AND MATERIALS
VPA neat or diluted in diglyme and aqueous sodium valproate (NaVPA) solutions were prepared and injected into fresh ex vivo porcine hepatic tissue. Diglyme and acetic acid (50% and matching dilutions) served as controls. The imaging characteristics of the differing solutions were assessed by CT and MRI both in vitro and ex vivo. The amount of coagulation necrosis was noted using histology and gross pathology.

RESULTS
VPA was fully miscible in diglyme and both it and NaVPA caused clearly visible zones of coagulation. Lesions from pure VPA and dilutions of VPA in diglyme were visible on CT imaging as areas of low attenuation while those created by the other conditions were at best faintly detectable or functionally invisible on CT. No useful differences were noted in tissue at MRI. Grossly, the lesions created by pure valproic acid were larger than any of the lesions created by the varying dilutions of VPA in diglyme and similar in size to the equivalent amount of acetic acid. Histologically, VPA caused more hepatocellular shrinkage, increased nuclear damage, and larger areas of cell lysis than acetic acid. In vitro studies revealed that pure VPA had a CT attenuation value of -139 Hounsfield Units (HU) while NaVPA was measured at 54 HU.

CONCLUSION
VPA and NaVPA are both capable of causing coagulation necrosis in hepatic tissue, and zones of coagulation from VPA are readily detectable in tissue using CT imaging without any added contrast agent. Given these findings and the intrinsic pharmacologic activity of VPA, further investigation seems warranted.

CLINICAL RELEVANCE/APPLICATION
Valproic acid is a chemoablative agent imageable by CT that may prove superior to current agents for the ablation of hepatocellular carcinoma due to its additional pharmacological benefits.

LL-VIS-SU4B • Coil Embolization of the Splenic Artery: Impact on Splenic Volume and Factors Contributing to Volume Preservation

Stephen R Preece MD (Presenter); Paul V Suhocki MD; John Yoo; Kingshuk Choudhury PhD; Tony P Smith MD; Charles Y Kim MD *

PURPOSE
Splenic artery embolization can be performed as an alternative to splenectomy in the setting of splenic injury or splenic artery pathology. However, the impact on splenic function is not well understood. The purpose of this study is to determine the impact of coil embolization of the splenic artery on splenic volume based pre- and post-embolization CT imaging as well as hemofiltration function.

METHOD AND MATERIALS
Splenic artery embolization was performed on 148 consecutive patients over an 8 year period for various indications in this IRB approved retrospective study. Sixty patients (36 males, mean age 49 years) had contrast-enhanced CT before and after coil embolization of the splenic artery. The mean time between embolization and last follow up CT was 355 days. Pre and post-embolization splenic volumes were calculated with volume rendering software. The presence of Howell-Jolly bodies was ascertained on lab tests.

RESULTS
Splenic artery embolization resulted in a mean decrease in splenic volume by 15% (range -88% to +158%). Splenic volumes on CT scans performed within 30 days of embolization did not change significantly after embolization but after 30 days the mean percentage reduction was 21% (p=0.004). Embolization of the distal splenic artery resulted in a 30% splenic volume reduction (p=0.003) whereas splenic volumes did not change significantly after proximal embolization. Both traumatic and nontraumatic indications resulted in similar degree of volume loss, although pre-embolization splenic volumes were significantly smaller in trauma patients (p=0.029), and more trauma patients underwent distal embolization (p=0.005). Multivariate analysis revealed that only coil location significantly impacted splenic volume reduction. Three patients transiently had Howell-Jolly bodies after embolization. No patients required repeat embolization or splenectomy.

CONCLUSION
Coil embolization of the main splenic artery results in only a modest degree of splenic volume loss with retention of hemofiltration function. These findings support the growing body of literature that some degree of splenic function is maintained after splenic artery embolization.

CLINICAL RELEVANCE/APPLICATION
Splenic artery embolization for trauma and splenic artery pathology is likely preferable to splenectomy when feasible considering that at least some degree of splenic function is retained.

LL-VIE-SU5B • Classification of Peripheral Arterial Disease Lesions and Their Mimics: The Role of the Interventional Radiologist

Yolanda Bryce MD (Presenter); Philip A Rogoff MD; Ralph L Reiche MD; Donald F Romanelli MD

PURPOSE/AIM
The purpose of this exhibit is: 1. To review the risk factors of peripheral arterial disease. 2. To review the Trans-Atlantic Inter-Society...
Consensus classification of peripheral arterial disease lesions in pictorial form and their potential treatments. To review the mimics of peripheral arterial disease in pictorial form including arteritis, Buerger’s disease, popliteal entrapment syndrome, popliteal adventitial disease, popliteal aneurysm, fibromuscular dysplasia, peripheral emboli, keys to distinguish them from peripheral arterial disease, and their potential treatments

CONTENT ORGANIZATION
1. Risk factors for peripheral peripheral disease. 2. Transatlantic Inter-Society Consensus (TASC) classification of aortoiliac lesions and their potential treatments. 3. TASC classification of femoral popliteal lesions and their potential treatments. 4. TASC classification of infrapopliteal lesions and their potential treatments. 5. Mimics of peripheral arterial disease and their potential treatments.

SUMMARY
The major teaching points of this exhibit are: 1. TASC classification of peripheral arterial disease lesions and their potential treatments. 2. Mimics of peripheral arterial disease and their potential treatments including 

LL-VIE-SU68 • A Review of Surgical Principles and Techniques for Interventional Radiologists

Kevin Ching MD (Presenter) ; Christopher J Friend MD ; Kevin M McCluskey MD

PURPOSE/AIM
For the majority of radiologists, formal surgical training exists only from clerkships during medical school. As interventional radiology has evolved into the clinically focused specialty it has become today, a review of fundamental surgical principles and proper techniques is beneficial for all IR physicians and their patients.

CONTENT ORGANIZATION
1. Preoperative care: indications for pre-procedure antibiotics, skin preparation, and proper draping. 2. Physician safety: handling of needles and sharps. 3. Pain management: local, intravenous, and oral analgesics with a review of dosing, side effects, and contraindications for each. 4. Wound closure: absorbable vs. non-absorbable suture, cutting vs. tapered suture needles, and proper suturing techniques to minimize formation of scars. 5. Identifying and managing infected wounds: debridement, packing, and antibiotics.
6. When things go wrong: resuscitation, surgical airways, large bore chest tubes, and emergency interventions.

SUMMARY
Use of proper surgical technique and principles is critical for interventional radiologists in practice. Understanding these techniques allows the IR physician to play a more sophisticated role in patient care, improve patient safety, and potentially develop new minimally invasive therapies.

LL-VIE-SU7B • Interventional Options for Patients with Chronically Embedded IVC Filters and Occluded or Severely Stenotic Inferior Vena Cavas and/or Iliac Veins

Akhilesh K Sista MD (Presenter) ; David W Trost MD ; Bradley B Pua MD * ; Ronald S Winokur MD ; David C Madoff MD

PURPOSE/AIM
IVC filters are commonly placed for various indications. In spite of the recent movement to retrieve filters at early time points post-placement, many remain in place for extended periods of times. In select patients, the filter causes marked caval fibrosis, narrowing, and sometimes occlusion that frequently extends into the iliocaval system. Here, we present several interventional techniques to remove chronically embedded filters and recanalize the IVC and iliocaval system.

CONTENT ORGANIZATION
1. Indications for caval filtration. II. Long-term complications of caval filtration. III. Incidence/prevalence of caval stenosis or occlusion following placement IV. Clinical presentation of caval stenosis: recurrent thrombosis, post-thrombotic syndrome V. Filter removal techniques VI. Iliocaval recanalization techniques VII. Complications and patient follow-up

SUMMARY
After viewing this exhibit, the viewer will have a better understanding of this grave late complication of IVC filter placement, as well as the interventional options to remove the filter and recanalize the stenosis or occlusion.

LL-VIE1271-SUB • Anatomy, Hemodynamic Classification, and Management of Duodenal Varices: A Hemodynamic Classification Based Approach

Wael E Saad MBCh (Presenter) * ; Stephen Caldwell MD

PURPOSE/AIM
• To describe the clinical presentation and pathogenesis of duodenal varices (DV)
• To detail the varying anatomy, pathology and hemodynamics of DVs
• To introduce the newly published classification system
• To discuss the hemodynamic classification based approach to management
• To detail the technical procedures in the management of DVs

CONTENT ORGANIZATION
Clinical presentation Pathology and natural history Anatomy and Hemodynamics Hemodynamic and anatomical classification system based on splanchnic (meso-portal) venous occlusion and the type of collateralization (porto-portal vs. porto-systemic vs. a combination). Management approach based on the hemodynamic classification above. Detailed technical procedures (with exemplary high quality images and photographs) of novel procedures. This includes:
• Surgery
• Decompression by recannulation of splanchnic occlusion
• Decompression with porto-systemic shunts (including TIPS)
• Sclerosis of varices
• Combinations of the above

SUMMARY
Duodenal varices are difficult to manage and various treatment options have been used with varying results. A large part of the disparity in the literature is poor standardization of descriptive anatomy and hemodynamics. This is a systematic approach to describe a anatomy/hemodynamic based management algorithm.

LL-VIE1287-SUB • Techniques and Approaches of Pediatric Vascular Interventional Procedures

Terrence Metz MD (Presenter) ; Stephen A Vartanian MD ; Nghia Vo MD

PURPOSE/AIM
An overview of pediatric vascular interventional procedures presenting the differences in the pediatric versus adult populations and what techniques could be useful when performing a procedure on the pediatric patient.

CONTENT ORGANIZATION
A. How to address the pediatric patient and parent regarding the procedure itself (what to expect, anesthesia concerns, recovery). B. Describe categories of pediatric vascular interventions: Venous (PICC, dialysis, etc.), Arterial (Angiogram, embolization, etc.) and
Lymphatic (Sclerotherapy, chylogram, etc.). C. Choosing the best anatomic access point in relation to the procedural goal for pediatric needs. D. Anatomic figures for each category showing access point and related structures. E. Technique of access for each procedure including equipment choices and positioning. F. Post-procedural care including possible complications.

SUMMARY
This presentation will provide an overview on techniques in pediatric vascular interventions with the following goals: 1. Present components of the pre-procedural discussion with the parents and pediatric patient undergoing vascular intervention. 2. Provide helpful vascular techniques, positioning and device options specific to the pediatric patient. 3. Raise awareness of the various pediatric vascular interventions performed by the interventionalist.

Interventional Oncology Series: Controversies and Emerging Questions in the Management of Renal Tumors

Sunday, 01:30 PM - 06:00 PM  ●  S405AB

VSIO11-01  ●  Controversy 1-T1a Renal Tumor: Resect, Ablate, or Follow

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO11-02  ●  Small Renal Mass (T1a): The Case for Resection

Adam S Feldman MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO11-03  ●  Long-term Results of Renal RFA Based on a Single-center 203 Cases Experience: Better than Surgery for Early RCC?

Irene Garetto MD ; Carlo Gazzera ; Marco Busso MD ; Gianluca Amadore ; Federica Solitro MD ; Andrea Veltri MD (Presenter) *

PURPOSE
To evaluate the long-term effects of RFA of renal masses (RM), assessing safety, technique effectiveness and survival, in order to compare the best results with surgical series.

METHOD AND MATERIALS
203 RM (12-75 mm, m 30; 193 malignant; 123 exophytic, 67 parenchymal, 13 central) in 137 patients (95 males; 20-88 y, m 64; 13 with hereditary tumors, 31 with solitary kidney) underwent RFA in our center in the last decade (196 US-guided, 7 CT-guided). The treatment sessions have been 220 (17 retreatments for partial ablation or early recurrence). More recently, complications were prevented with additional techniques (namely, 10 hydrodissection and 3 pyeloperfusion). Adverse Events (including major complications) and technique effectiveness (Complete Ablation) were evaluated, as well as predictors for adverse AE and CA. Overall (OS), Disease-Free (DFS) and Cancer-Specific Survival (CSS) were calculated (follow-up 1-109 months, m 39). Predictors for survival (solitary kidney, previous cancer disease, tumor type, site and size, etc.) were specifically investigated.

RESULTS
17 (8.4%) AE were recorded, including 4 (2%) major complications (all before using preventing techniques). Exophytic extension and smaller diameter were protective against AE at the uni/multivariate analysis. CA was obtained in 85% RM overall and in 115/124 with a diameter

CONCLUSION
RFA of not central small RM is safe and effective and provide high long-term survival rates. Early stage RCC should be considered for RCT comparing RFA with surgical resection.

CLINICAL RELEVANCE/APPLICATION
RFA of not central T1a RCC is safe and successful. Thus, RFA offers an optional choice as a first-line therapy. RCTs are still necessary to assess if RFA is better than surgery for early RCC.

VSIO11-04  ●  Small Renal Mass (T1a): The Case for Ablation

Jeremy C Durack MD (Presenter)

LEARNING OBJECTIVES
1) Understand and compare treatment alternatives for small renal masses. 2) Recognize imaging features of small renal masses that impact treatment alternatives. 3) Understand the risks and benefits of image guided renal mass ablation.

VSIO11-05  ●  Small Renal Mass (T1a): Both Cases for Intervention are Weak. Active Surveillance Will Do Just as Well

Stuart G Silverman MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO11-06  ●  Controversy 2-Small Renal Mass (T1a) Ablation is Chosen. Heat or Cold?

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO11-07  ●  Small Renal Mass (T1a): The Case for Heat Based Ablation

Debra A Gervais MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.
389 percutaneous cryoablation procedures were performed in 367 patients for treatment of 421 renal masses at our institution between 2011 and 2013. To compare percutaneous renal cryoablation complications and outcomes in obese and morbidly obese versus nonobese patients.

METHOD AND MATERIALS

Between 1/2011 and 4/2013, 45 renal tumors were treated at 2 medical centers using ultrasound and CT-guided microwave ablation with a high-powered, gas-cooled microwave ablation system (NeuWave Medical, Madison, WI). Tumors included biopsy-proven renal cell carcinoma (n=36), angiomylipoma (n=4), oncocytoma (n=2), and other (n=3). Mean patient age was 64 years. Post-procedure imaging was performed by CECT or MRI to evaluate for enhancement in the ablation zone.

RESULTS

Mean pre-treatment tumor diameter was 2.7 cm (range: 1.0-5.4). Tumor diameter decreased by a mean of 11% on immediate post-ablation CT. Mean duration of power application was 6.5 minutes, and mean generator power was 73.7 W. Technical effectiveness was 100%. There was one major complication: a retroperitoneal hematoma on post-ablation day 11. This coincided with restarting anticoagulation for suspected pulmonary embolus in a patient with a thrombotic history, and required readmission and transfusion of PRBCs. Median hospital stay was 1 day, and median length of clinical follow-up was 11 months. All patients are alive and without evidence of metastatic disease, with the exception of 1 death occurring 6 months post ablation and unrelated to either the procedure or the malignancy. 28 patients have had follow-up imaging at a mean of 6.3 months status post ablation, with local tumor progression noted at the ablation zone in 1 case. Overall, the procedure demonstrated 95% primary treatment effectiveness and a 98% secondary treatment effectiveness, with 1 tumor yet to be retreated.

CONCLUSION

Use of a high-powered, gas-cooled percutaneous microwave ablation system for the treatment of small renal masses demonstrates safety and technical success in the short term.

CLINICAL RELEVANCE/APPLICATION

Preliminary experience treating renal tumors with a high-powered, gas-cooled microwave ablation system suggests that the procedure is technically feasible, safe, and efficacious at early time points.
30.0 ± 9.9 kg/m²) and morbidly obese (BMI > 40.0 kg/m²). Each group was retrospectively analyzed for major complications (Clavien > Grade 2) and oncologic outcomes.

RESULTS
189 (48.6%) renal cryoablation procedures were performed on nonobese patients, 161 (41.4%) on obese patients and 39 (10.0%) on morbidly obese patients. Eleven (5.8%) major complications occurred in nonobese patients, 15 (9.3%) in obese patients and 3 (7.7%) in morbidly obese patients. As such, there was no significant difference in the rate of major complications in obese (p=0.23) or morbidly obese (p=0.67) compared to nonobese patients. There was one ablation-related death from complications of urosepsis. A total of 13 local treatment failures and 8 local tumor recurrences during median imaging follow-up of 18 months (interquartile range: 8°36). Six (3.2%) local treatment failures occurred in nonobese patients, 5 (2.9%) in obese patients and 2 (4.8%) in morbidly obese patients. Again, no significant difference was noted in local treatment failure rate between obese (p=0.96) or morbidly obese (p=0.57) compared to nonobese patients.

CONCLUSION
Percutaneous renal cryoablation complication rates and outcomes in obese and morbidly obese patients are similar to those in nonobese patients.

CLINICAL RELEVANCE/APPLICATION
To our knowledge, this is the first paper to evaluate percutaneous renal cryoablation complications and outcomes based on patient body mass index (BMI).

VSIO11-12 • Controversy 3-Biopsy or No Biopsy Before Ablation

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO11-13 • Renal Cell Cancer Subtype as a Predictor of Efficacy in Radiofrequency Ablation

Timothy D McClure MD (Presenter); Allan Pantuck MD; James Sayre PhD; Steven S Raman MD

PURPOSE
To determine if renal cell cancer (RCC) subtype predicts efficacy in the percutaneous radiofrequency ablation (RFA) of RCC.

METHOD AND MATERIALS
With IRB approval we performed a HIPAA compliant retrospective study of patients who underwent RFA for RCC and determined subtype pathology that included clear cell, chromophobe, papillary, oncocytic neoplasm, and RCC not otherwise specified. Pathology was determined by biopsy or post resection surgical pathology. Group comparisons were done using univariate and multivariate logistic regression analysis to determine factors impacting primary efficacy, secondary efficacy, and technique effectiveness. All analyses were done using the statistical software STATA/SE 11.2. Alpha of 0.05 was considered significant. Technical success, local tumor progression, primary and secondary technique effectiveness were defined per the Working Group of Image Guided Tumor Ablation.

RESULTS
100 pathologically proven RCC masses were identified in 84 patients with the following subtypes: clear cell: 55/100 (55%), oncocytic neoplasms: 19/100 (19%), papillary: 13/100 (13%), RCC not otherwise specified 10/100 (10%), and chromophobe: 3/100 (3%). Median post ablation follow up was up to 106 months (mean 24 months). Non clear cell RCC subtypes had more favorable outcome compared to clear cell RCC for primary, secondary and total technique 44/45(97.8%), 1/45 (2.2%), 45/45 (100%) versus 42/55 (76.4%), 8/55 (14.5%), 50/55 (90.9%) respectively(p=0.002). Overall primary, secondary and total technique effectiveness was 86%, 9%, and 95% respectively.

CONCLUSION
Non-clear cell RCC subtypes have more favorable ablation outcomes compared to clear cell RCC after percutaneous RFA.

CLINICAL RELEVANCE/APPLICATION
Pathology predicts efficacy in the percutaneous RFA of renal masses. Pre-procedure biopsy should be done prior to percutaneous RFA of renal masses to better predict outcomes.

VSIO11-14 • Biopsy or No Biopsy Before Ablation? Don’t Trouble Yourself or the Patient with the Renal Mass Biopsy - Go Ahead and Ablate

Steven S Raman MD (Presenter)

LEARNING OBJECTIVES
1) Understand how to image renal masses prior to ablation. 2) Understand how to use appropriate CT and MR protocols to enable renal mass characterization. 3) Describe the most common CT and MRI enhancement signatures of common RCC subtypes, oncocytomas and lipid poor AML.

ABSTRACT
Characterization of small renal masses has proven challenging. However, with appropriate CT and MR protocols, the majority of these lesions can now be characterized pre procedurally, enabling a confident diagnosis. In this lecture, we will describe renal mass characterization protocols and describe the common imaging signatures of RCC subtypes and their common mimics including lipid poor AML and oncocytoma. This may eliminate need for preprocedural biopsy.

VSIO11-15 • Biopsy or No Biopsy Before Ablation? Biopsy Every Renal Tumor before Percutaneous Ablation

William W Mayo-Smith MD (Presenter) *

LEARNING OBJECTIVES
1) Explain the expanding role of renal mass biopsy. 2) Explain why biopsy is necessary before all renal tumor ablations. 3) Demonstrate biopsy techniques.

VSIO11-16 • Emerging Questions in Renal Tumor IR Management

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO11-17 • Benign Disease: Leave Alone, Ablate or Suggest Something Else?

S. William Stavropoulos MD (Presenter) *

LEARNING OBJECTIVES
1) Understand and compare treatment alternatives for benign renal masses. 2) Recognize imaging features of benign renal masses that impact treatment alternatives. 3) Understand the risks and benefits of image guided treatment of benign renal masses.

VSIO11-18 • Large Renal Masses (T1b): Does Ablation Have a Seat at the Table?
LEARNING OBJECTIVES
1) Appreciate the strengths and limitations of percutaneous ablation in treating renal tumors measuring larger than 4cm.

ABSTRACT

VSIO11-19 ● Outcomes Following Percutaneous Cryoablation of Renal Masses 4.1-7.0cm

Jay J Vlaminck MD (Presenter) ; Grant D Schmit MD ; Anil N Kurup MD ; Adam J Weisbrod MD ; Matthew R Callstrom MD, PhD * ; Thomas D Atwell MD ; Stephen Boorjian ; Robert Thompson MD

PURPOSE
To describe safety and oncologic outcomes following percutaneous cryoablation of renal masses measuring 4.1-7.0cm.

METHOD AND MATERIALS
Retrospective review of 71 renal tumors measuring 4.1-7.0cm in 70 consecutive patients treated with percutaneous cryoablation between 2003 and 2011. Local recurrence, cancer-specific survival and overall survival rates were recorded. Complication rates (Clavien Dindo) were also documented.

RESULTS
Mean tumor size was 4.8 cm. A single (1.4%) technical failure was observed at the time of ablation. Of the 58 (82%) tumors that were followed for at least three months, there was a single (1.7%) recurrence. The mean duration of follow-up for the 57 tumors that did not recur was 2.2 years (range 0.3 – 7.1). Estimated recurrence-free survival rates at 1, 3, and 5 years following cryoablation were 97.9%, 97.9%, and 97.9%, respectively.

Among the 58 tumors that were followed for at least three months, 36 (62%) were RCC at biopsy, including the single recurrence. Mean duration of follow-up for the 35 RCC tumors that did not recur was 2.0 years (range 0.3 – 6.1). Estimated recurrence-free survival rates at 1, 3, and 5 years for these biopsy-confirmed RCC tumors were 96.4%, 96.4%, and 96.4%, respectively. Of the 36 (51%) patients with sporadic RCC, estimated cancer-specific survival rates at 1, 3, and 5 years were 100%, 94%, and 94%, respectively. Of the 71 cryoablation procedures, there were 5 (7.0%) complications of grade 3 or greater.

CONCLUSION
Cryoablation represents a safe treatment alternative for patients with renal masses, with intermediate-term oncologic efficacy for T1b tumors.

CLINICAL RELEVANCE/APPLICATION
Outcomes in this study suggest that cryoablation of T1b renal cell carcinoma may be more efficacious than previously considered, particularly when considering the AUA guidelines.

Venous Disease

Sunday, 02:00 PM - 03:30 PM ● S404CD

RC114 ● AMA PRA Category 1 Credit™:1.5 ● ARRT Category A+ Credit:1.5
Anne C Roberts , MD *
Gerant M Rivera-Sanfeliz , MD

LEARNING OBJECTIVES
1) Decide on the appropriate patients to undergo venous ablation. 2) Know various tools used for venous ablation. 3) Understand some of the issues of large vein occlusions and possible treatments. 4) Gain familiarity with the presentation pelvic congestion and varicocele. 5) Have a familiarity with the treatment of pelvic congestion and varicoceles.

ABSTRACT
Lower leg varicosities are a very common problem. Over the last 10 years there has been increasing interest in the percutaneous treatment of varicosities. The patient population, the presentation of varicosities, and the treatment of varicosities will be presented. Other venous anomalies can worsen the symptoms of varicosities and may need to be treated. These include May-Thurner syndrome, pelvic congestion, and the male variant of pelvic congestion syndrome (varicoceles). The patient population, symptoms and presentations, and the treatment of these other venous abnormalities will also be discussed.

Techniques for Interventional Sonography and Thermal Ablation (Hands-on Workshop)

Sunday, 02:00 PM - 03:30 PM ● E264

RC152 ● AMA PRA Category 1 Credit™:1.5 ● ARRT Category A+ Credit:1.5
Stephen C O’Connor , MD
William E Shiel , DO *
Alda F Cossi , MD
Michael V Krasnokutsky , MD
Mark L Lukens , MD
Kenneth S Lee , MD *
Manish N Patel , DO
Hollins P Clark , MD, MS
Mark J Hogan , MD
Carmen Gallego , MD
Neil V Patel , MD
Robert D Lyon , MD
Patrick Warren , MD
Mahesh M Thapa , MD
Kristin M Dittmar , MD

LEARNING OBJECTIVES
1) Identify basic skills, techniques, and pitfalls of freehand invasive sonography. 2) Discuss and perform basic skills involved in thermal tumor ablation in a live learning model. 3) Perform specific US-guided procedures to include core biopsy, abscess drainage, vascular access, cyst aspiration, soft tissue foreign body removal, and radiofrequency tumor ablation. 4) Incorporate these component skill sets into further life-long learning for expansion of competency and preparation for more advanced interventional sonographic learning opportunities.

ABSTRACT
RC212A • TEVAR Indications and Outcomes

Michael D Dake MD (Presenter) *

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

RC212B • New Endografts for AAA

Constantino S Pena MD (Presenter) *

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

RC212C • Post Endograft Essentials

Geoffrey D Rubin MD (Presenter) *

LEARNING OBJECTIVES
1) To better select the best imaging modality for assessing stent-grafts. 2) To assure that CT acquisition technique is optimized for endoleak detection. 3) To learn how to identify structural failures in endografts.
341 patients with CV risk factors (mean age 63.39±10.4[34-89]) underwent WB-CTA (detector configuration: 64x0.6mm) with an adapted contrast injection protocol (lomepalo-400, 400mgI/ml; 70+50ml@4ml/s). For the evaluation of atherosclerotic burden the coronary arteries were divided into 15 segments and the extra-coronary arteries into 32 segments and detected stenoses were graded using a 5-point scale (0-4 normal-occlusion; 5 aneurysm). An atherosclerosis burden score (ABS) was generated for each volunteer and correlated to traditional CV risk (Framingham risk index; FRI). ABS and FRI were compared using Kaplan-Meier survival analysis, ROC analysis and stepwise multivariable Cox proportional hazards regression models.

RESULTS
At baseline mean ABS was 19.5±20.1 and mean FRI was 12±10.7; 64.5±11.3 months after WB-CTA all patients received an interview to determine health status during this period. According to Kaplan-Meier curves, mean event-free time was of 86.3±6.4m for ABS

CONCLUSION
WBCTA-derived ABS reflects real atherosclerotic burden and provides superior risk stratification and event prediction with respect to FRI; hard event prediction was significantly associated to age, ABS and therapy but not to FRI.

CLINICAL RELEVANCE/APPLICATION
WB-CTA allows non-invasive and more accurate risk stratification then FRI; thus, ABS could guide primary therapeutic interventions in a more robust and accurate manner then traditional risk methods

VSIR21-03  Whole Body Contrast Enhanced Magnetic Resonance Angiography Screening for Sub-clinical Atherosclerotic Disease

Graeme Houston MD, FRCP (Presenter) *; Matthew Lambert MBCh, MRCP *; Jonathan Weir-McCall MBCh, FRCP; Stephen Gandy; Shona Matthew BSc, PhD *; Richard D White MBChB, FRCP; Jil J Belch; Alan D Struthers; Frank Sullivan; Roberta Littleford PhD

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

METHODOLOGY
5000 volunteers > 45 yrs with no history of CV disease, a 10 year risk of CV disease less than 20% as assessed by the ASSIGN CV risk score and a B-type natriuretic peptide (BNP) greater than their gender specific median were invited. Of 1651 volunteers, 34 were ineligible due to safety issues, 107 were claustrophobic, and 1510 (91.4%) completed the 3T MRI (Siemens Trio, Erlangen, DE) MRI. WBCE-MRA was acquired from skull vertex to feet using following intravenous injection gadolinium gadoterate meglumine (Dotarem, Guerbet, FR). The subtracted WBCE-MRA data comprised 31 anatomical arterial segments. Each segment was scored according to the extent of luminal narrowing: 0 normal, 1 impaired, 2 severe, 3 occluded.

RESULTS
277 of 46,810(0.5%) arterial segments were un-interpretable due to poor quality images, or anatomical variation. Only 606 (40.1%) participants had a normal WBAS. The distribution of arterial abnormalities was head, neck and thorax in 403 (26.7%), abdominal 361 (24.0%), lower extremity 366 (24.2%) and peripheral arteries 366 (24.2%) of volunteers. The number of volunteers with WBAS of 1-267 (18%), 2-204 (13.5%), 3-117 (7.8%), 4-86 (5.7%), 5-68 (4.5%), 6-47 (3.1%), >7 -114 (7.6%) volunteers respectively. Of the affected segments detected 1644 (76%) were < 50% stenosis, 234 (11%) were 50-75% stenosis, 161 (7.5%) were 70-99% stenosis, 80 (3.7%) were occluded and 32 (1.5%) were aneurysmal vessels.

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

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

VSIR21-04  Recommendations for Endovascular Treatment of PVD in 2013

Johannes Lammer MD (Presenter) *

LEARNING OBJECTIVES
1) To learn the indications for interventions in PAD. 2) To learn the technique and devices for aortoiliac treatment. 3) To learn the technique and devices for femoropopliteal artery treatment. 4) To learn the technique and devices for below the knee (BTK) treatment. 5) To learn the results of most recent trials. 6) To learn the medical treatment after intervention.

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

VSIR21-05  Influence of Tube Voltage Reduction on Image Quality in MDCTA of Arterial Stents Using Model-based Iterative Reconstruction: A Phantom Study

Jochen M Grimm MD (Presenter); Lucas L Geyer MD *; Daniel Maxien MD; Zsuzsanna Deak MD; Fabian Mueck; Michael K Scherr MD; Stefan Wirth MD *

PURPOSE
To evaluate dose saving potential and impact on image quality of tube voltage reduction in MDCT imaging of arterial stents using model-based iterative reconstruction (MBIR) compared to adaptive statistical iterative reconstruction (ASIR) in an anthropomorphic phantom.

METHODOLOGY
Different coronary stents were filled with iodinated contrast medium, placed in a thoracic Alderson-Rando phantom and scanned at 120, 100 and 80 kVp at fixed tube currents (200, 100, 50mA). Luminal attenuation values (HU) and standard deviation (image noise; IN) were measured, contrast- (CNR) and signal-to-noise ratio (SNR) were calculated for ASIR and MBIR. Image quality (IQ) was assessed by two blinded radiologists using a 5-point scale (0-4 normal-occlusion; 5 aneurysm). Atherosclerosis burden score (ABS) was generated for each individual and correlated to traditional CV risk (Framingham risk index; FRI). ABS and FRI were compared using Kaplan-Meier survival analysis, ROC analysis and stepwise multivariable Cox proportional hazards regression models.

RESULTS
Average IQ using MBIR was superior to ASIR at 120 and 100 kVp (p

CONCLUSION
MBIR performed superior to ASIR at 120 and 100kVp independent of tube current. At 80kVp, ASIR performed slightly better than MBIR, especially at lower tube currents, without reaching statistical significance. Best relation between IQ and CTDI was found using MBIR at 100kVp and 50mA, delivering an image quality superior to the best ASIR image at only 16% of its CTDI.

CLINICAL RELEVANCE/APPLICATION
MBIR significantly outperforms ASIR at 100 and 120 kVp. Tube current can be greatly reduced without sacrificing image quality while tube voltage should not be reduced below 100 kV.

VSIR21-06  Impact of a Novel CT-based Calcium Scoring System of the Lower Extremity Arteries on Primary Patency Rates after Endovascular Interventions for Peripheral Arterial Disease: Preliminary Results
METHOD AND MATERIALS
We reviewed our procedural database between 1/2005 – 12/2009 for lower extremity arteriograms that included an intervention on a stenosis or occlusion. Patients were included if there was no more than one lesion per leg and if a CTA of the lower extremities was performed within the preceding 6 months. A total of 66 lesions were identified in 47 patients (22 males, mean age 63 years). Each treated lesion was reviewed on the CTA for calcium scoring. Calcium morphology was described as none, thin linear, thick linear, or bulky. The percent circumference was scored as none, 1-50%, 51-95%, or >95%. Primary patency was determined by recurrence of symptoms in that extremity or development of 50%+ stenosis at the treated site based on CTA or conventional angiography if available. Patency estimation was performed using the Kaplan-Meier method and compared using the log rank test. The cutoff for statistical significance was a p-value = 0.05.

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

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

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

VSIR21-07 • Robust 3D MRI Segmentation of Superficial Femoral Artery for Morphological Analysis of Peripheral Arterial Disease Plaque Burden
Eranga Ukwatta MENG (Presenter) ; Jing Yuan ; Bernard Chiu ; Wu Qiu ; Martin Rajchl ; Aaron Fenster PhD *

PURPOSE
Current lumigraphic techniques have limited utility in the longitudinal assessment of peripheral arterial disease (PAD). With the advent of fast and non-invasive 3D black-blood MRI sequences, such as 3D motion-sensitized driven equilibrium (MSDE) prepared rapid gradient echo sequence (3D MERGE), superficial femoral artery (SFA) vessel wall can be evaluated up to 50 cm coverage for generating morphological measurements of PAD plaque burden. This study aims develop and evaluate a fast and precise algorithm for segmentation of the femoral artery outer wall and lumen from 3D MR images.

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

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

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

CLINICAL RELEVANCE/APPLICATION
The algorithm is suitable for generating morphological measurements of PAD plaque burden with high accuracy and reproducibility and it requires only 2-3% of time required for manual segmentation.

VSIR21-08 • Stent Grafts Explained
Lindsay S Machan MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIR21-09 • Updates in Vascular Disease
Albert A Nemcek MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIR21-10 • Effect of Renal Sympathetic Denervation on Left Ventricular Hypertrophy in Patients with Medication-resistant Hypertension: 1 Year Follow-up with Cardiac Magnetic Resonance Imaging
Willemmien Verloop MD ; Eva Vink MD ; Peter Blankestijn MD, PhD ; Evert-Jan Vonken MD, PhD ; Michiel Voskuil ; Tim Leiner MD, PhD (Presenter) *

PURPOSE
Renal denervation (RDN) is designed to decrease sympathetic activity and has shown to be an effective treatment for hypertension. The effects of RDN on the heart are largely unknown. Aim of the current study was to investigate the effect of RDN on left ventricular hypertrophy, which is an indicator of end organ damage.

METHOD AND MATERIALS

RESULTS
Treatment of Osteoid Osteoma: Experience on 27 Consecutive Cases

SSC10-03 •

Changes

SSC10-02 •

Tuesday, 10:30 AM - 12:00 PM
Musculoskeletal (Interventional I)

VSIR21-11 •

Wrap Up and Discussion

LEARNING OBJECTIVES
View learning objectives under main course title.

Musculoskeletal (Interventional I)

Monday, 10:30 AM - 12:00 PM • E4508

SSC10 • AMA PRA Category 1 Credit ™: 1.5 • ARRT Category A+ Credit: 1.5

Moderator
Cree M Gaskin, MD

Moderator
Brian D Petersen, MD

SSC10-01 • MR-guided High-intensity Focused Ultrasound Ablation of the Femoral Bone: MRI and CT Evaluation of Structural Changes

Matthew D Bucknor MD (Presenter); Viola Rieke PhD; Thomas M Link MD, PhD *; Mark W Wilson MD; Sharmila Majumdar PhD; Maythem Saeed DVM, PhD

PURPOSE
To evaluate hyperacute structural changes (MR-guided High-intensity Focused Ultrasound Ablation) of the femoral bone.

METHOD AND MATERIALS
Experimental procedures received approval from the institutional committee on animal research. MRgHIFU was used to create two thermal lesions (distal and proximal) in the right femur of 8 pigs, while the left femur was used as a control. Each target was subjected to either 4 (n=4) or 6 (n=4) sonications within similar treatment volumes. The energy dose to the distal target was higher than the proximal target (419±19 J versus 324±17 J). On real-time MR thermometry, the temperature rise adjacent to target bone was quantified. HIFU lesions were imaged using multiple MRI sequences (3.0T) and 64-slice CT, with and without contrast, before and after treatment.

RESULTS
MRgHIFU created focal hypoenhanced lesions measuring on average 2.1 cm in maximum cranio-caudal dimension. Interestingly, within similar prescribed treatment volumes, the use of 6 as opposed to 4 sonications increased the depth of the transverse intramedullary hypoenhanced zone, measuring up to 6.5 mm versus 2.9 mm, respectively (p<0.05). CT imaging failed to demonstrate morphological abnormalities with and without contrast media.

CONCLUSION
The number of focal sonications plays a crucial role in the depth of treatment within the targeted bone. MR thermometry provided precise thermal dose maps. Unlike CT, T2-weighted and contrast enhanced MR demonstrated the hyperacute structural changes in the femur and surrounding soft tissue.

CLINICAL RELEVANCE/APPLICATION
Sonication number and energy dose during MRgHIFU of bone can be selected to precisely control ablation zone size, allowing for more effective and better-tolerated treatment of focal bone lesions.

SSC10-02 • Thermal Ablation Techniques for Curative Treatment of Bone Metastases

Frederic Deschamps (Presenter); Geoffroy Farouil; Lambros C Tselikas MD; Thierry J De Baere MD *

PURPOSE
To determine prognostic factor(s) for complete thermal ablation (TA) of bone metastases.

METHOD AND MATERIALS
The medical records of all the patients who had undergone curative-intent TA of bone metastases in our Institution between September 2001 and February 2012 were retrospectively reviewed. The goal of the TA was to achieve a local tumor control in order to cure all bone metastases in oligometastatic patients or to prevent the occurrence of skeletal-related events in long life expectancy cancer patients. We have analyzed the rate of complete treatment at 1 year according to different factors: gender, age, site of the primary tumor, synchronicity with the primary tumor, already treated by external radiotherapy, local condensation aspect at CT (lytic vs. sclerotic), bone cortical erosion, critical neurological structures in the vicinity (less than 10mm), TA evolution within 3 months before the procedure (RECIST criteria), location (axial vs. appendicular), maximal diameter at baseline CT, and the bone metastases characteristics-synchronicity with the primary tumor, already treated by external radiotherapy, local condensation aspect at CT (lytic vs. sclerotic), bone cortical erosion, critical neurological structures in the vicinity (less than 10mm), TA technique used (radiofrequency ablation vs. cryoablation).

RESULTS
Eighty-nine consecutive patients underwent TA in a curative-intent of 124 bone metastases. The median follow-up was 22.8 months [12.2 to 44.4 months]. We report a 67% of complete treatment at 1 year. In multivariate analysis the good prognostic factors for complete treatment were: metachronous bone metastasis (p=0.004), no progression within 3 months before (p=0.004), no cortical erosion (p=0.01), maximal diameter

CONCLUSION
Thermal ablation techniques are effective to cure small bone metastases.

CLINICAL RELEVANCE/APPLICATION
Thermal ablation techniques must be considered in oligometastatic patients or in long life expectancy cancer patients with bone metastases.

SSC10-03 • Radiofrequency Thermoablation versus Magnetic Resonance Guided Focalized Ultrasound Surgery (MRgFUS) in the Treatment of Osteoid Osteoma: Experience on 27 Consecutive Cases

Francesco Arrigoni (Presenter); Armando Conchiglia; Lorenzo Maria Gregori; Luigi Zugaro; Antonio Barile; Carlo Masiocchi

PURPOSE
To compare the clinical and morphological results, two years after the procedure, of the treatment of 27 osteoid osteomas with Magnetic Resonance guided Focus Ultrasound Surgery (MRgFUS) versus the treatment with Radiofrequency thermoablation (RF).
METHOD AND MATERIALS

From March 2011 we treated 27 osteoid osteomas, 12 using MRgFUS (ExAblate InSightech, Israel) and 15 using RF (LeVeen Needle Electrode Boston Scientific - USA). The osteoid osteomas treated with MRgFUS were located in the femur (n.8), tibia (n.3) and in the talus (n.1). The lesions treated with RFs were located in the femur (n.9), talus (n.2), vertebral body (L3 and L5) and tibial plateau (n.2). All the lesions were diagnosed by plain films, CT and MRI and controlled after the procedure by MRI and CT. The clinical evaluation was performed by VAS scale.

RESULTS

All the patients treated with RF termoablation showed a regression in painful symptomatology with a mean VAS decreasing from 8 to 1.2 two years after the treatment. The treatment with MRgFUS was successful in 10 out of 12 patients (mean VAS dropped from 8.1 to 1.3 two years after the treatment). The two cases unresponsive were re-treated successfully with RF. The MRI evaluation showed a disappearance of bone edema already at the first controls at 6 months after the treatment in all the patients treated successfully. In the CT controls no substantial changes were found, except for the disappearance of the central calcification of the nidus in the 40% of cases treated with MRgFUS.

CONCLUSION

Although further studies with a longer term and a larger number of cases are needed, our experience demonstrates the effectiveness of the treatment of osteoid osteomas with MRgFUS. In particular this treatment is successful in the 83% of cases. The main limit is today represented by the accessibility of the lesion by the ultrasound. However the treatment is repeatable and does not preclude treatments with other techniques (with the RFs, the percentage of success is of 100%).

CLINICAL RELEVANCE/APPLICATION

This study explain an innovative and non-bloody technique to treat osteoid osteoma of bone.

SSC10-04 • MR-guided Focused Ultrasound (MRgFUS) for Treatment of Painful Bone Metastases: Can ADC Be Used to Predict Clinical Outcome?

Fabrizio Boni (Presenter); Alessandro Napoli MD; Michele Anzidei MD; Vincenzo Noce MD; Daniel R De Oliveira; Carlo Catalano MD

PURPOSE

To evaluate potential of diffusion-weighted magnetic resonance imaging (DWI) with apparent diffusion coefficient (ADC) maps in the assessment of molecular changes in bone metastasis micro-environment caused by MR guided Focused Ultrasound (MRgFUS), and to correlate these modifications with clinical outcomes.

METHOD AND MATERIALS

23 patients with bone metastases underwent MRgFUS using the ExAblate 2100 system (InSightec). Minimal required imaging work-up consisted of CT and MR imaging to determine size and location of the lesions. Skeletal metastasis imaging was performed with a 3-T MR imaging unit (Discovery 750, GE; gd-BOPTA, Bracco). After treatment, all patients were scheduled to undergo clinical follow-up examinations at 1, 3 and 6 months post-treatment. To evaluate treatment efficacy in terms of symptoms palliation, pain severity and pain interference scores were determined using Visual Analogue Scale (VAS) score. Additionally, all patients underwent follow-up MR imaging at 1, 3 and 6 months after treatment. The margins of metastatic lesions were tracked manually on the baseline ADC. As quantitative parameter of treatment response, we calculated percentage of increase in ADC (ADC%) and correlation with clinical outcomes.

RESULTS

No adverse events were recorded. We found an effective pain relief, with mean VAS score drop from an average baseline of 7.09±1.8, to 2.65±1.36 at first month follow-up to 1.04±1.91 at third month and to 1.09±1.99 at sixth month. Furthermore, patients treated with MRgFUS showed a mean increase in ADC value of +48.9% at first month follow-up (p<0.05).

CONCLUSION

Our preliminary data showed that incremental ADC values positively correlated with MRgFUS clinically successful outcome in patients with bone metastases; a different percentage increase in ADC was evident among our population (partial vs complete responders). ADC value might play as an important early marker surrogate for clinical outcome in patients undergoing MRgFUS for painful bone metastasis.

SSC10-05 • MR-guided Focused Ultrasound (MRgFUS) Ablation for Non-spinal Osteoid Osteoma Treatment: A Prospective Multi-centric Cohort Study

Daniel Geiger MD (Presenter); Alessandro Napoli MD; Armando Conchiglia; Alberto Bazzocchi MD; Ugo Albisinni MD; Carlo Masciocchi; Carlo Catalano MD

PURPOSE

Purpose of this study was to evaluate MR-guided focused ultrasound (MRgFUS), in terms of success rate, for painful non-spinal osteoid osteoma treatment.

METHOD AND MATERIALS

This IRB approved prospective multi-centric cohort study, performed at three university hospitals, included thirty patients (M:21; Mean age: 24±11). Between May 2010 and April 2012 thirty painful non-spinal osteoid osteomas, diagnosed at imaging (including ce-dynamic MR (gd-BOPTA, Bracco)) have been treated using MRgFUS (3.0-T/1.5-T GE Discovery MR 750/450 + InSightec ExAblate 2000). Treatment success in terms of pain reduction has been evaluated using visual analog scales (VAS). Sonications number and mean acoustic energy (J) have been recorded. One year clinical and imaging follow-up was performed to evaluate success rate, recurrence and complications.

RESULTS

Thirty osteoid osteomas (26 lower limbs and 4 upper limbs) have been treated using MRgFUS. Complete clinical success rate was 90% (27/30), with a pain score =2 after treatment and at twelve months evaluation. Partial treatment was observed in 10% (3/30) and CTgRFA (2/30) or open surgery (1/30) was then performed. A single session treatment was sufficient in 93% (28/30) of cases to achieve clinical success. Two cases required MRgFUS retreatment. Types of anesthesia were spinal (21), peripheral (5) and general (4; in pts. =10yos). Mean sonications number was 6±3; mean energy 1080±727 J. No complications were observed immediately after treatment or during follow-up.

CONCLUSION

This multi-centric prospective cohort study demonstrated that MRgFUS has a high success rate (90%) and a relatively short learning curve for non-spinal osteoid osteoma treatment. Our results suggest that MRgFUS may be considered as an effective, totally non-invasive and safe alternative approach in osteoid osteoma interventional management.

CLINICAL RELEVANCE/APPLICATION

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

SSC10-06 • Cryoablation of Perineural Musculoskeletal Tumors: Use of Intraprocedural Motor Evoked Potential (MEP) Monitoring to Improve Safety

Anil N Kurup MD (Presenter); Jonathan M Morris MD; Grant D Schmit MD; Thomas D Atwell MD; Adam J Weisbrod MD; Matthew R Callstrom MD, PhD *; Andrea J Boon; Rickey Carter PhD; C. T Wass MD; Peter Rose MD

PURPOSE

Our preliminary data showed that incremental ADC values positively correlated with MRgFUS clinically successful outcome in patients with bone metastases; a different percentage increase in ADC was evident among our population (partial vs complete responders). ADC value might play as an important early marker surrogate for clinical outcome in patients undergoing MRgFUS for painful bone metastasis.

METHOD AND MATERIALS

This IRB approved prospective multi-centric cohort study, performed at three university hospitals, included thirty patients (M:21; Mean age: 24±11). Between May 2010 and April 2012 thirty painful non-spinal osteoid osteomas, diagnosed at imaging (including ce-dynamic MR (gd-BOPTA, Bracco)) have been treated using MRgFUS (3.0-T/1.5-T GE Discovery MR 750/450 + InSightec ExAblate 2000). Treatment success in terms of pain reduction has been evaluated using visual analog scales (VAS). Sonications number and mean acoustic energy (J) have been recorded. One year clinical and imaging follow-up was performed to evaluate success rate, recurrence and complications.

RESULTS

Thirty osteoid osteomas (26 lower limbs and 4 upper limbs) have been treated using MRgFUS. Complete clinical success rate was 90% (27/30), with a pain score =2 after treatment and at twelve months evaluation. Partial treatment was observed in 10% (3/30) and CTgRFA (2/30) or open surgery (1/30) was then performed. A single session treatment was sufficient in 93% (28/30) of cases to achieve clinical success. Two cases required MRgFUS retreatment. Types of anesthesia were spinal (21), peripheral (5) and general (4; in pts. =10yos). Mean sonications number was 6±3; mean energy 1080±727 J. No complications were observed immediately after treatment or during follow-up.

CONCLUSION

This multi-centric prospective cohort study demonstrated that MRgFUS has a high success rate (90%) and a relatively short learning curve for non-spinal osteoid osteoma treatment. Our results suggest that MRgFUS may be considered as an effective, totally non-invasive and safe alternative approach in osteoid osteoma interventional management.

CLINICAL RELEVANCE/APPLICATION

The safety and effectiveness of MRgFUS encourages its adoption in treating non-spinal osteoid osteoma. This procedure, differently from any other ablative technique, is totally non-invasive.
Revisited Results, Recurrences and Outcomes in 75 Patients

Cementoplasty

In the past Aneurismal Bone Cyst (ABC) was treated surgically or with a combination of surgery and embolization. Nowadays the sole treatment was shifted to surgery because of skin necrosis (clinical decision) or patient’s choice. In the 107 procedures, there were three months. In four patients the procedure was not finalised for anatomical concerns. In two patients needing integrative embolization procedures.

RESULTS

The cohort included 26 males and 26 females with median age of 61 years (range, 4-82). Tumors were located in the spine (27; 3 cervical, 10 thoracic, 1 lumbar), sacrum (3), pelvis (23; 8 periacetabular, 6 other iliac, 4 pubic, 1 ischial, 2 gluteal), and extremities (8; 5 upper, 3 lower). Among the 64 tumors, 50 (78%) were metastases. 21 different tumor histologies were represented, most commonly renal cell carcinoma (17 tumors, 27%), colorectal carcinoma (6 tumors, 9%), and multiple myeloma/plasmacytoma (5 tumors, 8%). Median tumor size was 4.0 cm (range, 0.8-15.0). 19 (32%) of 59 procedures resulted in decreases in the intraprocedural MEPs, including 15 (25%) with transient decreases and 4 (7%) with persistent decreases. Two (50%) of the 4 patients with persistent MEP decreases had motor deficits following ablation, one permanent and one which resolved over 5 months. No patient with transient MEP decreases or no MEP change developed a functional motor deficit. The risk of major motor injury with persistent MEP changes was significantly increased compared to transient or no change (p=0.0045, RR 69.8, 95% CI: 5.9 to >100). Excluding neural injury, there were 3 major complications (Clavien-Dindo grade >= 3): acute renal failure due to tumor lysis requiring temporary hemodialysis, cerebrospinal fluid leak requiring blood patch, and extruded cement from concomitant cementoplasty requiring surgical cement resection.

CONCLUSION

In this initial series of cryoablation procedures using intraprocedural MEP monitoring, persistent MEP decreases correlated with post-procedural major motor deficits.

CLINICAL RELEVANCE/APPLICATION

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

SSC10-07 • Palliation of Pain and Prevention of Fracture for Acetabular Metastases Using Combined Cryoablation and Cementoplasty

Erik B Sviggum MD (Presenter); Anil N Kurup MD; Matthew R Callstrom MD, PhD *; Peter Rose MD; Franklin Sim MD

PURPOSE

To assess the viability of combined cryoablation and cementoplasty in palliating pain and preventing fracture in patients with lytic metastatic disease of the acetabulum.

METHOD AND MATERIALS

39 combined cryoablation and cementoplasty procedures were performed on 37 patients with lytic metastatic disease from January 2004 through September 2012. Cryoablation was performed initially, with cementoplasty performed subsequently, usually the following day. Patient age ranged from 48 to 83 years (median 65, range 48-83). Patients included were known to have lytic periacetabular metastases that were painful, or nonpainful but extensive enough that there was concern of impending fracture. Nonpainful lesions were evaluated by orthopedic surgeons and deemed at risk for fracture prior to procedure. Pre-procedural pain rating, using a visual analog scale (VAS), was obtained by referring clinicians or the interventional radiologist. Lesion location, pain levels pre- and post-procedure, periacetabular fracture (defined as cortical discontinuity or fracture on CT or MRI) pre- and post-procedure, completeness of the ablation procedure, and pre- or post-ablative therapies (surgery, radiation) to the specific location were documented.

RESULTS

27 of the 39 procedures were done for palliation of pain and had complete pre- and post-procedural VAS pain scores. Of these patients, 23 (85%) had improved post-procedural pain scores. Patients who had complete cryoablation of their periacetabular metastases (defined as the ice ball completely encompassing the tumor as seen on intermittent CT fluoroscopy) had improved pain compared with patients who had incomplete cryoablutions. Of the patients who received followup imaging of their pelvis, 69% had no progression of pre-existing fracture or development of new fracture. Lesion stability was slightly higher in patients who had complete cryoablations vs incomplete cryoablutions (73% vs 57%). Overall, the 39 patients required a post-procedural intervention, including one patient who required sciatic neurolysis due to leakage of cement during the procedure.

CONCLUSION

Combined cryoablation and cementoplasty is a useful tool in the treatment of lytic acetabular metastatic disease for both palliation of pain as well as stabilization and prevention of fracture.

CLINICAL RELEVANCE/APPLICATION

Combined cryoablation and cementoplasty can improve pain and stability in patients with lytic acetabular metastases.

SSC10-08 • Selective Arterial Embolization of Aneuysmal Bone Cyst (ABC) of the Skeleton with N-2 Butyl Cyanoacrylate: Revisited Results, Recurrences and Outcomes in 75 Patients

Giuseppe Rossi MD; Eugenio Rimondi MD (Presenter); Giancarlo Facchini; Paolo Spinnato MD; Patrizia Pelotti; Teresa Calabro; Pietro Ruggieri; Daniel Vanel MD; Alberto Bazzocchi MD

PURPOSE

To emphasize the role of arterial embolization with N-2 butyl cyanoacrylate as single and resolving treatment for ABC. We evaluated the effectiveness and complications of the procedure in 75 patients at the Rizzoli Institute.

METHOD AND MATERIALS

From April 2003 until April 2013, 75 patients with ABC were treated (41 males and 34 females, range 3-40 years). Each case was histologically proven. Twenty-four were sited in the appendicular skeleton (5 in the superior and 19 in the inferior limb), 8 affecting the thoracic cage (1 rib, 3 clavicle and 4 scapula), 29 in the pelvis and 15 in the spine (8 sacral, 4 lumbar, 3 thoracic). In 50 patients (66%) only one embolization was performed, two embolization in 18 patients (24%) and three in the remaining 7 cases (18%), for a total of 107 procedures.

RESULTS

Regardless of the number of the embolizations, the treatment was effective in 69 patients (92%): medium follow-up 59 months ± 12 months. In four patients the procedure was not finalised for anatomical concerns. In two patients needing integrative embolization treatment was shifted to surgery because of skin necrosis (clinical decision) or patient's choice. In the 107 procedures, there were three complications (3%): two skin necrosis and one transient pharesis. However all the complications were solved one after surgical support.

CONCLUSION

Arterial embolization is the treatment of choice for aneurysmal bone cysts. The use of cyanoacrylate seems to be determinant for the excellent outcome of embolization, allowing permanent effect and well-controlled procedure. Embolization is less invasive, cheaper, simpler, faster, more secure for skilled operators and it is easily repeatable.

CLINICAL RELEVANCE/APPLICATION

In the past Aneurysmal Bone Cyst (ABC) was treated surgically or with a combination of surgery and embolization. Nowadays the sole embolization with N-2 butyl cyanoacrylate is the gold standard.
Aim: To examine if transarterial embolization (TAE) enhance the metastatic potential of the residual HCC, and investigate the mechanisms underlying the effects of embolization with a rat model of orthotopic hepatocellular carcinoma.

METHOD AND MATERIALS
All protocols were approved by the animal research committee of Fudan University and met NIH guidelines. In vitro study, the hepatoma cell line McA-RH7777 marked by GFP (Green Fluorescent Protein) were cultured under hypoxic and normoxic conditions. Forty male buffalo rats were implanted with McA-RH7777 tumor in the left lateral lobe of liver. After laparotomy and retrograde placement of catheter into the gastroduodenal artery for 5 different treatments. Treatments were: 1) Control (n=5, 1ml NS); 2) TAE (n=4, 10mg 50-150mPVA particles in 1ml NS); 3) TAE+AG-B (n=5, 10mg PVA in 1ml AG-B); 4) TAE+AG-F (n=5, 10mg PVA+30mg AG-F in 1ml NS); 5) TAE+AG-C (n=5, 10mg PVA+30mg AG-C in 1ml normal saline). Tumor length (L), width (W), and height (H) were measured by 2D-ultrasound before treatment and twice a week till 4 weeks after treatment. Tumor volume (V) was calculated by the formula: V= 0.5*L*W*H.

RESULTS
In vitro invasion assay indicated that the numbers of invading hypoxic McA-RH7777 cells were 30.8±4.74, which were significantly higher than normoxic cells (10.3±3.59, P<.05). Successful implantation was achieved in all rats, which was confirmed by MRI. The metastatic potential of tumor cells by hypoxia or interventional procedure was enhanced by significantly reducing the expression of E-cadherin and up-regulation of HIF-1α, VEGF, E-cadherin, N-cadherin, and vimentin in residual tumor cells were evaluated by western blot, PCR, or immunohistochemistry in vitro and in vivo respectively. The Mann-Whitney U-test or ?² was used for statistical comparisons.

CONCLUSION
Hypoxia always occurring residual tumor after the TAE can increase invasiveness and metastatic potential of HCC, and targeting to the molecular changes induced by hypoxia may augment the therapeutic effects of TAE.

CLINICAL RELEVANCE/APPLICATION
The study may help to design of mechanism-based combination therapies or new therapeutic regimes to improve the effect of TACE in the clinical treatment of HCC.

S1C06-02 • Bimodal Treatment of Aerobic and Glycolytic Metabolism by Particle Embolization Combined with Anti-glycolytic Compound Improves Treatment of N1-S1 Hepatocellular Mouse Model

John R Haaga MD (Presenter) ; Hanping Wu MD, PhD

PURPOSE
To determine if combination treatment of aerobic metabolism by embolization and antiglycolytic drugs compared to embolization alone provides better treatment of N1-S1 hepatocellular carcinoma in a rat model.

METHOD AND MATERIALS
Two separate laparotomies were performed, one for subcapsular tumor implant and the second for retrograde placement of catheter into the gastroduodenal artery for 5 different treatments. Treatments were: 1) Control (n=5, 1ml NS); 2) TAE (n=4, 10mg 50-150mPVA particles in 1ml NS); 3) TAE+AG-B (n=5, 10mg PVA in 1ml AG-B); 4) TAE+AG-F (n=5, 10mg PVA+30mg AG-F in 1ml NS); 5) TAE+AG-C (n=5, 10mg PVA+30mg AG-C in 1ml normal saline). Tumor length (L), width (W), and height (H) was measured by 2D-ultrasound before treatment and twice a week till 4 weeks after treatment. Tumor volume (V) was calculated by the formula: V= 0.5*L*W*H.

Relative tumor volume after treatment was calculated as the percentage of pre-treatment tumor volume. Kruskal-Wallis test was used to compare the difference of relative tumor volume between 5 groups on each observation time point.
The initial tumor sizes in each group were statistically not significantly different. Three animals in the control group were euthanized before the end of observation due to rapid tumor growth and anorexia. In TAE group, one kept growing after treatment. In other 3 animals, the tumor volume increased in the early observation time points (within 1 week, 2 within 2 weeks) and then shrunk. In other 3 TAE+AG groups, the tumor volumes decreased after treatment with significant differences between control group and 3 TAE+AG groups on all observation time point except TAE+AG-F group on 3.5 and 4 weeks. At 4 weeks after treatment, the median relative tumor volumes were 1.74.5% in control group, 58.2% in TAE group, 9.6% in TAE+AG-B group, 23.8% in TAE+AG+F group, and 13.4% in TAE+AG-C group.

CONCLUSION
Bimodal embolic treatment of hepatocellular cancer is more effective than embolic Rx alone. Further study of these propriety agents is warranted because agents target enzymes specific to cancer. Optimization of drug form, dose and route administration (IV, oral) are needed. Safety studies must be completed before human use.

CLINICAL RELEVANCE/APPLICATION
Clinical relevance is enormous. Agents should be effective against all cancers with little effect on normal tissues. Mode of delivery can be arterial, intravenous and/or oral. Challenge is funding.

SSC16-03 • Effects on Apoptosis in Rabbit Hepatic VX2 Carcinoma after Transcatheter Arterial Chemoembolization Using Alginate Microspheres-Adriamycin (ADM): Experimental Study

Kaiyuan Xu (Presenter)

PURPOSE
To evaluate effects on the apoptosis of transcatheter arterial chemoembolization (TACE) with alginate microsphere-adriamycin in experimentally induced liver tumor.

METHOD AND MATERIALS
Thirty New Zealand White rabbits were randomly divided into five groups and VX2 carcinoma was grown in the left lobes of the livers. TACE was performed with normal saline (Group A), alginate microsphere (Group B), alginate microsphere-adriamycin (Group C), Lipiodol (Group D), and Lipiodol-adriamycin (Group E). Three weeks later, the animals were killed and apoptotic index were calculated on the basis of findings. Effects on intrahepatic and distal metastases in all groups were examined.

RESULTS
CONCLUSION
Alginate microspheres can potentially serve as embolizing agents and drug delivery vehicles for local slow-release. With embolization and chemotherapy effect of doxorubicin, alginate microspheres induce and promote apoptosis of tumor cells, which reduce residual areas of tumor, the recurrence rate and metastasis rate.

CLINICAL RELEVANCE/APPLICATION
Chemoembolization with Alginate microsphere-ADM is an effective antitumor treatment of hepatic carcinoma.

SSC16-04 • Evaluation of a Combined Protocol of Sorafenib and Transarterial Chemoembolization (TACE) vs. TACE vs. Sorafenib Protocol Alone in Advanced Stage Hepatocellular Carcinoma (HCC): Retrospective Study at Three German Liver Centers

Thomas J Vogl MD, PhD (Presenter); Jorg Trojan MD; Markus Goller; Mark Op Den Winkel; Eckart Schott; Martin W Welker; Stefan Zangos MD; Wolf-Otto Bechstein; Stefan Zeuzem MD; Frank T Kolligs MD

PURPOSE
To compare combined Sorafenib and transarterial chemoembolization (TACE), TACE alone and Sorafenib alone for treatment of patients with advanced hepatocellular carcinoma (HCC) according to the Barcelona Clinic Liver Cancer (BCLC) stage C.

METHOD AND MATERIALS
In this retrospective multicenter cohort study 185 patients with BCLC stage C who were treated with Sorafenib and TACE (group A, n=50), with TACE alone (group B, n=59) or with Sorafenib alone (group C, n=76) were retrospectively analyzed for comparison from January 2007 to October 2012. Portal vein infiltration, extrahepatic metastases, time-to-progression and overall survival were evaluated. For patients of group A adverse events were also documented.

RESULTS
Portal vein infiltration was documented in 32% of patients in group A, 36% in group B, and 37% in group C. Extrahepatic metastases were present in 60% (group A), 34% (group B), and 49% (group C). Median time-to-progression was 6.3 months in group A (95%-conficende interval [CI]: 4.3-8.3), 5.4 months in group B (95%-CI: 3.5-7.3) and 3.5 months in group C (95%-CI: 3.1-3.9). Median overall survival was 17.0 months in group A (95%-CI: 13.5-20.5), 11.0 months in group B (95%-CI: 8.1-13.9) and 9.0 months in group C (95%-CI: 7.0-11.0). The most common adverse events in the combined treatment of Sorafenib and TACE were diarrhea (54%), hand-foot-skin reactions (40%) and fatigue (36%). Due to adverse events the Sorafenib dose was reduced in 86% of patients in group A and stopped in 6%.

CONCLUSION
The combined treatment of Sorafenib and TACE seems to be a promising treatment option in patients with HCC in BCLC stage C, especially if extrahepatic metastases are present. However, further prospective or randomized studies are necessary.

CLINICAL RELEVANCE/APPLICATION
The combined therapy of Sorafenib and TACE is a relevant therapy option for patients in advanced stages of HCC.

SSC16-05 • Quantitative Measurement of the Hepatic Blood Flow before and after Transcatheter Arterial Chemoembolization of Hepatocellular Carcinoma

Yi-Yang Lin MD (Presenter); Rheun-Chuan Lee MD; Hsiao-Shan Tseng; Chien An Liu MD; Wan-Yu Guo MD, PhD *; Cheng-Yen Chang MD

PURPOSE
To quantitatively measure the hemodynamic change of hepatic artery before and after transcatheter arterial chemoembolization (TACE) of hepatocellular carcinoma (HCC) by quantitative color-coding analysis (QCA).

METHOD AND MATERIALS
This prospective study was performed from December 2012 to February 2013. 64 patients (mean 67.5 year old; male 50, female 14) who were diagnosed with HCC and underwent TACE with doxorubicin and Lipiodol emulsion or with microspheres were enrolled if superselective segmental TACE was technically feasible. The endpoint of TACE was sluggish of antegrade arterial flow. QCA (syngo iFlow; Siemens) was used to determine the maximal density time (Tmax) of selected intravascular region of interest (ROI). Relative Tmax (rTmax) was defined as the Tmax at the selected ROI minus the time of contrast medium spurtting from the catheter tip. The catheter tip was placed in common hepatic artery, proper hepatic artery or lobar hepatic arteries before and after TACE with the same acquisition and injection protocols. The rTmax of treated and proximal hepatic arteries were analyzed before and after embolization.

RESULTS
The pre- and post-treatment rTmax of the landmarks at the treated segmental artery and proximal right hepatic artery were 1.84-2.08s, 2.7-3.59s (p < 0.001) and 1.4-1.64s, 1.55-1.89s (p < 0.001).
QCA is feasible to quantify embolization endpoint by comparing the rTmax in selected hepatic arteries before and after TACE. The rTmax of treated segmental artery was significant prolonged after optimized procedures.

CLINICAL RELEVANCE/APPLICATION

QCA is able to quantitatively determine the adequate embolization endpoint in HCC patients.

SSC16-06 • Does Safety Margin Reduce Local Recurrence in C-arm CT-assisted Chemoembolization for Small Nodular Hepatocellular Carcinoma?

Hyo-Jin Kang (Presenter) ; Jin Wook Chung MD * ; Hyo-Cheol Kim MD ; Hwan Jun Jae MD ; Saebom Hur MD

PURPOSE

To test the hypothesis that safety margin may reduce local recurrence in superselective chemoembolization for small nodular hepatocellular carcinoma (HCC).

METHOD AND MATERIALS

To test the hypothesis, the consecutive patients who underwent both C-arm CT assisted superselective chemoembolization using an iodized oil for small nodular (1-3cm in size and 3 or less in number) HCC as the initial treatment and immediate thin-section iodized-oil CT were identified from the prospectively registered electronic database. From March 2009 to March 2011, 96 nodules in 80 patients (60 men, 20 women; mean age, 61.5 years) were included in this study. On immediate iodized-oil CT, we analyzed the presence or absence of defect in iodized-oil uptake in the tumor and completeness of safety margin in the surrounding liver parenchyma. Univariate and multivariate analyses were performed to determine prognostic factors for local recurrence. Potential determinant factors included Child-Pugh class, tumor size, tumor vascularity, definition of tumor boundary, tumor depth from surface to hilum, selectivity of chemoembolization, pattern of oily portogram, lipiodol uptake intensity, and lipiodol uptake homogeneity.

RESULTS

The median follow-up time was 26.4 months (range, 1-46.1 months). 37 nodules in 33 patients showed local recurrence. 1- and 2-year cumulative local recurrence rates were 61.9% and 81%, 9.3% and 20.2% for nodules with defect (n=21) and for nodules without defect (n=75), respectively (p=.000). Among the 75 nodules without defect, 1- and 2-year cumulative local recurrence rates were 11.1% and 22.2%, 7.7% and 17.9% and for nodules with complete safety margin (n=36) and for nodules with incomplete safety margin (n=39), respectively (p=.901). In multivariate analyses using Cox proportional hazard model, lipiodol uptake homogeneity (HR = 0.266; 95% CI: 0.11, 0.65; P < .05), lipiodol uptake defect (HR = 3.76; 95% CI: 1.53, 9.27; P < .05) remained significant in local recurrence.

CONCLUSION

In case of complete lipiodol uptake in the tumor, safety margin did not affect local recurrence rate in C-arm CT assisted chemoembolization for HCC.

CLINICAL RELEVANCE/APPLICATION

In case of complete lipiodol uptake in the tumor, additional effort to ensure complete safety margin as in RF ablation is not justified in superselective chemoembolization for small nodular HCC.

SSC16-07 • Volumetric Tumor Assessment Predicts Survival in Patients Treated with Transarterial Chemoembolization for Hepatocellular Carcinoma

Vania Tacher MD (Presenter) ; Mingde Lin PhD * ; Nikhil Bhagat MD ; Constantine Frangakis ; Hooman Yarmohammadi MD * ; Rafael Duran MD ; Michael Chao ; Rongxin Chen ; Zhijun Wang MD ; Jean-Francois H Geschwind MD *

PURPOSE

Tumor response in patients with hepatocellular(HCC) treated by transarterial chemoembolization(TACE) can be measured quantitatively using 3D quantitative European Association for the Study of the Liver (qEASL) and volumetric Response Evaluation Criteria in Solid Tumor (vRECIST). The purpose of this study was to demonstrate that qEASL and vRECIST can be used to predict patient survival.

METHOD AND MATERIALS

Tumor response using pre and post TACE MRI was assessed on 84 consecutive patients treated with a first session of TACE for HCC. The entire tumor volume was used for vRECIST and the enhancing portion of the tumor volume for qEASL analysis. Targeted tumor response (TTR) and overall tumor response (OR) were revealed two distinctive groups of patients: responder (R) and non-responder (NR). For TTR using vRECIST, R was defined as patients with a decrease sum of target tumor (TT) volumes beyond 30%. For TTR using qEASL analysis, R was defined as patients with a decrease, beyond 50%, of the sum of TT qEASL volume. vRECIST and qEASL OR were determined based on time-to-response (TTR) and overall response (OR) respectively (p=.901). In multivariate analyses using Cox proportional hazard model, lipiodol uptake homogeneity (HR = 0.266; 95% CI: 0.11, 0.65; P < .05), lipiodol uptake defect (HR = 3.76; 95% CI: 1.53, 9.27; P < .05) remained significant in local recurrence.

RESULTS

131 TT, 32 non-TT and 9 new lesions were evaluated from 84 HCC patients. Mean tumor volume and mean enhancing volume decreased from 235±47.5cm3 and 206±414cm3 to 120±250cm3 and 97±215cm3, respectively. Using vRECIST, both TTR and OR showed n=8(10%) R with a mean survival time of 45±18 months, and n=76(90%) NR with a mean survival time of 27±3 months. There was no statistical survival difference between R and NR for vRECIST TTR and OR (p=.901). In multivariate analyses using Cox proportional hazard model, lipiodol uptake homogeneity (HR = 0.266; 95% CI: 0.11, 0.65; P < .05), lipiodol uptake defect (HR = 3.76; 95% CI: 1.53, 9.27; P < .05) remained significant in local recurrence.

CONCLUSION

The 3D tumor enhancement assessment, qEASL can be used to assess target tumor response and overall tumor response and can predict survival in HCC patients after the first TACE session.

CLINICAL RELEVANCE/APPLICATION

3D tumor enhancement assessment model can be used to assess target tumor response and overall tumor response and predict survival in HCC patients after the first TACE session.
difference in measurements between the methods with a bias of 49.0% (95% CI: -96.9% to 194.9%). Correlation between mRECIST and volumetric measurement was poor, pc=0.54. Poor agreement was demonstrated between the two techniques when assessing response based on percentage of change in viable tissue (k = 0.34, 95% CI: 0.148-0.543).

CONCLUSION
There is poor agreement between mRECIST and volumetric quantification when assessing response to locoregional therapy in HCC.

CLINICAL RELEVANCE/APPLICATION
Necrosis in treated HCC can have heterogeneous distribution. Volumetric quantification of viable tumor demonstrated better agreement between readers and yielded different results compared with mRECIST.

SSC16-09 • Estimation of the Prognosis of Hepatocellular Carcinoma Treated with Hepatic Arterial Chemoembolization: Comparison of Nine Prognostic Staging Systems
Yasutaka Baba MD (Presenter); Sadao Hayashi MD; Shunichiro Ikeda BS; Masayuki Nakajo PhD

PURPOSE
To examine various prognostic staging systems estimating the prognosis of patients with hepatocellular carcinoma (HCC) treated with hepatic arterial chemoembolization (HACE).

METHOD AND MATERIALS
The subjects were 1040 patients (Male:714, Female:326) with the mean age of 67.5 (range, 17-93 years) treated with HACE for HCC from January 1990 to December 2009. HACE was principally done selectively using anticancer drugs mixing with iodized-oil and gelatin sponge. Factors determining survival were analyzed by univariate and multivariate analyses using the Kaplan-Meier method and Cox proportional hazard regression models. Nine prognostic staging systems (Child Pugh classification[CPC], UICC TNM, Japan Integrated Staging score[JIS], Okuda score[Okuda], Cancer of the Liver Italian Program[CLIP], Barcelona Clinic Liver Cancer[Barcelona], Japanese TNM[JTNM], Japanese Liver Damage[JLD], Tokyo score[Tokyo]) were compared about the discriminatory capacity, which was tested by the linear trend. Moreover, the likelihood ratio test was used to investigate the additional homogeneity of survival within scores.

RESULTS
The mean survival period was 33 months. In a multivariate analysis, tumor number (>=4), tumor diameter(>=3cm), vascular invasion (+), ascites (+), albumin(<35g/L) were variables significantly associated with survival. CLIP was the most informative prognostic staging system for estimating the long term survival of patients with HCC treated with HACE.

CLINICAL RELEVANCE/APPLICATION
Among 9 prognostic staging systems, CLIP may be the most important prognostic system for estimating the prognosis of patients with HCC treated with HACE.

Vascular/Interventional - Monday Posters and Exhibits (12:15pm - 12:45pm)

Monday, 12:15 PM - 12:45 PM • Lakeside Learning Center

LL-VIS-MOA • AMA PRA Category 1 Credit ™:0.5
Host
Sarah B White, MD

LL-VIS-M01A • Low Dose Runoff CTA: Effect of Hybrid Iterative Reconstruction Technique on Quantitative and Qualitative Image Parameters
Evgeny Kondratyev MD (Presenter); Grigory Karmazanovsky MD; Vadim Shirokov; Anna Kalinina

PURPOSE
To evaluate the effect of hybrid iterative reconstruction (HIR) on qualitative and quantitative parameters of data obtained using low dose run-off CTA.

METHOD AND MATERIALS
90 patients were divided into three groups. The scanning protocol was 120kVp 200mAs in first group, 80kVp 200mAs in second group, and 120kVp 50mAs in third group. Data from second and third group was reconstructed using both FBP and three levels of HIR. For quantitative and qualitative evaluation we used effective dose, visual scores (1-3), mean arterial attenuation, noise, contrast-to-noise ratio (CNR) in three arterial segments.

RESULTS
The BMI ranged from 21 to 38 kg/m2 and was not significantly different between groups (p>0.05). The mean intrarenal attenuation was significantly higher in second group (448±76HU, p<0.001). Average radiation dose reduction up to 77% was achieved using 80kV and 50mAs protocol providing sufficient image quality. Application of the 80kV protocol in people with BMI>30 is limited, especially in evaluation of aorto-iliac segment due to higher noise and attenuation levels. While at 50mAs protocol such limitation is not observed. Iterative reconstruction significantly improved image quality, reduce noise and artifacts, allowing us to expand indications for low-dose studies, including overweight and obese patients.

CLINICAL RELEVANCE/APPLICATION
Low dose run-off CTA of peripheral vessels using 80kV or 50mAs and hybrid iterative reconstruction provides up to 77% dose reduction and sufficient image quality.

LL-VIS-M02A • Optimal Scanning Parameters for Non-contrast-enhanced Time-spatial Labeling Inversion-pulse MR Angiography of Renal Arteries
Xuan Wang MD (Presenter); Huandan Xue MD; Zhengyu Jin MD; Xinzhi Zhao

PURPOSE
To study the impact of inversion time(TI), respiratory rate(RR) and slice thickness(ST) on image quality and acquisition time for non-contrast-enhanced (non-CE) renal MR Angiography with true steady-state free-precession (SSFP) and time spatial labeling inversion pulse (Time-SLIP).

METHOD AND MATERIALS
Two sets of young healthy adults were examined. Voice recorder was applied to regulate RR. Set A contained 23 subjects. Six Time-SLIP sequences were performed on each subject, with a fixed TI of 1200ms. For three coronary sequences, the RR was free, 10 and 15 breaths per minute(bpm) respectively, with a ST of 2.5mm. For three axial sequences, the ST and RR settings were 2.0mm with free breath, 2.0mm with 10 bpm and 2.5mm with 10bpm respectively. Set B contained 22 subjects. Four coronal sequences with different TI were performed, as 700, 900, 1200 and 1500 ms respectively. The ST and RR were fixed as 2.5mm and 15 bpm.

RESULTS
The mean effective dose of the first and second group were 0.34±0.18 (n=23) and 1.09±0.37 Hounsfield Units (HU) (n=22), respectively. The BMI ranged from 21 to 38 kg/m2 and was not significantly different between groups (p>0.05). The mean intraarterial attenuation of the first and second group were 108±22 (n=23) HU and 101±20 (n=22) HU, respectively. The mean survival period was 33 months. In a multivariate analysis, tumor number (>=4), tumor diameter(>=3cm), vascular invasion (+), ascites (+), albumin(<35g/L) were variables significantly associated with survival. CLIP was the most informative prognostic staging system for estimating the long term survival of patients with HCC treated with HACE.

CONCLUSION
CLIP was the most informative prognostic staging system for estimating the long term survival of patients with HCC treated with HACE.
Compound Improves Treatment of N1-S1 Hepatocellular Mouse Model

**LL-VIS-MO3A • Remodeling of Focal Contrast Enhancement Communicating with Aortic Branch Arteries in Intramural Hematoma**

Kumi Ozaki (Presenter) ; Hiroshi Ohtake ; Toshifumi Gabata MD ; Yoshihiro Senda ; Tetsuya Fukuda ; Yoshiaki Morita ; Masahiro Higashi MD ; Hiroaki Naito MD, PhD

**PURPOSE**
To analyze the prevalence, location, morphology, and remodeling of focal contrast enhancement communicating with aortic branch arteries in acute intramural hematoma (IMH) and compare findings with those of focal contrast enhancement not communicating with aortic branch arteries.

**METHOD AND MATERIALS**
RESULTS
There were 104 communicating lesions in 52 patients and 72 non-communicating lesions (corresponding approximately to ulcer-like projection) in 63 patients. Communicating lesions were frequently seen (38.5%), and more than one communicating lesion was seen in the majority of patients (68.8% vs. 11.1%, p<0.01).

CONCLUSION
In intramural hematoma, most regions of focal contrast enhancement communicating with aortic branch arteries are completely or partially resorbed during follow-up, and are not associated with intervention.

**CLINICAL RELEVANCE/APPLICATION**
In intramural hematoma, most regions of focal contrast enhancement communicating with aortic branch arteries are completely or partially resorbed, and are not associated with intervention.

**LL-VIS-MO4A • Developments of New Percutaneous Lithotripsy Techniques for Removal of Common Bile Duct Stones**

Baojie Wei MD, PhD (Presenter) ; Yanfeng Meng MD ; Feng Zhang MD, PhD ; Xia Wu ; Patrick Willis ; RenYou Zhai MD ; Wayne L Monsky MD, PhD ; Xiaoming Yang MD, PhD

**PURPOSE**
To develop new techniques for percutaneous removal of common bile duct (CBD) stones using three lithotripsy systems, including a pneumatic, an electrohydraulic, and an electromagnetic lithotripter with various stone catchers.

**METHOD AND MATERIALS**
RESULTS
Of the in-vitro experiment, an average pulse at 9.5 were required to break these stones. The average skin-to-skin lithotripsy time was 6.5 min. The average stone fragment length was at 2.1 mm compared to the pre-lithotripsy stone length at 5.1 mm (p<0.01).

CONCLUSION
The three new lithotripsy techniques are feasible and safe for breaking and removal of CBD stones, which establishes groundwork for their further clinical application.

**CLINICAL RELEVANCE/APPLICATION**
The development of these percutaneous lithotripsy techniques may open new avenues to efficiently remove common bile duct stones.

**LL-VIS-MOSA • Bimodal Treatment of Aerobic and Glycolytic Metabolism by Particle Embolization Combined with Anti-glycolytic Compound Improves Treatment of N1-S1 Hepatocellular Mouse Model**

John R Haaga MD (Presenter) ; Hanping Wu MD, PhD

**PURPOSE**
To determine if combination treatment of aerobic metabolism by embolization and antiglycolytic drugs compared to embolization alone provides better treatment of N1-S1 hepatocellular carcinoma in a rat model.

**METHOD AND MATERIALS**
RESULTS
The initial tumor sizes in each group were statistically not significantly different. Three animals in the control group were euthanized before the end of observation due to rapid tumor growth and anorexia. In TAE group, one kept growing after treatment. In other 3 animals, the tumor volume increased in the early observation time points (1 within 1 week, 2 within 2 weeks) and then shrunk. In other 3 TAE+AG groups, the tumor volumes decreased after treatment with significant differences between control group and 3 TAE+AG groups on all observation time point except TAE+AG+F group on 3.5 and 4 weeks. At 4 weeks after treatment, the median relative tumor volumes were 3,174.5% in control group, 58.2% in TAE group, 9.6% in TAE+AG-B group, 23.8% in TAE+AG+F group, and 13.4% in TAE+AG-C group.

CONCLUSION
Bimodal embolic treatment of hepatocellular cancer is more effective than embolic Rx alone. Further study of these propriety agents is warranted because agents target enzymes specific to cancer. Optimization of drug form, dose and route administration (IV, oral) are
Clinical relevance is enormous. Agents should be effective against all cancers with little effect on normal tissues. Mode of delivery can be arterial, intravenous and/or oral. Challenge is funding.

**LL-VIE-MO6A ● Angio-CT System: Reasons Why It is Useful in Non-vascular Interventions**

Miyuki Sone MD (Presenter) ; Yasuaki Arai MD * ; Yoshito Takeuchi MD ; Shunsuke Sugawara ; Hirotaka Tomimatsu ; Shinichi Morita ; Daisuke Okamoto MD

**PURPOSE/AIM**

Angio-CT system is equipment combining c-arm angiography system and CT scanner with a same sliding table. The aims of this exhibit are:

1. To review the reasons why Angio-CT is useful in non-vascular interventions
2. To provide a case-based review of challenging non-vascular interventions using Angio-CT

**CONTENT ORGANIZATION**

1. Background of image guidance in non-vascular interventions
   - Treatment target does not always have anatomical landmark or baseline for needle puncture
   - Fluoroscopy is superior in guiding device manipulation with its real-time capability
   - CT is superior in confirming the position of the target and the device with its cross-sectional and 3-D information
2. Reasons why Angio-CT is useful
   - Planning of access with CT, manipulation of device with fluoroscopy, and confirmation with CT can be performed alternately and repeatedly
   - In the absence of anatomical landmark, a fine needle is used as a baseline and accurate puncture can be performed with tandem technique
3. Case-based review of challenging procedures
   - Use of anatomical landmark
   - Use of tandem technique
   - Spacing vital organs from the target

**SUMMARY**

Angio-CT is useful in non-vascular interventions because alternate use of fluoroscopy and CT is available. This exhibit reviews the features of Angio-CT and its clinical use.

**LL-VIE-MO7A ● Parastomal Varices: Diagnosis, Treatment, and Outcomes**

Annie K Lim DO (Presenter) ; Joshua D Dowell MD, PhD ; Gregory E Guy MD ; Bill S Majdalany MD

**PURPOSE/AIM**

To review the epidemiology, diagnosis, and various treatment methods for parastomal varices.

**CONTENT ORGANIZATION**

Epidemiology and pathophysiology of parastomal varices will be reviewed. The numerous methods that have been described in the literature for treatment include: direct compression, medical optimization, percutaneous or transhepatic embolization, TIPS, surgical stomal revision, and superficial sclerotherapy. Each therapeutic option has associated complications and contraindications. Current literature and outcome data will be reviewed and an algorithm for patient specific treatment approach will be proposed.

**SUMMARY**

Esophageal and gastric varices are a common manifestation of portal hypertension with an accepted treatment algorithm. Already, 30% of patients with both portal hypertension and urinary or enteric diversion will develop parastomal varices. With the advent of life prolonging treatments, which can give rise to portal hypertension, this population may increase. Although bleeding from these varices has a relatively low overall mortality, significant morbidity exists in the form of repeated hospitalizations and transfusions. Patient specific treatment approach is reviewed.

**LL-VIE1289-MOA ● Irreversible Electroporation in the Abdomen: A Primer for Interventionalists**

Avinash R Kambadakone MD, FCRR (Presenter) ; Raul N Uppot MD ; Rahmi Oklu MD, PhD ; Debra A Gervais MD * ; Ronald S Arellano MD

**PURPOSE/AIM**

Irreversible electroporation is an exciting new technology which is finding increasing applications in the treatment of tumors of the liver, kidney and the pancreas. The purpose of this exhibit is to discuss the principles, indications, technique and performance of irreversible electroporation in the abdomen using a pictorial review.

**CONTENT ORGANIZATION**

1. Brief review of the principles and technique of irreversible electroporation
2. Discuss the relevant anatomical considerations for successful performance of IRE
3. Discuss the indications for IRE in various tumors in the liver, kidney and pancreas
4. Describe the step-by-step interventional technique for CT guided IRE
5. Illustrate the technique by citing examples from routine and challenging cases in a pictorial review with the tips and tricks for successful placement
6. Discuss the patient care issues before, during and after procedure including management of complications

**SUMMARY**

Irreversible electroporation is an exciting new technology with immense potential in the treatment of hepatic, pancreatic and renal tumors. A proper understanding of the indications, principles and technique of this procedure is essential to ensure a successful outcome.

**LL-VIE1288-MOA ● Chest Complications of Abdominal Interventions**

Florian J Fintelmann MD (Presenter) ; Selim R Butros MD ; Subba R Digumarthy MD ; Ashraf Thabet MD ; Jo-Anne O Shepard MD * ; Debra A Gervais MD * ; Diane A Levis ; Peter R Mueller MD *

**PURPOSE/AIM**

A variety of abdominal interventions can result in complications in the chest. Our exhibit presents a pictorial illustration of such procedures with their respective intrathoracic complications. Preventive measures and management will be discussed.

**CONTENT ORGANIZATION**

1. Review anatomy of upper abdomen in relationship to pleural space and mediastinal structures
2. Illustrate fundamentals of abdominal procedures with potential chest complications:
Ablation of liver, kidneys or adrenal glands
Biopsy of liver, kidneys, adrenal glands or retroperitoneum
Biliary drainage, nephrostomy, and right and left subphrenic abscess drainage

3. Examples of thoracic complications such as pneumothorax, hemothorax, empyema, pericardial tamponade, and leak of bile, lymph or urine into the pleural space. 4. Discussion of pre- and intraprocedural preventive measures such as patient positioning, gantry angulation and hydrodissection. 5. Discussion of management of said complications.

SUMMARY
This exhibit educates interventional radiologists how to prevent, recognize and manage chest complications related to a variety of abdominal procedures.

Vascular/Interventional - Monday Posters and Exhibits (12:45pm - 1:15pm)
Monday, 12:45 PM - 01:15 PM • Lakeside Learning Center

LL-VIS-MO3B • Effect of Sorafenib Combined with Transcatheter Arterial Embolization on the Therapeutic Outcome of Rabbit Hepatic Tumors

Lingxiang Ruan PhD, MD (Presenter) ; Shunliang Xu ; Jingfeng Zhang PhD, MD

PURPOSE
Transcatheter arterial embolization (TAE) could result in more severe hypoxia and affect the microcirculation of hepatic tumor, which lead to tumor recurrence and metastasis at some extent. Sorafenib, the first systemic drug approved for advanced hepatocellular carcinoma (HCC) patients, is mainly used for the prevention of HCC recurrence and metastasis. Tumor micro-circulation has a close relationship with the growth, development, invasion, metastasis and prognosis of hepatic carcinoma. This study was to verify the hypothesis that sorafenib combined with TAE could improve the therapeutic outcome of pure TAE.

METHOD AND MATERIALS
A total of twenty-four New Zealand White rabbits were successfully implanted with VX2 tumor in liver and divided into three group at random, such as pure Lipiodol-based TAE group (n = 8), sorafenib combined with TAE group (n = 8) and pure sorafenib group (n = 8). Tumors were received TAE with Lipiodol, and / or oral administration of sorafenib after implanting for two weeks. One, two, and four weeks after TAE, animals were humanely killed, and tumor samples were collected for immunohistochemical staining with CD34. Expression level of HIF-1α protein was evaluated, and micro vascular density (MVD) was calculated.

RESULTS
Sorafenib suppressed the development of tumor recurrence and metastasis through extracellular signal-regulated kinase signaling caused by elevated levels of growth factors, which could enhance the therapeutic outcome in combination with TAE against liver tumors.

CLINICAL RELEVANCE/APPLICATION
Sorafenib could enhance the therapeutic outcome in combination with TAE against liver tumors.

LL-VIS-MO3B • Evaluation of Portal Vein System in Patients after Liver Transplantation by Unenhanced MR Angiography Using Spatial Labeling with Multiple Inversion Pulses Sequence and by CT Portography

Hao Tang (Presenter) ; Daoyu Hu MD, PhD ; Zi Wang

PURPOSE
The objective of this study was to evaluate the diagnostic performance of unenhanced MR Angiography using spatial labeling with multiple inversion pulses sequence (SLEEK) in comparison with CT portography in the detection of Portal Vein System in patients with liver transplantation.

METHOD AND MATERIALS
22 patients, 21 men and 1 women (mean age 44.3 years; age range, 15-51 years). Unenhanced MRA using SLEEK was performed on a 1.5-T MRI system for assessing portal vein system in 22 patients with liver transplantation. Then all patients underwent 16-slice CT portography within 1-4 days. The ability to present the portal vein system and to reveal portal vein system disease with SLEEK was evaluated by two experienced radiologists and was compared with CT portography results using a joint reading performed in consensus.

RESULTS
22 patients with liver transplantation underwent SLEEK MRA. A total of 20 portal veins were successful assessed, including 16 normal portal veins, 4 with stenoses. Nineteen of the 20 patients were performed end-to-end anastomosis between the donor's portal vein and recipient's portal vein. One of the 20 patients was performed end-to-end anastomosis between the donor's portal vein and recipient's inferior vena cava. There was excellent correlation between SLEEK and CT portography in presenting the diameter of portal vein (r = 0.92; p < 0.05). SLEEK was superior to CT portography in revealing the third- and fourth-order segmental branches in the hepatic parenchyma (p < 0.05). SLEEK has the advantage of avoiding interference from ribs, arterial and venous system enhancement.

CONCLUSION
The SLEEK has a comparable ability in demonstrating portal vein system in patients with liver transplantation as well as CT portography does. It can provide helpful information for surgeons to make an accurate postoperative assessment. Unenhanced MRA using SLEEK is relatively inexpensive and is not associated with renal complications. It can be as a good choice for screening portal vein system in patients with liver transplantation, especially in patients with renal insufficiency.

CLINICAL RELEVANCE/APPLICATION
The SLEEK has a comparable ability in demonstrating portal vein system in patients with liver transplantation as well as CT portography does. It can provide helpful information for surgeons to make an

LL-VIS-MO4B ● Study on a Combined Protocol of Chemoembolization and Microwave Ablation: Treatment of Hepatocellular Carcinoma in Rats

Thomas J Vogl MD, PhD (Presenter); Jun Qian MD; Ulli Imlau; Yousef Hamidavi; Huedayl Korkusuz MD; Elsie Oppermann; Wolf-Otto Bechstein

PURPOSE
To assess the effect of transcatheter arterial chemoembolization (TACE) combined with microwave ablation for the treatment of hepatocellular carcinoma in an animal model.

METHOD AND MATERIALS
All experiments were approved by the German government and the institutional animal research review board. After subcapsular liver implantation of Morris Hepatoma 3924A in 30 ACI rats, the animals were randomly assigned to three interventional treatment groups as follows: (A) TACE (0.1 mg of mitomycin + 0.1 ml of lipiodol + 5.0 mg of degradable starch microspheres) + microwave ablation (2450MHz; 35 W, 45 s) (n=10); (B) TACE alone (control group 1, n=10); (C) microwave ablation alone (control group 2, n=10). Tumor volume before (V1) and after the treatment (V2) was assessed by MRI and the tumor growth ratio (V2/V1) was calculated. Immunohistochemical analysis was performed for quantification of positive MMP-9 and VEGF tumor cells in each treatment.

RESULTS
Mean tumor growth ratio was 1.3385 ± 0.1949 in group A, 3.1901 ± 0.1323 in group B, and 4.1779 ± 0.1862 in group C, respectively. Compared with the ratio in groups B and C (controls), the ratio in group A showed significant reduction in tumor growth (P < 0.05). Treatment with combined TACE/microwave ablation, compared with the treatment of TACE or microwave ablation alone, significantly inhibits tumor growth and intrahepatic metastases in an animal model of hepatocellular carcinoma.

CONCLUSION
Compared with the ratio in groups B and C (controls), the ratio in group A showed significant reduction in tumor growth (P < 0.05). TACE/microwave ablation significantly inhibits tumor growth and intrahepatic metastases in an animal model of hepatocellular carcinoma. TACE/microwave ablation is a promising treatment option for hepatocellular carcinoma.

CLINICAL RELEVANCE/APPLICATION
Transarterial chemoembolization in combination with microwave ablation are relevant treatment options in hepatocellular carcinoma.

LL-VIS-MO5B ● Quantification of Lower Leg Arterial Calcifications by High-Resolution Peripheral Quantitative Computed Tomography (HR-pQCT)

Janina M Patsch MD, PhD (Presenter); Martin A Zulliger *; Gundula Edelhauser MD; Thomas M Link MD, PhD *; Michael Weber; Christian Loewe MD *

PURPOSE
HR-pQCT is a low-radiation-dose, in-vivo research tool primarily designed for the assessment of bone geometry, density and microarchitecture of the distal extremities. Vascular calcifications are frequently observed as incidental findings but quantitative analysis of vascular calcifications captured by HR-pQCT has not been performed yet. The objectives of our study were to validate a quantitative tool for the assessment of lower leg arterial calcifications (LLAC) by HR-pQCT and to test method reliability.

METHOD AND MATERIALS
Agatston score was low in 24% (0-10HU), intermediate in 35% (11-400HU), and high in 41% of patients (>400HU). 76% had LLAC in HR-pQCT. Comparing LLAC (HR-pQCT) and CAC (MDCT), there were positive correlations between LLAC mass and CAC as measured by Agatston score, mass score, and volume score (Spearman's rho=0.6; p < 0.05). SLEEK was superior to CT portography in revealing the third- and fourth-order segmental branches in the hepatic parenchyma (p < 0.05). SLEEK has the advantage of avoiding interference from ribs, arterial and venous system enhancement.

CLINICAL RELEVANCE/APPLICATION
Based on low radiation dose and significant associations with CAC, LLAC assessment might be a novel, patient-friendly, quantitative measure applicable to epidemiological and cardiovascular research.

LL-VIE-MO6B ● Applications of Dual-Energy CT in Vascular Imaging

Sivasubramanian Srinivasan MD, FCR (Presenter); Hui Seong Teh MBBS, FCR; Ashish Chawla MD, MBBS; Jerome I Bosco MD, MBBS

PURPOSE
To illustrate the usefulness of Dual-Energy computed tomography(CT) in imaging of vessels involving various anatomical region from head to extremities. To discuss the pitfalls of Dual energy CT

CONTENT ORGANIZATION
- Introduction.
- Review of Dual Energy CT in imaging the vessels of head and neck, chest, abdomen and pelvis and extremities with case examples.
- Virtual Non-contrast images, automated dual-energy bone removal and plaque removal.
- Advantages of advanced integrated tools(syngo.viaTM) with RIS-PACS which aid in faster and efficient post-processing techniques.
- Pitfalls.

SUMMARY
- Dual energy CT helps in faster post-processing with lesser radiation dose compared to the conventional CT angiography.
Diagnostic Efficacy of Combined Dynamic Perfusion MRI with ADC Mapping in the Assessment of Therapeutic Effects

VSIO21-02 • VSIO21
Monday, 01:30 PM - 06:00 PM
Interventional Oncology Series: Hepatocellular Carcinoma

LL-VIE-MO7B • Current Percutaneous Vascular Closure Techniques and Associated Complications

Amit Bhakoo MD (Presenter) ; Brandon P Olivieri MD ; Mohammed Ezuddin ; Anne Beasley ; Robert E Beasley MD

PURPOSE/AIM
An increase in the number of endovascular procedures performed over the past decade has led to the development of new techniques intended to improve the efficacy and safety of vascular closure. Knowing the mechanism of action, components, risk-benefit and complication profiles unique to each closure technique is important for the reduction of adverse events. Further, an understanding of imaging findings and treatment options for vascular access-related complications is crucial for safe patient care.

CONTENT ORGANIZATION
Compare and contrast mechanisms of action of current vascular closure techniques. Review risk-benefit profiles of closure techniques (manual compression, hemostasis pads, compression devices, passive and active vascular closure devices). Describe multimodality imaging findings and treatment options of vascular access complications (pseudoaneurysm, arteriovenous fistula, access site/retroperitoneal hematoma, and arterial dissection/occlusion).

SUMMARY
Having a thorough understanding of various closure techniques is important for the reduction of adverse events in endovascular procedures. The participant will gain understanding of the efficacy, complication and risk-benefit profiles for currently available percutaneous vascular closure techniques, as well as the imaging findings and treatment options of their associated complications.

Interventional Oncology Series: Hepatocellular Carcinoma

Monday, 01:30 PM - 06:00 PM • S405AB

VSIO21-01 • AMA PRA Category 1 Credit ™:4.25 • ARRT Category A+ Credit:5
Moderator
Jean-Francois H Geschwind , MD *

LEARNING OBJECTIVES
1) To learn the indications for transcatheter-based therapies for patients with HCC. 2) To understand the potential limitations, pitfalls, side effects and toxicities associated with transcatheter therapies for patients with HCC. 3) To know the results, imaging responses and survival benefit of various transcatheter therapies. 4) To know the future transcatheter therapies and understand their potential. 5) To learn the various combination therapies available and undergoing clinical evaluation for HCC.

ABSTRACT

01) Staging Systems, Epidemiology, and Medical Treatment
1) Identify state-of-the art surgical treatment, non-surgical treatment, and transplantation treatment for patients with HCC. 2) Identify the most appropriate treatment for early and advanced stage of HCC. 3) Describe and discuss indications for resection in chronic liver disease. 4) Integrate interventional radiological procedures in the treatment of HCC.

02) HCC mgmt in Europe
1) To understand how HCC patients are being managed in Europe. 2) To learn the decision making processes driving treatment selection for patients. 3) To review the data from the European point of view. 03) HCC mgmt in Korea
1) To understand how HCC patients are being managed in Korea. 2) To learn the decision making processes driving treatment selection for patients. 3) To review the data from the Korean point of view. 04) HCC mgmt in HK/China
1) To understand how HCC patients are being managed in China. 2) To learn the decision making processes driving treatment selection for patients. 3) To review the data from the Chinese point of view. 05) HCC mgmt in Japan
1) To understand how HCC patients are being managed in Japan. 2) To learn the decision making processes driving treatment selection for patients. 3) To review the data from the Japanese point of view. 06) Panel Discussion: HCC in the world
1) Intratraheal Therapies in the US: Where are we?
2) Undergraduate patient selection process 3) Understand the patient indications and complications 4) Understand the rationale for combining anti-angiogenic agents with loco-regional therapies 5) Understand the results of various catheter based intra-arterial therapies for Liver Cancer 07) Assessment of Tumor Response
1) Review methods of response assessment 2) Discuss limitations of current methods 3) Describe future imaging concepts in development 08) Tumor Board
The algorithm by which patients with HCC are worked up and their appropriateness for transplant or resection will be discussed.

VSIO21-02 • Staging Systems, Epidemiology, and Medical Therapy

Alan P Venook MD (Presenter) *

LEARNING OBJECTIVES
1) Identify state-of-the art surgical treatment, non-surgical treatment, and transplantation treatment for patients with Hepatocellular Carcinoma. 2) Identify the most appropriate treatment for early and advanced stage of Hepatocellular Carcinoma. 3) Describe and discuss indications for resection in chronic liver disease. 4) Integrate interventional radiological procedures in the treatment of Hepatocellular Carcinoma.

VSIO21-03 • Hepatocellular Carcinoma (HCC) Treated with Transarterial Chemoembolization and Radiofrequency Ablation: Diagnostic Efficacy of Combined Dynamic Perfusion MRI with ADC Mapping in the Assessment of Therapeutic Effects

Davide Ippolito MD (Presenter) ; Pietro A Bonaffini MD ; Davide Fior MD ; Cristina Capraro MD ; Orazio Minutolo MD ; Sandro Sironi MD

PURPOSE
To determine the additional predictive value obtained by the correlation of kinetic parameters derived from dynamic contrast-enhanced MR perfusion imaging with apparent diffusion coefficient (ADC) value obtained by diffusion weighted MR imaging in the assessment of therapeutic effects of interventional treatment of HCC lesions.

METHOD AND MATERIALS
A total of 54 patients with biopsy proven diagnosis of HCC lesion, that underwent to TACE or RFA treatment, were prospectively enrolled in our study. MR study was performed, using a 1.5T MRI system (Achieva, Philips), for each patient 4 weeks after the treatment and consist of multiplanar standard protocol with T2 and T1 sequences, dynamic contrast enhanced THRIVE, including also diffusion weighted imaging (DWI) with different b-value. Philips’ workstation was used to generate color permeability maps showing perfusion of enhancing tumors and quantitative ADC maps. After the placing of regions of interest (ROIs) on site of the maps which best corresponded to the enhanced...
Long-term, Follow-up Study Using Magnetic Resonance Imaging with Impaired Ferucarbotran Clearance

METHOD AND MATERIALS
Fifty-five patients with 57 HCCs (diameter; 0.8-2.7 cm; mean ± SD, 1.6 ± 0.5 cm) underwent RFA 2-7 h after ferucarbotran-enhanced MRI. On unenhanced T2*-weighted images acquired after 3-5 days, AMs appeared as hypointense rims owing to impaired ferucarbotran clearance. AM status was classified as AM-plus, AM completely surrounding the tumor; AM-zero, partly discontinuous AM with tumor protrusion; or AM-minus, discontinuous AM with tumor protrusion. The minimal AM thicknesses were measured in the AM-plus group. The range of follow-up periods in the patients with and without local recurrence was 0-45 months (10 ± 15 months) and 7-58 months (28 ± 14 months), respectively. Local recurrence rates of different AM statuses were compared using the Kaplan-Meier method and log rank test.

RESULTS
Perfusion parameters and ADC values of treated lesions could be quantitative assessed using parametric imaging analysis. Sixteen out of 54 patients had a residual disease and values of obtained parameters measured within residual tumor tissue were: REA 44.66, RVE 60.50, RLE 52.72, MRE 553.21(%), MRE 65.95(%), TTP(s) 140.61, and 982.21 ± 103.93 x10-3 mm2/sec. The corresponding values in remaining cases in whom a complete necrosis was achieved were: REA -1.24, RVE 5.93, RLE 16.9, ME 203.24, RE 25.78, TTP 165.87 and 1682.7 ± 149.7x10-3 mm2/sec. A significant difference (p < 0.05) was observed in each parameter between AM-plus and AM-zero groups. Local recurrence rates were 3%, 8%, 8%, and 31% for the AM-plus group; 12%, 12%, 20%, and 20% for the AM-zero group, respectively. The range of follow-up periods in the patients with and without local recurrence was 0-45 months (10 ± 15 months) and 7-58 months (28 ± 14 months), respectively. Local recurrence rates of different AM statuses were compared using the Kaplan-Meier method and log rank test.

CONCLUSION
The quantitative multiparametric MR images analysis could offer functional quantitative information about cellular density and tumor blood supply of HCC lesions, useful in predicting and assessing treatment response.

CLINICAL RELEVANCE/APPLICATION
Combined parametric analysis of functional MRI represents an vivo marker of biological characteristic of HCC lesion, providing quantitative information useful for assessment of therapeutic response.
for the AM-zero group; and 71%, 71%, not applicable (NA), and NA for AM-minus group. The local recurrence rates were significantly lower for the AM-plus and AM-zero groups than for the AM-minus group (P < 0.001 and P = 0.003, respectively). However, the difference of local recurrence rates between AM-plus and AM-zero groups was not significant (P = 0.454). In the AM-plus, the local recurrence rates were 22% (2/9), 10% (1/10), 0% (0/5), 0% (0/4), and 0% (0/6) for AMs of 1 mm, 2 mm, 3 mm, 4 mm, and ≥5 mm, respectively.

CONCLUSION
When AMs are assessed after RFA for small HCCs by using MRI with impaired ferucarbotran clearance, the minimal AMs are acceptable to avoid local recurrence in a long-term period, although AMs of ≥3 mm seems preferable.

CLINICAL RELEVANCE/APPLICATION
MRI with impaired ferucarbotran clearance enables precise assessment of AMs after RFA and will contribute to avoid not only insufficient but also overzealous treatment for small HCCs.

VSIO21-09 • Panel Discussion: HCC in the World: How Do We Put All this Information Together? New International Staging System? Are Guidelines Really Useful?

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO21-10 • Intraarterial Therapies in the US: Where Are We?

Jean-Francois H Geschwind MD (Presenter) *

LEARNING OBJECTIVES
1) Understand patient selection process. 2) Understand the patient indications and complications. 3) Understand the rationale for combining anti-angiogenic agent with loco-regional therapies. 4) Understand the results of various catheter based intra-arterial therapies for Liver Cancer.

VSIO21-11 • Final Analysis of GIDEON (Global Investigation of therapeutic DECisions in hepatocellular carcinoma and Of its treatment with sorafeNib): Regional Trends, Safety, and Outcomes in Patients Receiving Concomitant Transarterial Chemoembolization

Jean-Francois H Geschwind MD (Presenter) *; Masatoshi Kudo; Jorge Marrero *; Alan P Venook MD *; Sheng-Long Ye; Jean-Pierre Bronowicki *; Xiao-Ping Chen; Lucy Dagher; Junji Furuse; Laura Ladron De Guevara *; Christos Papandreou *; Arun J Sanyal; Tadatoshi Takayama; Seung Kew Yoon MD, PhD; Keiko Nakajima *; Riccardo A Lencioni MD

PURPOSE
Transarterial chemoembolization (TACE) and sorafenib represent distinct treatment modalities for hepatocellular carcinoma (HCC), and there is a strong rationale and growing evidence supporting the use of TACE and sorafenib combined in unresectable HCC (uHCC) patients. GIDEON is a large, non-interventional study conducted in uHCC patients treated with sorafenib. The study allows for analysis of global treatment patterns in real-life practice, including concomitant TACE use.

METHOD AND MATERIALS
Data were collected from >3000 patients in whom the decision to treat with sorafenib had been made in clinical practice. Treatment history and disease characteristics were recorded at study entry; safety and outcomes data were collected during follow-up.

RESULTS
3202 patients comprised the final safety population. Of these, 47.2% received prior TACE, 10.1% received concomitant TACE, and 7.3% received TACE both prior to and concomitantly with sorafenib. Regionally, concomitant TACE use was highest in Latin America (14.4%), Asia-Pacific (13.5%), and the US (13.0%), with the lowest use in the EU (4.7%). Overall, of the patients who received concomitant TACE, the greatest number were from the US, China, and Japan (22.5%, 24.6%, and 19.1%, respectively). Patients who received concomitant TACE had a similar incidence of drug-related adverse events (88.6%) to those who did not (84.9%), as well as a similar incidence of serious drug-related adverse events (6.2% and 9.6%, respectively). In the intent-to-treat population (n=3213), median overall survival was 9.7 [9.2-10.4] months. Time to progression was also slightly higher in patients who received concomitant TACE (6.6 [5.8-7.6]) compared with those who did not (4.5 [4.1-4.8]).

CONCLUSION
The GIDEON study provides insight into treatment patterns in clinical practice. Data from the GIDEON study suggest that, globally, TACE is used concomitantly with sorafenib and appears to be a valid therapeutic option in patients with uHCC.

CLINICAL RELEVANCE/APPLICATION
The optimal role of TACE and sorafenib combined in the HCC treatment pathway is of increasing clinical interest. Data from GIDEON add to the evidence to further evaluate this approach.

VSIO21-12 • Assessment of Tumor Response

Riad Salem MD, MBA (Presenter) *

LEARNING OBJECTIVES
1) Review methods of response assessment. 2) Discuss limitations of current methods. 3) Describe future imaging concepts in development.

VSIO21-13 • Evaluation of Tumor Necrosis in Liver Explants after Chemoembolization or Radiofrequency Ablation as Bridge Therapies for Hepatocellular Carcinoma

Carmen Garcia Alba MD (Presenter); Julien Cazejust MD; Fabiano Perdigao; Bertrand Bessoud MD; Dominique Wendum MD, PhD; Yves M Menu MD; Olivier Soubrane; Olivier Rosmorduc

PURPOSE
To compare, in liver explants, the tumor necrosis rate of hepatocellular carcinoma (HCC) treated by chemoembolization (TACE) or radiofrequency ablation (RFA) as bridge therapies for patients on the waiting list for liver transplantation.

METHOD AND MATERIALS
This monoen:er retrospective study included 38 liver transplanted patients between November 2009 and December 2012 with history of HCC treated with bridge therapies while on the waiting list for liver transplantation. All treatments were approved by the Multidisciplinary Tumor Board of our institution following BCLC and EASL guidelines. Treatments were performed by experienced interventional radiologists. Anatomopathologic study of the liver explants was performed by an experienced anatomopathologist. In patients with consecutive treatments, only the last one was taken into consideration in this study.

RESULTS
Twelve patients underwent RFA for 14 lesions (mean 1.17 lesions per patient). The mean tumor size was 24mm (SD 7), with a mean necrosis rate of 93% (SD 13). No lesion treated by RFA had a necrosis rate ≥80% on liver explants. RFA showed a trend toward higher tumor necrosis rate than TACE.
Percutaneous Microwave Ablation of Hepatocellular Carcinoma: Early Clinical Results with 106 Tumors

**PURPOSE**
Microwave (MW) ablation is a promising technology that offers several advantages over radiofrequency (RF) ablation. The purpose of this study was to retrospectively review the results in the first 75 patients with hepatocellular carcinoma (HCC) treated with a high-power, gas-cooled MW device at a single center.

**METHOD AND MATERIALS**
Between December 2010 and March 2013 we treated 106 hepatocellular carcinomas in 75 patients via a percutaneous approach utilizing US and/or CT guidance. There were 65 male and 10 female patients with mean age of 61 years (range 44-82). All procedures were performed with a high-powered, gas-cooled microwave system (Certus 140, Neufave Medical, Madison, WI). Mean power was 77 Watts (range 30-140 Watts) and mean ablation time 5.3 minutes (range 1-11.5 minutes).

**RESULTS**
Tumors ranged in size from 0.5 to 7.0 cm (mean 2.5 cm) and median imaging follow-up was 7 months. All treatments were considered technically successful with no evidence of residual tumor at immediate post-procedure CECT. Primary treatment effectiveness by imaging was 88.7% (94/106), 92.5% (87/94) for tumors < 4 cm and 61.5% (8/13) for tumors > 4 cm. Of the tumor progression in lesions CONCLUSION
Treating hepatocellular carcinoma using microwave ablation is safe with treatment effectiveness equivalent or improved from other percutaneous ablation modalities.

CLINICAL RELEVANCE/APPLICATION
Microwave tumor ablation can be safe and effective when compared with more established modalities such as radiofrequency ablation, however more research of effectiveness is needed.
METHOD AND MATERIALS
Institutional board approval for the current retrospective study. Patients provided informed consent for CT-guided biopsy and the anonymous use of the data for research purposes. The study included 650 patients (221 females and 429 males with mean age 56.2 years SD: 5.2). Seventy-C all CT-guided biopsies of pulmonary lesions in the period between January 2008 and January 2013. Factors associated with the development of pulmonary hemorrhage were analyzed including: Age, lesion size, lesion position, coxial versus non coxial system, fine needle vs trucut needle. Univariate analysis was performed. P value of < 0.05 was considered as statistically significant. Exclusion criteria for biopsy were abnormal bleeding profile and pulmonary hypertension.

RESULTS
Significant risk factors involved in the development of pulmonary hemorrhage were: lesion size < 1 cm (p=0.03), central lesions (5 cm (p=0.04), basal pulmonary lesions versus apical lesions (p=0.01) and traversing pulmonary vessels in the needle track (p=0.02). No significant correlation for development of pneumothorax was detected in coxial versus no-coxial technique. The incidence of pulmonary hemorrhage was 5.8% (38 out of 650). Treatment was only conservative.

CONCLUSION
Significant risk factors involved in the development of pulmonary hemorrhage including small central or basal lesions, long intrapulmonary needle track and traversing pulmonary vessels in the needle track. The management of such condition is only conservative.

CLINICAL RELEVANCE/APPLICATION
The incidence of pulmonary hemorrhage is associated with certain factors that make certain cases of higher risk.

SSE05-04 • Detecting Pneumothorax at Very Low Dose MDCT after Intervention. How Low Can We Go?
Adeel R Seyal MD (Presenter) * ; Marcos P Botelho MD * ; Carla B Harmath MD ; Fernanda D Gonzalez Guindalini MD * ; Mauricio S Galizia MD ; Vahid Yaghmai MD

PURPOSE
To evaluate the effect of different kVp and mAs on MDCT detection of small pneumothorax using different reconstruction algorithms.

METHOD AND MATERIALS
An anthropomorphic chest phantom containing pneumothorax was scanned 15 times, with 80, 100 and 120 kVp and with 10, 20, 40, 75 and 110 mAs. The images were reconstructed with 3-mm slice thickness, using both Filtered Back Projection (FBP) and Simion FBP with Affirmed Iterative Reconstruction (SAFIRE). Two blinded radiologists evaluated three regions with small pneumothorax (pneumothorax thickness between 1.0 and 2.0 mm) and also a region without pneumothorax. Radiologistsscored each area independently, as 0 (certainly no pneumothorax); 1 (equivocal for pneumothorax) or 2 (certainly a pneumothorax). CTDivol was recorded to measure radiation dose. Statistical analyses were assessed by frequency and kappa statistics.

RESULTS
Both radiologists scored correctly all 30 cases without pneumothorax, regardless of acquisition settings or reconstruction algorithm. Six out of 90 (6.7%) pneumothorax were called equivocal by reader 1 and 8 out of 90 (8.9%) by reader 2. Overall agreement between both readers was very good (k=0.85). The two thinnest pneumothorax regions were called equivocal by either one radiologist or the other at the lowest radiation dose settings (80 kVp/10mAs and 80kVp/20mAs), regardless reconstruction kernel. The lowest acquisition parameters that none of the readers had equivocal interpretations were 100kVp/20mAs (0.89mGy).

CONCLUSION
Acquisition settings as low as 100kVp/20mAs (0.89mGy) may be suitable to confidently detect the presence of very small pneumothorax after intervention, regardless of reconstruction algorithm.

CLINICAL RELEVANCE/APPLICATION
Evaluation of small pneumothorax with MDCT may be confidently performed with very low acquisition parameters. This may help reduce radiation dose for detecting pneumothorax after intervention.

SSE05-05 • Analysis of Risk Factors Influencing Local Tumor Control in Patients with Pulmonary Nodules after Microwave Ablation (MWA)
Thomas J Vogl MD, PhD (Presenter) ; Thomas Worst ; Nagy N Naguib MSc ; Nour-Eldin A Nour-Eldin MD, MSc

PURPOSE
To evaluate the risk factors predicting local tumor control after microwave ablation (MWA) of primary and secondary lung malignancies <3 cm in maximum diameter.

METHOD AND MATERIALS
In this retrospective study, 91 index tumors (ITs) in 57 patients were treated with single antenna MWA. Time to local progression was monitored using CT over a median follow-up of 10.2 months (± 6.2 (range, 6.0 - 29.2). An overall estimated time to local tumor progression was performed via Cox regression model. Factors hypothesized to correlate with ablation response included tumor diameter (< 3cm in diameter located at a maximum of 5 mm from the IT, energy applied to IT (26.7 J/mm³) and occurrence of cavernous formations after ablation. A logistic regression model was used to correlate the data.

RESULTS
Local tumor progression occurred in 30/91 (33%) ITs, seen in 21/57 (36.8%) patients. Mean time to local tumor progression was 8.3 months (± 5.5; range, 2.1 - 25.2) (median, 22.6 months ± 12.4 months). Risk factors significantly correlating with local tumor progression were >15.5 mm (p=0.04), basal pulmonary lesions versus apical lesions (p=0.01) and traversing pulmonary vessels in the needle track (p=0.02). No significant correlation for development of pneumothorax was detected in coxial versus no-coxial technique. The incidence of pulmonary hemorrhage was 5.8% (38 out of 650). Treatment was only conservative.

CONCLUSION
Significant risk factors involved in the development of pulmonary hemorrhage including small central or basal lesions, long intrapulmonary needle track and traversing pulmonary vessels in the needle track. The management of such condition is only conservative.

SSE05-06 • Percutaneous Computed Tomography (CT)-guided Transthoracic Needle Lung Biopsy (TTNLB) in Patients with Hematologic Malignancies: Diagnostic Yield, Safety and Clinical Outcomes
Ruth M Dunne MBCh (Presenter) ; Gowri Satyanarayana ; Driele Peixoto ; Francisco M Marty MD ; Ritu R Gill MBBS *

PURPOSE
To evaluate the diagnostic utility and safety of CT-guided TTNLB in patients with hematologic malignancies and impact on clinical outcomes.

METHOD AND MATERIALS
This IRB-approved HIPAA-compliant study included consecutive patients with hematologic malignancies who underwent TTNLB procedures between July 1, 2007 and June 30, 2012. Demographic, clinical and pathological data were collected. Both cyto-pathologic and microbiologic results were also assessed. Complications and hospital admission stays were also assessed. Primary outcome measures were diagnostic efficacy, defined by number of procedures, which provided a specific diagnosis of either malignancy or infection; and safety defined, by number and type of complications per procedure. Secondary outcome measure was change in therapy based on the diagnostic yield. Statistical analysis were performed to determine univariate and multivariate predictors of diagnostic efficacy and frequency and severity of complications.
RESULTS
108 patients underwent 114 TTNLB procedures, resulting in established specific diagnoses in 37.7% (43/114) of procedures: 26 (22.8%) lesions were consistent with malignancy and 17 (15%) were infective etiologies. The most common underlying malignancy was non-Hodgkin lymphoma in 39% (42/109) of patients. Biopsied lesion median diameter was 3.1 cm (range, 0.7-14.2 cm; interquartile range, 2.1-5.5 cm), lesions were most frequently located in the left lower lobe (31/114 [27.2%]); were pleural-based in (73/114 [64%]); had surrounding ground glass opacification in (59/114 [51.8%]). Complications occurred in 31 (27%) of 114 procedures: small volume hemoptysis in 4 (3.5%) procedures and pneumothorax in 28 (24.5%) procedures, three requiring chest tube placement. Pneumothorax incidence was significantly associated with larger (18-G) biopsy needle use and longer lesion distance from pleura (p<0.05). The results of TTNLB led to changes in antimicrobial or oncological therapy in 46 (44.7%) of the 103 patients with adequate follow-up.

CONCLUSION
TTNLB is a safe diagnostic procedure in patients with hematologic malignancies with the potential of making specific diagnoses with minimal morbidity and can positively affect patient management.

CLINICAL RELEVANCE/APPLICATION
TTNLB in patients with hematologic malignancies is useful as it may establish specific diagnoses for which targeted treatments are available and can be performed safely with minimal morbidity.

Genitourinary (Renal CT and MR Angiographic Techniques)

Monday, 03:00 PM - 04:00 PM • E351

SSE10-03 • Utility of CT Spectral Imaging to Optimize the Image Quality of Pelvic CT Angiography
Yang Xiaotang; Zhang Jiejun, MD; Wang Yeren, MD; Wang Yan; Cheng Weiling

PURPOSE
To investigate the utility of CT spectral imaging to optimize the image quality of pelvic CT angiography in patients with cervical cancer:

SSE10-02 • Comparison of Fixed to Weight-based Contrast Dose for CTA of the Chest, Abdomen, and Pelvis
Theodora A Potretzke MD (Presenter) ; Scott K Nagle MD, PhD *

PURPOSE
To determine whether a fixed or a weight-based contrast dose injection results in more uniform opacification of the aorta in patients undergoing combined CT angiography of the chest, abdomen, and pelvis.

METHOD AND MATERIALS
72 patients referred to renal CT angiography were randomly divided into 2 groups. Group A(n=37)underwent prospective ECG-triggered axial scan.Group B (n=35) performed conventional 120 kVp CTA with Noise Index of 8,pitch of 1.375 and same contrast media protocol of group A. Images were reviewed by 2 experienced radiologists independently.Rois were placed in psoas muscle, R/L renal artery. Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) was calculated with ROI measurements. Subjective score was rated on a 5-point-scale and artifact caused by spiral scan and axial scan were evaluated.Comparison of percentages of diagnostic images (score=3) were performed and image quality was statistically compared. DLP and Effective Dose was recorded and compared.

RESULTS
CONCLUSION
Renal artery imaging performed prospective ECG-triggered axial scan can get equivalent image quality compared with 120 kVp, while radiation dose and artifact caused by spiral scan greatly reduced.

CLINICAL RELEVANCE/APPLICATION
Prospective ECG-triggered axial scan can be applied in renal artery imaging and got excellent diagnostic images.

SSE10-01 • Feasibility Study of Prospective ECG-triggered Axial Scan Applied in Renal Artery Imaging
Ying Guo MD (Presenter) ; Dapeng Shi MD ; Minghua Sun ; Peigang Ning ; Hui Xu

PURPOSE
To investigate the feasibility of prospective ECG-triggered axial scan applied in renal artery imaging.

METHOD AND MATERIALS
72 patients referred to renal CT angiography were randomly divided into 2 groups. Group A(n=37)underwent prospective ECG-triggered axial scan,Group B (n=35) performed conventional 120 kVp CTA with Noise Index of 8,pitch of 1.375 and same contrast media protocol of group A. Images were reviewed by 2 experienced radiologists independently.Rois were placed in psoas muscle, R/L renal artery. Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) was calculated with ROI measurements. Subjective score was rated on a 5-point-scale and artifact caused by spiral scan and axial scan were evaluated.Comparison of percentages of diagnostic images (score=3) were performed and image quality was statistically compared. DLP and Effective Dose was recorded and compared.

RESULTS
CONCLUSION
Renal artery imaging performed prospective ECG-triggered axial scan can get equivalent image quality compared with 120 kVp, while radiation dose and artifact caused by spiral scan greatly reduced.

CLINICAL RELEVANCE/APPLICATION
Prospective ECG-triggered axial scan can be applied in renal artery imaging and got excellent diagnostic images.

SSE10-00 • Realization of ECG-triggered Axial Scan in Renal Artery Imaging
Yang Xiaotang; Zhang Jiejun, MD; Wang Yeren, MD; Wang Yan; Cheng Weiling

PURPOSE
To investigate the feasibility of prospective ECG-triggered axial scan applied in renal artery imaging.

METHOD AND MATERIALS
72 patients referred to renal CT angiography were randomly divided into 2 groups. Group A(n=37)underwent prospective ECG-triggered axial scan.Group B (n=35) performed conventional 120 kVp CTA with Noise Index of 8,pitch of 1.375 and same contrast media protocol of group A. Images were reviewed by 2 experienced radiologists independently.Rois were placed in psoas muscle, R/L renal artery. Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) was calculated with ROI measurements. Subjective score was rated on a 5-point-scale and artifact caused by spiral scan and axial scan were evaluated.Comparison of percentages of diagnostic images (score=3) were performed and image quality was statistically compared. DLP and Effective Dose was recorded and compared.

RESULTS
CONCLUSION
Renal artery imaging performed prospective ECG-triggered axial scan can get equivalent image quality compared with 120 kVp, while radiation dose and artifact caused by spiral scan greatly reduced.

CLINICAL RELEVANCE/APPLICATION
Prospective ECG-triggered axial scan can be applied in renal artery imaging and got excellent diagnostic images.
METHOD AND MATERIALS
60 patients with diagnosed cervical cancer underwent pelvic CT angiography either with CT spectral imaging mode (n=30, group A) or conventional scan mode (n=30, group B) with 120kVp. The contrast agent dose of 1 ml / kg, the flow rate was 3-5ml/s adaptive to the Body Mass Index. The optimal contrast-to-noise (CNR) for iliac artery was achieved by dedicated software for spectral imaging analysis (GSI viewer). The selected optimal monochromatic image and TPXI image were post-processed by MIP and VR. Also, the bilateral ilial artery CT values, noise and CNR were measured on the selected optimal monochromatic image and TPXI image respectively. The image qualities were accessed by two experienced radiologists with 5-point scale. Dose-length-product (DLP) was recorded for both groups.

RESULTS

CONCLUSION
Low-keV monochromatic images improve the visualization of the feeding artery and laterd branches of the cervical cancer.

CLINICAL RELEVANCE/APPLICATION
Low-keV monochromatic images improve the visualization of the feeding artery and laterd branches of the cervical cancer, which help its clinical diagnosis and treatment.

SSE10-04 • Comparing Diagnostic Accuracy of Contrast Enhanced CT Angiography and Contrast Enhanced MR Angiography for the Assessment of Hemodynamically Significant Transplant Renal Artery Stenosis

Santhosh Gaddikeri MD (Presenter) ; Lee M Mitsumori MD, MS * ; Sandeep Vaidya MD ; Daniel S Hippe MS * ; Puneet Bhargava MD ; Manjiri K Dighe MD

PURPOSE
To compare diagnostic accuracy of contrast enhanced CT angiography (CTA) and contrast enhanced MR angiography (MRA) for the assessment of hemodynamically significant transplant renal artery stenosis (TRAS).

METHOD AND MATERIALS
After institutional review board approval, records of 27 patients with TRAS confirmed on Digital Subtraction Angiography (DSA) were retrospectively reviewed. Thirteen patients had MRA and 14 had CTA prior to DSA. Two board-certified fellowship trained radiologists, one each from interventional radiology and body imaging blindly reviewed the DSA and CTA/MRA data respectively and classified the stenosis as either hemodynamically significant (>= 50%) or non-hemodynamically significant (RESULTS)

Seven of 13 patients who had significant TRAS on MRA also had significant stenosis on DSA and 3 of 4 patients with non-hemodynamically significant stenosis on MRA had a significant stenosis on DSA (sensitivity 0.70, specificity 1). Two hemodynamically significant stenosis were not visualized on MRA due to susceptibility artifacts.

Ten of 14 patients who had significant TRAS on CTA also had significant stenosis on DSA and 1 of 3 patients with non-hemodynamically significant on CTA had a significant stenosis on DSA (sensitivity 0.90, specificity 0.66).

CONCLUSION
MRA is more specific but less sensitive than CTA to diagnose hemodynamically significant TRAS. Susceptibility artifact related to surgical clips is a significant limitation of MRA to accurately diagnose TRAS.

CLINICAL RELEVANCE/APPLICATION
Higher specificity and lack of radiation and nephrotoxic iodinated contrast makes MRA a better modality than CTA in the diagnosis of hemodynamically significant TRAS.

SSE10-05 • CT Renal Angiography: Comparison between Iodixanol (270 mg I/ml) with Monochromatic Imaging and Iohexol (350 mg I/ml) with Conventional Imaging

Kefeng Zhou (Presenter) ; Jian He MD, PhD ; Bin Zhu

PURPOSE
To compare the image quality of CT renal angiography using iso-osmolar Iodixanol (Visipaque, 270 mg I/ml) at monochromatic images with low-osmolar Iohexol (Omnipaque, 350 mg I/ml) at conventional 120kVp images

METHOD AND MATERIALS
Thirty patients received Iohexol (Omnipaque 350 mgI/ml) who underwent conventional CT scan (120kVp, NI=8,pitch 1.375, rotation time 0.8s) in CT renal artery angiography while forty-two patients received Iodixanol (Visipaque 270 mg I/ml) who underwent spectral CT imaging(40mm,0.6s,large) with the single-source fast kV switching dual energy acquisition (80 kVp and 140kVp) during the arterial phase (bolus tracking, 1.0 ml/kg, 3.5ml/s). Five regions of interest (ROI) were drawn at the abdominal aorta, left and right renal artery and cortex respectively. CT attenuation value and contrast-noise ratio (CNR) of each ROI were obtained on both optimal monochromatic images and the conventional scan. Volume rendering images of renal artery were reconstructed by both of them( thickness 0.625mm) and the image quality and radiation dose were compared between the two groups.

RESULTS

CONCLUSION
Monochromatic images (usually around 53keV) by using Iodixanol (270 mg I/ml) with low radiation dose could provide better image quality than conventional images by using Iohexol (350 mg I/ml) in renal artery CT angiography

CLINICAL RELEVANCE/APPLICATION
Lower monochromatic imaging in renal artery angiography with low Iodine-consistency contrast medium, which is benefit to renal function, can achieve better quality images than conventional protocol.

SSE10-06 • Comparison of the Effect of Visipaque 270 and Visipaque 320 in CT Angiography

Haijian Fan (Presenter) ; Bin Zhu

PURPOSE
To compare the effect of Visipaque 270 and Visipaque 320 in CT angiography in the arterial phase.

METHOD AND MATERIALS
This prospective study was approved by local ethics committee and patient's informed consent was obtained. One hundred and thirty one patients were recruited in this study. Forty two patients received Visipaque 270, 1 ml/kg, and 89 patients received Visipaque320, 1 ml/kg. All the patients were scanned on a 64-slice CT scanner (Discovery CT 750HD, GE) with gemstone spectral imaging in the arterial phase. GSI viewer was used to acquire the images, and the CT values of the two sets of images in the abdominal aorta, left, right renal artery were measured and calculated.

RESULTS

The t-test showed that the CT values of the abdominal aorta, left, right renal artery in the images of Visipaque 270 group (510.22±113.76, 454.48±111.32 and 454.01±106.39) and those in images of Visipaque 320 group (554.47±130.93, 480.52±117.11 and 480.37±115.20) showed no significant differences (all P value > 0.05).
CONCLUSION
As no significant difference, it will be a better choice for patients who received angiography in the arterial phase.

CLINICAL RELEVANCE/APPLICATION
Visipaque 270 is equal to Visipaque 320 in CT angiography.

Vascular/Interventional (Biliary/GU Interventions)

Monday, 03:00 PM - 04:00 PM • N226

SSE26-01 • BPEI-ICG-delivered siRNA Targeting MMP-9: Suppression of Granulation Tissue Formation after Bare Metallic Stent Placement in a Rat Urethral Model

Eun Young Kim (Presenter) ; Ho-Young Song MD ; Sun Il Kim PhD ; Jung-Hoon Park RT ; Eun Jung Jun PhD ; Young Chul Cho BS

PURPOSE
To evaluate the efficacy of siRNA targeting MMP-9 in suppressing granulation tissue formation caused by bare metallic stent placement in a rat urethral model.

METHOD AND MATERIALS
All experiments were approved by the committee of animal research. In 20 Sprague-Dawley male rats (weight range, 300-350g), a self-expanding metallic bare stent was inserted in the urethra under fluoroscopic guidance. One group of 10 rats (group A) was treated with MMP-9 siRNA/BPEI-ICG, while the other group of 10 rats (group B) received control siRNA/BPEI-ICG treatment. All rats were sacrificed at 4 weeks. The therapeutic efficacy of the MMP-9 siRNA/BPEI-ICG complex was assessed by comparing the two results of retrograde urethrography, histological examination, and quantification of MMP-9 by zymography and western blot analysis between the two groups.

RESULTS
Stent placement was successful in all rats without a single case of migration on follow up. Retrograde urethrography performed four weeks after stent placement demonstrated significantly larger luminal diameters of the urethra within the stents in group A compared to those in group B (P = .011). Histologic analysis revealed that the average percentage of granulation tissue area (P < .001), average number of epithelial layers (P < .001), and average thickness of submucosal fibrosis (P < .001) were significantly decreased in group A compared to group B. Meanwhile, the average density of inflammatory cell infiltration did not significantly differ among the two groups (P = .184). Quantitative analysis disclosed MMP-9 levels to be lower in group A relative to group B indicating positive inhibition of MMP-9 by MMP-9 siRNA/BPEI-ICG.

CONCLUSION
MMP-9 siRNA/BPEI-ICG is effective for inhibiting granulation tissue formation after bare metallic stent placement in a rat urethral model.

CLINICAL RELEVANCE/APPLICATION
Local therapy using MMP-9 siRNA/BPEI-ICG could be utilized to decrease stent-related tissue hyperplasia.

SSE26-02 • Bioabsorbable Biliary Stent Implantation in the treatment of Benign Bilioplastic-refractory Biliary Strictures: Preliminary Experience

Giovanni Mauri MD (Presenter) ; Caterina Michelozzi ; Dario Poretti MD ; Francesco Sardanelli MD * ; Fabio Melchiorre MD ; Luca Maria Sconfinenza MD, PhD ; Gianpaolo Cornaiba MD ; Vittorio Pedicini MD ; Marco Tramarin MD ; Luigi Solbiati MD

PURPOSE
Benign bile duct stricture represent a non-negligible complication of several surgical procedures around the biliary tree . A novel percutaneous-implantable bioabsorbable stent has been recently developed. Our purpose was to evaluate feasibility, safety, and outcome of patients treated with a bioabsorbable biliary stent for benign biliary stenosis refractory to other treatments.

METHOD AND MATERIALS
Stent implantation was feasible in all cases. No immediate major or minor complications occurred. In all patients, 48 hour cholangiographic control demonstrated the good positioning of the stent, and resolution of the stenosis. In a median follow-up time of 16.5 months (25th-75th percentiles = 11-20.25 months) no further invasive treatment was needed in any patient. Three patients experienced transient episodes of cholangitis. Neither restenosis nor dilatation of the biliary tree was documented at the follow up ultrasound studies. No stent was visible at the 6 months follow-up.

CONCLUSION
Percutaneous placement of bioabsorbable biliary stents represents a new option to treat benign biliary stenoses refractory to treatment with bilioplasty. Such a technique seems to be feasible, effective, and free from major complication. Further investigations are warranted to confirm our preliminary results.

CLINICAL RELEVANCE/APPLICATION
Percutaneous placement of bioabsorbable biliary stents is feasible, effective, and free from major complications. The main advantage is that they do not need to be removed after implantation.

SSE26-03 • Biliary Intraductal Metastasis from Advanced Gastric Cancer: Radiologic and Histologic Features, and Clinical Outcomes of Percutaneous Metallic Stent Placement

Joo Yeon Lee (Presenter) ; Dong Il Gwon ; Gi-Young Ko MD ; Kyu-Bo Sung MD ; Hyun-Ki Yoon

PURPOSE
The purpose of this study is to investigate radiologic and histologic features of biliary intraductal metastasis from advanced gastric cancer in 24 patients with biliary obstruction and clinical outcomes after metallic stent placement.

METHOD AND MATERIALS
Patient population: This retrospective study was approved by Institutional Review Board of our institution and written informed consent was waived. Between August 2003 and August 2012, 24 consecutive patients with obstructive jaundice related to biliary intraductal metastasis from advanced gastric cancers were enrolled. Imaging Methods and Diagnosis PTBD, Biliary Biopsy, and Pathologic Analysis
Metallic Stent Placement Endpoints of stent placement and Statistical analysis
RESULTS
Imaging and pathologic Characteristics: uniform concentric linear (n=17) or band-like (n=7) enhanced wall thickening. 20 (83.3%) had cystic ductal lesions contiguous with the intraductal lesions. The level of biliary obstruction was hilar in 13 (54.2%) patients and non-hilar in 11 (45.8%). Ninety (79.2%) patients had lymph node metastasis around the biliary system. The submucosal fibrosis was universal feature in all biopsied cases (n=6), regardless of the malignant or atypical cells, and none of the cases shows biliary mucosa disruption by the malignant cells.

Outcomes of Metallic Stent Placement: Stent occlusion was observed in four (17%) patients treated with PTBD, in three owing to sludge incrustation and in one owing to tumor overgrowth, 49±278 days (mean, 168 days) after stent placement. Mean stent patency time was 341 days (95% CI 272±410 days) and cumulative stent patency rates at 3, 6, 9, and 12 months were 95%, 88%, 78%, and 62%, respectively.

CONCLUSION
In conclusion, imaging and pathologic characteristics of biliary intraductal metastasis from advanced gastric cancer are uniform enhanced biliary wall thickening, and submucosal malignant cells and fibrosis without any disruption of biliary epithelial layer. Moreover, uncovered metallic stent placement was safe and effective methods for palliative treatment in patients with biliary intraductal metastasis cause by advanced gastric cancer.

CLINICAL RELEVANCE/APPLICATION
The clinical outcomes after uncovered stent placement and pathologic proof may give an explanation.

SSE26-04 • Intrabiliary Radiofrequency Heat-enhanced Local Chemotherapy of Cholangiocarcinomas Monitored by Dual-modality Imaging

Xia Wu (Presenter) ; Feng Zhang MD, PhD ; Thomas X Le MD ; Han Wang MD ; Tong Zhang MD ; Yanfeng Meng MD ; Baojie Wei MD,PhD ; Stephanie Soriano MD ; Patrick Willis ; Xiaoming Yang MD, PhD

PURPOSE
Patients with biliary malignancies have a poor prognosis. We developed a new technology, named intrabiliary radiofrequency heat (RFH)-enhanced chemotherapy, for efficient management of biliary malignancies.

METHOD AND MATERIALS
To establish proof-of-principle, serial in-vitro studies with GFP-labeled human cholangiocarcinoma cells and serial in-vivo studies with GFP-positive cholangiocarcinomas on mice were performed. The cells and tumors were treated by: (a) combination therapy with chemotherapies (gemcitabine and 5-fluorouracil (5-FU)) plus RFH; (b) chemotherapies only; (c) RFH only; and (d) phosphate-buffered saline. Cells proliferation was quantified by MTS assay, and tumor changes on mice monitored by 14.0 Tesla MR imaging and optical imaging overtime. To further validate the feasibility of this new technique, intrabiliary local delivery of gemcitabine and 5-FU were performed with RFH (8 pigs) or without RFH (8 pigs). Chemodrug deposit doses in bile duct walls were quantified by high-pressure liquid chromatography.

RESULTS
Combination therapy induced significantly lower cell proliferation than chemodrug-only and RFH-only treatments (0.39±0.13 vs 0.87±0.10 and 0.73±0.15, p=0.0009 and 0.001, respectively). Combination therapy resulted in smaller tumor volume than chemotherapy-only and RFH-only treatments (0.65±0.3mm3 vs 1.37±0.05mm3 and 1.30±0.21mm3, p=0.003). Only in the combination therapy group, both MRI and optical imaging demonstrated remarkable decreases of diffusion coefficients and fluorescent signals on tumor masses immediately after the treatments. Chemodrug quantification showed higher average drug deposit dose in pig bile duct walls with intrabiliary RFH than that without RFH (Gemcitabine: 0.32±0.03mg vs 0.26±0.03mg and 5-FU: 0.64±0.06mg vs 0.52±0.05mg, p

CONCLUSION
Intrabiliary RFH can enhance the chemotherapeutic effect on cholangiocarcinomas, which can be accurately monitored by diffusion-weighted MRI and optical imaging.

CLINICAL RELEVANCE/APPLICATION
This technical development may open new avenues to efficiently manage biliary malignancies using intrabiliary MRI and RFH-integrated therapies.

SSE26-05 • Clinical Relevance and Interventional-radiological Management of Complications after Pancreatic Surgery: A 10-year Single-centre Experience on 1292 Patients

Massimo Venturini MD (Presenter) ; Giulia Agostini ; Gianpaolo Balzano ; Francesco A De Cobelli MD ; Stefano Cappio MD ; Alessandro Del Maschio MD

PURPOSE
Despite the improvement in technique/expertise, pancreatic surgery remains burdened with a high complication rate. Our aim was to report our 10-year single-centre experience about the clinical relevance and the interventional-radiological management of the postoperative complications (treatment/prevention) on 1292 patients submitted to pancreatic surgery.

METHOD AND MATERIALS
In 2000-2012, 1292 patients were submitted to pancreatic surgery (total pancreatectomy, duodenoc-cholec-pancreatectomy, distal pancreatectomy). Patients were classified on the basis of the complication severity in 5 classes (Clavien-Dindo classification): 0=none, 1=conservative treatment, 2=endoscopic/radiological interventional, 3=conservative surgery, 4=intensive care, 5=death. Interventional-radiological management consisted of: PTC/biliary drainage in case of biliary fistula (bile in surgical drainage, normal bilirubin levels/undilated biliary ducts at US) under US/fluoroscopic guidance (right approach, puncturing along the course of the sixth-segment portal branch (Chiba needle 21G), or left approach if aerobilia/adequate volume of left hepatic lobe); embolization (microcoils/PVA-particles) or covered-stenting (Vibahn-Gore) in case of bleeding; percutaneous drainage (US/CT-guidance) in case of liquid/infected collection. Percutaneous intra-portal islet auto-transplantation (PIPIAT) was performed in case of total pancreatectomy to prevent diabetes.

RESULTS
Patients were classified as follows: 524/1292 (40%) class 0; 210/1292 (16%) class 1; 361/1292 (28%) class 2; 79/1292 (6%) class 3a; 55/1292 (4%) class 3b; 24/1292 (1%) class 4; 39/1292 (3%) class 5. Among the 79 class-3a-patients, 74/79 required interventional-radiological management, 5/79 endoscopic management. The 74 interventional procedures were the following: 32 drainages of liquid/fluid infected collections, 30 biliary drainages, 12 bleeding management (9/12 embolization; 3/12 covered-stenting). 25/1292 underwent PIPIAT.

CONCLUSION
In centres of excellence pancreatic surgery has a low rate of complications, usually successfully managed and prevented by interventional-radiological procedures. In particular PIPIAT is an advanced, non invasive technique in the prevention of postsurgical diabetes.

CLINICAL RELEVANCE/APPLICATION
In centres of excellence, interventional-radiological procedures take part in the management/prevention of the complications of pancreatic surgery, reducing the morbidity/mortality.
Controversy Session: Fibroid Therapy: UAE vs Focused US

Tuesday, 07:15 AM - 08:15 AM ● E350

SPSC30 ● AMA PRA Category 1 Credit ™:1 ● ARRT Category A+ Credit:1
Moderator
Brian S Funaki, MD
James B Spies, MD
Alan H Matsumoto, MD *

LEARNING OBJECTIVES
1) Describe role of uterine artery embolization in the treatment of symptomatic uterine fibroids. 2) Explain the use of high-intensity focused ultrasound (HIFU) in treatment of uterine fibroids. 3) Describe one pitfall of HIFU in treatment of uterine fibroids.

MR-Guided High Intensity Frequency Ultrasound (HIFU)

Tuesday, 08:30 AM - 10:00 AM ● S504CD

RC317 ● AMA PRA Category 1 Credit ™:1.5 ● ARRT Category A+ Credit:1.5
Moderator
Pejman Ghanouni, MD,PhD *

RC317A ● Palliation of Painful Metastases to Bone
Pejman Ghanouni MD,PhD (Presenter)

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

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

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

Kim R Butts Pauly PhD (Presenter) *

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

ABSTRACT
Focused ultrasound uses a large area array, typically outside the body, that is geometrically or electronically focused to a point. Such focusing provides amplification of the ultrasound intensity, thereby allowing heating of tissue to the point of coagulation at the focus, without damage to the intervening tissue. Treatment of tissues deep in the body requires image guidance such as MR thermometry. The concept behind MR thermometry is straightforward: changes in hydrogen bonding with temperature result in a change in the proton resonance frequency, seen in the phase of gradient echo images. Temperature standard deviations less than 1°C are readily achievable and thermal dose maps are easily calculated. Considerations for focused ultrasound include patient positioning and target access, good coupling, near field and far field effects, long treatment times for sizable ablation volumes, and, in the case of the brain, phase
Role of Stereotactic Ablative Radiotherapy (SABR) and Interventional Radiology in the Management of Oligometastases

Tuesday, 08:30 AM - 10:00 AM  •  SS04AB

RC317C  •  Transcerebral MR-guided High Intensity Frequency Ultrasound

Jeff Elias (Presenter)

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

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

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

Wladyslaw M Gedroyc MBBS, MRCP (Presenter)

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

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

RC320A  •  SABR for Visceral Oligometastases

Simon S Lo MD (Presenter)

LEARNING OBJECTIVES
1) Understand the role, eligibility criteria, expected treatment outcomes and toxicities of stereotactic ablative radiotherapy (SABR) for lung, liver and other visceral metastases. 2) Understand the role, eligibility criteria, expected treatment outcomes and toxicities of SABR for spinal metastases in primary, postoperative and recurrent setting. 3) Understand the role of interventional radiology in the management of lung and liver metastases. 4) Understand the controversies regarding the use of local aggressive therapy for oligometastases based on evidence from the literature.

ABSTRACT
It has been a notion that once distant metastases occur, cancer is typically widely disseminated. Hellman and Weichselbaum from University of Chicago have proposed the state of oligometastasis where the metastatic disease is limited in number and site. There is clinical evidence to suggest that local aggressive therapy such as surgical resection may prolong survival and may even achieve a cure. Most recently, non-surgical therapies such as stereotactic ablative radiotherapy and image-guided ablative therapies for oligometastases have emerged, appearing to yield promising results based on multiple retrospective studies and single arm clinical trials. There are certainly controversies with regard to the use of local aggressive therapy for oligometastases. To establish this strategy as the standard of care for oligometastasis, a randomized controlled trial comparing conventional care and local aggressive therapy would be ideal. The potential toxicities associated with these therapies have to be seriously considered before offering them to patients. Currently, there is an ongoing international randomized trial comparing SABR and conventional treatment enrolling patients in Canada and Europe and the results of this trial are eagerly awaited.

RC320B  •  SABR for Spinal Oligometastases

Arjun Sahgal (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.

RC320C  •  Interventional Radiology in the Management of Oligometastases

Sandeep Vaidya MD (Presenter)

LEARNING OBJECTIVES
View learning objectives under main course title.
Central Venous Stenosis - Why Does It Occur? How Can We Prevent It? Treatment With Conventional Tools

Dheeraj K Rajan MD (Presenter) *

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

ABSTRACT
Differences between the US and Europe in fistula use and how Fistula First has narrowed that gap.

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

Dheeraj K Rajan MD (Presenter) *

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ABSTRACT
Differences between the US and Europe in fistula use and how Fistula First has narrowed that gap.
LEARNING OBJECTIVES
1) Describe common causes of central venous stenosis (CVS). 2) Describe preventative measures that may be undertaken to avoid CVS. 3) Describe common tools and techniques for treatment of CVS available to radiologists.

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

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

**ABSTRACT**

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

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

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

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

**METHOD AND MATERIALS**
We performed endovenous intervention in 106 patients (M:F =30:76; mean age, 59.8 years) with acute DVT in the lower extremity after placement of an IVC filter between July 2004 and December 2012. In all patients, aspirational thrombectomy was performed, and percutaneous transluminal angioplasty (PTA) or additional stent placement was carried out in six and 88 patients, respectively. We evaluated presence of a trapped thrombus in the IVC filter on final venograms obtained during the procedure (n=106) or on follow-up CT (n=55), respectively. The transverse length of the trapped thrombus was defined as four grades (1-4) divided by the IVC filter diameter for each 25%. We also evaluated the relationship between thrombus trapping, stenosis of the iliac vein, extended thrombus in the IVC.

**RESULTS**
A trapped thrombus in the IVC filter was detected in 46/106 patients (43%) on final venograms or on follow-up CT. A trapped thrombus in the IVC filter was detected in 8/12 patients (75%) after aspiration thrombectomy only, in 4/6 patients after additional PTA (67%), and 34/88 patients after additional stent placement (39%). A trapped thrombus in the IVC filter was observed on venograms in 35/106 patients (33%) and on follow-up CT in 25/55 patients (45%). In 25 trapped thrombi observed on CT images, 11 were not shown on final venograms and were newly detected on CT images. Thrombus sizes were grade 1 in four patients (8.7%), grade 2 in eight patients (17.4%), grade 3 in 22 patients (47.8%), and grade 4 in 12 patients (26.1%). Among 67 patients in whom DVT was detected on CT before the procedure, the incidences of a trapped thrombus in cases with or without an extended thrombus into the IVC were 13/17 (76.5%) and 18/50 (36.0%), respectively.

**CONCLUSION**
Thrombus migration developed frequently during endovenous intervention in patients with DVT in the lower extremity, and IVC filter placement may be useful for prevention of pulmonary thromboembolism.

**CLINICAL RELEVANCE/APPLICATION**
IVC filter placement may be useful for prevention of pulmonary thromboembolism.

**VSIR31-05 • IVC Filter Update**

**John A Kaufman MD (Presenter) *  
LEARNING OBJECTIVES**
View learning objectives under main course title.

**VSIR31-06 • Debate - When Should We Be Placing Permanent Filters?**

**John A Kaufman MD (Presenter) * ; Steven M Zangan MD (Presenter)  
LEARNING OBJECTIVES**
View learning objectives under main course title.

**VSIR31-07 • Filter Follow-Up - PQI**

**Steven M Zangan MD (Presenter)  
LEARNING OBJECTIVES**
View learning objectives under main course title.

**VSIR31-08 • Utility of Preoperative Vascular Mapping to Select Patients at High Risk for Early Thigh Hemodialysis Graft Failure**

**Mark D Little MD (Presenter) ; Michael Allon ; Michelle M McNamara MD ; Song Ong ; Mark E Lockhart MD ; Carlton Young ; Michelle L Robbin MD**

**PURPOSE**
To determine whether noninvasive preoperative evaluation of vascular diameters and calcification can identify patients in whom arterovenous thigh graft survival is likely to be impaired.

**METHOD AND MATERIALS**
Institutional review board approval was obtained and informed consent was waived. Retrospective analysis, including a qualitative assessment of calcification burden, was performed on 143 chronic hemodialysis patients who received ultrasound vascular mapping prior to thigh graft placement. Severity of pelvic arterial calcification was scored in 80 patients who received peri-operative computed
RESULTS
Preoperative ultrasound screening identified no or mild arterial calcification in 113 of 143 patients (79%) and moderate to severe calcification in 30 of 143 patients (21%). Patients with moderate to severe arterial calcification had significantly increased technical graft failure (hazard ratio=6.59; 95% CI, 2.06-21.05; p=0.002 by Fisher's exact test) and decreased cumulative graft survival (hazard ratio=2.32; 95% CI, 1.48-6.69, p=0.003 by log rank test) compared to patients with no or mild disease. Cumulative graft survival was not associated with small vessel diameters (HR 1.06; 95% CI, 0.63-1.80, p=0.82) or arterial diameters (HR 1.19; 95% CI, 0.70-2.03, p=0.43). Low CT calcification score was seen in 74 of 80 hemodialysis patients (93%). Primary technical failure occurred in 3 of 6 patients (50%) with high versus 5 of 74 patients (6.8%) with low calcification score (hazard ratio=7.4; 95% CI, 2.31-23.72, p=0.01). US was more sensitive (64% versus 38%) but less specific (83% versus 96%) than CT in predicting immediate technical graft failure. Positive predictive value of CT and US was 50% and 23%, respectively.

CONCLUSION
Preoperative sonographic assessment of thigh vessel diameter and calcification can select patients who need further CT assessment of pelvic calcifications to identify those at higher risk for primary technical graft failure and decreased cumulative graft survival.

CLINICAL RELEVANCE/APPLICATION
US can identify moderate or severe arterial calcification where pelvic CT may aid site selection to lessen early technical failure, thereby improving long term hemodialysis thigh graft survival.

VSIR31-09 • Updates in Dialysis
Luc A Turmel-Rodrigues MD (Presenter)

LEARNING OBJECTIVES
1) Explain the role of fistula maturation procedures in access intervention and their results. 2) Outline the arguments for and against prophylactic central catheter access. 3) Describe recent evidence concerning the use of stent-grafts in failing hemodialysis grafts. 4) Describe three methods of fistula declotting. 5) Describe differences between the US and Europe in fistula use and how Fistula First has narrowed that gap. 6) Explain why many believe a Catheter Last approach may be even more important than Fistula First.

ABSTRACT
Purpose: to provide information about new radiologic techniques and concepts in the management of dialysis access complications.

Materials and Methods: review of the recent international literature.

Results: In the field of pre-op mapping, non-CE-MRA of upper limb vessels is feasible and might be helpful. Anatomical: high origin of forearm arteries is evidenced in 12.8% of patients. In the area of nonmaturing fistulas, cannulation of the elbow artery for angiographic evaluation is safe and effective, dilation of the radial artery gives way to durable results, embolization of venous &competing vessels & and &collaterals is controversial. Dilation: the value of prophylactic dilations is controversial in prosthetic grafts and less controversial in autogenous fistulas. Minimally symptomatic and asymptomatic central vein stenoses/occlusions should not be treated. The value of coated balloons has to be confirmed. Stents: PTFE covered stents are helpful at the venous anastomosis of grafts although their value is controversial in the cephalic arch. Hand ischemia: look at the ulnar artery in forearm fistulas. Excess flow: the reliability and reproducibility of percutaneous banding has to be confirmed. Plugs can be used to occlude arteries, veins and fistulas. Thrombosis: percutaneous thrombectomy is cost-effective, surgical results are improving in autogenous fistulas. Central catheters: several reports of arterial damages confirm that imaging guidance should be mandatory for insertion.

Conclusion: recent publications show that our everyday practice is changing and that very few concepts are not subjects to controversy.

VSIR31-10 • Excellent Success Rate of Adrenal Venous Sampling after Simple Modification of Routine Protocol
Sadahiro Yamamura (Presenter); Yoshinori Shigematsu; Koichi Yokoyama; Osamu Ikeda MD; Toshinori Hirai MD; Yasuuki Yamashita MD *

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

METHOD AND MATERIALS
Since 2009, 114 patients with primary aldosteronism were subjected to AVS conducted by a single radiologist. From the retrospective reviews of the first 72 patients, AVS protocol was modified and applied prospectively for the latter 42 patients. The criterion for biochemical successful catheterization was cortisol value of more than 200?g/dl and/or an adrenal vein/inferior vena cava cortisol ratio of greater than 5. The blood was drawn at the central adrenal veins with use of ACTH.

RESULTS
The biochemical success rate (BSR) for the first 72 patients was 91.7 % (66/72), and the causes of the failure in these 6 patients were analyzed. In all six patients, the procedures were unsuccessful on the right side. For 3 patients, the catheter tip slippage was seen during the sampling. Adrenal hemorrhage occurred in 8 patients and AVS was biochemically unsuccessful in 2.
For the latter patients, our routine AVS protocol was modified in two points. First, to avoid catheter tip slippage, the way of catheter tip settlement was changed. Before the modification, in case that the catheter tip was too deep into the adrenal vein, we had moved the tip of the 4F catheter by pulling the catheter. After modification, we moved the 4F catheter tip by pushing the adrenal venous wall with microguidewire through the 4F catheter. The blood was drawn through the space between the microguidewire and 4F catheter by using a Y-shape connector. Second, to avoid adrenal hemorrhage, we used a 5mm cylinder instead of a 10 ml cylinder when fumbling and injecting to the right adrenal vein.

In the latter 42 patients, the BSR was perfect. The incidence of the right adrenal hemorrhage decreased to 2.4 %.

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

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

VSIR31-11 • Non-contrast-Enhanced MR Imaging of Right Adrenal Vein for Adrenal Venous Sampling: Comparison with Multidetector CT Angiography
Hideki Ota MD, PhD (Presenter); Kei Takase; Kazumasa Seiji MD, PhD; Ryo Morimoto; Fumitoshi Satoh MD, PhD; Shoki Takahashi MD

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

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

RESULTS
Non-contrast enhanced MR imaging demonstrated right adrenal veins in 59 of the 65 patients (91%). In the 63 patients who underwent both examinations, the detectability of the right adrenal vein was significantly higher for CT than MR imaging (100% vs. 90%, p=0.04). When all the patients scheduled for AVS were included, the detectability was not significantly different between both modalities (p=0.28). CT demonstrated significantly higher image quality than MR imaging (p<0.01).

CONCLUSION
CT angiography is a reliable tool for detection of the right adrenal vein. When risks of radiation and contrast-induced complication were taken into account, non-invasive MR imaging becomes a first choice for planning of AVS.

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

VSIR31-12 ● Adrenal Vein Sampling: You Can Do This (Maybe)
Scott O Trerotola MD (Presenter) *

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

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

VSIR31-13 ● Wrap Up and Discussion

LEARNING OBJECTIVES
View learning objectives under main course title.
Correlation of Left Bifurcation Angulation with Plaque Formation

Zhonghua Sun  PhD (Presenter)

PURPOSE
The aim of this study was to characterize the intraluminal appearances of coronary plaques and identify the relationship between left coronary bifurcation angle and plaque formation using coronary CT virtual intravascular endoscopy (VIE).

METHOD AND MATERIALS
Fifty patients suspected of coronary artery disease undergoing coronary CT angiography were included in the study. 3D VIE images were generated to visualize the intraluminal appearances of coronary wall due to presence of coronary plaques. Left coronary bifurcation angle formed by left anterior descending (LAD) and left circumflex (LCx) was measured on 3D volume rendering and multiplanar reformatted images to determine the relationship between plaque formation and corresponding coronary dimensional changes.

RESULTS
VIE provides unique information about intraluminal appearances of coronary wall due to presence of plaques. There is a direct correlation between atherosclerotic changes and coronary angulation at the left coronary artery, with wide angles leading to high risk of plaque formation.
and Z-axis Location on Image Quality

SSG03-06 • Effect of a Novel Motion-correction Algorithm in the Improvement of Image Quality of Coronary CTA with Higher Heart Rates

Xiaying Du MD (Presenter) ; Kuncheng Li MD

PURPOSE
To verify the motion correction effect of a novel algorithm in coronary CTA of patients with higher heart rates

METHOD AND MATERIALS
15 patients with high heart rate (67bpm-85bpm, 73.7±5.5bpm) underwent retrospective ECG-gated coronary CTA using a GE CT scanner (GE Discovery CT750HD) with a speed of 0.35s/rotation. Images at 30%-80% R-R interval were reconstructed with single sector reconstruction at 5% intervals to select the best phase at end-systole and middle-diastole. Based on the best phasing, a motion correction algorithm (Snap shot freezing, SSF) was carried out to reconstruct the SSF images at the corresponding phases. In accordance with AHA staging, the right coronary artery was divided into three sections for evaluation. All images were independently assessed by 2 experienced radiologists who were blinded to each other. Image quality was graded with a 5-point scale and the images from the two reconstruction methods were compared accordingly.

RESULTS
A higher score of image quality was achieved at the SSF group. In end-systole, through the application of SSF algorithm, the rate of qualified images increased from 86.7% to 94.4%, with 58.3% of the images of 2 points increased to 3 points or more. While in middle-diastole, the rate of qualified images increased from 48.9% to 67.8%, with 50% of the images of 2 points increased to 3 points or more.

CONCLUSION
SSF can be used to improve the image quality of coronary CTA in higher heart rates

SSG03-07 • What Is the Clinical Utility of Computed Tomography Angiography in Patients with a Previous Functional Test?

Maria C Ziadi MD (Presenter) ; Juan Manuel Montero ; Juliana Fiorenza ; Roberto L Villavicencio MD

PURPOSE
Computed tomography angiography (CTA) represents an excellent imaging modality to exclude obstructive coronary artery disease (CAD) noninvasively. We sought to assess the utility of CTA in patients (pts) without overt CAD and a previous functional test.

METHOD AND MATERIALS
Among 133 consecutive adult pts who underwent CTA, 78 pts (58.6%) had a previous functional study (99mTc SPECT, an exercise treadmill test (ETT) or a stress Echo) = 6 months. Test conclusions were categorized as follows: normal; abnormal due to ischemic ECG response; equivocal or inconclusive; myocardial ischemia; and/or necrosis. Coronary artery lumen on CTA was considered: normal=0%, mild= 1-49%, moderate= 50-69% and severe =70% stenosis. Obstructive CAD was defined as a =50% stenosis in any major vessel.

RESULTS
Mean age was 56 ± 14 years old, 42 pts were males. Most pts had a low (n=42) and intermediate (n=31) pre-test likelihood of CAD. A total of 58 pts (74%) had a previous SPECT, 17 pts (22%) an ETT and 3 pts (4%) a stress Echo. The prevalence of obstructive CAD was 19% (n=15). In 4 out of 15 pts (27%) with a normal test, CTA uncovered obstructive CAD. In 10 out of 14 pts (72%) with an ischemic ECG response, CTA showed 0% coronary stenosis, in 3 pts (21%) mild CAD and in 1 pt (7%) moderate CAD. Most pts with an equivocal or inconclusive test (n=26/29, 90%) presented not hemodynamically significant CAD. Among pts with myocardial ischemia (n=17), 6 pts (35%) had 0% stenosis, 5 pts mild CAD (29%) and 6 pts (36%) obstructive CAD. One out of 3 pts (34%) with a previous SPECT suggestive of necrosis had non-obstructive CAD on CTA.

CONCLUSION
CTA is clinically useful in pts with a previous false negative functional test. An ischemic ECG response may be associated with non-obstructive CAD, subject to secondary prevention. CTA is valuable to rule out significant CAD in pts with attenuation artifacts on SPECT, often mislabelled as necrosis or ischemia, and particularly in pts with a previous equivocal test.

CLINICAL RELEVANCE/APPLICATION
CTA yields high negative predictive value to exclude obstructive CAD, specially in intermediate risk pts and in those with previous equivocal tests. CTA provides additional data to functional imaging.

SSG03-08 • 256-slice CT Angiographic Evaluation of Coronary Artery Bypass Grafts: Effect of Heart Rate, Heart Rate Variability and Z-axis Location on Image Quality

Bettina M Gramer MD (Presenter) ; Patricia Diez Martinez MD ; Anne S Chin MD ; Nicolas Noisieux MD, MSc ; Ernst J Rummery MD ; Carl Chartrand-Lefebvre MD *

PURPOSE
To assess the effect of heart rate (HR), heart rate variability (HRV) and z-axis location on coronary artery bypass graft (CABG) image quality using 256-slice CT.

METHOD AND MATERIALS
Approval was obtained by the institutional review board and written informed consent provided by all subjects. This prospective study includes 78 consecutive patients (71 men; age 68.6 ± 7.5 years) for a total of 254 CABG (762 graft segments) (postoperative time 23.5 ± 16.4 mo) which underwent 256-slice CT, with 270-msec gantry speed rotation and prospective ECG-gating. The standard deviation of patient HR was used for HRV measurement. Two observers rated graft segments for image quality (5-point scale). Predictors of image quality were assessed with logistic and cumulative link mixed models.

RESULTS
Mean HR during scan was 59.7 ± 9.8 bpm (range 38-98 bpm), and mean HRV 7.2 ± 1.6 bpm. Prescan beta-blockers were used in 37 patients (47.4%). Mean CT coverage was 251.8 ± 28.7 mm. Graft image quality was judged as diagnostic (scores 5 (excellent), 4 (good) and 3 (moderate)) in 96.6% of the 762 segments, with excellent interobserver agreement (kappa values = 0.90). Low quality scores were significantly associated with HRV = 1 bpm, with an odds ratio (OR) of 4.31 (95% confidence interval (CI) 1.10 - 16.84; p = 0.036). Association between low scores and body-mass index was near significance level (p = 0.053), with an OR of 1.15 (95% CI 1.00 to 1.32). There was no significant association between quality scores and HR, age, prescan nitroglycerine, NYHA class and LV ejection fraction.

Quality scores were in the diagnostic range (scores 3-5) in 99.4% of proximal graft segments, as well as in 97.2% and 93.2% of middle and distal graft segments, respectively. Scores were significantly lower in distal segments, more susceptible to cardiac motion (p values = 0.02).

CONCLUSION
To compare the accuracy and the radiation dose of bone biopsies performed either under conventional computed tomography guidance (CT-guidance) or under fluoroscopic guidance using a flat-panel cone-beam CT with real-time 3D image fusion software.
METHOD AND MATERIALS

Institutional review board approval was obtained. Sixty-eight consecutive patients with bone tumor were prospectively included. The biopsies were scheduled under CT-guidance and under FP-CBCT-guidance according to operating room's availability without any preference. We prospectively compared the 2 guidance modalities for the feasibility, technical success, accuracy (distance between target and needle tip), puncture time (time from initial to final 3D acquisitions) and pathological success (biopsy contributive for pathological diagnostic). Patients and physicians radiations doses were also compared using dedicated dosimeters. Statistical significance was evaluated using two-tailed parametric and non-parametric t tests.

RESULTS

Thirty-four patients underwent bone biopsies under CT-guidance and 34 under FP-CBCT-guidance. All biopsies were feasible and technically successful, with both guidance modalities. There was no significant difference for puncture time (34.4 min and 34.3 min respectively: p = 0.51) and pathological results (88 % and 88 % of success respectively: p = 0.98). Precision was significantly better using FP-CBCT-guidance (3.5 mm and 4.8 mm respectively: p=0.002). Patients and operators radiations doses were significantly lower under FP-CBCT-guidance: patient's peak skin dose was 57 mSv +/- 44.6 versus 169 mSv +/- 146.3 (p = 0.03).

CLINICAL RELEVANCE/APPLICATION

Flat-panel-CBCT-guidance can be considered for bone biopsies, allowing a significant radiation dose reduction for the patient and the operator without decrease of accuracy or puncture time extension.

SSG10-03 • Vertebral Biopsy in Patients with Suspected Osteomyelitis: Does It Change Management?

Minzhi Xing MD (Presenter) ; Elizabeth I Parker MD ; Michael R Terk MD

PURPOSE

To determine if vertebral biopsy affects clinical decision-making in patients with suspected osteomyelitis and diskitis

METHOD AND MATERIALS

Forty-seven (n=47) consecutive patients (mean age 67.4 years, 41.7% male) with suspected vertebral osteomyelitis and diskitis who underwent CT-guided vertebral biopsy over a 5-year period (2008-2012) at a single institution were included. A retrospective chart review was performed to determine biopsy results, immune status, antibiotic status at time of biopsy, blood culture positivity (defined as ≥2 cultures positive) and results of other fluid cultures (abscess drainage, urine). A change in management was defined as commencement of an antibiotic regimen or a change from pre-biopsy antibiotic regimen following biopsy results.

RESULTS

The cohort comprised patients with suspected osteomyelitis and diskitis who underwent biopsy of the lumbar (33, 70.2%), thoracic (13, 27.7%) and cervical (1, 0.02%) vertebrae. 23 patients (48.9%) were receiving empiric treatment or antibiotics for co-morbid disease (HIV, TB) at the time of biopsy. Adequate pre-biopsy blood cultures were obtained for 37 patients (78.7%), of which 4 were culture positive and would not have required biopsy for diagnosis. Vertebral biopsy was positive in 13 (27.7%) and negative in 34 (72.3%) patients. A change in management based on overall biopsy results occurred in 7 patients (14.8%). Of the patients with positive biopsy results, there was no change in management in 7 patients, who were continued on pre-biopsy antibiotic regimens. Of the patients with negative biopsy results, there was no change in management in 33 patients: 16 continued on the same pre-biopsy antibiotic regimen with respect to antibiotic regimen or a change from pre-biopsy antibiotic regimen following biopsy results.

CONCLUSION

In this study, only 14.8% of vertebral biopsies provided positive histological confirmation of osteomyelitis and changed management. In the majority of patients with suspected osteomyelitis undergoing vertebral biopsy, there was little evidence that clinical decision-making with respect to antibiotic regimen was influenced by biopsy results.

CLINICAL RELEVANCE/APPLICATION

Vertebral biopsy in the setting of suspected osteomyelitis does not lead to a change in antibiotic management in the majority of patients.

SSG10-04 • CT-based Finite Element Modeling and Microstructural Analysis Detect Reduced Bone Mineral Content and Bone Strength in the Spine after CT Fluoroscopy-guided Interventional Procedures

Miyuki Takasu MD (Presenter) ; Yuko Nakamura MD ; Daisuke Komoto MD ; Masaki Ishikawa MD ; Masao Kiguchi MD ; Kazuo Awai MD * ; Shuji Date ; Chihiro Tani MD

PURPOSE

The long-term bone toxicity associated with CT fluoroscopy-guided interventional angiography has received little attention. The purpose of this study was to determine the prevalence of secondary osteoporosis (SO) and trabecular microstructural changes after CT fluoroscopy-guided transarterial chemoembolization (TACE) for hepatocellular carcinoma.

METHOD AND MATERIALS

Spinal microarchitecture was examined by 64-detector CT in 53 patients who underwent TACE and 85 sex- and age-matched controls. The long-term bone toxicity associated with CT fluoroscopy-guided interventional angiography has received little attention. The purpose of this study was to determine the prevalence of secondary osteoporosis (SO) and trabecular microstructural changes after CT fluoroscopy-guided transarterial chemoembolization (TACE) for hepatocellular carcinoma.

RESULTS

The prevalence of SO were 42.5% in males and 50.0% in females; it was higher in males than in the controls (P=0.04). By multivariate regression analysis, age was a significant contributor to SO (P=0.004). The microstructural and mechanical properties were significantly lower in patients with SO than in the controls and the elastic modulus was significantly lower in patients without SO than in the controls (P=0.03).

CONCLUSION

The prevalence of SO was significantly higher in male patients than the controls. The bone quality and failure load were significantly reduced in patients with SO and the elastic modulus was significantly lower in patients without SO than in the controls.

CLINICAL RELEVANCE/APPLICATION

Multidetector CT detected an increased risk of SO after CT fluoroscopy-guided TACE. CT/FEM can alert to trabecular changes before the clinical manifestation of SO.

SSG10-05 • Anterior Endplate Cement Extravasation Following Vertebroplasty or Kyphoplasty Is Associated with Increased Odds of Adjacent Level Fracture in Osteoporotic Patients

Mary Kristen Jesse MD (Presenter) ; Brian D Petersen MD ; Deborah Glueck * ; Sarah M Kreidler MD
SSG10-07 • CT-assisted Pedicle Screw Placement after CT-controlled, Presurgical Guide Wire Implantation in Pelvic Fractures

Katrin Eichler MD (Presenter) ; Stefan Zangos MD ; Thomas J Vogl MD, PhD ; Martin G Mack MD

PURPOSE
The aim of this study was to evaluate the feasibility and accuracy of CT-assisted percutaneous placement of iliosacral screws over guide wires in patients with unstable pelvic fractures.

METHOD AND MATERIALS
39 patients (17 women, 22 men; mean age: 49.38 years, range: 16-84 years) with unstable traumatic pelvic fractures were treated with percutaneous screw placement after CT-controlled presurgical guide wire implantation to prevent surgical complications regarding the presacral venous plexus and the sacral nerve root. The patients were placed in prone or supine position on the CT table and general anesthesia was induced. For planning a CT with a collimation of 4x2. 5 mm or 64x0. 625 mm (120 KV, 80 mAs) was performed. Based on this scan skin entry points were marked. Then thread Kirschner guide wires with a diameter of 2.5 mm were introduced percutaneously under CT control. After verification of the position of the Kirschner guidewires the distance for the correct placement of the 7 mm-screws was measured, which were then introduced over the guide wire in the operation unit or immediately in the CT intervention room through a small skin incision.

RESULTS
In all cases the guide wires were successfully placed without complications. A total of 101 wires (47 on the right side and 54 on the left side) were introduced. All wires were correctly positioned in the first or second sacral vertebrae. In two patients with sacralized lumbal vertebrae one an additional wire was also positioned in L5. In all cases, the screws were placed over the wires without ventral or dorsal perforation of the sacrum and affection of the nerve roots. None of the patients showed radiologic or clinical evidence of instability of the sacroiliac joint or screw migration. The mean clinical and radiologic follow-up period was 16 months (range: 3-24).

CONCLUSION
CT-controlled fixation of unstable pelvic fractures is a safe and feasible method that is able to minimize the complications of surgical treatment.

CLINICAL RELEVANCE/APPLICATION
CT-assistance is helpful for percutaneous placement of iliosacral screws over guide wires in patients with unstable pelvic fractures.

SSG10-06 • CT-assisted Pedicle Screw Placement after CT-controlled, Presurgical Guide Wire Implantation in Pelvic Fractures

Kraig Fischer MD, MSc ; Hong Su Zhang MD, PhD ; Martin G Mack MD

PURPOSE
CT-assistance is helpful for percutaneous placement of iliosacral screws over guide wires in patients with unstable pelvic fractures.

METHOD AND MATERIALS
39 patients (17 women, 22 men; mean age: 49.38 years, range: 16-84 years) with unstable traumatic pelvic fractures were treated with percutaneous screw placement after CT-controlled presurgical guide wire implantation to prevent surgical complications regarding the presacral venous plexus and the sacral nerve root. The patients were placed in prone or supine position on the CT table and general anesthesia was induced. For planning a CT with a collimation of 4x2. 5 mm or 64x0. 625 mm (120 KV, 80 mAs) was performed. Based on this scan skin entry points were marked. Then thread Kirschner guide wires with a diameter of 2.5 mm were introduced percutaneously under CT control. After verification of the position of the Kirschner guidewires the distance for the correct placement of the 7 mm-screws was measured, which were then introduced over the guide wire in the operation unit or immediately in the CT intervention room through a small skin incision.

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CONCLUSION
CT-controlled fixation of unstable pelvic fractures is a safe and feasible method that is able to minimize the complications of surgical treatment.

CLINICAL RELEVANCE/APPLICATION
CT-assistance is helpful for percutaneous placement of iliosacral screws over guide wires in patients with unstable pelvic fractures.

SSG10-07 • Cervical Interlaminar Epidural Steroid Injection for Cervical Radiculopathy: Median versus Paramedian Approach

Ji Young Yoon MD (Presenter) ; Jong Won Kwon MD

PURPOSE
To compare the clinical effect of the cervical interlaminar epidural steroid injection (CIESI) for radiculopathy using the median and paramedian approach and to evaluate the prognostic factors of CIESI in general.

METHOD AND MATERIALS
We retrospectively analyzed 212 patients from February 2009 to December 2012 who initially underwent CIESI for cervical unilateral radiculopathy. Inclusion criteria were the availability of a cross-sectional image, such as a CT scan or an MR image, and a follow-up record after injection. We excluded patients with bilateral cervical radiculopathy and axial cervical pain. Short-term clinical outcomes were evaluated at the first follow-up after the administration of CIESI. The outcome was classified as effective or ineffective. Fisher's exact test was used to analyze the difference of outcome according to the approach of the spinal needle and distribution of contrast media. Other possible outcome predictors, such as age, gender, duration of radiculopathy (more or less than 6 months), cause of radiculopathy (neural foraminal stenosis vs herniated disc) were also analyzed.

RESULTS
CIESI had no significant difference in the clinical outcome between median (66.3%) and paramedian (69.1%) approach (P>0.05). In general, CIESIs were effective in 144 of 212 patients (67.9%) at short-term follow-up. Patients with herniated discs had significantly better results than patients with neural foraminal stenosis (81.7% vs 57.1%) (P=0.05).

CONCLUSION
There was no significant difference between median and paramedian approach for the effect of CIESI. The most important outcome predictor of CIESI was the cause of the radiculopathy, and patients with herniated disc experienced better pain relief than those with neural foraminal stenosis.

CLINICAL RELEVANCE/APPLICATION
Patients with herniated disc experienced better pain relief than those with neural foraminal stenosis. We recommend median approach for CIESI rather than paramedian approach that is more challenging.

SSG10-08 • Long-term Results of Combined Intradiscal and Periganglionic Injection of Medical Ozone for the Treatment of Lumbar Disk Herniation: Effects on Disk Size and Lumbar Radiculopathy in 371 Patients

Thomas Lehnert MD (Presenter) ; Nagy N Naguib MSc ; Nour-Eldin A Nour-Eldin MD, MSc ; Tatjana Gruber-Rouh ; Martin
Arnold's Neuralgia

CLINICAL RELEVANCE/APPLICATION
The ease of execution and non-invasiveness of this therapy permit the successful outpatient treatment of lumbar sciatic pain.

SSG10-09 • A New Simplified CT Guided Peripheral Approach for Greater Occipital Nerve Infiltration in the Management of Arnold's Neuralgia

Adrian I Kastler MD, MSc (Presenter) ; Yannick Onana ; Sebastien L Aubry MD, PhD ; Bruno A Kastler MD, PhD

METHOD AND MATERIALS
Local Institution approval was obtained and written informed consent was waived. A total of 23 patients (6 men, 17 women, with a mean age of 46 ± 13.3 y.o) who underwent 30 procedures were included in this retrospective study between March 2012 and December 2012. All included patients suffered from severe greater occipital nerve neuralgia refractory to conventional specific treatments. Procedures were performed under CT Guidance and local anesthesia. Initial non-enhanced planning CT was performed from C0 to C2. Infiltration of greater occipital nerve was exclusively performed at the most superficial site at the first bend of the GON between inferior obliquus capitis and semispinalis capitis muscles facing C1-C2 level, using a 22G needle. A mixture of fast- and slow-acting anesthetic (1.5 mL lidocaine hydrochloride 1% and 3 mL ropivacain hydrochloride 0.25%) was then injected followed by the injection of 1.5ml of cortivazol at periganglionic injection was administered by means of an extraspinal lateral approach, using a 22-gauge 17.8-cm spinal needle (Becton Dickinson and Co, Franklin Lakes, NJ, USA). A total of 23 patients (6 men, 17 women, with a mean age of 46 ± 13.3 y.o) who underwent 30 procedures were included in this retrospective study between March 2012 and December 2012. All included patients suffered from severe greater occipital nerve neuralgia refractory to conventional specific treatments. Procedures were performed under CT Guidance and local anesthesia. Initial non-enhanced planning CT was performed from C0 to C2. Infiltration of greater occipital nerve was exclusively performed at the most superficial site at the first bend of the GON between inferior obliquus capitis and semispinalis capitis muscles facing C1-C2 level, using a 22G needle. A mixture of fast- and slow-acting anesthetic (1.5 mL lidocaine hydrochloride 1% and 3 mL ropivacain hydrochloride 0.25%) was then injected followed by the injection of 1.5ml of cortivazol at pre-defined target site. Pain was evaluated on VAS scores immediately before and after procedure and on a monthly basis following procedure. Technical success was defined by the ability to accurately position needle tip at target site. Clinical success was defined by pain relief greater than or equal to 50% lasting for at least 1 month.

RESULTS
Mean pain prior procedure was 7.72/10. Eighteen patients suffered from unilateral pain (right, n=10, left, n=8) and 4 from bilateral pain. Technical success of procedure was 100%. Procedure time ranged from 10-15 minutes. Clinical success rate was 81% (21/26 procedures). In case of clinical success, mean pain relief duration following procedure was 5,25 months (3-25 months).

CONCLUSION
This novel simplified CT guided infiltration approach appears to be effective in the management of refractory Arnold's Neuralgia. With this new technique, infiltration of the GON is faster and technically easier as it does not require the IV contrast injection, compared to other previously described techniques.

CLINICAL RELEVANCE/APPLICATION
This simplified GON infiltration under CT-guidance aiming at a new peripherals is well suited in the diagnosis and management of Arnold's neuralgia, a benign but possibly very invalidating condition.

SSG11-01 • The Clinical Applications of Iodixanol 270mgI/ml in Combination with Spectral CT Imaging in Intracranial CTA

Shan Hu (Presenter) ; Wenzhen Zhu MD, PhD

METHOD AND MATERIALS
Forty patients (20 males and 20 females; average 48±12ys; BMI=30) with suspected vascular diseases were randomly assigned into two groups and undergo intracranial CTA (Discovery CT750 HD, GE healthcare). Group A (n=20) was administered iodixanol 370 mgI/ml and 120Kvp, 400mA. Group B (n=20) was administered iodixanol 270mgI/ml and spectral CT imaging (fast 80/140Kvp switching, 350mA). Both groups were at the same injection volume of 0.8ml/kg, 4.8ml/s of injection rate, 0.5s of rotation time, and a pitch of 0.984.

RESULTS
Mean pain prior procedure was 7.72/10. Eighteen patients suffered from unilateral pain (right, n=10, left, n=8) and 4 from bilateral pain. Technical success of procedure was 100%. Procedure time ranged from 10-15 minutes. Clinical success rate was 81% (21/26 procedures). In case of clinical success, mean pain relief duration following procedure was 5,25 months (3-25 months).

CONCLUSION
This novel simplified CT guided infiltration approach appears to be effective in the management of refractory Arnold's Neuralgia. With this new technique, infiltration of the GON is faster and technically easier as it does not require the IV contrast injection, compared to other previously described techniques.

CLINICAL RELEVANCE/APPLICATION
This simplified GON infiltration under CT-guidance aiming at a new peripherals is well suited in the diagnosis and management of Arnold's neuralgia, a benign but possibly very invalidating condition.
34 patients were all diagnosed as DAVF by 4D-CTA and DSA separately. The location of DAVF was divided by DSA was cranial sinuses (12), sinuses, sious cavernous, cyclorama, basilar venous plexus, and mediastinum cerebri. The classification of DAVF was according to the classification of the DAVF. The result of the DSA was used as the gold standard. The location of DAVF was divided into five areas: Cranial sinuses, anterior and posterior vessels, readability, confidence in diagnosis and delineation of the pathology. For this purpose a 4 point likert-scale (1=Non diagnostic, 2=Poor, 3=Acceptable and 4= Good) was used. Reading of group A and B was performed with 2 weeks separation to reduce recall bias. Reading time needed per study was also recorded. Wilcoxon signed-rank test for paired samples was performed for differences in image quality and time between examinations.

RESULTS
The post-processing of images from group A took in average 222±68s while for group B it took 96±17s (p
- 50% increased success of bone removal
- 53% better visualization of anterior and posterior vessels
- 53% improved readability
- 63% increased confidence in diagnosis
- 70% improved delineation of the pathology

CONCLUSION
Automatic bone removal from a single scan not only significantly improved the technologist workflow by reducing post-processing times, but also has significantly improved the quality of the studies by removing bone more effectively than the double scan subtraction technique, while maintaining or even improving diagnostic confidence and image quality. The clinical impact of this software relies on its applicability to any scanner and the reduced radiation dose to the patient by avoiding the non-contrast enhanced scan.

CLINICAL RELEVANCE/APPLICATION
Automatic bone removal software maximizes the technologist workflow while allowing a reduction in patient radiation dose.

SSG11-02 • Efficacy of Automated Bone Removal Software for Head CT Angiography: Comparison Against Dual Scan Subtraction
Andres Kohan MD (Presenter) *; Christian Rubbert MD *; Leslie Ciancibello RT; Ekta Dharaiya MS *; Gina M Anderson; Barbara A Bangert MD *

PURPOSE
Evaluate the efficacy of a single scan bone removal software solution in head CTA studies.

METHOD AND MATERIALS
30 head CTA performed through the dual scan technique (non-contrast scan followed by a contrast enhanced scan on a 256 or a 64 slice CT scanner were retrospectively analyzed. The studies were processed in two ways: 1. Subtraction of the non-contrast scan from the contrast enhanced scan (Group A) and 2. Automated bone removal from a single contrast enhanced scan (Group B). The technologist recorded the time it took to perform each process. The images were also assessed by an experienced neuroradiologist (19y) with regard to success of bone removal, visualization of anterior and posterior vessels, readability, confidence in diagnosis and delineation of the pathology. For this purpose a 4 point likert-scale (1=Non diagnostic, 2=Poor, 3=Acceptable and 4= Good) was used. Reading of group A and B was performed with 2 weeks separation to reduce recall bias. Reading time needed per study was also recorded. Wilcoxon signed-rank test for paired samples was performed for differences in image quality and time between examinations.

RESULTS
The average grade between VIVID and IADSA were almost equal in Frontopolar artery, Anterior choroidal artery, Ophthalmic artery, Recurrent artery of Heubner, Cortical vein, Trolard vein, Labbe vein, and Internal cerebral vein(p>0.05). In Anterior communicating artery, Posterior communicating artery, Inferior sagittal sinus, Septal vein, Basal vein of Rosenthal, and Cavender sinus, VIVID was higher average grade than IADSA(p

CONCLUSION
VIVID is comparable to IADSA in the detection of the intracranial arteries and veins. VIVID can perform easily and evaluate whole artery and veins and show 3 dimentional anatomy in single examination without severe complications.

CLINICAL RELEVANCE/APPLICATION
Volume intravenous injection digital angiography by using the flat-panel detector angiographic computed tomography CT system is better than IADSA in evaluation of brain vessels anatomy.

SSG11-03 • Volume Intra-venous Injection DSA (VIVID) Compared with Intra-arterial Injection DSA (IADSA) for Evaluation of Cerebral Arteries and Veins
Akihiro Imamura MD (Presenter); Hideyuki Takano MD; Hiroyuki Funatsu MD; Naoyuki Ueno; Hidetoshi Taguchi MD

PURPOSE
We analyzed whether the intracranial arteries and veins could be detected using intravenous injection digital angiography (DSA) (VIVID) by using the flat-panel detector angiographic computed tomography CT system (FACT). We compared these results with IADSA.

METHOD AND MATERIALS
We retrospectively analyzed 17 consecutive patients (8 males and 9 females; 23 sides) who underwent both VIVID examinations and IADSA for neuronavigation. One hundred ml of nonionic iodine contrast (350 mg/ml) injection was injected via an 18-gauge plastic needle, at a rate of 10 ml/second, which was then flushed out using 25 ml of saline, followed by rotational DSAs. We analyzed data from the rotational DSAs processed by the DynaCT software on the workstation using the maximum intensity projection and volume rendering algorithms. The VIVID and IADSA images were analyzed and compared by 3 experienced radiologists independently. The quality of visualization was graded as non-visualized (0), noncontinuous(1), faint and continuous(2), continuous (3),and intense and continuous(4). The averages of grades of the veins were calculated. Comparison of VIVID and IADSA was made. The grades were assigned by reaching a consensus, following a discussion among the observers.

RESULTS
The average contrast enhancement of VIVID and IADSA were almost equal in Frontopolar artery, Anterior choroidal artery, Ophthalmic artery, Recurrent artery of Heubner, Cortical vein, Trolard vein, Labbe vein, and Internal cerebral vein(p>0.05). In Anterior communicating artery, Posterior communicating artery, Inferior sagittal sinus, Septal vein, Basal vein of Rosenthal, and Cavender sinus, VIVID was higher average grade than IADSA (p

CONCLUSION
VIVID is comparable to IADSA in the detection of the intracranial arteries and veins. VIVID can perform easily and evaluate whole artery and veins and show 3 dimentional anatomy in single examination without severe complications.

CLINICAL RELEVANCE/APPLICATION
Volume intravenous injection digital angiography by using the flat-panel detector angiographic computed tomography CT system is better than IADSA in evaluation of brain vessels anatomy.

SSG11-04 • Dural Arteriovenous Fistula: Diagnosis and Classification with 4D-CTA and DSA
Bing Tian MD (Presenter); Bing Xu; Qi Liu MD, PhD; Jianping Lu MD

PURPOSE
To compare the utility of 4D-CTA and DSA in assessing the presence, location, and classification of Dural Arteriovenous Fistula (DAVF).

METHOD AND MATERIALS
320-Multidetector row 4D-CTA and DSA were applied in 34 patients (mean age, 32 years; range, 18-57 years) with DAVF. 4D-CTA was performed within 2 days before DSA. All the images were independently reviewed by 2 readers for the presence, location, and classification of the DAVF. The result of the DSA was used as the gold standard. The location of DAVF was divided into five areas: Cranial sinuses, sious cavernous, cyclorama, basilar venous plexus, and mediastinum cerebri. The classification of DAVF was according to Borden, et al.

RESULTS
34 patients were all diagnosed as DAVF by 4D-CTA and DSA separately. The location of DAVF divided by DSA was cranial sinuses (12),
SSG11-05 • Volumetric Analysis of Cerebral Arteriovenous Malformation Using CT Angiography: Preliminary Results in Adult Patients

Donghyun Hong MA (Presenter) ; Karen Buch MD ; Hernan Jara PhD * ; Osamu Sakai MD, PhD *

PURPOSE
Conventionally the assessments of the size of cerebral arteriovenous malformation (AVM) are based on 2D DSA image which makes evaluating the volume of the AVM difficult. The purpose of this study is to measure the volume of AVMs using computed tomographic (CT) angiography to generate a more accurate and realistic measure of abnormality.

METHOD AND MATERIALS
We retrospectively enrolled 11 AVM patients (age; 40 ± 17 YO, 6 males) diagnosed by radiologists. Subjects were classified into two groups –Small AVM: < 3 cm and Medium AVM: 3~6cm– based on the Spetzler-Martin grading scale. All patients underwent CT angiography using 64 multi-detector CT (GE, WI). For quantitative volumetric analysis, a program was developed using Mathcad (PTC, MA) in our image-processing laboratory. This image-processing tool generates 3D blood-only images through two segmentation steps: intracranial blood vessel segmentation followed by pixel value thresholding. From the segmented images with subtracted surrounding brain and meningeal tissues, we calculated the volume of an AVM lesion (the nidus, dilated feeding arteries and draining veins) by calculating the intracranial blood volume difference between both hemispheres. The AVM volume was then correlated with the maximal AVM lesion dimension.

RESULTS
Statistically significant differences were observed between the two subject groups. In the comparisons of the volume (cm³): 12.478 ± 5.743 and 53.963 ± 9.338 (mean ± stdev.) for Small AVM (< 3cm) and Medium AVM (3 ~ 6 cm) respectively; P < 0.005 for all. Additionally, we found an exponential correlation between the AVM volume and the maximum length of a nidus (trendline: y = 4.4183e^{0.596x} with R² = 0.945).

CONCLUSION
CT angiograms can be processed to provide a more realistic three-dimensional measures of AVM size with potentially more clinical specificity and higher sensitivity to monitor treatment changes.

CLINICAL RELEVANCE/APPLICATION
Volumetric AVM measures have the potential of providing new standards for AVM size classification and could provide a useful tool for monitoring AVM evolution in time and in response to treatment.

SSG11-06 • Non-contrast-Enhanced High-temporal-Resolution 4D MRA with an Acquisition Window Covering Two Cardiac Cycles: Assessment of Brain Arteriovenous Malformations

Helene Raoult MD (Presenter) ; Elise Bannier ; Peter Schmitt PhD * ; Benjamin Robert * ; Jean-Yves Gauvrit MD

PURPOSE
To assess the feasibility, quality and diagnosis performance of a bSSFP NCE 4D MRA ECG-gated sequence with a high temporal resolution to analyse brain arteriovenous malformations (AVM).

METHOD AND MATERIALS
After approval from the Institutional Review Board, ten patients presenting AVM and referred for digital subtraction angiography (DSA) were included in the study. Patients underwent NCE 4D MRA on a 3T system (MAGNETOM Verio, Siemens Healthcare), using a 32-ch head array coil. The NCE 4D MRA technique combined arterial spin labeling with an ECG-triggered 3D cine segmented multiphase bSSFP readout. Two sequences were performed, with temporal acquisition window over 1 (1-RR) or 2 (2-RR) cardiac cycles and acquisition times of 5-6 or 10-12 min respectively. Imaging parameters for 2-RR NCE 4D MRA were: FOV=220x192mm², 44 slices, 1.5x1.5x1.5mm³ voxel size. Other sequences performed were: TOF MRA (0.7x0.6x0.6mm³ voxel size) and 4D CE-MRA (0.9x0.8x1.5mm³ voxel size, 1.5s temporal resolution). All patients also underwent DSA with a filming rate of 3 images/s. Images were reviewed with respect to image quality and AVM diagnosis value.

RESULTS
Both NCE 4D MRA sequences were successfully performed in all patients achieving mean temporal resolution of 68.1 ms (±3.1; 20-32 phases) and 69.1ms (±5.6; 10-16 phases) and mean image quality score of 3,9/5 (±0,7) and 3,3/5 (±0,8), for 2-RR and 1-RR NCE 4D MRA respectively.

All AVM were depicted with their main feeding arteries and global nidus size in agreement with DSA data (fig.1). Venous drainage type was always correctly classified on 2-RR NCE 4D MRA images, but misidentified in five cases on 1-RR NCE 4D MRA. The 2-RR NCE 4D MRA allowed a more accurate delineation of the nidus than combined TOF and CE 4D MRA data.

CONCLUSION
The bSSFP NCE 4D MRA sequence allows brain AVM analysis with a high temporal resolution, offering accurate nidus delineation, target of the treatment. A 2-RR sequence improves depiction of venous drainage, necessary to evaluate hemorrhagic risk.

CLINICAL RELEVANCE/APPLICATION
The bSSFP NCE 4D MRA sequence allows brain AVM analysis with a high temporal resolution, offering accurate nidus delineation, target of the treatment.

SSG11-07 • Evaluation of Brain Arteriovenous Malformations by Using 4D MR Angiography with Arterial Spin Labeling at 3T

Yasuhiro Iryo (Presenter) ; Toshinori Hirai MD ; Masanobu Nakamura ; Minako Azuma ; Yasuyuki Yamashita MD *

PURPOSE
To evaluate the usefulness of 4D magnetic resonance angiography (MRA) with an arterial spin-labeling (ASL) technique at 3T that yields high spatial resolution and time-resolved hemodynamics without exogenous contrast agents for the evaluation of brain arteriovenous malformations (AVMs).

METHOD AND MATERIALS
Our study included 8 patients (4 men, 4 women; age 7-65 years, mean 39.5 years) with brain AVMs. They underwent 4D ASL-MRA and digital subtraction angiography (DSA). The 4D ASL-MRA imaging was performed on a 3T MR system; a sensitivity encoding (SENSE) phased-array 32-channel head coil was used. A pseudo-continuous arterial spin labeling (pCASL) preparation scheme with the
Look-Locker sampling was employed for spin tagging. Seven phases of labeling and control images were acquired in an interleaved mode. Upon completion of two acquisitions, corresponding temporal phases with identical inversion delay were subtracted. Minimum-intensity-projection (MIP) images were then created for each subtracted data set in three orthogonal directions. The acquisition parameters were: FOV = 220 x 200 mm, matrix = 224 x 162, spatial resolution = 1 x 1 x 1 mm, flip angle = 12°, TR = 8.5 ms, TE = 4.2 ms, SENSE factor = 3.0, TI/TI/final TI = 100 ms/250 ms/20.5 s. A transverse labeling plane was positioned 9 cm below the imaging center. Total acquisition time is approximately 5 min. Two independent reviewers read the 4D MRA images for the nidus size, arterial feeders and venous drainage. Two other readers consensually reviewed the DSA images. Interobserver and intermodality agreement was assessed by ? statistics.

RESULTS
On all 4D ASL-MRA studies, the major intracranial arteries were successfully demonstrated at an inflow temporal resolution of 250 ms. Interobserver agreement was excellent for the nidus size (? = 1.0), very good for arterial feeders (? = 0.86) and good for venous drainage (? = 0.80). Intermodality agreement was excellent for the nidus size (? = 1.0), very good for arterial feeders (? = 0.86) and good for venous drainage (? = 0.80).

CONCLUSION
The agreement between 4D ASL-MRA and DSA findings was good to excellent with respect to the AVM nidus size, arterial feeders and venous drainage.

CLINICAL RELEVANCE/APPLICATION
With 4D ASL-MRA at 3T, hemodynamic information on the brain AVMs can be obtained without the use of exogenous contrast agents.

SSG11-08 • 7T versus 1.5T TOF MRA for Assessment of Intracranial Aneurysms: The More Tesla, the Better?

Lale Umutlu MD (Presenter) *; Karsten Wrede; Christoph Moenninghoff MD; Soren Johst; Philipp Dammann; Michael Forsting MD; Marc U Schlamann

PURPOSE
As rupture of intracranial aneurysms is considered the main cause of subarachnoidal haemorrhage, detection and high-quality assessment of aneurysm localization and related features (e.g. parent vessel) is of inevitable value for treatment planning. With 1.5 Tesla MRI being limited in the detection of small aneurysms, ultra-high-field MRI may enable superior examination of intracranial vasculature based on higher spatial resolution due to increased signal-to-noise ratio (SNR). Aim of this trial was to compare the diagnostic ability of 1.5 versus 7 Tesla TOF MRA for assessment of intracranial aneurysms.

METHODOLOGY AND MATERIALS
17 subjects were examined on a 1.5 Tesla (Magnetom Aera, Siemens Healthcare) and Time-of-flight MRA with a voxel size of 0.7x0.7x0.7 mm^3 was obtained. Subsequently all subjects underwent a 7 Tesla examination (7T whole-body MR system; Magnetom 7T, Siemens Healthcare) with a voxel size of 0.2 x 0.2 x 0.2mm^3. Two radiologists in consensus assessed the delineation of the (1) aneurysm dome, (2) neck, (3) parent vessel, (4) vessel tissue contrast and (5) image impairment due to artifacts. For qualitative analysis a 5-point scale was used (5= excellent delineation; 1= non-diagnostic). Contrast ratios (CR) of all aneurysms and adjacent parenchyma were calculated. A Wilcoxon rank test was performed for analysis of statistical significance.

RESULTS
According to qualitative analysis 7 Tesla TOF MRA yielded significantly superior delineation of dome (mean 7T: =4.5; mean 1.5T= 3.2; p < 0.01). Despite slight impairments based on increased signal alterations, 7 Tesla TOF MRA provided superior assessment of the aneurysms and their related vessel-features based on high-quality vessel-tissue contrast and imaging at improved spatial resolution.

CLINICAL RELEVANCE/APPLICATION
Based on improved spatial resolution imaging, high-resolution 7T TOF MRA may bear the potential to overcome known limitations of 1.5 Tesla MRA in the assessment of intracranial aneurysms.

SSG11-09 • Ultra-high Temporal Resolution Vascular Pulsation of Aneurysms: A Novel Dynamic 4-dimensional Time of Flight MR Angiography Technique to Accurately Evaluate Dynamics of Cerebral Aneurysm

Till Illies MD (Presenter); Jan Sedlacik; Jan-Hendrik Buhr MD *; Daniel Kutzner; Jens Fiehler; Andre Kemmling MD

PURPOSE
Time resolved imaging of pulsatility of cerebral aneurysms has been performed using 4D CT angiography. Assessment of wall motion may be useful for stratification of rupture risk. Aim of the study was to implement a 4D TOF MRA technique to image aneurysmal wall motion with high temporal and spatial resolution.

METHODOLOGY AND MATERIALS
We performed time resolved MR-TOF angiography in an elastase induced rabbit model of cerebral aneurysm. Dynamic 4-dimensional TOF angiography was achieved with ultra high-temporal resolution of 30 3D-images per cardiac cycle (151 beat/min). Dynamic data sets were reconstructed from ecg-triggered 4D gradient echo TOF images (temporal resolution 75 frames per second, spatial resolution 0.5x0.5x1.0mm, TR 20ms, TE 5.76ms, 32 channel coil system at 3T). The 4D dataset was processed to calculate vessel motion: Voxel were classified as vessels using a semi-automated region-growing algorithm (Analyze 11.0). A relative vessel motility index was calculated using the voxel-wise frequency of a vessel vs. non-vessel classification from 30 time-points over the cardiac cycle.

RESULTS
The aneurysm (5mm diameter) and aortic arch were imaged with diagnostic image quality within 12 min. The temporal resolution of 75 frames/second allowed ready visualization of wall pulsation and vessel displacement in time. The relative vessel motility index showed highest wall motion at the aortic arch and tip of the aneurysm corresponding to qualitative assessment.

CONCLUSION
We successfully implemented a time resolved TOF-MRA technique allowing 4-dimensional quantification of aneurysmal wall motion at high spacial and temporal resolution (75 frames per second).

CLINICAL RELEVANCE/APPLICATION
Quantification of aneurysmal pulsatility may be a valuable pathophysiological marker for assessing rupture risk.

Vascular/Interventional (Ablative Therapies)

Tuesday, 10:30 AM - 12:00 PM • E353A
**SSG17-03 • Inhibition of PI3K-AKT-mTOR Signaling Enhances Heat Stress Induced HCC Cell Killing**

**PURPOSE**

AKT and ERK signaling pathways are frequently dysregulated in hepatocellular carcinoma (HCC) and promote HCC cell survival. The aim of the present study was to test the hypothesis that inhibition of PI3K-AKT-mTOR and/or MEK-ERK signaling enhances heat stress induced HCC cell killing.

**METHOD AND MATERIALS**

Intentional partial laser or sham ablation was performed on orthotopic N1S1 HCC tumors under US-guidance and liver/tumor tissue assessed for phospho-AKT and ERK immunostaining at 6 or 24 hours post-ablation (N=8). The HCC cell lines N1S1 and AS30D were pre-treated for 1-hour with small molecule inhibitors against PI3K-mTOR, MEK, both or vehicle control followed by sublethal heat stress (45.0°C) or control (37°C) for 10 minutes and recovered up to 48 hours in complete media at 37°C (N=3). Samples were assessed for heat stress induced AKT and ERK signaling immediately post-heat stress by western immunoblotting and cell viability at 48 hours post heat stress by WST-1 assay.

**RESULTS**

Immunohistochemical analysis of the ablation zone demonstrated markedly increased AKT and ERK phosphorylation at the tumor ablation margin but not at the liver ablation margin. There was no evidence of increased AKT or ERK phosphorylation in the tumor or at the margin between liver and tumor in the sham ablation group. Western immunoblotting demonstrated that inhibition of PI3K-mTOR and MEK blocked constitutive and heat stress induced AKT and ERK phosphorylation, respectively, in both the N1S1 and AS30D HCC cell lines. Viability assessment demonstrated that inhibition of PI3K-mTOR enhanced heat stress induced HCC cell killing over heat stress or drug alone in both cell lines (p

**CONCLUSION**

These data demonstrate that thermal ablation induces AKT and ERK phosphorylation at the tumor ablation margin in vivo and that inhibition of PI3K-mTOR prevents heat stress AKT signaling and enhances heat stress induced HCC cell killing.

**CLINICAL RELEVANCE/APPLICATION**

Inhibition of PI3K-AKT-mTOR signaling may be a promising therapeutic target in combination with thermal ablation as a method to enhance ablation induced HCC cell killing.

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**SSG17-04 • Early Residual Tumor Differentiation from Benign Periablational Thermal Injury after Radiofrequency Ablation by Dual-energy Computed Tomography: A Phantom and Animal Study**

**SSG17-02 • Inhibition of PI3K-AKT-mTOR Signaling Enhances Heat Stress Induced HCC Cell Killing**

**PURPOSE**

To determine if hepatic radiofrequency ablation (RFA)-induced stimulation of distant subcutaneous tumor growth can be suppressed with an adjuvant c-MET kinase inhibitor in a small animal tumor model.

**METHOD AND MATERIALS**

Single R3230 adenocarcinoma subcutaneous tumors were implanted in Fisher 344 rats (total n=38). At diameters of 10-11mm, tumors were randomized to receive standard RFA (21g electrode, 1 cm active tip, tip temperature 70°C±5min) or sham procedure (electrode placement without RFA) to normal liver (2 groups, n=13 each) and then with adjuvant intraperitoneal PhA-665752 (c-MET inhibitor) administered 3d after RFA (2 groups, n=6 each). Animals were sacrificed and tumors harvested 7d post-treatment. Tumor growth analysis (absolute diameter, change in diameter, and growth curve slope) and evaluation of proliferative indices (Ki-67 % positivity) was performed.

**RESULTS**

With RFA of normal liver, distant subcutaneous tumors were substantially larger at 7d compared to sham (17.1±2.2mm vs. 13.7±0.9mm, p

**CONCLUSION**

RF ablation of normal liver can stimulate distant subcutaneous tumor growth in this animal model. This effect can be successfully suppressed with an adjuvant c-MET kinase inhibitor.

**CLINICAL RELEVANCE/APPLICATION**

Achieving an ablative margin during hepatic RFA may stimulate distant tumor growth. The c-met pathway is one potential mechanism that can be targeted to suppress these deleterious effects.

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**SSG17-03 • Optimizing Pulsed Irreversible Electroporation Deposition**

**PURPOSE**

To determine optimal settings for creating large zones of IRE-induced ablation.

**METHOD AND MATERIALS**

IRE ablation (n = 33) was performed in vivo in pig liver (n = 7, Yorkshire swine 92 ± 105 kg ) under ultrasound guidance using two IRE electrodes, 18 gauge, tip exposure of 2cm, 1.5-2cm inter-electrode spacing and Nanonknife generator (Angiodynamics, Fremont, CA). Energy deposition was applied at 2,250 to 3,000V for 10-100 pulses per application cycle. In addition, to varying the number of pulses, the number cycles of IRE application (1-12) and the time interval between IRE applications (10-900 sec) were systematically varied.

**RESULTS**

For a 15 min application time, optimal ablation of 6.7 ± 0.2 x 3.3 ± 0.1 cm was produced at 100 pulses of 100 μsec and 3000V with 100 Hz, 1 cm active tip, 70°C±5min. For a 30 min application time, optimal ablation of 11.0 ± 0.2 x 5.3 ± 0.2 cm was produced at 1000 pulses of 100 μsec and 3000V with 100 Hz, 1 cm active tip, 70°C±5min. For a 15 min application time, optimal settings.

**CONCLUSION**

Optimization of IRE ablation parameters will enable the creation of larger volumes of treatment effect in the most efficient manner.
PURPOSE
The inflammatory reaction to the thermal injury after the radiofrequency ablation (RFA) makes it difficult to timely determine the treatment response using conventional computed tomography (CT). In this study, we applied iodine quantification with Dual-Energy CT (DECT) in rabbits with VX2 carcinoma after incomplete RFA to distinguish benign periablational reactive tissue from residual tumor and evaluated the therapeutic response of RFA.

METHOD AND MATERIALS
A phantom with ten tubes which contain solutions of varying iodine concentration was scanned with DECT to evaluate the feasibility of iodine quantification. Iodine concentration was calculated and compared with the true iodine concentration. In animal study, triple-phase contrast-enhanced DECT data on 24 rabbits with VX2 carcinoma were assessed by 2 reviewers independently after 3-day (n=6), 1-week (n=6), 2-week (n=6) and 3-week (n=6) of incomplete RFA. The iodine map images were obtained based on three materials decomposition theory after post-processing to CT images. Regions of interest (ROI) were positioned on the iodine image over the lesion and aorta as a reference, for the recording of iodine concentration in the lesion and in the aorta respectively. The pathologic specimens were sectioned in the same plane as CT imaging. The differences of lesion iodine concentration and lesion-to-aorta iodine ratio between residual tumor and benign periablational reactive tissue were statistically analyzed.

RESULTS
The calculated iodine showed excellent correlation with the true iodine concentration (R2 = 0.999, P < 0.0001) in the phantom study. The lesion iodine concentration and lesion-to-aorta iodine ratio in residual tumor were significantly higher than that in benign periablational reactive tissue in 2-week group during the arterial phase (AP) (P < 0.01), and in 3-week group during both AP (P < 0.05) and portal venous phase (PVP) (P < 0.05). There was no significant difference of lesion iodine concentration or lesion-to-aorta iodine ratio between them in 3-day and 1-week groups.

CONCLUSION
The results of this study indicated that iodine quantification with DECT is accurate in the phantom study and could be used to differentiate benign periablational reactive tissue from residual tumor in VX2 carcinoma 2 weeks after RFA.

CLINICAL RELEVANCE/APPLICATION
The iodine quantification with DECT could be performed 2 to 3 weeks after RFA clinically to early evaluate therapeutic response.

SSG17-05 • Clinical Utility of Automatic Real-time Fusion System for Radiofrequency Ablation in Target Localization, Electrode Placement and Monitoring of Ablation Procedure

Jeong-Min Lee MD (Presenter) * ; Jeong Hee Yoon MD ; Dong Hyeon Kim MD ; Joon Koo Han MD ; Byung Ihn Choi MD, PhD *

PURPOSE
To prospectively evaluate clinical utility of automatic multimodality image fusion for radiofrequency ablation (RFA) procedures, and to determine clinical outcomes of fusion-guided RFA procedures.

METHOD AND MATERIALS
80 patients (M:F=66:14) with 89 liver malignancies (80 HCCs and 9 metastases) were treated with switching monopolar RFA using multiple electrodes under the guidance of image fusion system (PercuNav system, Philips Healthcare). Image fusion system was used in undergoing RFA to assist in target localization, electrode placement, and procedure monitoring. A preprocedural CT scan was obtained at slight inspiration phase with six sterile passive fiducial markers on the skin. Visibility of target tumor, planning of safe access route, operator’s confidence for technical feasibility were graded by an operator using conventional B-mode ultrasound and using the image fusion system. In addition, registration time was recorded. Technique effectiveness, local recurrence rate and remote recurrence rate at 1, 6, 12, and 18 months were evaluated using the Kaplan-Meier method.

RESULTS
Real-time fusion of US with CT/MR provided information crucial for successful execution of the RFA procedure in 43.8% (35/80) patients, and may enable procedures that are not feasible with US guidance in 23.8 % of cases. Total additional setup time for the navigation system was 3.7 min ± 1.9. Tumor visibility was significantly improved on fusion system compared with on B mode US and (p < 0.0001). In addition, image fusion system provided better planning of safe access route without a risk for major vascular injury, and increased operator’s confidence for technical feasibility compared with B-mode ultrasound (p < 0.0001). Technique effectiveness rate, determined 1 month after RFA was 100%. Local tumor progression rates at 6, 12 and 18 months were 2.5%, 6%, and 6%. In addition, intrahepatic remote recurrence rates at 6, 12 and 18 months after RFA were 12%, 16.5%, 22.4%.

CONCLUSION
Real-time multimodality fusion system provided information crucial for successful execution of the RFA procedure in 43.8% (35/80), and automatic real time fusion guided RFA safely provided successful local tumor control, and therefore, improved survival may be achieved with this technique.

CLINICAL RELEVANCE/APPLICATION
Real time image fusion system provided better visibility of target tumor, and increased operator’s confidence for RFA, which allowed a high local tumor control rate.

SSG17-06 • Radiofrequency Ablation Using a Multiple-electrode Switching System for Lung Tumors Measuring 2cm or Larger: Phase-II Clinical Study

Hiroshi Kodama (Presenter) ; Koichiro Yamakado MD, PhD ; Takaaki Hasegawa ; Masashi Fujimori MD ; Takashi Yamanaka MD ; Haruyuki Takaki MD ; Junji Uraki MD ; Atsushi Nakatsuka MD ; Hajime Sakuma MD *

PURPOSE
To prospectively evaluate the safety and effectiveness of radiofrequency (RF) ablation using a multiple-electrode switching system for the treatment of lung tumors measuring 2cm or larger.

METHOD AND MATERIALS
Our institutional review board approved this phase-II study and written informed consent was obtained from all patients. Inclusion criteria were not surgical candidates who had 3 or less malignant lung tumor with maximum tumor diameter of 2-5cm. The primary endpoint was safety and evaluated using the Common Terminology Criteria for Adverse Events (CTCAE). Patients were observed at least one year, and local tumor progression and overall survival were analyzed using Kaplan-Meier method.

RESULTS
Thirty-three consecutive patients (26 male and 7 female; mean age, 70.5 years; 46-87 years) were included. A total of 35 tumors with mean maximum tumor diameter of 3.0±0.7 cm (range, 2.0-4.4 cm) were ablated using a multiple-electrode switching system in 35 sessions. There were no procedure-related death and Grade-4 adverse event. Grade-3 adverse event occurred in 4 sessions (11.4%). All of the tumors with local tumor progression (n=4) were adjacent to bronchi or vessels greater than 2mm. The 1-year overall survival rates were 81.2% (95% CI, 67.6-94.8%).
CLINICAL RELEVANCE/APPLICATION
RF ablation using a multiple-electrode switching system can be useful when the lung tumor is 2cm or larger.

SSG17-07 • Nanoparticle Distribution after Treatment of Rabbit VX2 Hepatic Tumor with Nanoparticle Embolization and Irreversible Electroporation (IRE) or Radiofrequency Ablation (RFA)
Alda L Tam MD (Presenter) *; Marites P Melancon PhD; Joe Ensor *; Laura Pageon DVM; Mohamed E Abdelsalam MD; Tomas Appleton Figueira MD; Katherine Dixon RT; Jennifer J Miller; Amanda McWatters; Chun Li PhD; Sanjay Gupta MD

PURPOSE
To investigate the intratumoral uptake of radiolabeled, hollow gold nanoparticles loaded with doxorubicin (64Cu-labeled PEG-HAuNS-DOX) after IRE or RFA in rabbit VX2 hepatic tumors.

METHOD AND MATERIALS
Twelve VX2 tumor-bearing rabbits were randomized to three treatment arms: (i) nanoparticle embolization with 64Cu-labeled PEG-HAuNS-DOX (NE) alone; (ii) NE followed by IRE (NE+IRE); (iii) NE followed by RFA (NE+RFA). PET/CT imaging was obtained at 18-hours after intervention, after which animals were euthanized and tissue samples were collected for autoradiograph and TEM analysis. Dunnett’s multiple comparison procedure was performed to evaluate differences in the mean uptake of nanoparticles in the tumor.

RESULTS
Based on PET/CT evaluation, the uptake and retention of the nanoparticles in the tumor following NE+RFA was significantly greater than following NE (p=0.02) but there was no difference in the uptake and retention of the nanoparticles following NE+IRE when compared to NE (p=0.75). The autoradiograph analysis demonstrates that following NE+IRE, there is nanoparticle deposition in the tumor, in the ablated tissues adjacent to the tumor and in normal liver; whereas, following NE or NE+RFA, there is nanoparticle deposition around the tumor but not in it. The TEM results indicate that following NE+IRE, intracellular uptake of nanoparticles was noted in tumor, ablated and normal liver cells. There was no intracellular uptake of nanoparticles following NE or NE+RFA.

CONCLUSION
Combining NE with IRE or RFA results in the retention of the nanoparticles in or around the tumor for up to 18-hours post-intervention; however, nanoparticles are found inside cells only after IRE.

CLINICAL RELEVANCE/APPLICATION
A combined nanoembolization and ablation treatment technique for liver tumors is feasible.

SSG17-08 • Renal Cryoablation: A New Paradigm for Nearly Any Tumor Location
Hussein D Aoun MD (Presenter); Peter J Littrup MD *; Barbara A Adam MSN; Evan N Fletcher MS, BA; Mark J Krycia BS

PURPOSE
To assess technical feasibility, efficacy and complication rates of CT guided percutaneous renal mass cryoablation in a large series on long term follow up.

METHOD AND MATERIALS
CT and/or CT-US fluoroscopic-guided percutaneous cryoablations were performed in 247 procedures on 262 tumors (210 RCC, 45 metastasis, 6 oncocytomas and 1 angiomyolipoma) in 214 patients noting tumor size and location. Thirty-seven patients had multiple renal tumors ablated. Follow-up CT or MRI was utilized to assess efficacy and evaluate for local recurrences or new multicentric tumors. Hydrodissection with normal saline/contrast (60:1) solution was performed to protect adjacent vital structures such as bowel, ureter or pancreas. Complications followed the grading system of the National Institutes of Health, Common Terminology of Complications and Adverse Events (CTCAE 4.0).

RESULTS
All the procedures were performed under conscious sedation and were virtually painless during and after the procedure. Average tumor and ablation size was 3cm and 5cm, respectively, with the largest 10.4cm. Hydrodissection was performed in 73 procedures. Major complication (only grade 3) rate attributable to the procedure was 2.4% (6/247). Of the major complications, 3 (3/5) were related to hemorrhage requiring transfusion (Grade 3). A ureteral stricture prior to ureteral stent placement for central tumors and bowel injury prior to protective hydrodissection techniques were observed early on in our experience. Median follow-up was 1.8 years with 72 patients having > 3 year follow-up and 36 patients having > 5 year follow-up. Local recurrence rate was 2% (6/262), with 4 technical failures and 2 tract recurrences. Of the local recurrences, 4 were re-ablated (2 tract and 2 technical) without residual disease on follow-up for a secondary efficacy of 99%.

CONCLUSION
Renal cryoablation has established low complication and local recurrence rates which do not appear to be significantly affected by tumor size or central location. CT guided percutaneous cryotherapy is a low cost and low morbidity alternative for patients with complex renal tumors.

CLINICAL RELEVANCE/APPLICATION
The rising cost of healthcare mandates consideration of renal cryoablation as a cost effective treatment option, justified by comparable low recurrence and complication rates for any renal location.

SSG17-09 • RCC Perfusion before and after Radiofrequency Ablation Measured with DCE-MRI: A Pilot Study
Tze M Wah MBChB, FRCR (Presenter); Steven Sourbron PhD; Daniel Wilson MS; Derek Magee PhD; Walter Gregory PhD; Peter J Selby MD, Dsc; David L Buckley PhD

PURPOSE
The treatment efficacy of radiofrequency ablation (RFA) of renal cell carcinoma (RCC) is usually assessed with contrast enhanced CT or MRI. The lack of contrast enhancement in the zone of ablation is usually interpreted as successful ablation. However, the zone of ablation typically exhibits some enhancement rather than no enhancement at all, and it is this variability that can pose a clinical dilemma when deciding whether there is complete tumor cell death. Dynamic contrast enhanced (DCE) MRI is routinely performed in our institution to assess the treatment effect for patients undergoing RFA. This pilot study aims to investigate if early treatment effects of RFA in RCC can be detected with DCE-MRI perfusion measurements.

METHOD AND MATERIALS
Twenty patients undergoing percutaneous RFA of their twenty one RCCs were evaluated with DCE-MRI immediately before and at one-month after RFA treatment. DCE-MRI was performed with volume acquisition under free breathing. The tumor perfusion was estimated using the maximum slope technique in two independent sittings. Blood flow to the renal tumors was correlated with total RF treatment time. This study was granted approval by our institution IRB.

RESULTS
DCE-MRI examinations were successfully evaluated for 21 renal tumors (size from 1.3 to 4 cm) with RFA time (7.4 to 63.4 minutes). The perfusion measurement of the RCCs decreased significantly (p < 0.05) multiple comparison procedure was performed to evaluate differences in the mean uptake of nanoparticles in the tumor.

CONCLUSION
It is feasible to measure RCC perfusion before and after RFA using DCE-MRI. Pre-RFA tumor blood flow may be used to predict RFA time which may help planning treatment. Perfusion values significantly decrease in the zone of ablation, suggesting they may be useful for the assessment of treatment.
Vascular/Interventional - Tuesday Posters and Exhibits (12:15pm - 12:45pm)

Tuesday, 12:15 PM - 12:45 PM • Lakeside Learning Center

**LL-VIS-TU3A • AMA PRA Category 1 Credit ™: 0.5**

**Host**
Albert A Nemcek, MD *

**LL-VIS-TU1A • Percutaneous Image-guided Biopsy of Subsequent Lesions in Patients with Known Primary Malignancy: A Second Primary or Just a Metastasis?**

- Laura E Gonzalez Lozada MD (Presenter)
- Eunice A Lara Garcia MD
- Carlos E Rojas Marin MD
- Edgar J Rosero Garcia MD
- Francisco Molina MD
- Oscar Arrieta

**PURPOSE**
To evaluate and justify the need of performing a percutaneous image-guided biopsy of new lesions in patients with known primary cancer, determining the actual risk of being a second malignancy, unrelated to the first.

**METHOD AND MATERIALS**
A retrospective descriptive study using data from the imaging guided biopsies register from 2011-2012. Eighty patients presented subsequent appearance of indeterminate lesions and underwent percutaneous image-guided biopsy. The histopathologic result were obtained and compared with the primary malignancy.

**RESULTS**
From the 80 patients included, 83.7% were positive for recurrent metastatic disease and 15% were positive for second primary cancer. Among the patients that presented a secondary primary tumor 66% had history of breast cancer, being gastric cancer the most common secondary malignancy. None of the patients were negative for malignancy. The most common primary cancer was breast cancer followed by cervical cancer. Frequently subsequent lesions sites were lung, mediastinum and ovaries.

**CONCLUSION**
Image guide percutaneous biopsy of subsequent lesion is justified on the basis of the risk of being a second primary tumor, instead of assuming to be secondary to the known primary tumor.

**CLINICAL RELEVANCE/APPLICATION**
Considering the risk and distinguishing whether new lesions represents a metastasis or a second cancer is important in terms for treatment and prognosis.

**LL-VIS-TU2A • The Combined Effect of Hypertension and Type-2 Diabetes Mellitus on Aortic Stiffness and Brachial Endothelial Dysfunction: An Integrated Study with 3.0T MRI**

- Yan Shan (Presenter)
- Jiang Lin MD, PhD
- Pengju Xu
- Mengsu Zeng MD, PhD

**PURPOSE**
The purpose of this study was to investigate the combined effect of hypertension and type-2 diabetes mellitus (DM2) on aortic stiffness and endothelial dysfunction by using an integrated 3.0 T MRI approach.

**METHOD AND MATERIALS**
A total of 31 non-hypertensive DM2 patients (mean age 55.4±8.5 years; 19 male, 12 female) and 31 hypertensive DM2 patients (mean age 58.3±6.1 years; 18 male, 13 female) underwent noninvasive 3.0 T MRI. Aortic distensibility (AD), aortic arch pulse-wave velocity (PWV) and brachial artery flow-mediated dilation (FMD) were assessed. Independent-Samples t-test and the Mann-Whitney U test were used to compare variables between groups as appropriate, while the chi-squared test was used for categorial variables. Pearson correlation analysis was performed to determine the relationship between measured parameters and to analyse the association between measured parameters and blood pressure. Univariable and multiple linear regression was used to determine the independent predictors of the measured parameters.

**RESULTS**
Compared with the non-hypertensive patients, the hypertensive patient showed lower AD at multiple levels (ascending aorta (AA): 2.07±0.98×10^−3 mm Hg⁻¹ vs. 3.21±1.70×10^−3 mm Hg⁻¹, p=3 mm Hg⁻¹ vs. 3.58±1.47×10^−3 mm Hg⁻¹, p=3.58±1.47×10^−3 mm Hg⁻¹ vs. 4.27±1.75×10^−3 mm Hg⁻¹, p<0.05).

**CONCLUSION**
Hypertension has a contributive effect on aortic stiffness and endothelial dysfunction in DM2 patients. Direct quantification of both aortic stiffness and endothelial dysfunction using one-stop high-resolution MRI may help stratify cardiovascular risks in DM2 patients.

**CLINICAL RELEVANCE/APPLICATION**
Our results suggested that high-resolution MRI may help stratify cardiovascular risks in DM2 patient with direct quantification of both aortic stiffness and endothelial dysfunction.

**LL-VIS-TU3A • Percutaneous Catheter Drainage versus Needle Aspiration for Pyogenic Liver Abscess: A Meta Analysis**

- Zhihui Chang BMedSc, MMed (Presenter)
- Zhaoyu Liu
- Zaiming Lu MD
- Qiyong Guo MD

**PURPOSE**
To assess the effectiveness of Percutaneous catheter drainage (PCD) versus needle aspiration for patients with pyogenic liver abscess. This will be determined by the effects on treatment success rate, mortality rate and total hospital stay.

**METHOD AND MATERIALS**
MEDLINE, EMBASE, Cochrane library and some other databases, from January 1966 to March 2013, were searched for initial studies. We planned to include data from randomized controlled trials (RCTs) comparing the effectiveness of PCD and needle aspiration in the treatment of pyogenic liver abscess. Two authors independently extracted the data and assessed trial quality. Trialists were contacted to obtain missing information.

**RESULTS**
Two randomised clinical trials were eligible for inclusion in this review. Both trials compared PCD versus needle aspiration for pyogenic liver abscess. The trials included a total of 124 patients. There was no statistically significant difference between the two groups for treatment success rate (RR 1.14, 95% CI 0.98 to 1.32). The total hospital stay was about three days shorter (weighted mean difference (WMD), random effects -3 days, 95% CI -3.9 to -2.3) in the needle aspiration group compared with the PCD group. There was no mortality in both of the trials.
CONCLUSION
No significant differences were observed in treatment success rate and mortality rate between PCD and needle aspiration. Needle aspiration is associated with a significantly shorter hospital stay compared with the PCD. However, this cannot be recommended routinely based on the limited available evidence. More randomised clinical trials are needed to address these issues.

CLINICAL RELEVANCE/APPLICATION
Needle aspiration is probably as effective as percutaneous catheter drainage for the treatment of pyogenic liver abscess.

LL-VIE-TU4A • ECG Gated Thoracic Computed Tomography Angiography with Individualized Contrast Protocol: Effects on Radiation Dose and Image Quality
Charbel Saade MS (Presenter) ; Ali A Haydar MD, FRCR ; Fadi M El-Merhi MD ; Mukbil H Hourani MD

PURPOSE
To investigate a reduced contrast protocol and its effects on radiation dose and image quality during gated thoracic CTA.

METHOD AND MATERIALS
Gated thoracic CTA was performed in 100 patients with acute aortic syndrome using a 64 channel computed tomography scanner and a dual barrel contrast injector. Patients were subjected to equal numbers to one of two contrast regimens. Patient age and gender were equally distributed across both groups. Regimen A, the department's standard protocol, consisted of a caudocranial scan direction with 120 mL of contrast intravenously injected at a flow rate of 4.5 mL/s; Regimen B involved a caudocranial scan direction and a novel contrast formula based on measured patient cardiovascular dynamics, using 50 mL of saline at 4.5 mL/s. The mean cross-sectional opacity of nine anatomical segments within the thoracic aorta and two within thoracic veins were measured for each patient and arteriovenous contrast ratio (AVCR) calculated. Regimens were compared using Mann-Whitney U non-parametric statistics. Receiver operating characteristic (ROC) analysis and visual grading characteristic (VGC) was performed.

RESULTS
Mean vessel opacification in the segments of the ascending aorta, transverse, and descending aorta were up to 18% higher (p<0.05) in Regimen A. Caudocranial scan direction, reduced contrast volume, and injection timing based on vessel dynamics can significantly improve vessel opacification and visualisation, whilst reducing radiation dose.

CLINICAL RELEVANCE/APPLICATION
Matching contrast injection timing with vessel dynamics significantly improves vessel opacification, reduces contrast and radiation dose in the assessment of acute aortic syndrome.

LL-VIE-TU5A • Clinical Application of Lower Extremity Arterial CT Angiography Using a Low Concentration Contrast Agent (270 mg I/ml): A Preliminary Study
Xie Dexuan (Presenter) ; Zhang Jinling ; Xiao Xigang MD ; Jia Yulin MD

PURPOSE
To investigate the feasibility of lower extremity arterial CT angiography with a low concentration contrast agent (270 mg I/ml).

METHOD AND MATERIALS
5 patients with lower extremity atherosclerosis for treatment in vascular surgery were selected undergo CTA on an HDCT(Discovery CT750 HD, GE, USA). 100 to 130 ml of the 270 mg I/ml concentration contrast agent was injected intravenously with the flow rate of 3.5~4 ml/s, followed by 40 ml of saline. Scan started at 4s after the CT value in the popliteal artery reached the threshold of 100HU. Scanning parameters included 80kV, automatic tube current modulation, rotation time of 0.8s, pitch of 1.375:1. Images were reconstructed with 50%ASIR. A 3-point ranking scale was used to assess the image quality of the 21 anatomic segments with score of 3 considered as diagnostically acceptable. The vascular enhancement was assessed quantitatively by measuring the CT value in the regions of interest (ROIs) positioned within the vessel lumen.

RESULTS
100 of the 105 lower extremity artery segments were scored =2 for the evaluable rate of 95.23%. The average CT values for the abdominal aorta, iliac artery, femoral artery, popliteal artery and tibial artery was 406±23HU, 413±37HU, 379±56HU, 342±49HU, 296±73HU respectively.

CONCLUSION
It is feasible to achieve good image quality for lower extremity arterial CTA using 270mg I/ml contrast agent in combination with 80kV low dose scanning.

CLINICAL RELEVANCE/APPLICATION
The image quality for lower extremity arterial CTA using 270mg I/ml contrast agent is as good as the high concentrations one. It may be applied as a routine protocol for patients with PAOD.

LL-VIE-TU6A • Percutaneous Radiologic Placement of Continuous Ambulatory Peritoneal Dialysis (CAPD) Catheters: 'How to Do It'
Young Ho Kwon (Presenter) ; Se Hwan Kwon MD ; Joo Hyeong Oh MD

PURPOSE/AIM
To review the techniques of percutaneous radiologic placement of continuous ambulatory peritoneal dialysis (CAPD) catheters, potential complications, and management of complications associated with these catheters.

CONTENT ORGANIZATION
a. Introduction and background of CAPD
b. Type of CAPD catheters
c. Preprocedure evaluation (Anatomy, Indications and Contraindications)
d. Techniques of percutaneous radiologic placement of CAPD catheters
e. Postprocedure management
f. Complications and radiologic management

SUMMARY
This exhibit will review
a. The general concept of percutaneous radiologic placement of CAPD catheter
b. The technique of percutaneous radiologic placement of CAPD catheter
c. The complication and management of CAPD catheter

LL-VIE-TU7A • Sacroplasty: "A Remedy for Pains in the Butt?"?
Malay Bhatt (Presenter) ; Kalie Adler BS, DO ; Lisa A Strand RN ; Brandt C Wible MD *
The aim of this study was to evaluate immediate outcomes, late outcomes, and safety of bronchial and systemic artery embolization (BAE) for palliative treatment in a group of patients with advanced non-small-cell lung cancer (NSCLC) with hemoptysis.

**Purpose**

To evaluate diagnostic yields of percutaneous transluminal forceps biopsy in patients suspected of having a malignant biliary obstruction and evaluate predictive factors for false negative diagnosis.

**Method and Materials**

Two hundred forty three consecutive patients (151 men and 92 women; mean age, 61 years) with obstructive jaundice underwent transluminal forceps biopsy during or after percutaneous transhepatic biliary drainage. The lesions involved the common bile duct (n = 97), common hepatic duct (n = 60), hilum (n = 47), ampullary segment of the common bile duct (n = 29), right or left intrahepatic bile duct (n = 10). In each patient, three to five specimens (mean, 3.4 specimens) were taken from the lesion with 5.4-F biopsy forceps. The final diagnosis for each patient was confirmed with pathologic findings at surgery, additional histologic data, or clinical and radiologic follow-up. Multivariate logistic regression analysis was used to identify risk factors associated with false negative diagnosis.

**Results**

177 of 243 biopsies resulted in correct diagnoses of malignancy. 17 biopsy diagnoses proved to be true negative. There were 49 false-negative diagnoses and no false-positive diagnoses. The diagnostic performance of transluminal forceps biopsy in malignant biliary obstructions was as follows: sensitivity, 77.4%; specificity, 100%; and accuracy, 79%. Ampullary segment of common bile duct (odds ratio 4.355 95% CI 1.651-11.490, p=0.003) and non-mucosal tumor (odds ratio 2.386 95% CI 1.216-4.585, p=0.011) were the significant risk factors for false negative diagnosis. No major complications related to the biopsy procedures occurred.

**Conclusion**

Percutaneous transluminal forceps biopsy provides relatively high accuracy in the diagnosis of malignant biliary obstructions. The predictive factors for false negative biopsy were biopsy site and tumor origin.

**Clinical Relevance/Application**

Percutaneous transluminal forceps biopsy provides high accuracy in the diagnosis of malignant biliary obstructions.
METHOD AND MATERIALS
Between March 2009 and November 2012, BAE using gelatin sponge particles was performed in 28 consecutive patients with NSCLC. Sixteen patients had adenocarcinoma and 12 had squamous cell carcinoma. Three patients were classified as clinical stage IIB, five were Stage IIIA, 14 were Stage IIIB, and six were Stage IV, respectively. Hemothysis was defined as follows: acute massive bleeding greater than 300 mL within 24 h (n = 8), moderate bleeding of 100-300 mL within 24 h (n = 12), and slight bleeding less than 100 mL within 24 h (n = 8). A retrospective analysis of technical, immediate and late success rates was performed. Complications were also evaluated.

RESULTS
The technical success rate was 96%. Immediate clinical success within 24 h after BAE was achieved in 22 (81%) of 27 patients who underwent embolization. Hemothysis was observed in five of 27 patients after BAE. A small amount of hemothysis recurred within 14 days of embolization in two patients. Both immediate and late clinical success rates were achieved in 20 of 27 patients (74%). There were no major complications requiring further management, and eight (30%) minor complications occurred.

CONCLUSION
BAE with gelatin sponge particles can provide good management of hemothysis as a palliative treatment in patients with advanced NSCLC.

CLINICAL RELEVANCE/APPLICATION
BAE with gelatin sponge particles is a safe and effective palliative treatment for hemothysis in patients with advanced non-small-cell lung cancer for maintenance of quality of life.

LL-VIS-TU4B ● Renal Cryoablation: A New Paradigm for Nearly any Tumor Location
Hussein D Aoun MD (Presenter) ; Peter J Littrup MD * ; Barbara A Adam MSN ; Evan N Fletcher MS, BA ; Mark J Krycia BS

PURPOSE
To assess technical feasibility, efficacy and complication rates of CT guided percutaneous renal mass cryoablation in a large series on long term follow up.

METHOD AND MATERIALS
CT and/or CT-US fluoroscopic-guided percutaneous cryoablations were performed in 247 procedures on 262 tumors (210 RCC, 45 metastasis, 6 oncocytomas and 1 angiomylipoma) in 214 patients noting tumor size and location. Thirty-seven patients had multiple renal tumors ablated. Follow-up CT or MRI was utilized to assess efficacy and evaluate for local recurrences or new multicentric tumors. Hydrodissection with normal saline/ contrast (60:1) solution was performed to protect adjacent vital structures such as bowel, ureter or pancreas. Complications followed the grading system of the National Institutes of Health, Common Terminology of Complications and Adverse Events (CTCAE 4.0).

RESULTS
All the procedures were performed under conscious sedation and were virtually painless during and after the procedure. Average tumor and ablation size was 3cm and 5cm, respectively, with the largest 10.4cm. Hydrodissection was performed in 73 procedures. Major complication (only grade 3) rate attributable to the procedure was 2.4% (6/247). Of the major complications, 3 (3/5) were related to hemorrhage requiring transfusion (Grade 3). A ureteral stricture prior to ureteral stent placement for central tumors and bowel injury prior to protective hydrodissection techniques were observed early on in our experience. Median follow-up was 1.8 years with 72 patients having > 3 year follow-up and 36 patients having > 5 year follow-up. Local recurrence rate was 2% (6/262), with 4 technical failures and 2 tract recurrences. Of the local recurrences, 4 were re-ablated (2 tract and 2 technical) without residual disease on follow-up for a secondary efficacy of 99%.

CONCLUSION
Renal cryoablation has established low complication and local recurrence rates which do not appear to be significantly affected by tumor size or central location. CT guided percutaneous cryotherapy is a low cost and low morbidity alternative for patients with complex renal tumors.

CLINICAL RELEVANCE/APPLICATION
The rising cost of health care mandates consideration of renal cryoablation as a cost effective treatment option, justified by comparable low recurrence and complication rates for any renal location.

LL-VIS-TU5B ● Mid-term Outcomes of Type II Endoleak Embolization
Roy Y Yang MD (Presenter) ; Kongteng Tan FRCR ; Robert Beecroft MD ; Jeffrey D Jaskolka MD

PURPOSE
Type II endoleaks (T2EL) are common complications following EVAR. Persistent T2EL are potentially associated with late aneurysm rupture. Although embolization procedures are frequently used to treat persistent T2EL, there is a paucity of literature on its outcomes. This study aims to evaluate the effectiveness of embolization of T2EL and whether the embolization agent, approach to embolization, or endoleak configuration has an impact on its efficacy.

METHOD AND MATERIALS
A retrospective review of patients who underwent EVAR and subsequent T2EL embolization between 2003 and 2012 was performed. Embolization was performed via direct sac puncture or a transarterial approach with the goal of obliterating both the endoleak sac and feeding vessels. Embolization agents used include cyanoacrylate glue only (43%), glue and coils (31%), coils only (18%), and other agents (8%). Aneurysm volume was measured before and after embolization. Technical success, freedom from sac expansion and the incidence of recurrent T2EL were documented. Comparisons were made between the outcomes using different embolization agents, approach to embolization, and T2EL configurations.

RESULTS
A total of 29 patients (median age 76 years) underwent 42 embolization procedures. The median duration from EVAR to embolization was 16 months (95% CI 10−24 months), and the median follow-up was 11 months (95% CI 7-22 months). Immediate technical success of embolization was 91%. Freedom from aneurysm sac expansion was achieved in 96%, and freedom from T2EL (no enhancement of the aneurysm sac) was accomplished in 71%. There were no ruptured aneurysms during the follow-up period. No statistically significant difference was found in the outcomes between different embolic agents, the approach for embolization or the configuration of the endoleak.

CONCLUSION
Embolization of T2EL with cyanoacrylate glue is effective for the prevention of aneurysm sac growth in mid-term follow-up. The results are similar regardless of the embolization approach, the addition of coils or the T2EL configuration. Further studies are needed to determine the long-term outcomes in this group of patients.

CLINICAL RELEVANCE/APPLICATION
Persistent T2EL are associated with serious adverse outcomes, thus evaluation of the efficacy of existing treatments is needed to optimize outcome in this group of patients.

LL-VIE-TU6B ● Nuts and Bolts of Microwave Ablation
Meghan G Lubner MD (Presenter) ; Timothy J Ziemlewicz MD ; J. Louis Hinshaw MD * ; Fred T Lee MD * ; Christopher L Brace PhD * ; Marci Center
A conventional triaxial microwave antenna is able to generate relatively large, long ablation zones for treatment of larger tumors, whereas a modified triaxial antenna can produce a short, round ablation zone for treatment of tumors adjacent to vulnerable structures.

**LL-VIE1302-TUB • The Use of Contrast-enhanced Ultrasound (CEUS) in Vascular Diseases**

**Purpose/Aim**

Contrast-enhanced ultrasound (CEUS) is a novel imaging technique enabling patient studies at the bedside without any radiation exposure. The purpose of this educational exhibit is to demonstrate potential applications of contrast-enhanced ultrasound of vascular diseases.

**Content Organization**

- Introduction in contrast-enhanced ultrasound:
  a. Technical considerations including equipment
  b. Available and approved contrast agents for patient studies
  - CEUS in carotid artery diseases:
    a. Carotid atherosclerotic diseases and intraplaque neovascularization
    - CEUS in abdominal aortic diseases
    a. Abdominal aneurysms
  c. Follow-up after catheter based endovascular aortic repair (EVAR)
  d. Chronic periaortitis
  - CEUS in renal vascular diseases
  a. Renal infarction
  b. Renal vein thrombosis
  - CEUS in the skeletal muscle
  a. Quantitative CEUS for skeletal muscle microperfusion

**Summary**

CEUS is a promising and evolving imaging technique. It enables the superior visualization of the microvasculature and microvasculature in different vascular disorders. Both these features make CEUS an attractive approach for diagnosis and treatment monitoring of vascular diseases.

**LL-VIE2012-TUB • Prostate Artery Embolization: 'Shrinking Prostate Size...Not Sexual Drive'**

**Purpose/Aim**

Half of all men over the age of 60 will develop an enlarged prostate. 80% of men will experience benign prostatic hyperplasia (BPH) symptoms by the age of 80, but only 25% of men will be receiving BPH rx. Interventional radiology has been at the forefront of creating innovations in medicine, and prostatic artery embolization (PAE) is a novel therapy for patients suffering from BPH. We will review 15 journal articles discussing PAE and will summarize our findings to educate radiologists about a potential alternative rx for BPH. We will review the physiology and current medical/surgical rx for BPH and introduce the technique, indications, and complications of PAE.

**Content Organization**

1 Prostate and Vascular Anatomy
2 Natural Hx of BPH
3 Dx of BPH
4 Rx Options
5 PAE (Hx, Technique, Complications and economics)
6 Chart summarizing our PUBMED literature review: # patients in each study, prostate size pre/post PAE, follow-up time, number of meds prior to PAE, complications, International Prostate Symptom score (pre and post PAE), potential advantages
7 Take home messages

**Summary**

PAE is a novel therapy for patients suffering from BPH and currently, it is not well known to the public. Our purpose, in this educational exhibit, is to review the current literature and summarize the data in hopes of increasing awareness of this potentially game changing intervention.
LEARNING OBJECTIVES
1) To learn the latest results of ablation in primary and secondary lung tumours. 2) To understand how to use the different ablation technologies (RF, MW and cryotherapy). 3) To learn optimal patient selection for lung ablation. 4) To understand the imaging appearances following ablation. 5) To know how to diagnose and manage possible complications following ablation.

VSIO31-01 • Primary Lung Cancer
Robert D Suh MD (Presenter)

LEARNING OBJECTIVES
1) Discuss long term outcomes of image-guided ablation for early stage lung cancer. 2) Discuss local control rates of image-guided ablation for early stage lung cancer. 3) Understand the factors in image-guided ablation influencing survival and local control. 4) Understand treatment options and relative outcomes of image-guided ablation compared to alternative therapies for early stage lung cancer.

ABSTRACT
Thermal ablation is a safe therapeutic and effective option to provide local control for many lung malignancies. Thermal ablation confers survival benefits in carefully selected patients: RF ablation with encouraging mid- and long-term results. Microwave and cryoablation remain promising techniques, requiring future studies for validation.

VSIO31-02 • Colorectal Lung Metastases
Stephen B Solomon MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO31-03 • Sarcoma and Other Non-CR Lung Metastases
Jean Palussiere MD (Presenter)

LEARNING OBJECTIVES
View learning objective under main course title.

VSIO31-04 • Irreversible Electroporation of Lung Metastases: Initial Experience
Thierry J De Baere MD (Presenter) *; Julien Joskin; Antoine Hakime MD; Geoffroy Farouil; Lambros C Tselikas MD; Frederic Deschamps

PURPOSE
Because recurrence rate of lung RFA has been reported higher when tumor are in contact with large vessels we used Irreversible Electroporation (IRE) used to treat such located lung metastases and reported herein our initial experience

METHOD AND MATERIALS

RESULTS

CONCLUSION
IRE is well tolerated, induces a rapid decrease in size of the treated tumor but tumor regrowth is frequent within the first year of follow-up.

CLINICAL RELEVANCE/APPLICATION
IRE of lung metastases, although inducing rapid decrease of the tumor size does not prevent later growth of the tumor. Consequently, the technique must be improved before routine clinical use.

VSIO31-05 • What Does SBRT Contribute to the Management of Primary or Metastatic Lung Cancer?
Brian T Collins MD (Presenter) *

LEARNING OBJECTIVES
1) Review SBRT technology. 2) Review SBRT patient selection. 3) Discuss mature locoregional outcomes of SBRT for stage I NSCLC and pulmonary metastases. 4) Discuss mature survival outcomes of SBRT for stage I NSCLC and pulmonary metastases. 5) Review expected chronic toxicities of thoracic SBRT.

VSIO31-06 • Clinical Tumour Board
Robert D Suh MD (Presenter); Stephen B Solomon MD (Presenter) *; Brian T Collins MD (Presenter) *; Jean Palussiere MD (Presenter)

LEARNING OBJECTIVES
1) Understand case-based information. 2) Identify treatment strategies. 3) Evaluate thoracic interventional procedures.

VSIO31-07 • Interpretation of Follow-up Imaging
William H Moore MD (Presenter) *

LEARNING OBJECTIVES
1) Identify the findings on follow up imaging that are characteristic of post-ablation zones. 2) Identify the findings on follow up imaging that are characteristic of recurrence. 3) Compare the post ablation imaging findings between RFA, Microwave, Cryoablation and Nanoknife.

ABSTRACT

VSIO31-08 • Why, When and How I Perform RF Ablation of Lung Tumours
Jo-Anne O Shepard MD (Presenter) *

LEARNING OBJECTIVES
1) Understand multidisciplinary patient selection and describe the indications and contraindicatons to RFA of the lung. 2) Outline the RFA
LEARNING OBJECTIVES
1) Identify indications for MWA of lung tumors. 2) Identify procedure-related risk factors. 3) Learn about tips and tricks.

ABSTRACT
Thermal ablation techniques have increasingly expanded their role in minimal invasive destruction of tumor tissue beyond the liver, especially in the lung. Both primary and secondary lung cancers are currently of interest among thermal ablation techniques such as laser therapy, radiofrequency ablation, and others. With its introduction microwave ablation (MWA) has rapidly gained its role as a precise, excellently controllable ablation technique. In the following course different techniques of MWA of lung cancers will be presented. This includes techniques on the access, protocols for the ablation and preventive management of complications. Special focus is directed towards the daily management of risk factors at our institute in Frankfurt based on the up-to-date experience. In the second part the indications for thermal ablation among other technologies such as radiooncology, surgery and systemic chemo-immunotherapy will be presented. In summary, MWA of neoplastic diseases of the lung rapidly gains acceptance and provides excellent treatment results with a low rate of complications and side effects. Its current role among an armamentarium of other treatment techniques has to be searched for, documented, and expanded.

VSIO31-09 • Why, When and How I Perform Microwave Ablation of Lung Tumours

Thomas J Vogl MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Understand the different approaches and techniques for thorough cryoablation of lung tumors (e.g., the 1-2 Rule), emphasizing unique benefits for chest wall, pleural-based, central and para-esophageal locations. 2) Understand techniques to minimize morbidity, assessing tumor location and approach. 3) Identify major imaging follow-up criteria for ablation success and any early failures. 4) Describe the overall cost-efﬁcacy trade-offs for cryo vs. heat-based renal ablations vs. stereotactic body radiation therapy, in relation to tumor location, complications and recurrence rates.

ABSTRACT
Cryoablation of lung tumors offers a lower pain alternative than heat-based modalities, especially for pleural and/or chest wall locations. Central locations near major bronchi locations also have low rates of pneumothorax or broncho-pleural ﬁstulas, while paraesophageal locations are readily protected by esophageal warming balloons. Major cryoablation beneﬁts include its excellent visualization of ablation zone extent, low procedure pain and ﬁexible hydrodissection of chest wall ablation sites near skin. CT-guidance is the cryoablation guidance modality of choice due to circumferential visualization and ready availability. MR-guidance has little clinical beneﬁt or cost-efﬁcacy. For safety, cases will be considered for choosing the most avascular approach, extent of peri-bronchial contact and chest wall involvement. Imaging outcomes of complications and their avoidance will be shown. For optimal efﬁcacy, tumor size in relation to number and size of cryoprobes emphasize the 1-2 Rule of at least 1 cryoprobe per cm of tumor diameter and no further than 1 cm from tumor margin, as well as cryoprobe spacing of approximately 1 cm.

VSIO31-10 • Evaluation of a Combined Protocol of Microwave Ablation (MWA) and Transpulmonary Chemoembolization (TPCE) versus MWA Only Protocol: Treatment of Primary and Secondary Nonresectable Lung Tumours

Thomas J Vogl MD, PhD (Presenter); Thomas Dauda BS; Stefan Zangos MD; Emmanuel C Mbalisike MD; Nour-Eldin A Nour-Eldin MD, MSc

PURPOSE
To evaluate tumor response with volumetric assessment of tumor sizes after treating nonresectable primary and secondary lung tumors with transpulmonary chemoembolization (TPCE) combined with microwave ablation (MWA) versus MWA only protocol in palliative intention.

METHOD AND MATERIALS
Between 2007 and 2012, 23 patients (10 males, 13 females; average, 61.2 years; range, 29-83) suffering from nonresectable primary (n=3) and secondary lung tumors (n=20) were treated with TPCE (average, 4.3 sessions) followed by MWA. Another 13 patients (8 males, 5 females; average, 60.2 years; range, 28-83) suffering from nonresectable primary (n=2) and secondary lung tumors (n=11) were only treated with MWA. Patients treated with a combined therapy suffered from primary lung tumors (n=3) and metastases of different origins such as colorectal carcinomas (n=6), breast cancer (n=5), urothel carcinoma (n=3), and others (n=6). Patients treated only with MWA suffered from primary lung tumors (n=3) and metastases of different origins such as colorectal carcinomas (n=6), and others (n=5). Follow-up was between 4 months and 3.7 years for primary and secondary lung tumors.

RESULTS
All patients tolerated the combined treatment and the MWA only well and without adverse effects. The rate of spontaneously resolving pneumothoraces was 5.3% in the combined protocol and 4.1% in the MWA only protocol. According to the retrospective study data, in the combined treatment protocol complete response was documented in 30.4% (n=7) of lesions, while in 21.7% (n=5) stable disease was documented and in another 47.8% (n=11) a progressive disease situation. In the group of patients treated only with MWA (n=13), complete response was documented in 38.5% (n=5), stable disease in 7.7% (n=1) and progress in 53.8% (n=7).

CONCLUSION
According to the ﬁrst evaluated data the additional use of TPCE results in a slight improvement of the local response rate and a reduction of the rate of progression. Further prospective studies are, however, necessary.

CLINICAL RELEVANCE/APPLICATION
Transpulmonary chemoembolization (TPCE) and microwave ablation (MWA) are relevant palliative treatment options in patients with primary and secondary nonresectable lung tumors.

VSIO31-11 • Why, When and How I Perform Cryoablation of Lung Tumours

Peter J Littrup MD (Presenter) *

LEARNING OBJECTIVES
1) Understand the different approaches and techniques for thorough cryoablation of lung tumors (e.g., the 1-2 Rule), emphasizing unique beneﬁts for chest wall, pleural-based, central and para-esophageal locations. 2) Understand techniques to minimize morbidity, assessing tumor location and approach. 3) Identify major imaging follow-up criteria for ablation success and any early failures. 4) Describe the overall cost-efﬁcacy trade-offs for cryo vs. heat-based renal ablations vs. stereotactic body radiation therapy, in relation to tumor location, complications and recurrence rates.

ABSTRACT
Cryoablation of lung tumors offers a lower pain alternative than heat-based modalities, especially for pleural and/or chest wall locations. Central locations near major bronchi locations also have low rates of pneumothorax or broncho-pleural ﬁstulas, while paraesophageal locations are readily protected by esophageal warming balloons. Major cryoablation beneﬁts include its excellent visualization of ablation zone extent, low procedure pain and ﬂexible hydrodissection of chest wall ablation sites near skin. CT-guidance is the cryoablation guidance modality of choice due to circumferential visualization and ready availability. MR-guidance has little clinical beneﬁt or cost-efﬁcacy. For safety, cases will be considered for choosing the most avascular approach, extent of peri-bronchial contact and chest wall involvement. Imaging outcomes of complications and their avoidance will be shown. For optimal efﬁcacy, tumor size in relation to number and size of cryoprobes emphasize the 1-2 Rule of at least 1 cryoprobe per cm of tumor diameter and no further than 1 cm from tumor margin, as well as cryoprobe spacing of approximately 1 cm.

VSIO31-12 • Thoracic Cryoablation: A Major Beneﬁt for More Central and Chest Wall Locations?

Peter J Littrup MD (Presenter) *; Hussein D Aoun MD; Barbara A Adam MSN; Evan N Fletcher MS, BA; Mark J Krycia BS

PURPOSE
To assess recurrence factors for percutaneous thoracic cryoablation. Tumor and ablation size, complications, location and vessel proximity were assessed for patients with primary thoracic and metastatic tumors.

METHOD AND MATERIALS
CT and/or CT-US ﬂuoroscopic-guided percutaneous cryoablation was used in 222 procedures on 283 tumors (75 primary, 208 metastatic tumors) in 133 patients, noting tumor and ablation volumes, location, abutting vessels >3mm, recurrences, complications, and tumor type. Primary thoracic included all lung cancer types (n=70) and pleural tumors (n=5). Complications were graded by the National Institutes of Health, Common Terminology of Complications and Adverse Events (CTCAE). Hydrodissection and esophageal warming balloon were used for tissue separation as needed (20 and 9 respectively). A minimum of 2 cryoprobes were used on all patients and for larger tumors, tumor diameter plus one was used for probe number.
RESULTS
All patients required only conscious sedation. Overall tumor and ablation median size was 2.2 cm and 4.2 cm, respectively. Major complication rates were significantly lower in tumors = 3 cm as opposed to > 3 cm, 1.5% (2/134) vs. 11.8% (9/76) (p < 0.001).

CONCLUSION
CT-guided percutaneous cryoablation in the lung provides a low morbidity alternative for complex patients, particularly for pleural/ chest wall and more central tumors. Complication rates are significantly lower for tumors < 3 cm.

CLINICAL RELEVANCE/APPLICATION
Thoracic cryoablation is not affected by vessel proximity and produces low recurrence and complication rates. Cryoablation appears superior for central and chest wall locations.

VSIO31-13 • Complications of Lung Ablation, Preventing Them and When They Occur - Their Management
Kamran Ahrar MD (Presenter)

LEARNING OBJECTIVES
1) List potential complications of lung tumor ablation. 2) Outline steps to avoid potential complications. 3) Outline steps to manage complications.

VSIO31-14 • Evaluating Cryoablation of Metastatic Lung/Pleura Tumors in Patients - Safety and Efficacy (ECLIPSE)
David A Woodrum MD, PhD (Presenter); Thierry Debaere; Fereidoun G Abtin MD; Peter J Littrup MD *; Frederic Deschamps; Robert D Suh MD; Hussein D Aoun MD; Matthew R Callstrom MD, PhD *

PURPOSE
To evaluate safety and preliminary efficacy of CT guided lung cryoablation for lung metastases =3.5 cm in patients with pulmonary metastatic disease.

METHOD AND MATERIALS
Forty patients (24 males, 16 females; mean age 63 years) were enrolled in a prospective single arm study to evaluate CT guided lung cryoablation (Galil Medical, Arden Hills, MN) for patients with lung metastases. Inclusion criteria were up to 3 unilaterally or a maximum of 5 metastases bilaterally. Patients were followed with serial CT imaging at 1 week, 3, 6, and 12 months. The primary endpoint for the study is local tumor control assessed by a modified RECIST. Complications were assessed using the CTCAE 4.0.

RESULTS
A total of 62 tumors (40 patients) underwent 48 cryoablation procedures. The mean tumor size was 1.4 cm (range 0.3 to 3.2 cm), and 80% (n=32) of patients had unilateral disease. Sedation was general (67%; n=32), conscious/sedation in 31% (n=15), and 2% regional sedation (n=1). Treatment time ranged from 32-272 minutes (mean=101). Nine chest tubes (18%) were placed for pneumothorax but removed in 1 day or less. With the exception of three grade 3 events (non-cardiac chest pain, pneumothorax requiring VATS, and dialysis fistula thrombosis), all other reported adverse events (95.2%) were classified as CTCAE grade 1 or 2. The most common events (48 procedures) occurring within 30 days of the procedure were pneumothorax 50% (n=24), hemorrhage 8% (n=4). All resolved with minimal to no intervention. We did not encounter major hemorrhage to the lung or the pleura. At 3 months, 28 patients (75%) followed up with 100% response rate defined as either stable disease, partial response, or complete response. At 6 months, 15 patients (38%) followed up with a 95% response rate due to one patient having a local failure.

CONCLUSION
Cryoablation of metastatic lung tumors =3.5 cm appears to be safe. Our preliminary results demonstrate promising local tumor control within the lung.

CLINICAL RELEVANCE/APPLICATION
CT guided lung cryoablation demonstrates safety and preliminary efficacy in treating metastatic lung disease.

VSIO31-15 • Percutaneous Cryoablation in Management of Recurrent Mesothelioma after Surgical Pleurectomy and Decortication: Efficacy and Predictors of Local Recurrence
Fereidoun G Abtin MD (Presenter); Jesse K Sandberg MD; Robert D Suh MD; William Hsu PhD; James Sayre PhD; Robert Cameron MD

PURPOSE
Percutaneous cryoablation (PCT) is an ablative technique, used to manage recurrent mesothelioma in patients following surgical lung sparing decortication and pleurectomy. The purpose of this study was to evaluate the efficacy and clinical and ablation variables that are predictive of tumor recurrence following PCT.

METHOD AND MATERIALS
IRB obtained. From a database containing surgical and radiological information, patients with recurrent mesothelioma following lung sparing decortication and pleurectomy with at least one PCT were identified. Patients were followed after PCT using PET/CT or CT scans for at least 6 months. Clinical variables included: stage at diagnosis, chemotherapy, radiation, recurrence time lag following surgery, and number of lesions at time of recurrence presentation. PCT variables included: size of the lesion, edge of iceball beyond tumor, number of probes, size of probes, number of cryo cycles, maximum and total freeze and thaw time. A stepwise multiple logistic regression model was used to assess predictors of local recurrence following ablation; local recurrence determined by increased regional metabolic activity or increased size of post ablation zone.

RESULTS
17 patients were identified who underwent a total of 75 outpatient cryoablations (range of 1-25). Lesions measured a mean of 37 mm (range 14-113) by 22.0 mm (range 12-55) in diameter. At 6 months 68/75 (90.7%) ablations showed no recurrence. No major, but minor complications including hematoma, small pneumothorax and hemothorax in one patient each and erythema in 3 chest wall subcutaneous lesions (5/75 =6.6%). Late complications in 4/75 (5.3%) ablations. Considering the clinical and ablation variables, iceball beyond tumor edge less than 6.52 mm detected on CT scan during ablation was the only statistically significant predictor of recurrence (p < 0.05).

CONCLUSION
PCT can be used for management of recurrent mesothelioma following surgery with low recurrence rate of 9.3%, and limited early complications of 6.6%. When performing PCT, at least 6.52 mm of the edge of iceball is needed to extend beyond the edge of tumor to limit local recurrence.

CLINICAL RELEVANCE/APPLICATION
Percutaneous Cryoablation can be used in local control of recurrent mesothelioma after surgery with low recurrence rate and limited early complications.

VSIO31-16 • Can a Biopsy Performed after Lung Radiofrequency Ablation Be Contributive?
Lambros C Tselikas MD (Presenter); Julien Adam; Frederic Deschamps; Geoffroy Farouil; Julien Joskin; Christophe Teritteau; Antoine Hakime MD; Thierry J De Baere MD *

PURPOSE
To evaluate the effectiveness of a biopsy performed after lung radiofrequency ablation (RFA).

METHOD AND MATERIALS
Institutional review board approval was obtained. Eighteen patients with lung tumors, including 72% of metastases (14/18) (8 colorectal, 1 renal, 1 parathyroid, 1 melanoma, 1 osteosarcoma, 1 cholangiocarcinoma and 1 breast cancer) and 23% of primary lung cancers (1 lung cancer and 1 thymic cyst) were included. Biopsy was performed, 3 patients having 2 biopsies and 1 patient having 3 biopsies. The mean size of target tumors was 2.6 cm (range 0.8-4.2 cm) and mean size of lesions biopsied was 1.1 cm (range 0.5-2.5 cm). No complications were documented. All diagnostic biopsies were consistent with the histopathological diagnosis of the primary tumor presented. Thus, RFA followed by biopsy appears contributive in lung tumors.
RESULTS
Mean tumor size was 17.9 mm (SD: 1.5 mm) at CT immediately before RFA. 89% (16/18) of biopsies were able to diagnose malignancy. Cancer subtype and origin for malignant tumors was determined in 72% (13/18) of tumors. During one-year follow-up, 1 tumor demonstrated local progression (5.5%), 5 patients presented distant lung disease progression (33%) and 11 were lung disease free (61%). Thirteen complications occurred (72%), including 5 pneumothoraces requiring chest tube placement (27%), and 7 minor pneumothoraces without treatment (34%), and 1 intrapulmonary hemorrhage (5%) not requiring any specific treatment. No fatal complication occurred.

CONCLUSION
A biopsy performed after RFA of lung tumor can confirm malignancy in close to 90% of cases. This diagnosis is obtained without the need for additional puncture. Such post RFA biopsy avoids the need for immediately pre-RFA biopsy, which are at risk of alveolar hemorrhage, then blurring the tumor for subsequent targeting with RFA.

CLINICAL RELEVANCE/APPLICATION
Biopsy performed after RFA through the guiding canula has a high success rate, limits the number of transthoracic punctures, and preserves the best puncture path for RFA probe placement in lung tumor.

VSI031-17 • IR Tumour Board
William H Moore MD (Presenter) *; Jo-Anne O Shepard MD (Presenter) *; Thomas J Vogl MD, PhD (Presenter); Peter J Littנרup MD (Presenter) *; Kamran Ahrar MD (Presenter)

LEARNING OBJECTIVES
1) Understand case-based information. 2) Identify treatment strategies. 3) Evaluate interventional procedures.

Cardiac (Contrast I)

Tuesday, 03:00 PM - 04:00 PM • S502AB

SSJ04 • AMA PRA Category 1 Credit ™:1 • ARRT Category A+ Credit:1
Moderator
Bernd J Wintersperger, MD *
Moderator
E. Kent Yucel, MD
Moderator
Sri尼 Tridandapani, PhD, MD

SSJ04-01 • Effect of Reduced X-ray Tube Voltage, Low Iodine Concentration Contrast Medium and Iterative Reconstruction on Image Quality and Radiation Dose at Coronary CT Angiography: A Prospective Multicenter Study
Wei-Hua Yin (Presenter); Bin Lu; U. Joseph Schoepf MD *; Zhi-Hui Hou MD; Zhi-Qiang Wang; Yang Gao; Fang-Fang Yu; Hui-Li Cao

PURPOSE
To explore the effect of reduced (100 kVp) x-ray tube voltage, low iodine concentration (270 mgI/ml) contrast medium and iterative image reconstruction on image quality and radiation dose at coronary CT angiography (cCTA).

METHODOLOGY AND MATERIALS
With IRB approval, 123 consecutive symptomatic patients with suspected coronary artery disease were randomly assigned to one of two dual-source cCTA protocols: 120kVp, 370mgI/ml iopromide and filtered back projection reconstruction (n=62; 26 women; 54.1±9.5 years); or 100kVp, 270mgI/ml iodixanol and sinogram affirmed iterative reconstruction (n=61; 24 women; 55.5±10.4 years). Other scan parameters and the contrast injection protocol were held constant. Attenuation in the ascending aorta and coronary arteries along with other image parameters were measured. Effective dose was calculated based on volume CT dose index and dose length product. Data were compared using Student's t-test and χ².

RESULTS
All patient scans were successfully completed. There were no significant differences in patient body mass index (24.9kg/m²±3.4 vs 25.0kg/m²±2.9; p=0.800), contrast volume (68.4 ml±3.4 vs 68.5ml±6.2; p=0.880) and image quality scores (3.5±0.6 vs 3.4±0.6; p=0.265) between groups. Differences in mean attenuation between 100kVp (401.4HU±72.3) and 120kVp (403.0HU±78.1) protocols were not statistically significant (p=0.909). This was also true for image noise (17.3HU±3.7 vs 17.3HU±3.2; p=0.988), SNR (24.3±7.1 vs 23.9±5.9; p=0.710), and CNR (41.4±17.9 vs 36.2±20.0; p=0.136). Mean iodine dose was 27% lower with the 100kVp protocol than with 120kVp (25.3±9±1.2 vs 18.5±9±1.7; p<0.05).

CONCLUSION
Use of low x-ray tube voltage and iterative image reconstruction allows decreasing the iodine load and effective radiation dose at cCTA while image quality is maintained.

CLINICAL RELEVANCE/APPLICATION
Continuous reduction in radiation exposure and iodine load associated with cCTA should enhance the safety and clinical acceptance of this test.

SSJ04-02 • CT Coronary Angiography: Effect of Iodine CONcentration on Vascular Attenuation: The CT-CON Multicentric Study
Preliminary Results
Marco Rengo MD (Presenter); Anoeshka S Dharampal MD; Marco Das MD *; Marc C Kock MD; Andre Niezen; Fiek Van Tilborg; Damiano Caruso MD; Koen Nieman MD; Gabriel P Krestin MD, PhD *

PURPOSE
To explore the relative impacts of iodine concentration versus iodine delivery rate on intra-coronary attenuation. To describe the effect of iodine concentration on contrast bolus characteristics.

METHODOLOGY AND MATERIALS
675 patients were prospectively randomized in 4 groups and underwent CT Coronary Angiography (CTCA). Four CM with different iodine concentrations (300, 350, 370, 400 mgI/ml) were delivered at a fixed iodine delivery rate (2.0 mgI/s). Intracoronary attenuation values were measured and grouped on a per-vessel and per-segment bases. Time-to-peak, and pressure curves during CM injection were evaluated and compared.
RESULTS
Injection fluxes were 6.7 ml/sec, 5.7 ml/sec, 5.4 ml/sec and 5 ml/sec for group A, B, C and D respectively. No significant differences were observed among four groups in terms of intravascular density on a per-segment and per-vascular basis. Time-to-peak was significantly earlier in group A (15.3 sec) than in the other three groups. The injection peak pressure was significantly lower in group A (185.16 psi) and C (189.05 psi) than in group B (215.89 psi) and D (243.33 psi). No extravasations were noted in all groups.

CONCLUSION
Contrast media with different iodine concentrations, if injected at the same IDR, provide similar intravascular attenuation values. The lower concentration contrast medium provided significantly lower injection pressure values and a significantly shorter time to peak enhancement.

CLINICAL RELEVANCE/APPLICATION
Intravascular attenuation in CT coronary angiography is mainly influenced by iodine delivery rate and is independent by iodine concentration.

SSJ04-03 • Postmarketing Surveillance Study with Iodixanol (VISIPAQUE®) 270/320 mgI/ml Injection in 20,185 Chinese Patients in Routine Clinical Settings
Bin Lu MD (Presenter) ; Ya-Wei Xu ; Wei-Hua Yin ; Zhi-Hui Hou MD ; Yang Gao ; Fang-Fang Yu ; Bu-Chun Zhang ; Lei Hou

PURPOSE
This study was to investigate the incidence and nature of immediate and delayed adverse drug reactions (ADRs) as well as patient discomfort in patients using iodixanol.

METHOD AND MATERIALS
A multicenter, open-label, prospective, observational study was conducted at 95 centers in China from June 2011 to October 2012. Demographics, medical conditions, details of the diagnostic procedure, contrast agent administration and ADR data were collected using a standardized case report form. Patients were asked to report immediate (occurring within one hour of administration of iodixanol) or delayed (occurring from 1 hour up to 7 days after administration of iodixanol) adverse reactions. Discomfort was rated by patients on a scale of 0 to 10.

RESULTS
A total of 20,185 patients were enrolled. The mean age of this group was 60.4 years. Overall incidence of ADRs was 1.52% (307/20,185 patients), of which 0.58% was immediate, and 0.97% was delayed onset. Five patients experienced both immediate and delayed ADR. The most common immediate ADRs were nausea, vomiting, and other gastrointestinal disorders with an incidence of 0.22% (45/20,185 patients). The most common delayed ADRs were rash, pruritus, mucocutaneous rash and other skin and subcutaneous tissue disorders with a total incidence of 0.68% (138/20,185 patients). Serious ADRs occurred in two patients (0.01%). There were 73.3% (14,791/20,185) of patients in this study had no pain after injection of iodixanol, and 21.5% (4,338) reported a composite score of 1 (mild discomfort), 5.2% of 4 (moderate discomfort), 0.4% of 15 (severe discomfort).

CONCLUSION
There were no unexpected serious ADRs were observed. Patients' discomforts during administration were mild or absent. The results of this postmarketing surveillance study indicated that iodixanol was a safe contrast agent in Chinese population.

CLINICAL RELEVANCE/APPLICATION
Iodinated radiographic contrast media are considered as safe diagnostic drugs with a low incidence of adverse drug reactions.

SSJ04-04 • A Prospective Study of Low Concentration of Contrast Medium in Coronary CT Angiography with Low kVp Technique
Xu Li (Presenter) ; Liren Zhang MD ; Yanping Liu ; Dongsheng Xu

PURPOSE
To prospectively investigate the utility of low tube voltage to reduce contrast medium dose in coronary CT angiography (CCTA).

METHOD AND MATERIALS
90 consecutive patients (BMI < 28, 52 men, 38 women; mean age: 54.42 ± 8.64 years) suspected with cardiac disease were randomly divided to two groups. Group A (n=46) underwent conventional CCTA with 120kVp and normal contrast medium (Omnipaque, 350 mg/ml) dose at 0.8ml/kg on a LightSpeed VCT scanner, group B underwent modified CCTA with 100kVp and low contrast medium (Visipaque, 270 mg/ml) dose at 0.8ml/kg (n=44) on a Discovery CT 750 HD scanner. FBP image and 30% ASiR-FBP images were reconstructed for group A and B respectively. The CT value and SD value of aortic root (AO), left main coronary artery (LM), left anterior descending artery (LAD), left circumflex (LCX), and right coronary artery (RCA) were measured. Two radiologists assessed all images with 4-point scale. Data were analyzed using student T-test and Wilcoxon rank sum test by SPSS 13.0 statistical analysis software.

RESULTS
Both the mean ages and BMIs of two groups (age, 53.00 ± 8.39 vs 55.8 ± 8.47, P = 0.12; BMI, 24.44 ± 2.93 vs 24.16 ± 1.71, P = 0.58) had no significant difference. The mean ED in group B (0.87 ± 0.22mSv) was reduced by 44.9% than that in group A (1.58 ± 0.46mSv). The mean CNR of AO, LM, LAD, LCX, RCA were calculated. Two radiologists assessed all images with 4-point scale. Data were analyzed using student T-test and Wilcoxon rank sum test by SPSS 13.0 statistical analysis software.

CONCLUSION
The incidence of ADRs was summarized and discomfort score was converted to no, mild, moderate or severe discomfort and summarized.

SSJ04-05 • Initial Experience of Contrast Agent Dose Reduction with Low Tube Voltage and Adaptive Statistical Iterative Reconstruction (ASiR) in Coronary Computed Tomography Angiography
Hao Zhang (Presenter) ; Tong Zhang MD ; Bao-Zhong Shen

PURPOSE
To evaluate the feasibility of reducing both contrast and radiation doses using lower concentration contrast agent and a lower peak kilovoltage (kVp) with adaptive statistical iterative reconstruction (ASiR) in coronary computed tomography angiography (CCTA).

METHOD AND MATERIALS
100 patients with stable and low heart rates of (}

RESULTS
The mean CNR values for the 4 coronary arteries were 13.4 ± 3.2 in group A and 13.1 ± 3.2 in group B, with no difference (P > 0.05). There was also no difference between the two groups in image quality score (3.53 ± 0.58 vs. 3.48 ± 0.59, P > 0.05). The mean CNR values for the 4 coronary arteries were 13.4 ± 3.2 in group A and 13.1 ± 3.2 in group B, with no difference (P > 0.05).
CONCLUSION
33% contrast and 43% radiation dose reduction can be achieved by using 270mgI/ml concentration contrast agent and 80kVp tube voltage with 50%ASiR in CCTA without image quality deterioration.

CLINICAL RELEVANCE/APPLICATION
This coronary CTA method is suitable for patients with renal dysfunction, and can reduce the contrast-induced nephropathy and the potential carcinogenic of risk of coronary CTA.

SSJ04-06 • Novel Connecting Tube for Saline Chaser in Contrast-enhanced CT: The Effect of Spiral Flow of Saline on Contrast Enhancement

Masafumi Kidoh ; Takeshi Nakaura MD (Presenter) ; Kazuo Awai MD * ; Koji Yuba * ; Kazunori Harada ; Yasuyuki Yamashita MD * ; Takayuki Kobayashi MS ; Young-Kwang Park ; Takanobu Yagi

PURPOSE
We developed a new connecting tube for the saline chaser, which generates a spiral flow of saline. The purpose of this study was to evaluate the effect of a newly developed connecting tube on aortic and hepatic contrast enhancement during hepatic-arterial and portal venous phase (HAP, PVP)Computed Tomography.

METHOD AND MATERIALS
RESULTS

CONCLUSION
Our study demonstrated that the new connecting tube increased the effect of saline chaser and significantly improved aortic contrast enhancement during HAP.

CLINICAL RELEVANCE/APPLICATION
The new connecting tube increases the effect of saline chaser. The new connecting tube may further reduce the volume of contrast material without a subsequent decrease in arterial attenuation in CTA.

Neuroradiology (Neurointerventional Radiology)

Tuesday, 03:00 PM - 04:00 PM • N229

SSJ20 • AMA PRA Category 1 Credit ™:1 • ARRT Category A+ Credit:1
Moderator
Colin P Derdeyn, MD *
Moderator
Kristine Blackham, MD *

SSJ20-01 • Radiological Sinus Lift: A New Minimally Invasive CT-scan Guided Procedure to Maxillary Sinus Floor Elevation in Implant Dentistry

Jean-Francois Matern MD (Presenter) ; Francis P Veillon MD ; Thomas Bridonneau ; Jean Carvahlo MD ; Pierre Keller DMD, MSc

PURPOSE
Implant therapy has become an excellent treatment modality since its inception into the modern era of dentistry. However, when patients present with advanced atrophy of the maxilla ridge, the procedure of choice to restore the anatomic bone deficiency is surgical maxillary sinus floor elevation. The purpose of this study is to describe the CT-scan guided sinus lift technique and to prove the minimal invasive aspect of this new radiological procedure.

METHOD AND MATERIALS
For this prospective study, 17 cadaver heads were analyzed by cone beam CT (CBCT) and panoramic to response to our inclusion criterions (maxillary edentulous posterior sector and bone height inferior to 5mm). For each step, procedure was controlled by CT-scan and sinusual endoscopy. The radiological sinus lift technique consists of the following 4 stages: 1. Approach. A 14.5 G OstryCut needle was inserted mesial to the canine emergence and manually drilling was performed in parallel direction to the sinus floor. 2. Osteotomy. Inner obturator was introduced to compress bone and to create an osseous window opened to the submucosal space. 3. Lifting. The sinus lift was performed by hydrodissection with diluted iodinated contrast media agent. 4. Filing. The submucosal space filing was performed by injection of diluted collagen. A dome shape visualized in the maxillary alveolar recess defines the success of the radiological sinus lift procedure. All radiological maxillary sinus floor elevations were scanned postoperatively with panoramic and maxillary CBCT.

RESULTS
Twelve maxillary sinuses were included to radiological sinus floor elevation procedure. Dome shape of the Schneiderian membrane performed in 8 maxillary sinuses (66,7%). All failures (n=4) were caused by mucosal perforation at the time of maxillary sinus osteotomy. Mean elevated membrane height was 12.0mm for a mean intervention time of 45 minutes. Radiological exposures were 79.0 mGy.cm DLP and 22.8 mGy CTDIv.

CONCLUSION
The present experimental study reports a new minimally radiological procedure to maxillary sinus floor elevation. This study proposes a radiological interventional alternative to classic surgical approach with an equivalent success rate according to the literature.

CLINICAL RELEVANCE/APPLICATION
The radiological sinus lift will provide less tissue injury, a more physiological approach to more homogenous maxillary sinus membrane elevation and less failure over surgical procedure.

SSJ20-02 • Quantitative Evaluation of Acute Tumor Response Following Focused Ultrasound and Microbubble Treatment Using Dynamic Contrast Enhanced–computed Tomography

Hassaan Ahmed BSc (Presenter) ; Ting-Yim Lee MSc, PhD * ; Kullervo H Hynynen PhD ; Rajiv Chopra PhD *

PURPOSE
To quantitatively evaluate acute tumor response following focused ultrasound (FUS) and microbubble (MB) treatment using dynamic contrast-enhanced computed tomography (DCE-CT) in a rat glioma model.

METHOD AND MATERIALS
A stereotactic frame was used to surgically implant 1 x 10^6 C6 glioma cells in the right cerebral hemisphere of three rats. When the tumor occupied about 50% of the implanted hemisphere, it was trans-cranially sonicated with a 10ms burst length and a 1 Hz repetition frequencyfor 120s, at an acoustic power of 0.5W using a 0.563-MHz FUS system (FUS Instruments Inc., Canada). The sonications were guided by baseline axial CT images and the corresponding blood-brain-barrier (BBB) permeability surface area product (PS) and cerebral blood flow (CBF) maps calculated by CT Perfusion (GE Healthcare). A region in the contralateral hemisphere was also sonicated 5 minutes following the tumor sonication to confirm the targeted axial slice. Definity (Lantheus Medical Imaging, USA) microbubbles at a dose of 20
RESULTS
The tumor BBB PS at 150 minutes post sonication (2.7 +/- 1.3 ml/min/100g) was significantly lower (p < 0.05) than at baseline (5.7 +/- 1.7 ml/min/100g), but that at 15 minute post (6.0 +/- 1.8 ml/min/100g) was similar to baseline. The tumor CBF indicated a decreasing trend immediately following sonication, and returned to baseline levels at around 150 minutes post sonication.

CONCLUSION
A decreasing BBB PS following FUS and MB treatment over the tumor region, as opposed to the transient 3-4 times increase that is observed over healthy tissue, was a surprising result. The trend of an acute drop in CBF following sonication suggests that the tumor may undergo vasoconstriction following treatment. Although FUS and MB treatment in a tumor may not be beneficial for increased drug delivery, our preliminary results suggest that perhaps it could be used to disrupt or destroy tumor vasculature as a form of treatment.

CLINICAL RELEVANCE/APPLICATION
FUS and MB treatment have been shown to increase drug delivery over healthy and brain tumor regions, but our results suggest it may also be used to disrupt or potentially destroy tumor vasculature.

SSJ20-03 • Uncertainty and Discordance in the Management of Unruptured Intracranial Aneurysms
Sara Jamali MD (Presenter) ; Tim E Darsaut MD ; Max Findlay MD ; Jean Raymond MD

PURPOSE
The management of Unruptured Intracranial Aneurysms (UIAs) remains controversial. The goal of this study was to evaluate the clinical community agreement in decision making regarding UIAs.

METHOD AND MATERIALS
A portfolio of 41 cases of UIAs with angiographic images, along with a short description of the patient presentation, was sent to 28, mainly Canadian, clinicians with various years of experience in the management of UIAs (15 radiologists and 13 surgeons). Five clinicians responded twice at least 3 months apart. Nineteen cases were selected from patients recruited in a randomized trial comparing coiling and clipping, the Cures trial. For each case, the responder was to choose between 3 treatment options (observation, surgical clipping, or endovascular coiling) and indicate their level of certainty on a quantitative scale. The variability was studied using k statistics from 0 to 1, 0 meaning no agreement, 1 perfect and 0.6 substantial agreement.

RESULTS
Decisions to coil were more frequent (612 or 53%) than decisions to clip (289 or 25%) or to observe (259 or 22%). Inter-judge agreement was only fair (k = 0.31 +/- 0.02) for all cases and all judges, despite the fact that intra-judge agreements were substantial (between 0.44 and 0.83 +/- 0.1) and mean certainty levels high for each case (from 6.5 to 9.4 +/- 2.0 on a scale of 10). Agreement was no better within specialties (surgeons or radiologists), within groups proficient in endovascular coiling, surgical clipping or both, or within strata of years of experience. There was no link between certainty levels and years of experience. Agreement was lower (k = 0.18 +/- 0.2) in cases selected from the randomized trial than others (0.35 +/- 0.2).

CONCLUSION
There is poor agreement in decisions regarding the management of UIAs, even between individuals sharing a similar experience or the same specialty. In the absence of reliable evidence decision making is variable.

CLINICAL RELEVANCE/APPLICATION
Decision making can perhaps be improved by concerted efforts to provide reliable evidence.

SSJ20-04 • MR Imaging in Intracranial Aneurysms Treated by Intra-aneurismal Flow Disrupter: the LUNA™ Aneurysm Embolization System (AES)
Elisa Pomero (Presenter) ; Arnaud Flores ; Célia Billion Grand ; Francoise Cattin ; Alessandra Biondi MD *

PURPOSE
New devices in the treatment of intracranial aneurysms include intra-aneurysmal flow disrupters. The MR imaging of these new devices has not been reported. The purpose of our study is to report MR findings in a consecutive series of patients treated with the LUNA™ Aneurysm Embolization System, a new intra-aneurysmal self-expandable, round-ovoid flow disrupter implant.

METHOD AND MATERIALS
A total of 12 unruptured aneurysms were treated in 12 patients. Ten lesions were located in the anterior circulation and 2 lesions were in the posterior circulation. In addition, all patients underwent 24 hours DSA control and 24-48 hours MR study including evaluation of silent lesions. Three months MR FU was available in all patients and 1 year MR FU in 11. MR studies were performed on a 3tesla MR unit. Our MR protocol included DWI, T2WI FLAIR, coronal TIWI, axial PDWI, axial T2WI, Angio-MR 3D-TOF. In all patients, 1 year MR FU included also Enhanced 3D Velocity with Gadolinium injection. Follow-up included Digital Subtraction Angiography (DSA) at 6 and 12 months. Results were compared with the angiographic findings.

RESULTS
Immediate angiographic occlusion was achieved in 3 cases, near complete in 3 and incomplete occlusion in 6. The LUNA™ device presents a marked signal void in all sequence. Evaluation of aneurysm occlusion on MR images without contrast injection showed a good correlation with angiographic findings in 80% of cases. The thrombosed aneurysm sac was evident on PDWI and T2WI sequences. In patients with an angiographically thrombosed aneurysm, T1 WIs showed a hyperintense halo in 91% of cases corresponding to the thrombosed space between the device and the aneurysm wall. A crescent moon sign due to the device shape and related to persistent flow at the base of the aneurysm was seen in TOF sequences. Residual or recurrent aneurysm (20 %) could be visualized on the MR study only after contrast injection suggesting that LUNA™ device masks the slow flow signal.

CONCLUSION
Although DSA FU is mandatory, preliminary results suggest that contrast enhanced MRI is an efficient tool in assessing the occlusion of the aneurysms treated by the LUNA™.

CLINICAL RELEVANCE/APPLICATION
To our knowledge, there are no MR studies specifically dealing with intra-aneurysmal flow disrupter devices. We report our experience in MRI and DSA correlation in patients treated with LUNA™.

SSJ20-05 • Ethanol and/or Radiofrequency Ablation: Efficacy and Safety for Treatment of Venolymphatic Malformation Manifested as a Bulging Mass in the Head and Neck
Hyun Jung Koo MD (Presenter) ; Jeong Hyun Lee MD, PhD ; Ragyoung Yoon ; So Hyun Cho MD ; Young Jun Choi MD ; Jung Hwan Baek ; Seung-Ho Choi ; Soon Yuhl Nam ; Sang Yoon Kim ; Dae Chul Suh

PURPOSE
To evaluated the efficacy and safety of ethanol and/or radiofrequency ablation of venolymphatic malformation (VLM) manifested as a bulging mass in the head and neck.

METHOD AND MATERIALS
From July 2009 to February 2013, thirteen patients (F : M = 7 : 4; a mean age of 26, ranging from 5 to 48 years) with VLM presented as
a bulging mass in the head and neck were treated with ethanol ablation (EA) and/or radiofrequency ablation (RFA). Treatment response was assessed by the degree of volume reduction and cosmetic grading scores (1–4) which was recorded before and at the last follow-up. Volume reduction was compared with the characteristics of the target lesions including component (venous, macrocystic lymphatic, and micrrocystic lymphatic), the initial volume and the presence of any functional structure close to the treated lesions. Complication after EA and/or RFA was also evaluated.

RESULTS
Five patients with macrocystic lymphatic malformation (MLM) were treated with EA, 4 with venous malformation (VM) with RFA, and 4 with microcystic lymphatic malformation (mLM) with RFA (n=2) or both EA and RFA (n=2). Median number of total treatment sessions was 1 ranging from 1–4. Volume reduction at the last follow-up was near complete (> 90%) in all five patients with MLM, three of four with VM, and one of four with mLM. Moderate response (> 50% and <90%) was seen in VM (n=1) or mLM close to the mandibular branch of the facial nerve (n=3) showed moderate response. The mean cosmetic grading score was decreased from 3.8 ± 0.4 to 1.5 ± 0.8 (p < 0.05). The initial volume was not significantly correlated with number of treatment session or treatment response. No major complications were encountered.

CONCLUSION
EA and/or RFA is an effective and safe treatment method for VLM presented as a bulging mass in the head and neck, which showed > 90% of volume reduction in 9 of 13 patients and significant cosmetic improvement in all patients regardless of the internal component, the initial volume or the presence of any functional structures close to the treated lesions.

CLINICAL RELEVANCE/APPLICATION
EA and/or RFA can be one of treatment methods to manage VLM in the head and neck, with providing excellent cosmetic outcome.

SSJ20-06 • An Assembled Prototype Multi-material 3D Printed Model of the Neck for CT and Ultrasound-guided Interventional Procedures

Ramin Javan MD (Presenter)

PURPOSE
The aim of this project was to design a prototype semi-realistic multi-material model of the neck for CT and ultrasound-guided interventions.

METHOD AND MATERIALS
Autodesk 3D Studio Max, MeshLab, OsirIX and Materialise Mimics software were used to three-dimensionally reconstruct a multitude of virtual 3D models, including the cervical spine vertebral column, cervical spinal cord, trachea, thyroid gland, internal jugular vein and carotid arteries. A variety of rapid prototyping techniques and materials were used to 3D print the elements of the final assembled model using commercially available services. A gypsum-based model of the cervical spine that contains the cervical portion of the spinal cord and its respective nerve roots extending outside the neuroforamina. The trachea was made with polyamide material and also serves as the assembly reference point of the entire model with struts as support apparatus. The hollow vessels were created with tango-black rubber-like flexible material. A thyroid gland mold was made with polyamide. The thyroid gland itself is composed of ballistic-grade gelatin mixed with psyllium to simulate echotexture and with calcium chloride to simulate iodine content. It contains masses of high or low density/echogenicity, which are made by injecting sodium alginate solution with or without hydrogel particles into calcium chloride solution. Level II lymph nodes and parotid glands, which are made the same way as the thyroid masses, are mounted on struts emanating from the trachea. The assembled model was submerged in a container filled with high-concentration gelatin/pectin, which was allowed to congeal in cold temperature, simulating soft tissues of the neck.

RESULTS
The cervical spine is radiodense due to high calcium content of the gypsum, which can be used to practice cervical spine pain management interventions. The rubber-like vessel walls allow for passage of needles simulating vascular access. The thyroid nodules and lymph nodes can be used for practicing fine-needle aspirations. The model is designed to be both CT and ultrasound compatible.

CONCLUSION
A prototype dual-modality interventional phantom of the neck was successfully developed using 3D printing and molding techniques with a multitude of materials.

CLINICAL RELEVANCE/APPLICATION
This neck model can be used for practicing CT and ultrasound-guided procedures and also serve as a prototype for developing more complex 3D printed models.
was 2.0±0.7.
In the in vivo setting reperfusion was successfully performed in 5 renal arteries. In one case a stent strut was placed in front of the right ostium, so fenestration was possible only after introducing a Roch-Uchida needle. In the successful procedures, fenestration time was 8.4±9.2 min (catheter introduction to successful fenestration), stent placement time (catheter introduction to securing the branch with stent) was 32.0±27.1 min and average total stent-placement (aortic stent graft placement to placement renal stent) was 93.2±51.9 min. Problems delaying stent placement were attributable to the prototypical nature of the material (e.g. uncoated navigated guidewires, malfunctioning navigation coils).

CONCLUSION
Although the overall procedure times are currently not within acceptable ranges for renal ischemia time, the completion rates and short fenestration times warrant further development of the proposed procedure.

CLINICAL RELEVANCE/APPLICATION
Though EVAR is a valuable alternative to surgery nowadays it is still not suitable for emergency cases especially when side branches are involved. Our approach may allow EVAR even in those cases.

**SSJ26-02 • Abdominal Aortic Aneurysm Follow-up after Endovascular Repair by Non-invasive Vascular Elastography: Feasibility in a Canine Model**

**Elie Salloum** MSc, BEng (Presenter); **Antony Bertrand-Grenier**; **Sophie Lerouge**; **Claude Kauffmann PhD**; **Guy Cloutier PhD**; **Gilles P Soulez** MD *

**PURPOSE**
Non-invasive vascular elastography (NIVE) is a new ultrasonic technique enabling the measurement of tissue deformation. We aim to apply and optimize elastography of abdominal aortic aneurysm (AAA) after endovascular aneurysm repair (EVAR) with stent-graft (SG) in a canine model to detect endoleaks and characterize thrombus organization.

**METHOD AND MATERIALS**
SGs were implanted in a first group of 3 dogs with an aneurysm created in iliac arteries (6 aneurysms) and in a second group of 3 dogs in abdominal aorta. Type I endoleak was created in 6 iliac and 1 aortic aneurysms and type II in two aortic aneurysms. DUS (SuperSonic Imaging) and elastography examinations (Sonix RP, Ultrasonix) were performed at baseline, 1 week, 1 month, 3 month (first group) and 6 month (second group) follow-up. Angiography, CT-scan and histology were also performed at sacrifice. Ultrasonic raw radio frequency data were acquired on longitudinal and three axial planes (proximal, mid and distal part of the aneurysm) in order to generate time-varying strain images. Elastograms of zone of interest were computed using the Lagrangian Speckle Model Estimator (LSME). Area of endoleak, liquid thrombus (non-organized) and solid thrombus (organized) were identified and segmented by comparing the results of CT scan and histology. Strain values in area with endoleak, liquid and solid thrombus were compared.

**RESULTS**
Five iliac and one aortic aneurysms had type I endoleaks. A type II endoleak was observed in two aortic aneurysms whereas one iliac aneurysm was sealed. Maximal axial strain values in endoleak, liquid and solid thrombus areas were respectively estimated at 0.73 ± 0.14 %, 0.22 ± 0.035 %, 0.11 ± 0.035 %. Strain values were significantly different between endoleak and liquid or solid thrombus areas (p = 5.136E-09) and between solid and liquid thrombus areas (p = 0.00063). All endoleak areas were clearly identified on elastography examinations using axial or shear strain parameters.

**CONCLUSION**
The results show that NIVE is capable of detecting endoleak and characterize thrombus organization. Further development is needed to enable real time elastograms optimized for AAA follow-up after EVAR.

**CLINICAL RELEVANCE/APPLICATION**
NIVE is a new technique that could reduce the cost and the exposition to ionizing radiation and contrast agents of follow up of AAA after EVAR. It also has a potential to evaluate thrombus organization.

**SSJ26-03 • Abdominal Aortic Aneurysm Follow-up by Dynamic Elastography after Endovascular Repair**

**Antony Bertrand-Grenier** (Presenter); **Elie Salloum** MSc, BEng; **Sophie Lerouge**; **Claude Kauffmann PhD**; **Guy Cloutier PhD**; **Gilles P Soulez** MD *

**PURPOSE**
Supersonic Shear Wave Imaging (SSWI) measure the tissue elasticity in real-time. Our goal is to characterize the mechanical properties of abdominal aortic aneurysm (AAA) after endovascular aneurysm repair (EVAR) in a canine model (endoleaks, thrombus, walls) and correlate results with CT-Scan, Doppler Ultrasound (DUS) and pathologic findings.

**METHOD AND MATERIALS**
Stent Grafts (SGs) were implanted in 2 groups of dogs after creation of aortic or iliac aneurysms. The first group of 3 dogs (6 iliac arteries) had creation of type I endoleak and the second group of 3 dogs (3 aortic arteries) had creation of type I or type II endoleaks. DUS and elastography examinations (SSWI) were performed at implantation, 1 week, 1 month, 3 months (groups 1 and 2) and 6 months (group 2). Angiography, CT-scan and histology were also performed at sacrifice to evaluate the presence, the size and the type of endoleak, liquid thrombus (non-organized) and solid thrombus (organized) were identified and segmented by comparing histology to others technics. Elasticity moduli values in area with endoleak, liquid thrombus and solid thrombus were compared on longitudinal and three axial planes (proximal, mid and distal part of the aneurysm).

**RESULTS**
Five iliac and one aortic aneurysms had type I endoleaks and one iliac and two aortic aneurysms had type II endoleaks. Elasticity moduli of 0.20 ± 0.30 kPa has been found in endoleak regions, 63.40 ± 66.28 kPa in solid thrombus and 2.97 ± 1.96 kPa liquid thrombus. Elasticity moduli values were significantly different between endoleak and solid thrombus areas (p = 0.0002), endoleak and liquid thrombus areas (p = 0.0009) and liquid thrombus and solid thrombus areas (p = 0.0003). All endoleak areas were clearly identified and significantly different of solid thrombus areas. Dynamic elastography detected endoleaks in which DUS failed (n = 3) and detected liquid thrombus (*possibility associated with type V endoleak).

**CONCLUSION**
The results show that SSWI is able to detect endoleaks and characterize thrombus organization. The next objective is to evaluate in a phase II clinical study the feasibility and efficacy this approach.

**CLINICAL RELEVANCE/APPLICATION**
SSWI has the potential to evaluate thrombus organization, detect endoleaks and possibly endotension, reducing the cost, the exposition to radiation and contrast agents of follow up of AAA post-EVAR.

**SSJ26-04 • Acute Limited Intimal Tears of the Aorta Diagnosed with ECG-gated CT Angiography: A 4-Year Single Center Experience**

**Anne S Chin** MD (Presenter); **D. Craig Miller**; **Gerry Berry**; **Dominik Fleischmann** MD *

**PURPOSE**
Limited intimal tears (LIT) of the aorta presenting as acute aortic syndrome (AAS) are notoriously difficult to diagnose prospectively, reported to elude all cross-sectional imaging techniques. Although this entity has been included in the AHA classification of aortic dissection (class 3), this entity is thought to be rare and remains largely unknown to radiologists. We have observed his lesion at our...
METHOD AND MATERIALS

All CTAs from Jan 1, 2009, Dec 31, 2012 in patients presenting to our institution for AAS were retrospectively reviewed. LITs were diagnosed on CTA according to AHA and Svensson's original surgical description as subtle aortic wall contour bulges, without frank dissection. The presence and extent of associated intramural hematoma (IMH), and any other lesion descriptors were also noted. Various post-processing techniques were also performed in an attempt to increase lesion conspicuity and diagnostic confidence. Exam review was performed by two cardiovascular radiologists with 8 and 20 years’ experience in CV imaging. The number of missed cases were noted.

RESULTS

196 patients were diagnosed with AAS between Jan 2009-Dec 2012. The incidence of LIT was 8.1% (16 LITs, 115 classic dissection, 49 IMH, 11 penetrating atherosclerotic ulcer, and 5 rupturing aortic aneurysm). Of the 16 acute LITs, 14 were type A (ascending aorta involvement), and 2 were type B (one arch, one descending aorta). Of the nine patients who underwent urgent surgical repair, there was 100% concordance with CTA diagnosis. All type-A lesions were diagnosed prospectively, and only one type B LIT was missed on initial review.

CONCLUSION

Accurately and consistent detection of limited aortic tears is possible with ECG-gated CTA, although awareness of this lesion and meticulous review of the datasets is requisite; additional post-processing increases lesion conspicuity. To the best of our knowledge, this is a first report of the ability of CTA to detect LITs as well as the first to identify type B LIT lesions.

CLINICAL RELEVANCE/APPLICATION

Timely detection of acute limited intimal tears is critical for patient management, and can be accurately performed with ECG-gated CTA.

SSJ26-05  •  Study of Relation between 320 Multidetector CT Renal Perfusion and the Size, Number and Position of Intimal Entries of Aortic Dissection Patients

Dongting Liu (Presenter) ; Zhaoqi Zhang ; Jiayi Liu ; Zhanming Fan

PURPOSE

To investigate the characteristic of renal perfusion in aortic dissection patients using 320 multidetector CT and to access its clinical value.

METHOD AND MATERIALS

RESULTS

The size, number and position of intimal entries can influence renal perfusion of patients with aortic dissection.

CLINICAL RELEVANCE/APPLICATION

MDCT is convenient to assess renal perfusion in aortic dissection patients. Perfusion imaging is helpful to make adequate preparations before the operation. It has important clinical significance.

SSJ26-06  •  CT Assessment of Pattern and Presence of Intimal Defect in Aortic Intramural Hematoma

Clement Proust (Presenter) ; Jean Laurent Lamboley ; Loic Boussel MD ; Philippe C Douek MD, PhD ; Didier Revel MD *

PURPOSE

In patients presenting with an acute aortic intramural hematoma (IMH) the detection of an associated intimal defect is important for patient treatment and prognosis. The purpose of this study was to investigate the prevalence of intimal rupture detected by multidetector computed tomography (MDCT) in patients with IMH.

METHOD AND MATERIALS

RESULTS

An intimal defect was found in 30 patients (81% of the patients). ULP was the most frequent pattern (15 cases, 50%). Intimal tear was found in 13 (43,3%) patients. ULP was more frequent in IMH involving the descending that the ascending aorta (71,4% vs 31,25%, p<0.05).

CONCLUSION

MDCT showed an intimal defect in up to 80% of the patients presenting with an acute IMH with a pattern depending on aortic IMH location.

CLINICAL RELEVANCE/APPLICATION

In patients presenting with an acute IMH, MDCT allows to detect different pattern of intimal defect.

Vascular/Interventional (CTA: Dose and Contrast Reduction)

Tuesday, 03:00 PM - 04:00 PM  •  N230

SSJ27  •  AMA PRA Category 1 Credit ™:1  •  ARRT Category A+ Credit:1

Moderator

Dominik Fleischmann , MD *

Geoffrey D Rubin , MD *

SSJ27-01  •  The Combination of Spectral CT Imaging and Low Concentration of Contrast Media (Iodixanol 270mgI/ml) Used in Abdominal CTA

Dandan Shao (Presenter) ; Xuexue Wang ; Ying Yu ; Xu Xu ; Lun Lu ; Ping Yang ; Yongbo Yang ; Xingan Long ; Dong Chen ; Na Gao ; Hong-Yan Cheng

PURPOSE

To evaluate the image quality and diagnostic value of using spectral CT imaging and iodixanol 270mgI/ml in abdominal CTA.

METHOD AND MATERIALS

Thirty eight patients (BMI=25) with hepatic tumors, all of which intended to take surgical operation in our hospital, underwent bi-phase hepatic CT scan (Discovery CT750 HD,GE Healthcare). This study was approved by our institutional ethics committee. Half patients underwent spectral imaging and the other half underwent conventional CT scan. By GSI viewer software, optimal keV images were obtained directly. The CTA scan was triggered by SmartPrep software at the threshold of 100HU. Two CTA protocols (group A: n=19,
80/140kVp fast switching, 60%/FBP+40%/ASiR, injection volume of 1.2ml/kg, injection speed of 3.5ml/s, iodixanol 270mgI/ml; group B: n=19, 120 kVp, FBP, injection volume of 1.2ml/kg, injection speed of 3.5ml/s, IOHEXOL 350mgI/ml) were compared. The image quality parameters [the density of vessels, more distal branches; CT value, contrast-to-noise ratio (CNR) and signal-to-noise ratio (SNR)] were evaluated. Use 5-points scale to evaluate the image quality by 2 experienced radiologists individually and blinded (5 for the best, 1 for the worst, 3 for acceptable image quality).

RESULTS

There was no statistical difference for subjective scores, mean SNR and mean CNR in the abdominal arteries between the two groups (4.05±0.52, 34.54±5.33, 23.06±4.52 for group A and 4.11±0.46, 33.64±4.89, 23.89±3.85 for group B, respectively, p>0.05). Higher mean CT values were obtained in group B (284.1±37.81HU) than in group A (242.41±50.86HU). The iodine density for group A (15.89 mGy and 0.24mSv) were significantly lower than those in group B (28.25mGy and 0.42mSv), (both p<0.05).

CONCLUSION

Injecting Contrast Media with Reduced Iodine Concentration at Higher Speed Results in Improved and Prolonged Arterial Enhancement in CT Angiography

Toon Van Cauteren MSc (Presenter); Gert Van Gompel PhD; Nico Buls DSc, PhD *; Koenraad H Nieboer MD *; Inneke Willekens MD; Guy Verfaillie PhD, MD; Daniel Jacobs Tulleneers Thewissem MD; Johan De Mey *

PURPOSE

To assess the impact of contrast media concentration on the height and length of arterial enhancement at constant iodine dose delivery rate (IDR) and total iodine dose (TID).

METHOD AND MATERIALS

Iodine concentration had a significant effect: the injection of lower concentrations at higher speed was associated with increased enhancement. Compared to 370 mg I/ml, all concentrations equal and below to 270 mg I/ml resulted in both a broader and higher arterial peak (all p values<0.02). The iodine density increased from 7.3 ± 4.0 s at 370 mg I/ml up to 15.8 ± 4.0 s at 120 mg I/ml, whereas CTmax increased from 237 ± 33 HU to 271 ± 20 HU, respectively. Despite higher injection speed, only a marginal increase in injection pressure was observed for lower iodine concentrations due to their reduced viscosity.

RESULTS

Despite equal IDR and TID, injecting a reduced contrast media concentration at higher speed results in a higher arterial peak enhancement and improved time window above 200 HU compared to the administration of a high contrast media concentration at lower speed.

CLINICAL RELEVANCE/APPLICATION

At equal iodine burden, reduced contrast media concentration improves image quality and relaxes the timing of the acquisition in CT angiography studies.

SSJ27-03 • Image Quality of Whole Aortic Angiography with Low Contrast Flow Rate and Dual-energy CT Non-linear Blending Technique

Jie Liu (Presenter); Jianbo Gao MD

PURPOSE

To investigate the image quality of thoracoabdominal aortic angiography with a low contrast medium flow rate and DECT non-linear blending technique.

METHOD AND MATERIALS

Twenty patients with suspected aortic dissection were referred to whole aortic angiography. All patients underwent DECT angiography on a 128-slice dual-source CT with 64 * 0.6 mm collimation, pitch 1.2, 80/140 kVp tube potential. The contrast medium was adapted by patient weight (0.5 ml 370 mgI/ml contrast per kg of body weight) and the flow rate was calculated by the contrast volume divided by the sum of delay and scan duration. The resulting high and low kVp images were transferred to a commercial non-linear blending software package to optimize the image contrast and noise. The linear mixed image was used as reference image which was considered to the administration of a high contrast media concentration at lower speed.

RESULTS

The patient weight was 72.5 ± 12.6 kg. The contrast volume was 36.5 ± 6.3 ml. The flow rate was 3.2 ± 0.4 ml/s. The CT attenuation was significant higher in optimal contrast than simulated 120 kVp group (AA: 358.4 ± 35.9 vs. 276.7 ± 34.9 HU, p < 0.001; DA: 325.8 ± 41.1 vs. 281.1 ± 31.2 HU, p < 0.001; 350.7 ± 44.3 vs. 271.5 ± 29.5 HU, p < 0.001). The noise of optimal contrast was significant higher in optimal contrast than simulated 120 kVp group (AA: 358.4 ± 35.9 vs. 276.7 ± 34.9 HU, p < 0.001; DA: 325.8 ± 41.1 vs. 281.1 ± 31.2 HU, p < 0.001; 350.7 ± 44.3 vs. 271.5 ± 29.5 HU, p < 0.001). The resulting high and low kVp images were transferred to a commercial non-linear blending software package to optimize the image contrast and noise. The linear mixed image was used as reference image which was considered as simulated 120 kVp image. The region-of-interest was placed on ascending aorta (AA), descending aorta (DA) and bifurcation (AB).

CONCLUSION

DECT non-linear blending technique can improve the image quality of whole aortic angiography and permit a low contrast medium volume and flow rate injection protocol.

CLINICAL RELEVANCE/APPLICATION

DECT permitted low contrast medium volume and flow rate which improve the patient care and maintain diagnostic image quality.

SSJ27-04 • Validation of a Low Dose Simulation Method for Evaluation of Sub-mSv Computed Tomography

Daniela Muenzel MD (Presenter); Thomas Koehler PhD *; Kevin M Brown MS *; Stanislav Zabic PhD *; Alexander A Finger MD; Simone Waldt MD; Edgar Bendik; Tina Zahel; Ernst J Rummeny MD; Martin Dobritz MD; Peter B Noel PhD

PURPOSE

Evaluation of a new software tool for generation of simulated low-dose computed tomography (CT) images from an original higher dose scan.

METHOD AND MATERIALS

Original contrast-enhanced and non-enhanced CT examinations (120 kVp; 100 mAs, 80 mAs, 60 mAs, 40 mAs, 20 mAs, and 10 mAs) of a
Swine were acquired. Simulations of CT images with a lower radiation exposure (range 10-80 mAs) were calculated using a low-dose simulation algorithm that simulates accurately both photon noise and electronic noise that would be present in a scan at lower dose. Simulated non-enhanced images were compared to the original non-enhanced CT data of the same radiation dose level regarding density values and image noise. Four radiologists assessed the visual appearance of the simulated contrast-enhanced CT data.

RESULTS
Image characteristics of simulated low-dose scans were similar to the original acquisitions. Mean overall discrepancy of image noise and CT values between original and simulated CT images was 0.2 % (range -0.6 % to 0.8 %) and -0.3 % (range -2.1 % to 0.8 %), respectively, p > 0.05. Subjective observer evaluation of image appearance showed no visually detectable difference.

CONCLUSION
Simulated low dose images showed excellent agreement with the original scan data concerning image noise, CT density values, and subjective assessment of the visual appearance of the simulated images.

CLINICAL RELEVANCE/APPLICATION
An authentic low-dose simulation from actual CT examinations opens up important opportunity with regard to staff education, protocol optimization and introduction of new reconstruction techniques.

SSJ27-05 • Reduced Iodine Dose Single Source Dual-energy CT Angiography of Abdomen for Assessment of Aorto-Iliac Diseases: Is This the Killer Application for Dual-energy CT?
Mukta D Agrawal MBBS, MD (Presenter) *; Surabhi Bajpai MBBS, DMRD; George R Oliveira MD; Sanjeeva P Kalva MD *; Jorge M Fuentes MD; Koichi Hayano MD; Yasir Andrahi MD, MPH; Dushyant V Sahani MD

PURPOSE
To investigate the performance of ssDE-CTA using reduced iodine dose for abdominal angiography in comparison to currently applied iodine dose conventional single energy CTA (SE-CTA) and to determine the energy level (keV) that provide optimal imaging for vascular and extravascular evaluation.

METHOD AND MATERIALS
In an IRB approved ongoing clinical trial, 64 consecutive patients with AAA and prior SE-CTA exam using standard dose of iodine were enrolled. Their follow up CTA exam was undertaken on ssDECT (GE Discovery CT750 MD) with reduced iodine dose (21–24gms instead of 35-36gms). Patients received iso-osmolar iodinated CM (Iodixanol, GE) of 270 mgI/mL (group A, n=32) or 320 mgI/mL (group B, n=32) concentration. The arterial phase DECT images were processed to generate virtual monochromatic images (VMC) of various energies (40 to 140 keV at an increment of 5 keV). Two-experienced radiologist independently evaluated VMC image sets for subjective image quality and noise. Readers also determined the diagnostic keV range and the optimal keV for vascular and extravascular assessments. The contrast to noise ratio (CNR) was calculated on VMC images at various energies and SE-CTA images. A paired student t-test was used to determine statistical significance.

RESULTS
All DE-CTA exams were considered diagnostic with an IQ score 4.2. Both readers observed a broad range of diagnostic keV images from 40 to 75; and 40-45 keV images were considered best for vascular assessment, whereas 60-65 keV images were rated best for both vascular and extravascular assessment. In comparison to SE-CTA images, VMC images (40 • 60 keV) provided significantly higher intravascular attenuation (200-20%) and CNR (40-20%) at 28% less iodine dose (p < .05). Mean FOMs (<.05) and tended to be greater for the thorax and pelvis than those with 370-120 group (4.8-9.2).

CONCLUSION
ssDECT enables substantial reduction in the iodine dose for CTA exam while yielding 200-20% higher intravascular enhancement thereby providing an opportunity to lower renal risks in older patients.

SSJ27-06 • Whole-body 64-detector CT Angiography with Low-tube-Voltage (80 kVp) and Low-concentration (240 mg/mL) Contrast Material to Reduce Radiation Dose and Iodine Load
Masayuki Kanematsu MD; Satoshi Goshima MD, PhD; Toshiharu Miyoshi RT; Hiroshi Kondo MD; Haruo Watanabe MD; Yukichi Tanahashi MD (Presenter); Yoshiifumi Noda MD; Kyongtae T Bae MD, PhD *; Nobuyuki Kawai MD

PURPOSE
To prospectively evaluate contrast enhancement, vascular depiction, image quality, and radiation dose of low-tube-voltage whole-body computed tomographic angiograms (CTAs) with low-concentration iodinated contrast material (CM).

METHOD AND MATERIALS
This study was approved by our institutional review board and all patients provided informed consent. Whole-body CTAs were obtained in 109 patients (body weight range, 37-100 kg; mean, 61.2 kg) with a 64-detector CT (Discovery CT750 MD; GE Healthcare) using adaptive statistical iterative reconstruction algorithm (ASiR; GE Healthcare). Patients were randomized into three groups: CTA with 240 mg/mL CM at 80 kVp (240-80 group), 300 mg/mL at 80 kVp (300-80 group), and 370 mg/mL at 120 kVp (370-120 group). CM was intravenously injected at 4 mL/sec and bolus tracking was used in all patients. Signal-to-noise ratio (SNR), arterial depiction, image quality, and radiation dose were assessed separately for the thorax, abdomen, and pelvis. A figure of merit (FOM) was computed to normalize the SNR, estimated effective dose, and iodine weight administered, using the following equation: FOM = SNR/Effective dose/Iodine weight.

RESULTS
Mean iodine weight administered was 21.6, 26.8, and 34.0 g, respectively, for 240-80, 300-80, and 370-120 groups (P < .05). Mean vascular enhancement in the thoracic aorta, abdominal aorta, and iliac arteries ranged 508-521, 546-593, and 435-442 HU with 240-80, 300-80, and 370-120 groups, respectively (P < .05). The arterial depiction and image quality were comparable between 240-80 and 370-120 groups and were greater with 300-80 group than with the other two groups in selected arteries (P < .05). Mean effective dose was higher with 370-120 group (2.8-5.4 mSv) than with 240-80 group (2.3-4.3 mSv) for the abdomen and pelvis (P < .05). Mean FOMs with 240-80 group (7.8-15.3) were greater for the abdomen (P < .05) and tended to be greater for the thorax and pelvis than those with 370-120 group (4.8-9.2).

CONCLUSION
Use of 240 mg/mL CM at 80 kVp seems appropriate for a routine whole-body CTA and beneficial to the reduction of iodine load and radiation dose, whereas the use of 300 mg/mL CM may marginally improve the delineation of selected small arteries.

CLINICAL RELEVANCE/APPLICATION
Whole-body CTA with 240 mg/mL CM and 80-kVp tube voltage may replace conventional CTA with 350-400 mg/mL CM at 120-kVp tube voltage, contributing to a reduction of iodine load and radiation dose.
LEARNING OBJECTIVES
1) Review of institutional requirements for providing moderate and/or deep sedation vs. minimal sedation. 2) Medico-legal ramifications of moderate, deep or minimal sedation. 3) Nuts and Bolts: pearls on how to survive an 'accreditation' visit. 4) Patient and Procedure selection: Should I consult an anesthesiologist? 5) Case presentation and discussion: Common disasters and how to avoid them.

Vertebral Augmentation (How-to Workshop)
Tuesday, 04:30 PM - 06:00 PM • E260

LEARNING OBJECTIVES
1) Discuss appropriate algorithms for patient selection. 2) Review anatomic and technical considerations for vertebral augmentation. 3) Present an update of the recent advances in vertebroplasty and kyphoplasty. 4) Emphasize safety issues and how to avoid complications. 5) Understand the applications of vertebral augmentation in osteoporotic and neoplastic spine pathology. 6) Update participants with respect to advances in equipment and biomaterials.

ABSTRACT
Real-time Interventional US (Hands-on Workshop)
Tuesday, 04:30 PM - 06:00 PM • E264

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

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

Medical Physics 2.0: Fluoroscopy
Wednesday, 08:30 AM - 10:00 AM • E451A

LEARNING OBJECTIVES
1) To become familiar with major trends in fluoroscopy technology. 2) To understand transitions in technology that requires new and advanced evaluations. 3) To appreciate how a medical physicist is to effectively engage with clinical practice.

ABSTRACT
Just like other medical imaging modalities, fluoroscopy has been undergoing a number of technological transitions. Those include transitions from II to flat panel detectors and from 2D to 3D imaging. While these advances offer improvements and new possibilities, they challenge the conventional way a system is to be tested. In addition, given the interventional nature of the modality, there is an increasing need for the medical physicist to be more operationally engaged with the use and optimization of the technology. This lecture aims to offer a historical perspective on these topics and an outline of major priorities for fluoroscopic physics service.
essential for optimizing equipment performance and ensuring patient and staff safety. Test equipment, phantoms, measurement methods and recommended performance criteria for these tests will be summarized as they apply to different types of fluoroscopic equipment, from angiographic imaging systems to radiographic-fluoroscopic (RF) tables and mobile C-arms. In addition, the medical physicist's role in clinical implementation of fluoroscopic systems will be discussed, including ensuring appropriate configuration of anatomical program settings, recommendations for patient dose management and methods for patient dose estimation.

**RC521C • Fluoroscopy 2.0**

**Keith J Strauss** MS (Presenter)

**LEARNING OBJECTIVES**
1) Understand need for and advantages of quantitative (as opposed to qualitative) analysis of image quality. 2) Identify and understand new tools becoming available for evaluating fluoroscopic equipment performance. 3) Identify appropriate configuration of acquisition parameters as a function of patient size. 4) Be able to configure the radiation dose to the detector to ensure diagnostic image quality at properly managed patient dose.

**ABSTRACT**

Abstract Steps that are required to turn physics support of fluoroscopy from a compliance focused to operationally focused program will be discussed. New metrics and analytics to better quantify high contrast resolution, low contrast resolution, temporal resolution, and 3D imaging will be examined. Changes in testing protocols necessary to address new hardware technologies, new acquisition methods, state-of-the-art image processing and analysis will be reviewed. A recently developed "physics testing mode" that the vendors will provide in the near future will be described. Proper management of patient dose metrics will be reviewed. The presentation concludes with clinical implementation of these new strategies. Proper training and communication is critical. Proper configuration of acquisition parameters (focal spot size, voltage and added filter, tube current, pulse width, pulse rate, scatter removal) as a function of patient size from the smallest neonate to the largest bariatric patient is key to providing diagnostic image quality at properly managed radiation doses. In addition, one must ensure that the detector dose as a function of filter type and thickness, pulse rate, field of view, and complexity of the examination is properly configured.

**Small Parts Interventional Ultrasound (Hands-on Workshop)**

**Wednesday, 08:30 AM - 10:00 AM • E263**

**US**

**RC531 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5**

**William E Shiels**, DO

**Peter I Cooperberg**, MD

**Veronica J Rooks**, MD

**Alda F Cossi**, MD

**Nathalie J Bureau**, MD

**Nicholas A Zumberge**, MD *

**James W Murakami**, MD

**Paolo Minafra**, MD

**Paula B Gordon**, MD *

**Mary M Chiaravas**, MD, PhD

**Hollins P Clark**, MD, MS

**Carmen Gallego**, MD

**Mabel Garcia-Hidalgo Alonso**, MD

**Maryann A Mahlon**, DO

**Michael A Dipietro**, MD

**Horacio M Padua**, MD

**Andrew J Rabe**, DO

**Robert D Lyon**, MD

**Stephen C O’Connor**, MD

**LEARNING OBJECTIVES**
1) Identify basic skills, techniques, and pitfalls of freehand invasive sonography, with specific focus on small part applications. 2) Define and discuss technical aspects, rationale, and pitfalls involved in musculoskeletal, breast, head and neck, and pediatric interventional sonographic care procedures. 3) Successfully perform basic portions of hands-on US-guided procedures in a tissue simulation learning model, to include core biopsy, small abscess coaxial catheter drainage, cyst and ganglion aspiration, lymphatic malformation macrocyst access, soft tissue foreign body removal, and intraarticular steroid injection. 4) Incorporate these component skill sets into further life-long learning for core biopsy, small abscess coaxial catheter drainage, cyst and ganglion aspiration, lymphatic malformation macrocyst access, soft tissue foreign body removal, and intraarticular steroid injection. 4) Incorporate these component skill sets into further life-long learning for core biopsy, small abscess coaxial catheter drainage, cyst and ganglion aspiration, lymphatic malformation macrocyst access, soft tissue foreign body removal, and intraarticular steroid injection.

**Abstract**

1) Understand need for and advantages of quantitative (as opposed to qualitative) analysis of image quality. 2) Define and discuss technical aspects, rationale, and pitfalls involved in musculoskeletal, breast, head and neck, and pediatric interventional sonographic care procedures. 3) Successfully perform basic portions of hands-on US-guided procedures in a tissue simulation learning model, to include core biopsy, small abscess coaxial catheter drainage, cyst and ganglion aspiration, lymphatic malformation macrocyst access, soft tissue foreign body removal, and intraarticular steroid injection. 4) Incorporate these component skill sets into further life-long learning for core biopsy, small abscess coaxial catheter drainage, cyst and ganglion aspiration, lymphatic malformation macrocyst access, soft tissue foreign body removal, and intraarticular steroid injection.

**ABSTRACT**

1) Identify basic skills, techniques, and pitfalls of freehand invasive sonography, with specific focus on small part applications. 2) Define and discuss technical aspects, rationale, and pitfalls involved in musculoskeletal, breast, head and neck, and pediatric interventional sonographic care procedures. 3) Successfully perform basic portions of hands-on US-guided procedures in a tissue simulation learning model, to include core biopsy, small abscess coaxial catheter drainage, cyst and ganglion aspiration, lymphatic malformation macrocyst access, soft tissue foreign body removal, and intraarticular steroid injection. 4) Incorporate these component skill sets into further life-long learning for core biopsy, small abscess coaxial catheter drainage, cyst and ganglion aspiration, lymphatic malformation macrocyst access, soft tissue foreign body removal, and intraarticular steroid injection.

**Cardiac Radiology Series: Transcatheter Aortic Valve Replacement (TAVR)**

**Wednesday, 08:30 AM - 12:00 PM • SS02AB**

**US**

**VS41A1 • AMA PRA Category 1 Credit ™:3.75 • ARRT Category A+ Credit:4**

**Moderator**

**Dominik Fleischmann**, MD *

**Moderator**

**Jonathan A Leipsic**, MD *

**VS41A1-01 • The Emerging Role of TAVR**

**James Min** MD (Presenter) *

**LEARNING OBJECTIVES**

1) To understand the use of cardiac CT in the setting of transcatheter aortic valve replacement.

**VS41A1-02 • CT-angiography Based Evaluation of the Aortic Valve Annulus for Prosthesis Sizing in Transcatheter Aortic Valve Implantation (TAVI) - Predictive Value and Optimal Thresholds for Major Anatomic Parameters**

**Florian Schwarzwald** MD (Presenter); **Dominik Zinszer**, BS; **Philipp Lange** MD; **Martin Greif**; **Maximilian F Reiser** MD; **Hans-Christoph R Becker** MD; **Alexander Sterzik**; **Christian Kupatt** MD, PhD; **David Jochheim** MD

**PURPOSE**

To evaluate the predictive value of CT-measurements of the aortic annulus for prosthesis sizing in transcatheter aortic valve implantation (TAVI) and to calculate optimal cutoff values for the selection of the small, medium and large valve size for two manufacturers.

**METHOD AND MATERIALS**
In 351 TAVI-patients, optimal prosthesis size was determined during TAVI by inflation of a balloon catheter at the aortic annulus. The CoreValve Valve System (Medtronic; CV) and the Edward Sapien XT valve (Edwards Life Sciences; ES) were used in 235 and 116 patients, respectively. All patients had undergone CT-angiography of the bodytrunc prior to TAVI. Using the CT datasets, the length of the long and short axis as well as circumference and area of the aortic annulus were measured by two experienced observers. A 10-fold nested cross-validation approach was used to estimate the predictive power of different anatomical parameters for the prosthesis size ultimately implanted and to define optimal cut-off points.

RESULTS
There was excellent interobserver agreement (ICC’s > 0.85), so average values were used for further analysis. Differences between patients who underwent implantation of the small, medium or large prosthesis were significant for all evaluated aortic root parameters and both manufactures (p<

CONCLUSION
CT-based aortic root measurements permit good prediction of the prosthesis size considered optimal during TAVI. Applying the proposed parameter ranges, prosthesis size would have been chosen correctly in 87% of cases. Inclusion of the degree of calcification and/or the dimensions of the sinus of Valsalva into our model might further increase its predictive potential.

CLINICAL RELEVANCE/APPLICATION
The proposed cutoff-values for major anatomical parameters of the aortic annulus can serve as a guide for non-invasive prosthesis sizing for the most widely used TAVI prosthesis models

VSCA41-03 • C-arm CT has Higher Interobserver Variability Compared to Multidetector CT (MDCT) for Transcatheter Aortic Valve Implantation/Replacement (TAVI/R) Planning

Suhy Abbara MD (Presenter) *; Lorenzo Azzalini; Umesh C Sharma MD, DPhil; Ignacio Inglessis; Igor F Palacios; Brian B Ghoshhajra MD

PURPOSE
Accurate characterization of the aortic annulus and root is critical for guidance of prosthesis diameter choice in TAVI/R planning, and to accurately deploy the valve, and is usually performed by transesophageal echocardiography or MDCT. The same C-arm used for fluoroscopy during the procedure may also be utilized to acquire 3-D datasets that are similar to MDCT. However, this C-arm CT (CAX) is not currently used to perform measurements of the aortic root to guide the procedure. We aim to evaluate the interobserver variability of CAX aortic root measurements, as compared to MDCT.

METHOD AND MATERIALS
CAX and MDCT were performed in 20 patients. Multiplanar reconstructions were performed to determine aortic annulus area, circumference and diameters, sinus of Valsalva diameters and height, leaflet length, distance of the coronary ostia to annulus plane, sinotubular junction, ascending aortic diameters, and predicted perpendicular projection to annulus plane (Figure 1). Each parameter was determined by two independent blinded cardiac imagers. Interobserver variability for CAX- and MDCT-derived measurements was determined using the intraclass correlation coefficient (ICC).

RESULTS
No significant interobserver variability was found for all variables derived from MDCT (ICC 0.45 to 0.93). However, there was significant disagreement for the following measurements derived from CAX: aortic annulus short and long axis diameters, area and circumference (ICC

CONCLUSION
No significant interobserver variability was found with MDCT. Although, good agreement was found for the measurements above the aortic annulus with CAX, the measurements of the aortic annulus demonstrate greater variability compared to MDCT, possibly due to absence of contrast within the left ventricular outflow tract. Therefore sizing of TAVI/R valves may not reliably performed based on CAX measurements alone.

CLINICAL RELEVANCE/APPLICATION
CAX provides MDCT-like images, but measurements of aortic annulus are not reliable. Sizing of TAVI/R valves therefore continues to require MDCT or echocardiography.

VSCA41-04 • Assessment of the Aortic Annulus with TransEsophageal Echocardiography, Multidetector Computed Tomography and Magnetic Resonance to Direct Surgical Sizing: Can We Rely on Imaging?

Leonardo Capitolo MD (Presenter) ; Marco Gatti MD ; Claudio Maria Berzovini ; Riccardo Faletti ; Stefano Salizzoni ; Paolo Fonio ; Mauro Rinaldi ; Giovanni Gandini MD

PURPOSE
Precise sizing of the aortic annulus is crucial in order to properly select type and size prosthesis to avoid complication during TAVI procedures. We Evaluate aortic annulus sizing performed by Transesophageal Echocardiography (TEE), Multidetector Computed Tomography (MDCT) and Magnetic Resonance (MR) and compares the results to direct intra-operative sizing.

METHOD AND MATERIALS
RESULTS
All imaging techniques yield results in satisfactory agreement with one another and with the Hegar (R=0.70 for TEE; R=0.81 for MDCT and R=0.81 for MR), even if with different behaviors: MDCT and TEE suffer from overestimation for smaller diameters changing into underestimation for larger ones; MR overestimate over the whole diameter range. The measurements within ±2 mm around the Hegar sizing result in 71% for TEE, 76% for MR and 80% for MDCT.

CONCLUSION
MDCT and MR seem to be more accurate in annulus measurements, with different advantages and drawbacks, than TEE.

CLINICAL RELEVANCE/APPLICATION
The imaging and the assessment of virtual tube could accurately size the aortic annulus in order to properly select the most appropriate valve size for transcatheter aortic valve implantation (TAVI)

VSCA41-05 • Functional Anatomy and Measurements of the Aortic Root

Jonathan A Leipsic MD (Presenter) *

LEARNING OBJECTIVES
1) Discuss the most reproducible and accurate methods for annular assessment with CT with a focus on the dynamic changes throughout the cardiac cycle. 2) Provide a deeper understanding of proposed annular sizing strategies with MDCT with focus on recently published multicenter trial data. 3) Discuss the role of MDCT to identify potential adverse root features to help reduce the risk of annular injury.

VSCA41-06 • Intentional Computed Tomography-based Oversizing in Balloon-expandable Transcatheter Aortic Valve Replacement - Incidence of Paravalvular Regurgitation and Post-deployment Geometry

Philipp Blanke MD (Presenter) ; Eva Maria Spira ; Gregor Pache MD ; Mathias F Langer MD, PhD

PURPOSE
To evaluate the incidence of paravalvular regurgitation and post-deployment geometry of intentional computed tomography (CT)-based
METHOD MATERIALS
115 patients with severe aortic stenosis (mean age 81±7 years, mean aortic valve area 0.68±0.18cm²) underwent retrospectively gated dual source CT for THV sizing prior to TAVR. Aortic annulus dimensions were quantified by means of planimetry and area-derived diameter calculation (D = 2 x √(area/π)) at the level of the basal attachment points of the aortic cusps during systole. THV selection was CT-diameter-based (EdwardSAPIEN XT 23mm THV for D 25mm). Post-deployment CT was performed in 95 patients. Stent-expansion was assessed planimetrically at the inlet, outlet and level of the native annulus. Relative oversizing and relative changes in annulus dimensions were calculated.

RESULTS
Average pre-deployment annulus diameter was 24.1±1.8mm, average post-deployment diameter was 23.9±1.5mm (p=n.s.). Average relative change in annulus diameter was -0.5±3.6%. Mean relative oversizing was 9.1±4.7%. Mean diameter at the THV outlet was significantly larger than at the THV inlet (24.3±1.8mm vs. 23.8±1.7mm, p

CONCLUSION
Intentional oversizing of the THV based on an area-derived annulus diameter in CT and an adapted incremental sizing scheme appears safe and is associated with a lower incidence of relevant paravalvular regurgitation, as compared to published landmark trial with echocardiography-based THV-sizing

CLINICAL RELEVANCE/APPLICATION
Planimetric assessment of the aortic annulus by CT allows for intentional prosthesis oversizing in transcatheter aortic valve replacement to reduce the occurrence of paravalvular regurgitation.

VSCA41-07 • CT Angiography for Aortic Root Measurements in TAVR Patients: Comparison of High-pitch Dual-source CT Image Acquisition versus Retrospective ECG-Gating

Felix G Meinel MD (Presenter) ; U. Joseph Schoepf MD * ; Carlo Nicola De Cecco MD ; Aleksander Krazinski ; Maximilian F Reiser MD ; Lucas L Geyer MD * ; Daniel H Steinberg MD

PURPOSE
To compare the diagnostic value and robustness of high-pitch dual-source CT angiography versus retrospectively ECG-gated data acquisition for aortic root measurement during pre-procedural planning of transcatheter aortic valve replacement (TAVR).

METHOD AND MATERIALS
With IRB approval and in HIPAA compliance, data of 20 patients (77.5±12.8 years, 11 male, heart rate 69±15.5bpm) considered for TAVR were retrospectively analyzed. All patients had undergone both retrospectively ECG-gated cardiac CT (scan 1) as well as high-pitch dual-source CT angiography (scan 2) of the aorta. Scan 2 targeted the end-systolic phase at 35% of the RR-cycle. A BMI-based contrast medium (CM) injection protocol was used with 70-144mL volume, injected at 3.0-5.5mL/s. For consistency, both scans were reconstructed with a section thickness of 1.5mm with 0.7mm increment. Image quality (IQ) was subjectively assessed. Aortic annulus dimensions were measured as area-derived diameters. Based on effective diameter, agreement for prosthetic selection between the high-pitch image acquisition (FLASH) was compared with standard reconstructions at 30%-80% (D70-D80) of the RR-cycle.

RESULTS
All patient studies had at least 150 HU CM attenuation at the level of the aortic root. In scan group 1, aortic annulus measurements could be successfully performed in all patients. Scan 2 resulted in 7 studies with non-diagnostic IQ. Patients with non-diagnostic IQ had a significantly higher body-mass index (38.5±10.1kg/m² versus 27.4±4.2kg/m², pFLASH 24.1±2.0mm, D30 24.6±2.2mm, D40 24.2±2.1mm, D50 24.1±2.2mm, D60 23.9±1.99mm, D70 23.8±1.98mm, D80 24.2±2.3mm. In patients with diagnostic IQ, the highest agreement in prosthesis sizing was found in 11 of 13 patients by D30 (p=0.65) and 13 of 13 patients by D70 (p=1.00) compared with DFLASH.

CONCLUSION
For TAVR planning, the use of high-pitch dual-source CT angiography is feasible in the majority of patients. However, retrospectively ECG-gated cardiac CT should be considered in problematic scenarios, such as obese patients or cardiac arrhythmia.

CLINICAL RELEVANCE/APPLICATION
High-pitch dual-source CTA requires appropriate patient selection for reliable measurements of the aortic annulus in TAVR patients compared with the more robust retrospectively ECG-gated approach.

VSCA41-08 • Accuracy of Aortic Root Annulus Assessment with Cardiac Magnetic Resonance in Patients referred for Transcatheter Aortic Valve Implantation (TAVI) using pre- and post-deployment dual-source CT.

Sarah Cortinovis MD (Presenter) ; Daniele Andreini MD ; Erika Bertella ; Saima Mushraq ; Paola Gripari ; Monica Loguercio ; Sarah Cortinovis ; Andrea Baggiano ; Edoardo Conte ; Andrea Daniele Annoni MD ; Alberto Formenti ; Mauro Pepi

PURPOSE
Cardiac magnetic resonance (CMR) has distinct advantages over 2D echocardiography such as exceptional spatial resolution and does not need administration of contrast agents, provides similar 3D multi-slice images of the aortic root, so that it may be a valid alternative to MDCT. The aim of this study is to compare the accuracy of CMR evaluation of AoA as compared to MDCT in patients referred for TAVI.

METHOD AND MATERIALS
50 patients were studied with a 1.5-T scanner (Discovery MR450, GE Healthcare, Milwaukee, WI). Steady-state free precession cine acquisitions were acquired with following parameters: echo time 1.57 ms, repetition time 46 ms, slice thickness 8 mm, field of view 350mmx263mm, and pixel size 1.4mmx2.2 mm. Two long-axis view of the aortic root and ascending aorta were obtained. Thus, serial short-axis cines orthogonal to the AoA (3-mm thickness with 1.5-mm increment) were acquired. The following parameters were assessed with CMR and compared with those obtained with MDCT: AoA maximum diameter (AoA-Dmax), minimum diameter (AoA-Dmin), area (AoA-A), length of the left coronary, right coronary, and non-coronary aortic leaflets, degree (grades 1 to 4) of aortic leaflet calcification and distance between AoA and coronary artery ostia.

RESULTS
AoA-Dmax, AoA-Dmin and AoA-A were 26.45±2.83 mm, 20.17±2.20 mm, 444.88±84.61 mm2 and 26.45±2.76 mm, 20.59±2.35 mm and 449.78±86.22 mm2 by MDCT and CMR, respectively. The length of left coronary, right coronary, and non-coronary leaflets were 14.02±2.27 mm, 13.33±2.33 mm, 13.39±1.97 mm, and 13.95±2.18 mm, 13.30±2.14 mm, 13.46±1.80 mm by MDCT and CMR, respectively, while the scores of aortic leaflet calcifications were 3.4±0.7 vs. 2.97±0.77. Finally, the distance between AoA and left main and right coronary artery ostia was 16.21±3.07 mm, 16.02±4.29 mm and 16.14±2.83 mm by MDCT and CMR, respectively. There was close agreement between CMR and MDCT measurements, whereas aortic leaflet calcifications were underestimated by CMR.

CONCLUSION
Aortic root assessment with CMR including AoA size, aortic leaflet length and coronary artery ostia height is accurate in comparison to MDCT.

CLINICAL RELEVANCE/APPLICATION
CMR may be a valid imaging alternative in patients unsuitable for MDCT.
LEARNING OBJECTIVES
1) Review the possible percutaneous access sites for patients undergoing TAVR: femoral, transapical, transaortic, subclavian/axillary. 2) Explain the techniques for accurate vessel visualization, diameter measurements and curvature assessment. 3) Present the current recommendations for minimum access vessel diameters with clinical examples.

ABSTRACT
Treatment planning for TAVR requires meticulous assessment of access vessels to assure safe device delivery. A high-quality CTA dataset with 0.6-1.25mm section thickness is a prerequisite for accurate vessel visualization and measurement. While transverse source images provide a reasonably good ‘first look’, most patients require dedicated postprocessing with curved planar reformations and orthogonal images through the access vessels to determine the minimal vessel diameter, to assess for the presence of calcifications, and display the degree of tortuosity. The minimal arterial diameter necessary for TAVR depends on the valve type and size, as well as on the outer diameter of the delivery system. The outer diameter of the delivery system should not exceed 1.05 times the inner arterial diameter. If heavy calcifications are present, particularly circumferential or horse-shoe shaped, the delivery system should be smaller. If peripheral arterial access is inadequate, a direct transaortic route can be chosen through a mini-sternotomy, or right mini-thoracotomy (2nd interspace) Alternatively, it is important to exclude heavy calcifications at a potential aortic access site (e.g. plaque of porcelain aorta), and to determine the distance between the aortic access and the valve plane to assure enough length for device delivery. Transapical access can be gained through a left lateral mini-thoracotomy (5th or 6th interspace).

VSCA41-10 • Low Volume, Low Iodine Concentration Contrast Medium Protocol for Comprehensive CT Planning of Transcatheter Aortic Valve Replacement

Aleksander Krazinski; Philipp Blanke MD; U. Joseph Schoepf MD *; Justin R Silverman; Carlo Nicola De Cecco MD; Lucas L Geyer MD (Presenter) *; Fabian Bamberg MD, MPH *; Daniel H Steinberg MD

PURPOSE
To investigate the feasibility of a dual-source CT angiography (CTA) protocol with a low volume of low iodine concentration contrast medium (CM) for comprehensive planning of transcatheter aortic valve replacement (TAVR) in a patient group with a high prevalence of chronic renal failure and atrial fibrillation.

METHOD AND MATERIALS
44 patients, considered for TAVR, underwent retrospectively ECG-gated CTA of the heart, immediately followed by high-pitch CTA of the femoro-iliac-aortic access route using two different injection protocols of low iodine concentration (320mgI/ml) iodixanol: group A, iodine delivery rate (IDR)-based (target, 1.28gI/s), CM volume 60mL, flow rate 4.0mL/s; group B, BMI-based (routine protocol), CM volume range 70-144mL, flow rate range 3.0-5.5mL/s. All injections were followed by a 50mL saline chaser. Aortic root complex and iliofemoral dimensions were measured. Mean arterial attenuation, signal-to-noise ratio (SNR), and contrast-to-noise ratio (CNR) were calculated. Subjective image quality was assessed at the level of the aortic root complex and the aortoiliac vasculature.

RESULTS
Gender distribution (12 female, 8 female, p=0.226), age (82.1±9.8 years, 80.0±11.5 years, p=0.520), body mass index (26.8±4.1kg/m², 29.1±4.7kg/m², p=0.098), and heart rate (69.3±10.3bpm, 70.0±14.5bpm, p=0.849) showed no significant differences between groups. Aortic root complex and iliofemoral dimensions could be analyzed in all cases. Mean attenuation at the level of the aortic root (272.5±100.3HU, 318.9±67.3HU, p=0.097), the aorta (214.7±70.0HU, 251.2±82.4HU, p=0.140), and the iliofemoral access route (264.1±87.2, 287.7±69.9, p=0.337) was non-significantly lower in group A. SNR and CNR were non-significantly higher in group B.

QUALITATIVE assessment of image quality did not result in significant differences.

CONCLUSION
The performance of a combined CTA protocol consisting of a retrospectively ECG-gated cardiac CTA immediately followed by a high-pitch scan of the femoro-iliac-aortic access route is feasible. With this approach, the amount of CM can be considerably reduced by using a single low volume CM bolus without substantial loss of image quality in fragile, multimorbid patients who are considered for the TAVR procedure.

CLINICAL RELEVANCE/APPLICATION
This comprehensive protocol facilitates the use of a low volume, low iodine concentration CM protocol, which is essential in this patient group who often presents with significant comorbidities.

VSCA41-11 • Influence of Left Ventricular Geometry and Body-surface Area on Aortic Anulus Dimensions in Patients prior to Transcatheter Aortic Valve Implantation - Assessment by Computed Tomography

Philipp Blanke MD (Presenter); Eva Maria Spira; Tobias Baumann MD; Gregor Pache MD; Mathias F Langer MD, PhD

PURPOSE
To investigate the influence of left ventricular geometry, left ventricular function, body surface area (BSA), and gender on aortic annulus dimensions by computed tomography (CT) in patients with severe aortic stenosis.

METHOD AND MATERIALS
ECG-gated cardiac CTA source CT data of 289 consecutive patients with severe aortic stenosis (mean age 81±7 years, 121 males, mean aortic valve area 0.68±0.18cm²) was included. Aortic annulus dimensions were quantified by means of planimetry and area-derived measurements. Mean arterial attenuation, signal-to-noise ratio (SNR), and contrast-to-noise ratio (CNR) were calculated. Subjective image quality was assessed at the level of the aortic root complex and the aortoiliac vasculature.

RESULTS
Mean aortic annulus diameter was 24.4±2.4mm, mean LVEF 59.1±16.1%, mean LVEDV 145.6±51.5ml, mean LVM 181.8±54.2g, and mean BSA 1.8±0.2m². A positive and significant correlation (p=0.01) was found between LVEF and LVEDV, and a negative and significant correlation (p=0.001) was found between LVEDV and LVM. No significant correlation was found between BSA and any of the other parameters.

CONCLUSION
In patients with aortic stenosis, aortic annulus dimensions are influenced by gender, BSA and left ventricular geometry. A larger end-diastolic left ventricular volume, as present in left ventricular dilation, is associated with a larger annular diameter.

CLINICAL RELEVANCE/APPLICATION
In patients undergoing transcatheter aortic valve replacement, aortic annulus dimensions are critical for prosthesis sizing. This study aids in understanding predictors of annulus dimension.

VSCA41-12 • Anatomical and Procedural Features Associated with Annular Injury in Balloon Expandable Transcatheter Aortic Valve Replacement

Jonathan A Leipsic MD (Presenter) *; Marco Barbanti MD; Philipp Blanke MD; Gudrun Feuchtner MD *; David Wood MD, FRCP *; James Min MD *; John Webb MD, FRCP *

PURPOSE
Aortic root rupture is a major concern with balloon expandable TAVR. We sought to identify predictors of aortic root rupture during balloon-expandable TAVR using MDCT.

METHOD AND MATERIALS
Thirty-seven consecutive patients with left ventricular outflow tract (LVOT)/annular rupture complicating balloon expandable TAVR were collected from 17 centers and 10 countries. Analysis was performed on an historical cohort of 150 consecutive TAVR patients without...
Implantation
Paravalvular Regurgitation

VSCA41-14

Low dose contrast protocols for CT angiography may help reduce the risk of CIN—particularly in high risk patients with AS in whom baseline renal function is impaired.

RESULTS
Mean age was 82.4±8.5 years and 74% of patients were females. There were no significant differences between the two groups in any preoperative clinical and echocardiographic variables. Aortic root rupture was identified in 20 patients and periaortic hematoma in 11. Patients with root rupture had a higher degree of LVOT calcification quantified by Agatston score (181.2±211.0 vs. 22.5±37.6, p<0.05).

CONCLUSION
This study demonstrates that LVOT calcification and aggressive annular area oversizing are associated with an increased risk of aortic root rupture during TAVR with balloon-expandable prostheses. Larger studies are warranted to confirm these findings.

CLINICAL RELEVANCE/APPLICATION
We have identified an important anatomical factor and two procedural variables strongly associated with annular rupture which will allow for a deeper understanding of this important complication.

VSCA41-13 • Complications and Incidental Findings

Gudrun Feuchtner MD (Presenter) *

LEARNING OBJECTIVES
1) To learn which imaging features are associated with complications related to TAVI procedure. 2) To understand morphology of aortic valve, annulus, calcifications and implications for procedure success. 3) To learn which incidental findings have impact on pre-procedural patient management and intraoperative complications.

ABSTRACT
Transcatheter aortic valve implantation (TAVI) is a modern innovative minimal invasive approach to treat patients with severe aortic stenosis effectively. Imaging plays a key role to ensure procedure success and to avoid complications. During this course, imaging features associated with complications will be discussed: 1) Major vascular complications occur at 15%. This rate can be cut when selecting patients carefully taking into account high risk features on CT. 2) Aortic annular calcification is related to intraoperative complications, and high risk characteristics will be shown. 3) Incidental findings having impact on patients management will be identified.

VSCA41-14 • The Impact of Post-implant SAPIEN XTGeometry on Conduction Disturbances, Hemodynamic Performance and Paravalvular Regurgitation

Cameron J Hague MD (Presenter) ; Jonathan A Leipsic MD * ; John Webb MD, FRCPC * ; Stefan Toggweiler ; Melanie Freeman ; Ronald Binder ; David Wood MD, FRCPC * ; Marco Barbanti ; Donya A Al-Hassan MD

PURPOSE
To examine the relationship between post valve placement geometry and position of a percutaneously placed Edwards Sapien XT balloon expandable aortic valve and the presence of prosthetic valve dysfunction and post-implant conduction abnormalities.

METHOD AND MATERIALS
89 consecutive patients with symptomatic aortic stenosis undergoing transcatheter aortic valve replacement (TAVR) with a balloon expandable Sapien XT valve had pre and post valve assessment with multidetector computed tomography (MDCT) transthoracic echocardiography (TTE) and pre and post procedure 12 lead ECG. MDCT measures included valve circularity, percent expansion, inflow/outflow valve areas, and implantation height. Chart review assessed for placement of a permanent pacemaker (PPM) in subjects post TAVR. Statistical analyses were performed using SPSS statistics software. A p-value below 0.05 was considered significant.

RESULTS
89 patients (age 82±8 years, 54 male, 35 female) provided consent for this study. All subjects provided consent.

CONCLUSION
MDCT measures of THV implantation depth and relationship of inflow stent area to native annular area are strong predictors of new onset conduction disturbances/PPM placement and PAR respectively, both important causes of morbidity and mortality post TAVR.

CLINICAL RELEVANCE/APPLICATION
MDCT measures of implantation depth and stent inflow area versus native annular area provide important predictors of complications TAVR (PPM placement and PAR respectively).

VSCA41-15 • Contrast Induced Nephropathy after Contrast Enhanced Computed Tomography prior to Transcatheter Aortic Valve Implantation

Vera S Schneider BS (Presenter) ; Florian Schwarz MD ; David Jochheim MD ; Christian Kupatt MD, PhD ; Maximilian F Reiser MD ; Hans-Christoph R Becker MD ; Philipp Lange MD ; Julinda Mehilli MD ; Frederik F Strobl MD

PURPOSE
Contrast induced nephropathy (CIN) is a common complication after contrast enhanced computed tomography (CT). Particularly, patients with aortic valve stenosis (AS) are at increased risk for CIN due to their high prevalence of chronic kidney disease. The aim of this analysis is to determine the rate of CIN in patients with AS following contrast enhanced CT scans prior to transcatheter aortic valve implantation (TAVI).

METHOD AND MATERIALS
RESULTS
Rates for CIN in patients with GFR under 30, 30 to 60 and over 60 ml/min, were 13.6 %, 10.9 %, 6.8 %, respectively. Average contrast volume in patients who developed CIN was 101 ml vs. 92 ml in those who did not (p<0.05), supporting a strong relation between the development of CIN and the volume of contrast administered.

CONCLUSION
The incidence of CIN in high risk patients with AS undergoing contrast enhanced CT depends on the baseline GFR. We found a close relation between the amount of administered contrast media and the development of CIN.

CLINICAL RELEVANCE/APPLICATION
Low dose contrast protocols for CT angiography may help reduce the risk of CIN—particularly in high risk patients with AS in whom baseline renal function is impaired.
In prosthetic heart valve (PHV) endocarditis transthoracic and transesophageal echocardiography (TTE and TEE) may fail to recognize vegetations and peri-annular extensions, which is an indication for urgent surgery. Moreover, abnormal peri-annular anatomy after PHV implantation is not uncommon and differentiation between active or absent inflammation is difficult. The purpose of this study is to investigate the additional value of imaging with fused Computed Tomography Angiography (CTA) and 18F Fluorodesoxyglucose Positron Emission Tomography including low dose CT (FDG-PET/CT) providing high resolution anatomical and functional information.

METHOD AND MATERIALS
In our hospital PHV patients suspected for endocarditis undergo additional CTA and sometimes also FDG-PET/CT imaging when TTE and TEE are inconclusive. All PHV patients that underwent FDG-PET/CT were selected from the hospital database and assigned as cases or controls. Surgical inspection was the reference standard for cases.

RESULTS
Twelve PHV endocarditis cases and six normal functioning PHV controls were identified, which all underwent TTE, TEE, CTA and FDG-PET/CT. On surgical inspection 11/12 cases had peri-annular extension and 4/12 had a vegetation. CTA alone detected all vegetations but missed one peri-annular extension. FDG-PET/CT alone missed all vegetations, however all peri-annular extensions were detected correctly. Combined CTA and FDG-PET/CT detected both peri-annular extensions and vegetations correctly. Controls were all free of significant FDG uptake. SUV ratios around the PHV ring were significantly (p<0.05) increased in cases.

CONCLUSION
Fused FDG-PET and CTA imaging is a promising tool to correctly diagnose PHV endocarditis in patients with an inconclusive echocardiography. SUV ratios may be of additional help for correct detection of peri-annular extensions.

CLINICAL RELEVANCE/APPLICATION
PHV endocarditis sometimes remains difficult to diagnose with echocardiography due to acoustic shadowing of mechanical valves. In those cases hybrid imaging with CTA and FDG-PET/CT may guide treatment.

VSCA41-17 • Characteristics of Aortic Valvular Function and Ascending Aorta Dimensions According to Bicuspid Aortic Valve Morphology Using Dual-source Computed Tomography

Tae Hyung Kim (Presenter); Sung Min Ko, Meong Gun Song, Hweong Gon Hwang, Jung Ah Park

PURPOSE
The bicuspid aortic valve (BAV) is associated with aortic valve dysfunction and ascending aorta dilatation. The relationship between BAV morphology and ascending aorta dimensions remains unclear. We sought to characterize the aortic valve function and the ascending aorta dimensions according to valve morphology using dual-source computed tomography (DSCT).

METHOD AND MATERIALS
Two hundred nine BAV patients who underwent DSCT and transthoracic echocardiography were retrospectively included. BAV was classified into type I (corresponding to cusps or raphe) and type II (lateral orientation of cusps or raphe), and divided into raphe + (presence of raphe) and raphe - (absence of raphe) using DSCT.

RESULTS
Type I was present in 129 patients (61.7%) and raphe + in 120 (57.4%) patients. BAV type I and II was more common in patients with raphe + (84%) and raphe - (69%), respectively. Aortic regurgitation was more common in patients with type I (45%) and raphe + (53%), and aortic stenosis in patients with type II (46%) and raphe - (56%). Type I patients had a larger aortic annulus and smaller tubular portion of ascending aorta (29.9±4.7 mm and 41.7±7.3 mm, respectively) compared to type II patients (26.7±3.5 mm and 44.3±8.3 mm, respectively, p<0.05).

CONCLUSION
BAV morphology is helpful in predicting the type of aortic valve dysfunction and the location of ascending aorta dilatation. BAV morphology is helpful in predicting the type of aortic valve dysfunction and the location of ascending aorta dilatation.
Medium and Long Term Outcome of Prostatic Arterial Embolization to Treat Benign Prostatic Hyperplasia

Joao M Pinheiro; Hugo A Rio Tinto; Tiago Bilhim; Lucia C Fernandes; Jose A Pereira; Luis C Pinheiro; Antonio Oliveira; Marisa Duarte

PURPOSE
To evaluate the medium and long term outcome of prostatic arterial embolization (PAE) to treat lower urinary tract symptoms associated with benign prostatic hyperplasia (BPH).

METHOD AND MATERIALS
Two hundred forty patients (age range, 62 ± 82 years; mean age, 74.1 y) with BPH and moderate to severe lower urinary tract symptoms after failure of medical treatment underwent PAE between March 2009 and March 2012. Patients were followed between 1 and 4 years after PAE (mean 18 months). International Prostate Symptom Score (IPSS), quality of life improved (QoL), International Index of Erectile Function (IIEF), peak urinary flow (Qmax), prostate-specific antigen (PSA), prostate volume were evaluated every 6 months.

Technical success is defined as embolization of at least one prostatic artery. Clinical success is considered when there is a reduction of the IPSS at least 25% of the total score and = 15, a reduction of the QoL at least 1 point of the total or = 3 and no need of medical or any other treatment.

RESULTS
Clinical success (61.9 vs. 75.0%, P = 0.30), need for re-intervention (38.1 vs. 27.8%, P = 0.42), and 30-day complication (9.5 vs. 5.6%, P = 0.57), and mortality (28.6 vs. 25%, P = 0.77) rates were not statistically different between the two groups.

CONCLUSION
Embolic treatment of non-ruptured VAA (n = 11). The conservatively treated patients presented a 30-day mortality of 6.1% (11 of 181).

CLINICAL RELEVANCE/APPLICATION
Arterial embolization in patients with angiographically NBU is as safe and effective as embolization in patients with BU.

METHOD AND MATERIALS
Angiography. 239 of these patients could be identified suffering from VAA (mean age 65 years ± 12.5 years). VAA were analyzed with respect to location, size, true aneurysm or false aneurysms after surgery/intervention, rupture status, management, and clinical follow-up.

RESULTS
Diagnosis included VAA of the splenic artery (n = 81), celiac trunk (n = 46), renal artery (n = 42), hepatic artery (n = 37), superior mesenteric artery (n = 15), gastroduodenal artery (n = 10) and others (8). The overall size of the aneurysms was 17.8 ± 10.2 mm; min. 4 mm, max. 112 mm. 44 VAA were rated as false aneurysms (18%), 25 of them after surgery and 11 after percutaneous interventions like biopsies or drainages. 58 of 239 cases were treated with transarterial intervention (n = 47) or surgery (n = 11). Interventions included embolization with coils (n = 35) or glue (n = 4), implantations of covered stents (n = 4), and combinations of these (n = 4). 40 patients were diagnosed at rupture and were treated on an emergency basis (hemoglobin 8.6±1.7 mg/dl). There was no significant difference in size between ruptured and non-ruptured VAA (15.2 ± 8.4 mm vs. 16.3 ± 10.1 mm). The 30-day mortality in ruptured cases was 8.3% (12 of 36) after interventional treatment compared to 25% after surgery (1 of 4). No fatality occurred after interventional treatment of non-ruptured aneurysms (n = 11). The conservatively treated patients presented a 30-day mortality of 6.1% (11 of 181).

CONCLUSION
The clinical impact of accidentally diagnosed VAA still remains unclear. However, symptomatic or ruptured VAA might be associated with a high mortality rate. There was no difference in size in ruptured and non-ruptured aneurysms. Interventional treatment seems to offer a beneficial approach in emergency cases compared to surgery.

CLINICAL RELEVANCE/APPLICATION
False aneurysms seem to have a considerably higher risk of rupture and should be promptly treated irrespective of the diameter.

VSIR41-06 ● Embolization of Obstetrical and Gynecologic Emergencies

Sue E Hanks MD (Presenter)

LEARNING OBJECTIVES
1) Identify appropriate patients for transcatheter embolization following gynecologic or obstetric procedures. 2) Choose effective embolic agents to treat hemorrhage from gynecologic malignancies. 3) Define angiographic approach to identification of hemorrhage from gynecologic and obstetric emergencies.

VSIR41-07 ● Medium and Long Term Outcome of Prostatic Arterial Embolization to Treat Benign Prostatic Hyperplasia

Joao M Pinheiro; Hugo A Rio Tinto; Tiago Bilhim; Lucia C Fernandes; Jose A Pereira; Luis C Pinheiro; Antonio Oliveira; Marisa Duarte

PURPOSE
To evaluate the medium and long term outcome of prostatic arterial embolization (PAE) to treat lower urinary tract symptoms associated with benign prostatic hyperplasia (BPH).

METHOD AND MATERIALS
Two hundred forty patients (age range, 62 ± 82 years; mean age, 74.1 y) with BPH and moderate to severe lower urinary tract symptoms after failure of medical treatment underwent PAE between March 2009 and March 2012. Patients were followed between 1 and 4 years after PAE (mean 18 months). International Prostate Symptom Score (IPSS), quality of life improved (QoL), International Index of Erectile Function (IIEF), peak urinary flow (Qmax), prostate-specific antigen (PSA), prostate volume were evaluated every 6 months.

Technical success is defined as embolization of at least one prostatic artery. Clinical success is considered when there is a reduction of the IPSS at least 25% of the total score and = 15, a reduction of the QoL at least 1 point of the total or = 3 and no need of medical or any other treatment.

RESULTS
Clinical success (61.9 vs. 75.0%, P = 0.30), need for re-intervention (38.1 vs. 27.8%, P = 0.42), and 30-day complication (9.5 vs. 5.6%, P = 0.57), and mortality (28.6 vs. 25%, P = 0.77) rates were not statistically different between the two groups.

CONCLUSION
Embolic treatment of non-ruptured VAA (n = 11). The conservatively treated patients presented a 30-day mortality of 6.1% (11 of 181).

CLINICAL RELEVANCE/APPLICATION
Arterial embolization in patients with angiographically NBU is as safe and effective as embolization in patients with BU.
Patients with Benign Prostatic Hyperplasia and Acute Urinary Retention with Bladder Catheter

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIR41-09 ● Prostate Embolization
Jafar Golzarian MD (Presenter)

LEARNING OBJECTIVES
Applying a new technique (PAE) in patients with BPH and AUR and with bladder catheter

CLINICAL RELEVANCE/APPLICATION
Prostatic Artery Ambolization can have a future place in urologic guidelines and it is important to report technical and clinical outcomes.

CONCLUSION
PAE is safe procedure with low morbidity as well as good short, medium and long term results.

CLINICAL RELEVANCE/APPLICATION
Prostatic Artery Ambolization can have a future place in urologic guidelines and it is important to report technical and clinical outcomes.

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Feasibility of Calcium Image Subtraction Using Second-generation 320-detector Row Coronary CT Angiography

Andreas Fuchs (Presenter) ; J. Tobias Kuhl ; Marco Razeto * ; Arakita Kazumasa * ; Steffen Helqvist ; Joanne Schuifj * ; Marcus Y Chen MD ; Andrew E Arai MD ; Klaus Kofoed MD

PURPOSE

The reader confidence and diagnostic accuracy of Coronary CT angiography (CCTA) can be compromised by the presence of calcified plaques causing blooming artifacts. Compared to conventional invasive coronary angiography (CAG), this may cause an overestimation of stenosis severity leading to false positive results. We tested the feasibility of a new coronary calcium image subtraction algorithm in relation to reader confidence and diagnostic accuracy.

METHOD AND MATERIALS

Twenty-seven patients underwent both CAG and CCTA on clinical indication using a second-generation 320-detector row CT. Median Agatston score was 345 (interquartile range 110–1328). Two datasets were reconstructed: a conventional CCTA (conCCTA) and a subtracted CCTA (subCCTA), where calcifications detected on non-contrast images were subtracted from the CCTA. Reader confidence (1=poor, 2=partial diagnostic, 3=diagnostic) and concordance with CAG for identification of >50% stenosis (17 segment model) were recorded. We defined study lesions on conCCTA as motion free coronary segments with calcified plaque. The impact of coronary calcium image subtraction was assessed in these coronary segments.
RESULTS
A total of 130 study lesions were identified. Out of these, low reader confidence (less than 3) was found in 41 due to severe coronary calcification or stents. The use of coronary calcium image subtraction improved the reader confidence in 36% (13/36) of the segments with severe calcification and in 60% (3/5) of the segments with coronary stents. In 31 of the study lesions CAG found stenosis >50%. With conCCTA the false positive rate in study lesions was 18% (24/130) compared to 14% (19/130) with subCCTA.

CONCLUSION
Our initial experience with coronary calcium image subtraction suggests that it is feasible, and could lead to an improvement in reader confidence and diagnostic accuracy for identification of significant coronary artery disease.

CLINICAL RELEVANCE/APPLICATION
Coronary calcium subtraction may improve reader confidence and diagnostic accuracy in the presence of calcified plaques and stents, and thus may possibly improve overall diagnostic strength of CCTA.

SSK03-02 • Effect of Snapshot Freeze Motion Correction Algorithm on Image Quality of Prospective ECG-triggered Coronary CT Angiography
Lijuan Fan (Presenter); Jiwang Zhang; Donghai Fu; Liren Zhang MD

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

METHOD AND MATERIALS
Thirty consecutive patients undergoing coronary CTA with prospective ECG-triggered. We compared image quality and interpretability between standard (STD) and snapshot freeze motion correction (SSF) reconstructions. Coronary CTA images were interpreted with Likert 5-points score by two experienced radiologists. The image qualities and interpretability were respectively assessed on per-patient, per-artery and per-segment levels. Comparisons of variables were performed with Wilcoxon rank sum test and McNemar test.

RESULTS

CONCLUSION
The use of snapshot freeze motion correction algorithm improves image quality and interpretability in patients undergoing prospective ECG-triggered coronary CTA.

CLINICAL RELEVANCE/APPLICATION
The use of snapshot freeze motion correction algorithm improves image quality and interpretability in patients undergoing prospective ECG-triggered coronary CTA.

SSK03-03 • Association of Calcium Score and Coronary Artery Disease on CCTA according to the Presence and the Degrees of Diabetic Retinopathy: Preliminary Results
Eun Young Kim (Presenter); Joon-Won Kang MD; Dong Hyun Yang MD; Tae-Hwan Lim MD, PhD

PURPOSE
To compare the difference of coronary artery calcium (CAC) score, plaque characterization and coronary artery disease in diabetes mellitus (DM) patients according to the presence and the type of retinopathy using coronary CT angiography (CCTA).

METHOD AND MATERIALS
From 1 February 2009 to 31 July 2011, 172 consecutive patients (89 men, 83 women mean age, 65.4±9.3 years) diagnosed with type 2 DM and CCTA taken were enrolled. The patients were categorized according to the presence of diabetic retinopathy (DR) and the types of DR. Differences in CAC score, plaque score, segment score and degree of stenosis were compared, simultaneously using Chi-square test and T-test.

RESULTS

CONCLUSION
CAC score, plaque burden is significantly higher in DR and it becomes clear that in addition to that result, significant stenosis is more common in PDR patients. At least, proliferative diabetic retinopathy patients need to identify coronary artery disease with CCTA.

CLINICAL RELEVANCE/APPLICATION
This study suggested that PDR could be a predictor for CHD in asymptomatic type 2 diabetic patient and PDR patients need to start screening test for CHD through the CCTA.

SSK03-04 • Combined Assessment of MR Flow Measurement of Coronary Artery Bypass Graft and Stress Perfusion MRI in Detecting Graft Stenoses
Tatsuro Ito MD (Presenter); Masaki Ishida MD, PhD; Kakuya Kitagawa MD, PhD; Hiroshi Nakajima MD; Kaoru Dohi; Shinji Kanemitsu; Hitoto Shimpo; Masaaki Ito; Hajime Sakuma MD *

PURPOSE
Stress myocardial perfusion MRI is useful for the detection of flow-limiting coronary stenosis. However, reduced sensitivity of stress myocardial perfusion MRI was reported in patients after coronary artery bypass grafts (CABG). MR flow measurement can provide functional assessment of CABG and permits noninvasive detection of significant graft stenoses. The purpose of this study was to evaluate the value of combined assessment of MR graft flow measurement and stress myocardial perfusion MRI for the detection of graft stenoses.

METHOD AND MATERIALS
Forty-eight patients (68±7 years) with CABG who had recurrent chest pain and underwent both coronary angiography and cardiac MRI including stress perfusion, late gadolinium enhancement (LGE) MRI and MR graft flow measurement within 3 months were studied. The observers recorded the presence or absence of myocardial ischemia using 4-point scale. The threshold of 24.8ml/min, determined by ROC analysis, was used for identifying functional abnormality of the graft. Stenoses >70% in bypass grafts were considered significant.

RESULTS
Ninety-nine grafts were eligible for the analysis. MR graft flow measurement was inconclusive due to metal artifact in 6 (6%) grafts, whereas stress perfusion MRI was diagnostic in all patients. When 93 areas with successful flow measurements were evaluated, the diagnostic performance assessed by the area under the ROC curve (AUC) was significantly higher with MR graft flow measurement (AUC 0.924; sensitivity 90%; specificity 85%) than with stress perfusion MRI (AUC 0.793; sensitivity 70%; specificity 74%) (p=0.040) (Figure 1). In the analysis of all 99 areas with bypass grafts, stress perfusion MRI yielded a sensitivity of 70% and a specificity of 75% in detecting significant graft stenoses. These values were improved to 87% and 86% by combining MR graft flow measurement and stress perfusion MRI, using MR flow measurement as a primary determinant.
CONCLUSION
MR graft flow measurement combined with stress perfusion MRI can provide excellent diagnostic accuracy for the detection of graft stenoses in patients after CABG.

CLINICAL RELEVANCE/APPLICATION
MR graft flow measurement combined with stress perfusion MRI is highly valuable for the accurate detection of graft stenoses in patients after CABG.

SSK03-05 • Feasibility Study of the 100kVp and 400mA Coronary CTA
Kai Zhao (Presenter) ; Yuan Jiang ; Jian-Xing Qiu MD ; Xiaoying Wang MD

PURPOSE
To study the image quality and radiation dose of 100 kVp and 400 mA CT imaging in patients undergoing coronary CT angiography (CCTA).

METHOD AND MATERIALS
From September to December 2012, 101 patients suspected of coronary artery disease were scanned by GE CT 750HD with retrospectively ECG-gated reconstruct mode, whose weight was less than 80 kg. They were divided into 100 kVp group (n=65) and 120kVp group (n=36). The patients in 100 kVp group were scanned with 100 kVp and ECG modulation tube current (peak current 400 mA), while 120 kVp group were scanned with 120 kVp and ECG modulation tube current (peak current 500 mA). Contrast medium injection rate and volume were personalized by patient's weight (370 mgI/ml, mean 40ml). CT image raw data sets were reconstructed with ASiR-FBP composite at 30%. The effective radiation dose (ED) and size specific dose estimate (SSDE) of each patient were calculated. CT attenuation of the main vessels were measured and the image quality (noise, CNR, SNR) were estimated. Subjective evaluation was assessed by an experienced radiologist. Independent samples T test and Mann-Whitney U test were performed to compare the difference between the 2 groups.

RESULTS
CONCLUSION
To those whose body weight is less than 80 kg, CCTA obtained by 100 kVp, may obtain diagnostic image quality with more than half of the radiation dose reduction.

CLINICAL RELEVANCE/APPLICATION
High radiation exposure for CCTA is a concern and a limitation for its use, 100kVp and 400mA provide a feasible way to solve the problem for most people.

SSK03-06 • Accuracy of Coronary Plaque Detection Using a Semiautomatic Plaque Analysis Software in Computed Tomography Coronary Angiography
Azien Laqmani (Presenter) ; Thorsten Klink MD ; Marcus Quitzke ; Domenique-Daniel Credner ; Gerhard B Adam MD ; Gunnar K Lund MD

PURPOSE
To assess the accuracy of coronary plaque detection with a semiautomatic plaque analysis software in computed tomography coronary angiography (CTCA) with a 256-MSCT scanner.

METHOD AND MATERIALS
RESULTS
The software automatically identified 114 structures as plaques. 32 (28%) of the automatically marked lesions complied with plaques (true-positive), 82 (72%) of the lesions did not correspond with visually detectable plaques (false-negative). 20 plaques were manually detected by observers but not by the software (false-positive). For 2 false-positive detected plaques the following potential reasons were noticed by the observers: high density in pericoronary fat (59%), vessel ramification (24%), contrast in adjacent veins (6%), artery kinking (4%) and falsely contoured vessel (7%).

CONCLUSION
The evaluated semiautomatic plaque analysis software demonstrates a very high false-positive detection rate of coronary plaques.

CLINICAL RELEVANCE/APPLICATION
Detection of coronary plaques with a semiautomatic plaque analysis software is not reliable. A revision of the software marked lesions as plaques is indispensable.

SSK03-07 • Restriction of Referral to CTCA by Clinical Evaluation Combined with Calcium Score
Anoeshka S Dharampal MD (Presenter) ; Alexia Rossi MD ; Admir Dedic MD ; Annick C Weustink MD, PhD ; Mohamed Ouhious MD, PhD ; Filippo Cademartiri MD, PhD * ; Eric H Boersma PhD ; Koen Nieman MD ; Pim Feyter MD, PhD ; Gabriel P Krestin MD, PhD *

PURPOSE
To investigate the value of calcium score (CaSc) in addition to clinical evaluation to restrict referral to CTCA by reducing the number of patients with intermediate probability of CAD.

METHOD AND MATERIALS
We retrospectively included 2042 symptomatic stable patients who underwent clinical evaluation, unenhanced CT-scan for the calculation of CaSc and CTCA. Obstructive CAD (≥50% lumen diameter narrowing) assessed by CTCA was the outcome. We investigated 2 models, first, clinical evaluation consisting of chest pain typicality, female sex, age, risk factors and ECG) and second model consisting of clinical evaluation with CaSc. The model discrimination of CAD was compared by using area under the receiver operating characteristic curves.

RESULTS
We assessed the net reclassification improvement (NRI) that allows both models to reclassify patients into low (evaluation with CaSc). The model discrimination of CAD was compared by using area under the receiver operating characteristic curves. We investigated 2 models, first, clinical evaluation consisting of chest pain typicality, female sex, age, risk factors and ECG) and second model consisting of clinical evaluation with CaSc. The model discrimination of CAD was compared by using area under the receiver operating characteristic curves.

CONCLUSION
Discrimination of CAD was significantly improved by addition of CaSc to clinical evaluation (AUC: 0.80 vs. 0.90, p < 0.001). The NRI using both model to reclassify all patients was 56%. The clinical net reclassification improvement by model 2 of patients first classified by model 1 having intermediate risk was 66%. Unenhanced CT-scan and CTCA could be avoided in 12% using model 1 and an additional 32% of CTCA could be avoided using model 2 subsequently.

CLINICAL RELEVANCE/APPLICATION
Risk reclassification of stable angina patients can be improved by using the calcium score model.

SSK03-08 • Effect of a Novel Motion Correction Algorithm (SSF) on the Image Quality of Coronary CTA with Higher Heart Rates: In Comparison with Bi-sector Reconstruction
Qianwen Li (Presenter) ; Xiangying Du MD ; Peng-Yu Li ; Xiaoguang Yang ; Kuncheng Li MD
SN229

Would We Miss?

SSK15-01 • Neuroradiology/Head and Neck (Head and Neck Tumors)

Wednesday, 10:30 AM - 12:00 PM

Results

SSK03-09 • Neuroradiology/Head and Neck (Head and Neck Tumors)

Wednesday, 10:30 AM - 12:00 PM

Society of Radiologists in Ultrasound (SRU) Recommendations for Workup of Imaging-detected Incidental Thyroid Nodules: What Types of Cancers Would We Miss?

Patricia M Carrascosa MD (Presenter) *; Carlos Capunay MD; Alejandro Deviggiano MD; Gaston Rodriguez Granillo; Jorge M Carrascosa MD

Purpose

The purpose of this study is to demonstrate that coronary angiography (CCTA) employing a novel intracyle motion compensation algorithm (SnapShot Freeze [SSF]) will be superior to CCTA without intracyle motion compensation algorithm (conventional CCTA) for diagnostic accuracy and image quality.

Method and Materials

The purpose of this study is to assess the effect of SSF algorithm on image quality in comparison with bi-sector reconstruction in higher heart rates.

CONCLUSION

SSF algorithm can provide superior image quality than bi-sector reconstruction in coronary CTA of patients with higher heart rates.

Clinical Relevance/Application

For higher heart rates patients, bi-sector reconstruction may be neglected by using the motion-correction algorithm, avoiding the higher radiation dose related to small pitch required by bi-sector.

SSK03-09 • Role of an Intracyle CT Motion Correction Algorithm in the Coronary CT Angiography Accuracy

Patricia M Carrascosa MD (Presenter) *; Carlos Capunay MD; Alejandro Deviggiano MD; Gaston Rodriguez Granillo; Jorge M Carrascosa MD

Purpose

The purpose of this study is to demonstrate that coronary angiography (CCTA) employing a novel intracyle motion compensation algorithm (SnapShot Freeze [SSF]) will be superior to CCTA without intracyle motion compensation algorithm (conventional CCTA) for diagnostic accuracy and image quality.

Method and Materials

Twenty patients with known or suspected coronary artery disease were studied with MSCT and ICA. CCTA were performed on a 128-slice CT scanner (Discovery CT750 HD, GE Medical Systems). Studies were done using prospective or retrospective ECG-gating depending on the heart rate of the patients. In the prospective scan a padding of 100 msec was used, while in the retrospective scans, cardiac x-ray modulation was performed (centered 45 % to 75% of the R-R interval).

First images were analyzed without the motion compensation algorithm and 2 weeks later in a random and blinded way with the algorithm.

The per-vessel and per-segment diagnostic interpretability and image quality of CCTA with and without motion compensation algorithm was calculated.

Results

From the 20 patients studied, 299 segments were analyzed.

In 215 of 299 segments, the motion compensation algorithm showed similar evaluation than conventional CCTA. In 84 segments, the motion compensation algorithm allowed a better evaluation.

In relation to vessel analysis, SSF showed improvement of vessel visualization in 30% of DA, 75% of CX and 40% of RCA.

SSF had only 1 segment non evaluable whereas conventional CCTA 15. The assessability was 99.6% versus 95 % for both modalities

Conclusion

SSF allowed better visualization of the coronary arteries as well as lesser non evaluable segments in comparison to conventional CCTA.

Clinical Relevance/ Application

Correction of coronary arterial motion on coronary CTA using an Intracyle CT Motion Correction Algorithm would be of clinical significance.

Neuroradiology/Head and Neck (Head and Neck Tumors)

Wednesday, 10:30 AM - 12:00 PM • N229

SSK15 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

Moderator

Yoshimi Anzai, MD

Moderator

Laurie A Loewner, MD

SSK15-01 • Using SRU Recommendations for Workup of Imaging-detected Incidental Thyroid Nodules: What Types of Cancers Would We Miss?

Manisha Bahl MD, MPH (Presenter); Julie A Sosa MD; Hasan A Hobbs MD; Nathan Wnuk MSc, BSc; Rendon C Nelson MD *

Purpose

To apply the Society of Radiologists in Ultrasound (SRU) recommendations to incidental thyroid cancers detected on imaging and to describe cancers that do not meet the workup criteria.

Method and Materials

We performed a retrospective review of 1721 patients who underwent thyroidectomy or lobectomy from 2003 to 2012 to identify thyroid cancers that were detected incidentally on imaging. Imaging-detected incidental cancer was defined as cancer in asymptomatic patients presenting with incidental thyroid nodules (ITN) on imaging with no other risk factors. The SRU recommendations were applied to nodules with ultrasound for review. SRU positive nodules include solid nodules or nodules with coarse calcifications ≥15 mm, nodules with microcalcifications =10 mm, and solid-cystic nodules ≥20 mm. Tumor characteristics for SRU- and SRU+ groups were compared.

Results

Of 1721 patients who underwent surgery, 578 (34%) patients had thyroid cancer and 86 (5%) patients had thyroid cancer first detected incidentally by imaging studies. Incidental cancers were first detected on ultrasound in 21 patients. Other cancers were seen incidentally on CT, MRI, PET, octreotide scan, echocardiogram, and radiographs. The SRU recommendations were applied to 72 patients, of which 21 had ultrasound-detected ITN and an additional 51 who had ultrasound workup of ITN detected on other imaging modalities. 15/72 (21%) patients did not meet SRU recommendations for workup and would not have undergone FNA if the recommendations had been used at the time of diagnostic ultrasound. The SRU- group represented 3% of all malignancies. SRU- cancers had a mean size of 1.1 cm (range 0.9-1.4 cm) compared to 2.4 cm (range 1.0-7.6 cm) for SRU+ cancers. Histology was papillary in 3/15 SRU- and 50/57 SRU+ cancers.
SSK15-02 • Thyroid Nodules: A Total Malignancy Score (TMS) for Ultrasound (US) - A Validation Pilot Study

Giovanni G Pompili MD (Presenter) ; Silvia Tresoldi MD ; Alessandra Primoleo ; Stefania Rossi ; Gaetano Bulfamante PhD ; Gianpaolo Cornalba MD

PURPOSE
The aim of our study was to validate a malignancy score of thyroid nodules (Total Malignancy Score \( \text{TMS} \)) based on their ultrasound features. Pilot study

METHOD AND MATERIALS
Based on a retrospective analysis of 102 patients with follicular pattern at US we recently suggested an US score for the characterization of thyroid nodules [a score from 0 (most likely benign) to 2 (most likely malignant) was assigned to each nodule feature \( \text{TMS} \) number, margins, colour-flow, structure, echogenicity, halo, calcifications, dimensional increment \( \text{TMS} \) leading to a total score \( \text{TMS} \) ranging from 0 to 11]. The malignancy score system is shown in Figure 1.

In the present study we prospectively apply that score to all the patients undergoing a thyroid nodule fine needle aspiration cytology (FNAC) at our Institution. The score results are then compared to the cytological diagnosis.

RESULTS
between September 2012 and April 2013 59 consecutive patients entered the study. Among patients with TMS 3 (20/59) 8 had non-negative cytological results. Patients with non-negative cytological results (n=9) were diagnosed with malignancy (TMS 4 n=3; TMS 6 n=1); follicular proliferation (n=2; both follicular adenomas at surgery; TMS 5 and 3 respectively) or high cellularity lesion (TMS 4 n=1; TMS 5 n=2).

CONCLUSION
The preliminary results of this pilot study confirms what previously suggested: the identification of a predictive US score would allow a more accurate estimation of risk. Nodules with a TMS 3 should undergo FNAC, nodules with a score

CLINICAL RELEVANCE/APPLICATION
Our US-TMS, when validated, will be useful in the management of patients with thyroid nodules avoiding useless FNAC when benign features are recognized, and suggesting cytology in potential malignancy.

SSK15-03 • Can Ultrasound Features of Thyroid Nodules Predict Outcomes after a Non-diagnostic Fine Needle Aspiration?

Thomas J Anderson MD (Presenter) ; Michael K Atalay MD, PhD ; David J Grand MD ; Michael D Beland MD

PURPOSE
Ultrasound characteristics of thyroid nodules are notoriously poor predictors of malignancy. The purpose of this study was to identify reproducible ultrasound characteristics that could indicate benignity to avoid repeat biopsies when the initial FNA is non-diagnostic.

METHOD AND MATERIALS
We identified 5399 nodules that were biopsied under ultrasound guidance in our radiology department between 2004 and 2012. Of these, 454 initially non-diagnostic and met inclusion criteria with adequate cytological, surgical, or ultrasound follow up. Three independent, board-certified radiologists who were blinded to outcomes scored the ultrasound features of each nodule. Nodule size, composition, border, calcifications, comet tail, and central vascularity were recorded. Outcomes data were collected through review of the medical record.

RESULTS
Of the 454 initially non-diagnostic thyroid FNAs, 10 malignancies (2.2%; 3 follicular, 7 papillary) were diagnosed by subsequent FNA (3, 0.7% or surgery (7, 1.5%). There were no cancers detected in nodules with a spongiform or cystic composition, with a comet tail, or with eggshell or indeterminate calcifications. The minimum diameter of any malignant nodule was 0.8cm, with an average of 2.2cm, compared to 0.3cm and 1.5cm in the benign group (p=0.049).

CONCLUSION
The incidence of malignancy after initial non-diagnostic FNA is very low (0.7%), particularly when the nodule is cystic, spongiform, or in the presence of a comet tail, or eggshell or indeterminate calcifications. In the setting of a non-diagnostic FNA with these features, clinical and ultrasound follow-up are more appropriate than repeat FNA, particularly in smaller nodules.

CLINICAL RELEVANCE/APPLICATION
Clinical and ultrasound follow-up may be more appropriate than repeat FNA in thyroid nodules with a non-diagnostic result and reassuring ultrasound characteristics.

SSK15-04 • Is Repeat FNA after a Non-diagnostic Thyroid Nodule FNA Necessary?

Thomas J Anderson MD (Presenter) ; Michael K Atalay MD, PhD ; David J Grand MD ; Michael D Beland MD

PURPOSE
Fine needle aspirates (FNA) of thyroid nodules have a diagnostic yield of 85-90%, but optimal management of non-diagnostic results is unknown. The aim of this study was to identify demographic features predictive of malignancy after an initially non-diagnostic FNA and the role of subsequent FNA.

METHOD AND MATERIALS
We identified 5399 nodules that were biopsied under ultrasound guidance in our radiology department between 2004 and 2012. Of these, 454 were initially non-diagnostic and met inclusion criteria with adequate cytological, surgical, or ultrasound follow up. Demographic and laboratory data were correlated with outcomes through review of the medical record.

RESULTS
Of the 454 initially non-diagnostic thyroid FNAs, 10 malignancies (2.2%; 3 follicular, 7 papillary) were diagnosed by subsequent FNA (3, 0.7% or surgery (7, 1.5%). 373 (82.2%) were benign at subsequent FNA (279, 61.5%) or surgical pathology (94, 20.7%), and 71 (15.6%) were stable or decreased in size by serial ultrasound examinations (mean follow up: 2.7 years). In 77 males (17%), 4 (5.2%) cancers were detected; in 377 females (83%), 6 (1.6%) cancers were detected (p=0.07). The average age of this cohort was 55.7 years, while patients with malignancies averaged 62.3 (p=0.02). No malignancies were detected in patients less than 47 years of age. 27 (5.9%) patients were noted to have a papillary cancer elsewhere in the thyroid either at the time of surgery or by FNA of a separate nodule.

CONCLUSION
The likelihood of a malignant FNA after a non-diagnostic FNA is very low (0.7%), and therefore clinical and ultrasound follow up may be more appropriate than repeat FNA, particularly in female patients under the age of 45.
Excitation Pulses

Standard- and High-b-value Diffusion Weighted MR Imaging

SSK15-07 • Tool for Post-surgical Follow-up Regardless of TSH Stimulation?

Ha Young Lee (Presenter); Jung Hwan Baek; Hyunkyung Yoo MD; Young Hye Kang MD; Myung Kwan Lim MD

PURPOSE
To evaluate which factors affected atypia with undetermined significance (AUS) results of thyroid nodules with initial nondiagnostic (ND) result and to determine whether repeat fine needle aspiration biopsy (FNAB) with short interval increases AUS result.

METHOD AND MATERIALS
A retrospective review of 128 nodules from 126 patients with initial ND results was performed from January 2009 to December 2012. Demographic and clinical factors; age, sex, and time interval of FNAB, and ultrasonographic factors; size, location, consistency, suspicious malignant finding and thyroiditis were recorded. Time interval was subdivided into < or = 5, 10, 15, and 20 weeks after initial FNAB. Their effects on AUS result were analyzed using Fisher’s exact test and Mann-Whitney U test.

RESULTS
None of the demographic, clinical, and ultrasonographic variables was significantly related with AUS result of repeat FNAB. Time interval of repeat FNAB was not related with AUS result (p=0.63, 0.57, 0.23, 0.48 for 5, 10, 15, 20 weeks, respectively).

CONCLUSION
Timing of repeat FNAB for the ND nodules did not influence the AUS result of repeat FNAB, and other clinical and US characters were not correlated with AUS result. Repeat FNAB for ND nodules could be performed without waiting for 3 months following to the need of patients and referring clinicians.

CLINICAL RELEVANCE/APPLICATION
1. To determine the recommended waiting period of 3 months is neccessary or not.
2. To provide clinical evidence for management of thyroid nodules with initial nondiagnostic results.

SSK15-06 • Thyroglobulin Measurement in Fine Needle Aspirates from Neck Lesions after Total Thyroidectomy: Is It a Reliable Tool for Post-surgical Follow-up Regardless of TSH Stimulation?

Youngheon Lee MD (Presenter); Hyung Suk Seo; Nan Hee Kim; Soon Young Kwon; Gil Soo Son

PURPOSE
Thyroglobulin (Tg) measurement in needle washout fluid has been reported to increase diagnostic accuracy of fine needle aspiration for sonographically suspicious neck lesions encountered in postoperative follow-up. Although TSH stimulation is needed to improve the diagnostic accuracy of serum Tg for detection of recurrence, it is not clear whether stimulated or suppressed TSH status affect FNA-Tg.

METHOD AND MATERIALS
A total of 104 consecutive patients with papillary thyroid carcinoma initially treated by total thyroidectomy followed by remnant iodine ablation were retrospectively enrolled. They were sonographically evaluated for cervical recurrence by FNA-Tg and cytology during recent 5 years. Final diagnoses were confirmed by histopathologic results or follow-up examination at least 3 years. We evaluated the diagnostic performances of their FNA-Tg and cytology, serum Tg, anti-Tg antibodies, depending on the TSH stimulated or suppressed.

RESULTS
Of 104 lesions, 30 were confirmed as recurrences and 74 were non-recurrence. On TSH stimulated condition, both serum Tg and FNA-Tg levels in recurrent group were significantly higher in those of non-recurrent group (p<0.05). On TSH-suppressed condition, FNA-Tg measurement may be sufficient postoperative follow tool for cervical recurrence in patients with thyroid cancer.

CONCLUSION
On TSH-suppressed condition, FNA-Tg measurement may be sufficient postoperative follow tool for cervical recurrence in patients with thyroid cancer.

SSK15-07 • Head and Neck Squamous Cell Carcinoma: Predicting Treatment Response to Induction Chemotherapy with Standard- and High-b-value Diffusion Weighted Imaging

Inseo Ryoo MD (Presenter); Ji-Hoon Kim MD; Soo Chin Kim MD; Tae Jin Yun MD; Seung Hong Choi MD, PhD; Chul-Ho Sohn MD; Jisang Park MD; Koung Mi Kang; Eun Kyoung Lee MD

PURPOSE
Recent publications reported the contradictory results of pretreatment diffusion-weighted MR imaging (DWI) for the prediction of chemoradiotherapeutic response in primary head and neck squamous cell carcinomas (HNSCC). The purpose of this study was to evaluate the diagnostic performance of DWI with both standard (b=1000 s/mm2) and high (b=2000 s/mm2) b-values for predicting treatment response to induction chemotherapy in primary HNSCC.

METHOD AND MATERIALS
Twenty seven patients with primary HNSCC who underwent DWI with both b=1000 and 2000 s/mm2 prior to treatment were included in this study, and corresponding apparent diffusion coefficient (ADC) maps were calculated. Regions of interest containing the tumor were correlated with treatment response using unpaired student t-test.

RESULTS
Among 27 patients, 14 showed good response (complete remission or partial response) and 13 showed poor response (stable disease or progressive disease) to induction chemotherapy. The mean ADC values of good responders (1252.7±91.4 s/mm2 at b=1000 and 625.36±36.9 s/mm2 at b=2000) were lower than those of poor responders (1294±19.5 s/mm2 at b=1000 and 746.5±41.8 s/mm2 at b=2000). But statistically significant difference was achieved at only high-b-value ADC map. (p=0.039) The 75th percentiles of cumulative ADC histogram of good responders (807.3±54.9 s/mm2) also showed statistically significant lower values than those of poor responders (363.7±48.7 s/mm2) at only high-b-value ADC map. (p=0.04)

CONCLUSION
Pretreatment DWI with high-b-value may facilitate and be better in predicting treatment response to induction chemotherapy than DWI with standard-b-value in primary HNSCCs.

CLINICAL RELEVANCE/APPLICATION
Based on our study results, high-b-value DWI has the potential to facilitate pretreatment prediction of the response to induction chemotherapy in primary head and neck squamous cell carcinomas.

SSK15-08 • Improved Zoomed EPI-DWI of the Head and Neck Using Two-dimensional Spatially-selective Radiofrequency Excitation Pulses
Diffusion-weighted MR imaging (DWI) in the head and neck is challenging especially because of susceptibility artifacts. Two-dimensional spatially-selective radiofrequency (RF) excitation pulses for single-shot echo-planar imaging (EPI) combined with reduced FOV i.e. zooming - in the phase-encoding direction lead to a decreased number of acquisition k-space lines and significantly shorten the length of the EPI echo train. This can potentially reduce susceptibility artifacts. The purpose of this study was to evaluate the feasibility of a zoomed DW EPI (z-EPI) sequence in the head and neck in a healthy volunteer population. The approach was compared to conventional single-shot EPI (c-EPI).

METHOD AND MATERIALS
The necks of 9 healthy volunteers were examined in this prospective IRB-approved study. All examinations were performed on a 3T whole-body MR system (MAGNETOM Skyra, Siemens Healthcare, Erlangen, Germany) equipped with a two-channel fully dynamic parallel transmit array, termed TimTX TrueShape. In all subjects, the experiment consisted of a conventional EPI sequence and two zoomed EPI sequences. Therefore the excitation of the standard DW EPI sequence was extended by the two-dimensional spatially-selective RF pulse using an echo-planar transmit trajectory. For quantitative assessment of distortion artifacts, DW images were merged with T2 TSE. Maximum misregistration of DW images with T2 TSE images was assessed in the cervical myelon. For qualitative assessment two readers ranked c-EPI and z-EPI sequences in terms of susceptibility artifacts, image blur and overall scan preference.

RESULTS
Zoomed DW EPI in the head and neck leads to substantial image quality improvements and has the potential to exhibit markedly reduced susceptibility artifacts and image distortion especially in regions close to major air cavities.

CLINICAL RELEVANCE/APPLICATION
Due to significantly reduced susceptibility artifacts zoomed DW EPI in the head and neck could have a potential value for identification of small malignant lymph nodes prior to neck dissection.

CONCLUSION
Sonoelastography has high accuracy in differentiating benign and malignant salivary gland tumors.

CLINICAL RELEVANCE/APPLICATION
Sonoelastography for differentiating benign and malignant salivary gland tumors.
Between 1992 and 2011, temporary and long-term CVA placement procedures increased from 638,703 to 808,071 (+27%) and 76,444 to 316,042 (+313%), respectively. For temporary CVCs, radiology (0.4% in 1992 to 32.6% in 2011) now exceeds anesthesia (37.0% to 22.0%) and surgery (30.4% to 11.7%) as the dominant provider group. Surgery continues to dominate in placement and explantation of long-term CVADS (80.7% to 50.4% and 81.6% to 47.7%, respectively), but radiology's share has grown enormously (0.7% to 37.6% and 0.2% to 28.6%). Although volumes remain small.

**CONCLUSION**
Over the last two decades, CVA procedures on Medicare beneficiaries have increased considerably. Radiology is now the dominant overall provider.

**CLINICAL RELEVANCE/APPLICATION**
As venous access procedures have increased dramatically in Medicare beneficiaries over the last two decades, radiology's relative contributions to these important services has expanded dramatically.

### SSK23-02 • Mechanical Failure with a Radiologically Placed Totally Implantable Central Venous Arm Port System

**Jasmin D Busch MD (Presenter) ; Catherine T Mahler ; Christian R Habermann ; Andreas Koops MD ; Gerhard B Adam MD ; Harald Ittrich MD**

**PURPOSE**
To evaluate the frequency of mechanical failures, in particular catheter line rupture and fragment embolization, related to a radiographically controlled and brachially placed totally implantable central venous arm port system (TCVAP) used for mid- to long-term vascular access.

**METHOD AND MATERIALS**
A retrospective audit of our Centricity Radiology Information System (GE Healthcare, Braunschweig, Germany) was performed from 2006 until April 2013 to determine the number of Cook Vital-Port Mini Titanium (Cook Medical Inc., Limerick/Ireland) implanted between January 1, 2006, and June 30, 2011 and the frequency of device-related complications (mechanical failure, rupture and fragment embolization) until demise or explantation.

**RESULTS**
**CONCLUSION**
With the Cook Vital-Port Mini Titanium implanted at the upper arm we observed in 2.3% a partially or complete catheter line fracture associated with a high incidence of fragment embolization. The high rate of clinically unapparent catheter line fractures demands special attention of TCVAP users to recognize malfunctions. Despite from the risk of extravasation in patients under chemotherapy, in particular, fragment embolization puts the patients at risk for further severe complications.

**CLINICAL RELEVANCE/APPLICATION**
TCVAP are a proper tool for vascular access. However, due to the accumulation of material failure further investigation are warranted to determine the cause of material failure.

### SSK23-03 • Characteristics of an Infectious Complication on Implantable Venous-access Port

**Jisue Shim ; Tae Seok Seo MD, PhD ; In-Ho Cha MD, PhD ; Myung Gyu Song MD (Presenter) ; Eun-Young Kang MD ; Hwan Seok Yong MD ; Chang Hee Lee MD**

**PURPOSE**
The purpose of this study is to assess the demographic and bacteriologic characteristics and risk factors of implantable venous-access port (IVAP)-associated infection.

**METHOD AND MATERIALS**
Between August 2003 and November 2011, we placed 1,747 ports in interventional radiology suites. A total of 144 and 1,603 ports were placed in patients with hematologic malignancy and with solid tumor, respectively. We removed 45 ports to treat port-related infection, from 37 patients with systemic febrile symptom and 8 patients with signs of local infection. We evaluated the incidence of port-related infection, demographic factors, bacteriologic data, and patients’ progress by review of medical record. Univariate analyses (chi-square test and Fisher’s exact test) and multivariate logistic regression analyses were used to determine the risk factors for complications.

**RESULTS**
Overall, 45 (2.58%) out of 1,747 ports were removed for infectious symptom, with an incidence rate of 0.075 events/1,000 catheter-days. The incidence rate of port-related infection was higher in hematologic disease patient than in solid organ tumor patient (p=0.03). The infection rate was higher in inpatients intervention than outpatients (p=0.02). Hematologic malignancy was the only significant risk factor of IVAP-related infection (OR 0.304, 95% confidence interval 0.144-0.643, p=0.002). Microorganisms were isolated from 30 (66.7%) blood samples. Causative organisms were Staphylococcus species (n=13), Candida species (n=9), Non-tuberculosis Mycobacterium (n=2), Escherichia coli (n=1), Acinetobacter baumannii (n=2), Klebsiella pneumonia (n=2), Rhodotorula mucilaginosa (n=1) and Enterococcus faecium (n=1). Additionally, catheter tip culture studies were positive in nine cases and isolated microorganisms were same as blood culture studies. Wound culture in localized infection revealed no organisms in all cases.

**CONCLUSION**
The incidence of IVAP-related infection was significantly higher in hematologic malignancy patient and when intervention was done after admission. The common causative organisms were Staphylococcus and Candida species. The explantation of devices seems to be helpful for treatment of local and systemic infection suspiciously related with IVAPs.

**CLINICAL RELEVANCE/APPLICATION**
The knowledge of the characteristics of IVAP-related infection may be helpful to manage infected port.

### SSK23-04 • Patients’ Perceptions of Peripherally Inserted Central Catheter for Cancer Treatment: A Comparative Single-institution Prospective Analysis

**Francois-Xavier Arnaud MD (Presenter) ; Christophe Teriitehau ; Gabrielle Weber-Donat ; Denis Metivier ; Caroline Bouzad ; Julien Potet MD**

**PURPOSE**
To prospectively assess the perceptions of cancer patients of having a PICC and to compare these perceptions with those of non-cancer patients.

**METHOD AND MATERIALS**
Patients’ perceptions were registered on three occasions (T1, right after PICC placement; T2: 1 week after placement and T3: three weeks after placement), with the use of two specific questionnaires. Questionnaire I contained 17 items covering five domains (anxiety, information, pain, procedure duration and discomfort), whereas questionnaire II was made up of 17 items covering 6 domains (pain, information, restrictions in daily activities, anxiety, discomfort and overall satisfaction) Results were analyzed considering the cancer group and then compared to the non-cancer group using Pearson chi-squared or Fisher’s exact tests and Student T-tests. Regression tests were performed to study the association between different factors and the procedure-related pain at T1 or the global satisfaction at T2 and T3.

**RESULTS**
150 PICCs were implanted in 125 consecutive patients (78 patients in the cancer group and 47 in the non-cancer group). Pain level was low (2.5, 95% CI 2.0-2.9) in cancer patients at T1 and decreased at the end of the procedure (0.5, 95% CI 0.2-0.7). 96.2% of cancer patients found that the pain was equal or lower than expected before the procedure. Disturbing factors were venous puncture (24.4% of
32 symptomatic uterine fibroids in 28 women (age 35-54 y-o) underwent MRgFUS treatment between September 2010 and January 2012 to evaluate the safety and efficacy of ultrasound guided high-intensity focused ultrasound (USgHIFU) treatment of symptomatic uterine fibroids using high sonication energy protocol.

METHOD AND MATERIALS

This was a prospective, on-going, phase I study. Protocol was approved by institutional review board and informed consent were obtained. A total of 20 patients with 22 symptomatic fibroids were included in the study and were treated with US-guided HIFU ablation. The fibroids were ablated using dot mode under power output of 800 - 1500W for 1500 - 2000 sonication pulses at each spot. The primary endpoints were peri-procedural complications. The secondary endpoints were clinical symptomatic improvement and radiological evidence of treatment response including degree of fibroid infarction and volume shrinkage at 3 months after treatment. The symptoms studied include pain, menorrhagia, and fibroid related urinary symptoms and these were assessed by pain score, pictorial chart score, Urogenital Distress Inventory (UDI-6) and Incontinence Impact Questionnaire (IQ-7). The degree of fibroid infarction was assessed by dynamic contrast 3T MRI and was reflected by non-perfused ratio (NPR) calculated as non-perfused volume as a percentage of the total fibroid volume.

RESULTS

Nineteen patients tolerated the treatment well and were treated on an outpatient basis. One patient who received treatment for a fibroid located in the neck developed a transient hypothyroidism. No other complications were observed during treatment or between 6 and 12 months. The safety of the procedure was confirmed using both clinical and imaging scores. There were no cases of uterine perforation or uterine rupture despite treatment of very large fibroids. The average NPR at 6 months was 0.73 ± 0.24 and at 12 months was 0.75 ± 0.24, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted. The average volume reduction at 6 months was 36 ± 15% and at 12 months was 41 ± 16%, indicating that the fibroids were mostly infarcted.

CONCLUSION

The results from our study show that it is possible to estimate thermal conductivity of human uterine fibroid tissue in vivo from spatio-temporal evolution of temperature during MR-guided HIFU. In-vivo uterine fibroid thermal conductivities across different cell sizes were within 13% of the mean, indicating close agreement, and is roughly similar to reported thermal conductivities of skeletal muscle. 1. Kohler, et al. Med. Phys., 36(8), 3521-35, 2009 2. Zhang, et al. JMRI, 37(4), 950-7, 2012

CLINICAL RELEVANCE/APPLICATION

1. Effectiveness of tissue ablation during MR-HIFU in vivo is influenced by tissue thermal properties such as thermal conductivity which can be estimated from spatio-temporal evolution of temperature.

SSK23-07 • MRgFUS Treatment of Uterine Fibroids: Evaluation of Fibroid Volume, Perfused Volume (PV) and Clinical Scores Modifications at 6-month and 12-month Follow Up

Marta Valani MD (Presenter) ; Irene Invernizzi MD ; Paola Enrica Colombo ; Fabio Zucconi MPH ; Angelo Vanzulli MD ; Cristiana Ticca MD

PURPOSE

to assess the correlation between fibroid volume, perfused volume (PV) and clinical scores modifications at 6-month (6-m) and 12-month (12-m) follow up, evaluation in 28 patients with 32 fibroids treated with Magnetic Resonance guided Focused Ultrasound Surgery (MRgFUS).

METHOD AND MATERIALS

32 symptomatic uterine fibroids in 28 women (age 35-54 y-o) underwent MRgFUS treatment between September 2010 and January 2012 using the ExAblate 2000 system (InSightec). Before treatment T2weighted multiplanar MR images were obtained to measure uterine fibroids volume. Immediately after treatment T1weighted contrast-enhanced fat-sat multiplanar MR images were used to measure the Non-Perfused Volume (NPV) and to define PV subtracting NPV from fibroid volume. Similar images obtained 6±1 months and 12±2 months after treatment were used to determine fibroid volume and PV modifications. The Symptom Severity Score (SSS) and Quality of Life Score (QOLS) were examined before treatment and at 6-m and 12-m. Quantitative and qualitative relations between fibroid volume,
Incidence and Prognostic Factor for Stent Migration after Retrievable Expandable Metallic Stent Placement:

**OBJECTIVE**

To evaluate the incidence, prognostic factor, and interventional management of stent migration after placement of retrievable expandable stents.

**METHOD AND MATERIALS**

A retrospective analysis of 444 patients who underwent stent placement from January 2012 to December 2016 was conducted. The stent migration was assessed by reviewing post-procedural imaging studies.

**RESULTS**

Stent migration occurred in 17% of the cases, with the highest rate observed in the esophageal strictures (30%). The risk factors for stent migration included longer stent length, larger stent diameter, and presence of comorbidities such as Barrett's esophagus.

**CONCLUSION**

Stent migration is a significant complication after stent placement in esophageal strictures. The risk factors identified can help in the selection of appropriate treatment strategies to prevent or manage stent migration.

**CLINICAL RELEVANCE/APPLICATION**

The findings highlight the need for careful patient selection and procedural planning to minimize stent migration complications.
To evaluate the incidence, prognostic factor, and interventional management of stent migration after placement of retrievable expandable metallic stents in patients with esophageal strictures.

**METHOD AND MATERIALS**

Retrievable expandable metallic stents were placed under fluoroscopic guidance in 444 patients with symptomatic esophageal stricture. We retrospectively reviewed collected patient records to evaluate the incidence and interventional management of stent migration. Multivariate analysis was performed to evaluate prognostic factors of stent migration. Stent migrations were classified into four patterns on the basis of the location of migrated stent.

**RESULTS**

Stent migration occurred in 50 (11.3%) of 444 patients 1 to 228 days (mean, 42 days) after stent placement. Multivariate analysis revealed that young patients (odds ratio [OR], 1.026; P = 0.036), grade 2; able to tolerate soft food without vomiting before the procedure (OR, 5.589; P < 0.001), and benign stricture (OR, 3.044; P = 0.017) were independent prognostic factors of stent migration. 39 (78%) of 50 patients with stent migration were required second interventional management. The remaining 11 patients showed improvement of the strictures until the end of the follow-up.

**CONCLUSION**

The overall incidence of stent migration was 11.3%. Stent migration occurs most commonly in young age, capability to tolerate soft food without vomiting before the procedure, and in patients with benign stricture. Stent migration can be successfully managed by additional intervention.

**CLINICAL RELEVANCE/APPLICATION**

Patients with capability to tolerate soft food without vomiting before the procedure were considered contra-indication for esophageal stent placement.

**SSK24-02 • Metallic Stent Placement in Patients with Recurrent Malignant Obstruction in Surgically Altered Stomach**

**Soo Hwan Kim** (Presenter); **Ho-Young Song** MD; **Jin Hyoung Kim** MD; **Jung-Hoon Park** RT; **Young Chul Cho** BS; **Ki Back Lee**

**PURPOSE**

To assess the technical feasibility and clinical effectiveness of expandable metallic stent placement in 196 patients for recurrent malignant obstruction in surgically altered stomach.

**METHOD AND MATERIALS**

The 196 patients were treated with five different types of gastric surgery for gastric cancer: total gastrectomy (type 1) in 72 patients, distal gastrectomy with gastroduodenostomy (type 2), in 39 patients, distal gastrectomy with a Roux-en-Y gastrojejunostomy (type 3) in 21 patients, distal gastrectomy with a gastrojejunostomy (ie, Billroth type II operation) (type 4) in 49 patients, palliative gastrojejunostomy for unresectable esophageal cancer (type 5) in 14 patients. Technical and clinical success, complications, and dysphagia score were evaluated and complications compared between fully covered stent and partially covered stent. Overall survival and stent patency rates were calculated according to the Kaplan-Meier method.

**RESULTS**

Stent placement was technically successful in 192 of 196 patients (97.9%) with 184 of 192 patients (95.8%) showing symptomatic improvement. In four patients, the guide wire could not pass through the stricture. The mean dysphagia score improved from 3.24 ± 0.64 to 1.48 ± 0.82 (P < 0.001). The complication rate was 25%. Incidence of stent migration was significantly greater in fully covered stents than partially covered stents (P < 0.001). The median survival and stent patency were 127 and 41 days, respectively.

**CONCLUSION**

Placement of expandable metallic stents in patients with recurrent cancer after surgically altered stomach technically feasible and clinically effective.

**CLINICAL RELEVANCE/APPLICATION**

Accurate knowledge of the type of surgical procedure performed and determination of the pattern of tumor recurrence are important for successful stent placement.

**SSK24-03 • The Use of Colorectal Stents to Avoid the Need for a Stoma When Treating Colorectal Cancer**

**Victoria H Wilkinson** MBChB, FRCR; **James N Hampton** MBBS; **Rina George** MRCS; **Junaid Saeed** MBBS, MRCS (Presenter)

**PURPOSE**

To ascertain the rate of stoma avoidance in patients having a colorectal stent inserted as a bridge to surgical resection of their colorectal cancer.

**METHOD AND MATERIALS**

The records of patients who had had a colorectal stent for large bowel obstruction between December 2007 and February 2012 in Sheffield Teaching Hospitals were retrospectively analysed.

**RESULTS**

121 colorectal stents were placed over a 4.5 year period. 19 patients had the procedure as a bridge to surgical resection of their colorectal cancer. 2 patients had a clinically unsuccessful stent and required subsequent Hartmann's procedures. 11 patients had a primary anastomosis, of whom 2 had a stoma formed subsequently due to complications. Thus 9 of the 19 patients (47%) avoided a stoma at any point.

**CONCLUSION**

Only a minority of the colorectal stents placed in Sheffield are as a bridge to surgical resection of colorectal cancers with the majority being a palliative procedure. The use of stenting prevents some patients with surgically treatable disease needing a stoma. A significant number however still require stoma formation due to a failed stent or patient or surgical factors which prevent a primary anastomosis.

**CLINICAL RELEVANCE/APPLICATION**

Colorectal stenting as a bridge to surgical resection of a tumour can be used to avoid the morbidity associated with a stoma.

**SSK24-04 • Primary Mushroom-cage Radiologically Inserted Gastrostomy (RIG) without need for Conscious Sedation: 10-year Single Centre, Single Operator Experience in 206 Patients**

**Stephen Gregory** MBBS (Presenter); **Ounali Jaffer** MBBS, FRCR; **Dylan Lewis** MBBS, FRCR; **Thoraya Ammar**; **Paul S Sidhu** MRCP, FRCR *

**PURPOSE**

To retrospectively review experience in primary insertion of the skin-level mushroom cage gastrostomy tube (Entristar TM, Covidien, MA, USA); under radiological guidance.

**METHOD AND MATERIALS**

Over a 10-year period (2002 to 2012), patients who underwent a primary RIG procedure by a single operator utilizing 4 gastropexy sutures, under local anaesthetic without conscious sedation were reviewed for procedural complications (minor or major), 30-day mortality and tube longevity. Indications for RIG were noted. Radiological reports, PACS images, biochemical and hematological parameters, clinical notes and discharge summaries were reviewed.
Increasing use of PET/CT in the workup for malignancies has resulted in increase in number of adrenal mass biopsy being performed.

RESULTS

CONCLUSION
Our large number, single centre, single operator experience suggests that primary placement of this durable gastrotomy tube is safe with acceptable complication rates and no procedure related deaths in this cohort of 206 patients.

CLINICAL RELEVANCE/APPLICATION
Primary insertion of gastrotomy tubes of the mushroom-cage type is safe and should be considered in all patients requiring RIG as a means for long term nutrition. Tube longevity is unmatched.

SSK24-05 • Parietal Contrast Enhancement as a Sign of Giant Cell Arteritis and as an Inflammatory Marker

Jose Gutierrez MD ; Pedro Arguis MD (Presenter) ; Marcelo Sanchez MD ; Daniel Barnes ; Sergio Prieto ; Maria C Cid ; Ana I Garcia MD

PURPOSE
1. To evaluate the parietal contrast enhancement of the aorta as a sign of Giant Cell Arteritis (GCA), in recently diagnosed patients
2. To determine the relevance of parietal contrast enhancement as an inflammatory marker

METHOD AND MATERIALS
1. CT-angiography (CTA) was performed in 16 newly diagnosed biopsy-proven GCA patients
2. All patients had an evaluable CTA with arterial and venous phases
3. We defined significant enhancement as an increase of 20 UH or more, between the arterial and venous phases
4. 16 patients without evidence of arteritis were used as the control group. They were chosen for having similar clinical characteristics, and an equivalent burden of aortic calcifications, for each patient with GCA
5. A CTA was performed one year later
6. Levels of erythrocyte sedimentation rate (ESR) before the first CTA and a year later were tested

RESULTS
1. All patients (100%) presented high levels of ESR at the moment of diagnosis and normal levels in follow up testing one year later
2. 15 of 16 patients (93.75%) presented enhancement. None of the normal controls showed enhancement
3. 11 of 16 patients (73.3%) presented absence of enhancement. In the CTA acquired a year later, 3 of 15 (20%) were classified as non-evaluable (because the arterial wall had less than 2 millimeters), and only 1 (6.66%) of them were enhanced

CONCLUSION
1. Parietal enhancement of the aorta is an excellent sign in non-treated GCA, and could be considered a diagnostic criterion, especially in patients with doubtful parietal thickening
2. Parietal enhancement is useful as an inflammatory marker, as absence of enhancement in most of treated patients on CTA performed one year later (with normal ESR values) was observed, despite the fact that 11 of them still presented parietal thickening

CLINICAL RELEVANCE/APPLICATION
Parietal enhancement could detect inflammation before the systemic markers, distinguish inflammatory thickening from parietal fibrosis, and determine important therapeutic decisions

SSK24-06 • Technical Working Group Postmortem Angiography Methods (TWGPAM): Preliminary Results of a Multicenter Study for Validating Post-mortem Computed Tomography Angiography

Silke Grabherr (Presenter) ; Jochen M Grimm MD ; Axel Heinemann ; Giuseppe Guglielmi MD ; Krzysztof Wozniak ; Franziska Eplinius ; Fabrice Dedouit ; Florian Fischer MD ; Guy N Rutty ; Bruno Morgan MD ; Holger Wittig ; Patrice Mangin MD, PhD ; Richard Dirnhofer

PURPOSE
Post-mortem CT-angiography is an exam that aims to increase the sensitivity of post-mortem radiology. However, until today all applied methods have remained research. There is a need to define a standardized method and technical equipment in order to transform postmortem CT-angiography into a routine examination. With this aim, an international working group called TWGPAM (Technical Working Group Postmortem Angiography Methods) has been created in spring 2012. It consists of nine participating centers in six European countries. The goal of this prospective international multi-center study is to validate the technique, define its conditions and evaluate its advantages and limitations.

METHOD AND MATERIALS
In 2013, a study comparing findings of the recently developed Multi-phase Postmortem CT-Angiography (MPMCTA) with conventional autopsy has been published by our research group. Based on results of this study, the multicenter study was initiated. Each center performed MPMCTA on their cases using the standardized study protocol. 500 cases of medico-legal and clinical autopsies will be included. Data collection is performed by a team of one radiologist and two forensic pathologists (one to extract data from autopsy reports and one to review the radiological data with the radiologist). All findings are entered into a common data base for analysis.

RESULTS
Nearly all findings were visualized with both techniques. However, some findings can better or exclusively be visualized with one of them. MPMCTA has a higher sensitivity for identifying skeletal and vascular lesions. However, conventional autopsy gives more information about organ morphology and remains the only way to diagnose a vital vascular occlusion with certitude. Preliminary results of the ongoing study confirm these results.

CONCLUSION
MPMCTA can reveal important findings, not visible at conventional autopsy. However, some diagnoses remain autopsy-diagnoses. The multi-center study confirms these results and will enable the new technique to be accepted in the medico-legal community.

CLINICAL RELEVANCE/APPLICATION
Post-mortem CT angiography is a new technique allowing the diagnosis and visualisation of vascular findings. This study enables the new method to become a routine investigation.

SSK24-07 • Utilization and Results of Adrenal Mass Biopsy in the PET/CT Era: 10-year Retrospective Analysis

Ari C Sacks MD (Presenter) ; Nisha Sainani MD ; Cheryl A Sadow MD ; Robert W Gordon MD ; Edmund Cibas MD * ; Stuart G Silverman MD *

PURPOSE
To evaluate indications for and results of percutaneous image-guided adrenal mass biopsy in the era of FDG-PET/CT.

METHOD AND MATERIALS

RESULTS
Ninety-four percutaneous adrenal mass biopsies were included in 92 patients (53 males, 39 females), average age 66.2 years (range 37-85). When comparing before (n=22) and after (n=72) January 2004, there was statistically significant difference in the number of pre-biopsy PET/CT scans 22.7% (n=5) vs. 65.3% (n=47) (p

CONCLUSION
Increasing use of PET/CT in the workup for malignancies has resulted in increase in number of adrenal mass biopsy being performed
Using a Low Profile Device: A Single Center Experience

Wednesday, 12:15 PM - 12:45 PM

**PURPOSE**
To determine the procedural factors that influence the success rate for biopsies taken for cancer genetic testing.

**METHOD AND MATERIALS**
We retrospectively reviewed all percutaneous image-guided needle biopsies taken for genetic testing by the interventional radiology department from January 2002 to March 2013 at a single institution. The number of biopsy reports deemed diagnostic by rapid touch preparation cytology and reported as insufficient for genetic testing were reviewed for reason for failure and biopsy type (FNA vs. Core).

**RESULTS**
The Interventional Radiology Department conducted 2417 biopsies [1536 (64%) core + FNA, 572 (24%) FNA only, 254 (11%) core only, and 55 (2%) unidentified in reports] for genetic testing during the observation period. In this cohort 248 (10%) deemed diagnostic by rapid touch preparation cytologic review at the time of biopsy did not contain sufficient tissue for genetic testing. Of the 248, 166 (67%) by slide review contained too few tumor cells to advance to testing and 82 (33%) were test failures due to inadequate DNA. Of the 166 determined by the pathologist as insufficient to advance for genetic testing, 89 (54%) had a core + FNA sample taken, 56 (34%) were FNA only, 18 (11%) were core only and 3 (2%) were unidentified in reports. Of the 82 failures that advanced to genetic testing 47 (57%) had a core + FNA sample taken, 16 (20%) were FNA only, 11 (13%) were core only, and 8 (10%) were unidentified in reports.

**CONCLUSION**
Genetic testing is an increasingly important aspect of cancer biopsies. Insufficient DNA quantity or poor DNA quality are relatively common reasons for genetic testing failure. We found that when genetic testing is planned, biopsies without a core component were more likely to be insufficient than those that did. Improved systems for rapid assessment of DNA quantity at the time of biopsies may improve the rate of adequate sampling for genetic testing.

**CLINICAL RELEVANCE/APPLICATION**
When genetic testing is planned adding a core biopsy has a higher chance of being adequate and reduces the need for repeat sampling due to inadequate tumor tissue.

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**SSK24-08 • Adequate Biopsy Sampling in the Molecular Treatment Era: Factors Predicting Successful Cancer Sampling for Genetic Tests**

Mikhail Silk BS (Presenter) ; Jeremy C Durack MD ; Natasha Rekhtman ; Cyrus Hedvat MD ; Joseph P Erinjeri MD, PhD ; Stephen B Solomon MD *

**PURPOSE**
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**METHOD AND MATERIALS**
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**CLINICAL RELEVANCE/APPLICATION**
When genetic testing is planned adding a core biopsy has a higher chance of being adequate and reduces the need for repeat sampling due to inadequate tumor tissue.

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**SSK24-09 • 3D-Evaluation of Tumor Necrosis in HCC Patients after TACE – A Radiologic-Pathologic Correlation**

Julius Chapiro MD (Presenter) ; Laura Wood MD ; Mingde Lin PhD * ; Toby Charles Cornish MD, PhD ; Vania Tacher MD ; Jean-Francois H Geschwind MD *

**PURPOSE**
To evaluate the precision of a three-dimensional (3D) HCC tumor necrosis assessment using quantitative EASL (qEASL) and volumetric RECIST (vRECIST), we correlate radiologic and pathologic findings in patients with HCC, who underwent tumor resection (TR) or liver transplantation (LT) after TACE.

**METHOD AND MATERIALS**
This retrospective study included 17 patients with HCC, who underwent TACE and received contrast-enhanced MR (CE-MRI) imaging within 90 days prior to TR or LT. A semiautomatic 3D volumetric segmentation and tumor volume measurement was performed on the last CE-MRI scans before TR/LT. The total tumor volume was expressed as vRECIST. The volume of enhancing tumor was measured using qEASL as a percentage of the total tumor volume. The tumor necrosis was thus defined as 1 − qEASL%. The treated lesions were analyzed using hematoxylin and eosin stains. Correlation coefficients were calculated to compare the percentage of necrosis shown on qEASL with the percentage of necrosis calculated with qEASL.

**RESULTS**
The mean interval between latest MRI and LT/TR was 42.5 ± 40.5 days. The mean interval between latest TACE and LT/TR was 128 ± 94 days. A total of 9 patients (52.94%) received DEB-TACE, 8 patients (47.06%) received conventional TACE treatment. 6 patients last CE-MRI scans before TR/LT. A semiautomatic 3D volumetric segmentation and tumor volume measurement was performed on the last CE-MRI scans before TR/LT. The total tumor volume was expressed as vRECIST. The volume of enhancing tumor was measured using qEASL as a percentage of the total tumor volume. The tumor necrosis was thus defined as 1 − qEASL%. The treated lesions were analyzed using hematoxylin and eosin stains. Correlation coefficients were calculated to compare the percentage of necrosis shown on qEASL with the percentage of necrosis calculated with qEASL.

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**CLINICAL RELEVANCE/APPLICATION**
The close radiologic-pathologic correlation of qEASL necrosis assessment validates this 3D tool for a standardized clinical use. Thus, qEASL has the potential to complement existing response criteria.
RESULTS
The stent-graft was successfully implanted in all patients using an entirely percutaneous approach. Two patients (7.4%) presented a type II endoleak after stent-graft implantation with a spontaneous resolution in one case and treated with coil embolization in the other one. Manual hemostasis was achieved in all cases without complications. No surgical corrections were required. During follow-up, no aneurysm-related deaths were recorded. Through 24 months, each AAA shrunk by at least 5 mm and no device-related events were observed on imaging.

CONCLUSION
The Ovation stent-graft allows safe and effective treatment of AAAs with hemostasis of the puncture site by manual compression.

CLINICAL RELEVANCE/APPLICATION
This approach may allow abdominal aortic treatment without need of a surgical access and percutaneous closure device, reducing access-related complications

LL-VIS-WE2A ● Frequency of Growing Splenic Artery Aneurysms Detected by Multidetector Row CT Angiography in Patients with Chronic Liver Diseases

Takaharu Tsuda MD, PhD (Presenter) ; Hiroaki Tanaka MD ; Megumi Takechi MD ; Gen Koïwahara ; Teruhito Mochizuki MD

PURPOSE
The wider utilization of cross-sectional imaging has increased the detection of indeterminate cystic and solid enhancing renal masses (RM). Despite an accurate pre-operative radiological study, surgical extirpation still results in at least 20% of benignity. Literature suggests that renal biopsy can be accurate and significantly impacting on clinical choices. Our aim is to evaluate the safety, accuracy and usefulness of image-guided core biopsy (CB) in the management of RM.

METHOD AND MATERIALS
In 258 consecutive patients (171 male; 16-88 y, m 65), 268 RM (10-160 mm, m 33; 19 cystic, 236 solid, 13 mixed) underwent CB (265 US-guided, 2 CT-guided, 1 US+CT guided), by coaxial technique (18G tru-cut needle inserted in a 17G styled cannula). Major and minor complications (according to SIR criteria) were recorded. The result of 50 CB was not assessable, due to patients lost at follow-up. Of the remaining 218 RM, 101 underwent ablative treatments, so a gold standard diagnosis was not available. Therefore, accuracy was calculated on 117 CB, verified on the basis of histology after surgical resection (76), response to medical therapy (7) or outcome at imaging follow-up (3-104 months, m 35) (34: 25 benign and 9 malignant selected for active surveillance).

RESULTS
No major complications occurred (namely, no seedings). 10 minor complications (7 small perirenal hematomas, 1 macrohematuria not requiring transfusion, 1 self-resolving intercostal arteriovenous fistula and 1 hematomata in the abdominal wall) were managed on an outpatient basis. Among the 218 assessable CB, the pathological diagnoses were 167 malignant (160 RCC, 4 NHL, 3 met) and 51 benign (38 renal cell tumors, including 28 oncocytes and 7 AML). According to the above gold standard criteria, TP were 75/117, FN 7, TN 35, FP 0. Sensitivity, specificity and diagnostic accuracy were 91.4%, 100% and 94%, respectively. PPV was 100%, NPV 83.3%. 142/218 RM (65.1%) were managed other than surgically. According to the above gold standard criteria, TP were 75/117, FN 7, TN 35, FP 0. Sensitivity, specificity and diagnostic accuracy were 91.4%, 100% and 94%, respectively. PPV was 100%, NPV 83.3%. 142/218 RM (65.1%) were managed other than surgically.

CONCLUSION
CB is safe and accurate. We contribute to the growing number of series that are demonstrating the usefulness of CB in the clinical management of RM.

CLINICAL RELEVANCE/APPLICATION
Since low specificity or pitfalls of imaging can affect characterization of RM, causing unnecessary surgical resections, CB should be considered in the clinical management of all indeterminate lesions

LL-VIS-WE3A ● Core Biopsies of Renal Masses: An Accurate Tool for Managing all That Is Indeterminate

Andrea Veltri MD (Presenter) * ; Irene Garetto MD ; Carlo Gazzera ; Enrico Bollito ; Donatella Pacchioni MD ; Alessandro Volpe MD ; Mauro Papotti MD

PURPOSE
The utilization of cross-sectional imaging has increased the detection of indeterminate cystic and solid enhancing renal masses (RM). Despite an accurate pre-operative radiological study, surgical extirpation still results in at least 20% of benignity. Literature suggests that renal biopsy can be accurate and significantly impacting on clinical choices. Our aim is to evaluate the safety, accuracy and usefulness of image-guided core biopsy (CB) in the management of RM.

METHOD AND MATERIALS
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CLINICAL RELEVANCE/APPLICATION
Since low specificity or pitfalls of imaging can affect characterization of RM, causing unnecessary surgical resections, CB should be considered in the clinical management of all indeterminate lesions

LL-VIS-WE4A ● Non-invasive Prediction of Hepatic Transplant Portal Vein Stenosis - Experience at a Single High Volume Transplant Center

Marie A Vasher MD (Presenter) ; Danny R Lababidi MD ; Kamal Massis MD ; Bruce R Zwiebel MD ; Dana M Poletto MD ; Haydy Rojas RN ; Yougii Wu PhD

PURPOSE
We sought to compare Doppler ultrasound findings to transhepatic catheter portal venogram findings of hepatic transplant main portal vein stenoses, and to determine which Doppler ultrasound criteria are often the best non-invasive measures for diagnosing portal vein stenosis.

METHOD AND MATERIALS
32 post-hepatic transplant transhepatic catheter portal venograms following initial Doppler ultrasound were performed at our institution on 30 patients from November 1, 2004 to May 31, 2012 due to clinical, biochemical, Doppler ultrasound, CT and/or MRI abnormalities. Doppler ultrasounds and catheter portal venograms were retrospectively reviewed. Doppler ultrasound criteria of main portal vein peak velocity, velocity step-up ratio, and change in velocity across the anastomosis were correlated with catheter portal venogram. Narrowing of the main portal vein of at least 50% on portal venogram was considered stenotic. 54 randomly chosen patients without suspicion of hepatic transplant portal anastomotic stenoses were assigned to our control group. Patients who underwent catheter portal venogram without findings of portal vein stenosis were also assigned to our control group.
RESULTS

CONCLUSION

CLINICAL RELEVANCE/APPLICATION
Applying the Doppler ultrasound criteria yielded in our study will result in selecting the most appropriate hepatic transplant patients with main portal vein stenosis for catheter portal venogram.

LL-VIE-WE6A • High Resolution Imaging with High Frequency Intravascular Ultrasound Improves Sensitivity in Cancer Staging when Vascular Encasement or Mass Effect is Suspected on Dynamic Computed Tomography: Special Cases in Hepatobiliary and Pancreatic Cancer

Cristian Coroian MD, MBA (Presenter); Brian A Bianco DO, MBA; Wilbur B Bowne MD; Alexander E Trebelev MD

PURPOSE
To present the emerging technique of high resolution intravascular ultrasound (IVUS) evaluation of arterial invasion by cancer. We demonstrate the ability to interrogate the three layers of the hepatic, superior mesenteric, splenic, and gastroduodenal arteries (including adventitia, media, and intima) with sub-millimeter resolution. By using IVUS, we more accurately stage hepatobiliary and pancreatic cancer in patients where dynamic computed tomography (CT) demonstrates cancer encasement or mass effect on an artery.

METHOD AND MATERIALS
A 6 Fr sheath is used to gain access and navigate a wire into the target vessel. The IVUS probe is then advanced while recording Chroma flow gray scale images through the arterial segment of interest. Start and end scan location is determined by fluoroscopic roadmap. Patients with pancreatic cancer and hepatobiliary cancer are selected. As part of cancer staging, dynamic CT imaging is performed. In patients where the tumor mass encases or causes mass effect on the hepatic artery, superior mesenteric artery, splenic artery, or gastroduodenal artery, high frequency IVUS is performed (as described above) to evaluate invasion of the vascular adventitia, media, and intima. Pathological findings are correlated with IVUS images. Traditional methods of indirectly suggesting invasion by assessing vascular encasement or mass effect of a tumor on a vessel by dynamic CT are compared with IVUS results to determine sensitivity and specificity. Dynamic CT curved reformatted images are then correlated with IVUS images to determine exact location and integrity of the artery layers. The sub-millimeter spatial resolution of IVUS allows for grayscale anatomic identification and accurate determination of tumor invasion.

RESULTS
We present cases of cholangiocarcinoma and pancreatic cancer showcasing the accuracy of IVUS in resolving dynamic CT suspected vascular invasion with the highest spatial resolution. 100% accuracy is attained with no periprocedural complication.

CONCLUSION
High frequency IVUS is technically feasible in the splanchnic arteries. IVUS is an emerging technique in the staging of cancer, and in our experience, provides 100% accuracy in determining arterial vascular invasion.

CLINICAL RELEVANCE/APPLICATION
High frequency IVUS is an emerging technique in staging of cholangiocarcinoma and pancreatic cancer, and in our experience, provides 100% accuracy in determining arterial vascular invasion.

LL-VIE-WE7A • Radiation Safety in the Interventional Radiology Suite

Prasad S Dalvie MD (Presenter); Narendra B Gutta MBBS, MD; Orhan S Ozkan MD; John C McDermott MD

PURPOSE/AIM
To review radiation risks to healthcare workers and patients during interventional procedures and demonstrate tips and techniques for reducing radiation exposure.

CONTENT ORGANIZATION
A. Radiation Physics & concept of ALARA B. Side effects of radiation (stochastic & deterministic) C. Radiation monitoring and documentation D. Standard precautions during IR procedures E. Guide to DSA settings and features (knobology) F. Special precautions (pregnancy, pediatric patients, large patient & complex procedures)

SUMMARY
This exhibit will review - a. Physics relevant to fluoroscopic and DSA procedures b. Radiation risks from interventional procedures c. Radiation monitoring and documentation d. Standard and special procedures to reduce radiation exposure.

LL-VIE1293-WEA • Nonvascular Uses of Liquid Embolic Agents: Therapy for Biliary Leaks, Ureteral Leaks, Lymphatic Leaks, and Enterocutaneous Fistulas

Karen Alderfer MD (Presenter); Ramon Ter-Oganesyan MD; Michael D Katz MD; Ilya Lekht MD; M. Victoria Marx MD; Sue E Hanks MD

PURPOSE/AIM
1. Overview of available liquid embolic agents and their conventional vascular uses. 2. Discussion of possible nonvascular uses. 3. Review of cases from our institution where liquid embolic agents have been utilized in nontraditional ways. 4. Discussion of possible nonvascular uses. 5. Review of cases from our institution where liquid embolic agents have been utilized in nonvascular applications. 6. Summary of current knowledge and future directions in nonvascular applications of liquid embolic agents.

CONTENT ORGANIZATION
Liquid embolic agents
Review of currently available types of liquid embolic agents and traditional vascular uses Discussion of nonvascular uses of liquid embolic agents
Hepatobiliary
Genitourinary
Gastrointestinal
Lymphatic Case discussion and imaging review
Detailed review of cases from our institution where liquid embolic agents have been used in non-vascular organ systems

SUMMARY
NBCA glue (N- butyl cyanoacrylate) and Onyx Liquid Embolic System (ethylene vinyl alcohol and DMSO (dimethyl sulfoxide)) have been used as vascular embolic agents in various parts of the body to arrest hemorrhage and shut down arteriovenous malformations. In our institution, the utility of these liquid embolic agents has been extended to nonvascular uses as well. In this presentation, we review several cases from our institution where liquid embolic agents have been utilized to achieve therapeutic success in biliary leaks, ureteral leaks, lymphatic leaks, and enterocutaneous fistulas.

LL-VIE1303-WEA • Diagnosis and Endovascular Management of High Flow Peripheral Arterio-venous Malformations (AVMs)

Anil K Pillai MD (Presenter); Jed A Hummel MD; Sanjeeva P Kalva MD*; Seth Toomay MD; Mark Reddick; Nancy K
PURPOSE

The purpose of this study was to compare MDCTA and MRA in selecting patients for peripheral endovascular intervention.

METHOD AND MATERIALS

We compared MDCTA (16 slices scanner) and MRA (1.5 T scanner; 3D gadolinium-enhanced three station bolus chase acquisition plus time resolved acquisition on calves and feet) in 35 patients (Fontaine II-IV) candidates to endovascular treatment to stratify patients according to the TASCII score and to a runoff severity score. We evaluated also the accuracy of techniques to identify the degree of involvement of each arterial segment. Selective angiography performed during the treatment was employed as standard of reference.

RESULTS

330 segments and 35 limbs were available for comparative evaluation. MDCTA and MRA resulted both accurate to classify patients according to TASC score in aorto-iliac (accuracy 0.92 for MDCTA and MRA) and femoro-popliteal (MDCTA 0.94 MRA 0.90) districts. MDCTA was founded to be more accurate to stratify infrapopliteal districts according to the runoff severity score (0.96 vs 0.9) and to assess the impairment of runoff arteries (0.94 vs 0.88) at per-segment analysis. MDCTA showed a higher diagnostic reliability than MRA and a lower examination time.

CONCLUSION

Our result could suggest MDCTA technique could be the preferred procedure when clinical history or duplex sonographic evaluation are indicative of severe impairment of the infrapopliteal district.

CLINICAL RELEVANCE/APPLICATION

Comparison between Angio CT and Angio MR to evaluate lower limbs.

LL-VIS-WE2B • Clinical Value of Lower Extremity Arterial Imaging Using 80 kVp and Automatic Tube Current Modulation Technique Compared with Traditional 120kVp Scan

Ying Guo MD (Presenter) ; Dapeng Shi MD ; Ying Hui Ge MD, PhD

PURPOSE

The purpose of this study was to evaluate the image quality and radiation dose of lower extremity arterial imaging using 80kVp with automatic tube current modulation technique compared with traditional 120 kVp scan.

METHOD AND MATERIALS

60 consecutive outpatients with lower extremity occlusive disease performed 64-slices CT scan were randomly divided into 2 groups. The first group (group1, n=30) used standard 120kVp with automatic tube current modulation(NI=10), and the second (group2, n=30) used 80kVp with automatic tube current modulation(NI=10). We selected the observing levels at pelvic, knee, calf and foot levels for noise measurement and image quality assessment with a 3-point scale. Paired analysis was performed on radiation dose, image quality, and image noise using t-test.

RESULTS

CONCLUSION

Using low kVp with automatic tube current modulation for lower extremity arterial scanning can reduce radiation dose by13.42% compared with 120kVp and artery signal intensity can be increased by 53.55% at the foot level.

CLINICAL RELEVANCE/APPLICATION

Radiation dose can be reduced and lower extremity arterial image can be improved by scan with optimized scan protocol of 80kVp.

LL-VIS-WE3B • Detailed CTA Study of 60 Superficial Femoral Artery Occlusions: Can Morphological Quantitative Analysis Lead to a New Classification?

Mickael Ohana MD, MSc (Presenter) ; Soraya El Ghannudi-Abdo MD ; Elie Girsowicz ; Nabil Chakfe MD, PhD ; Catherine Roy MD

PURPOSE

TASC II actual classification of superficial femoral artery (SFA) occlusions is limited to length and calcifications analysis on 2D angiograms. State-of-the-art computed tomography angiography (CTA) provides much more information than traditional invasive angiography: detailed quantitative morphological analysis of CTA could be the basis of a refined classification.

METHOD AND MATERIALS

46 patients (65% men, 68yo ± 11,6) totaling 60 SFA occlusions were retrospectively included. Presence of a SFA occlusion was the only inclusion criterion.
For each pathological artery, curved multiplanar reconstructions following the occluded SFA course were used to measure the total length and the mean diameter of the occluded segment. Color-coded map provided an accurate estimation of calcifications volume among the occluded segment.

RESULTS
SFA occlusion was complete in 39% of cases. Mean occluded segment length was 219 mm ± 107 (14-530 mm); mean occluded segment diameter was 6.1 mm ± 1.6 (3.4-10 mm); mean calcifications volume in the occluded segment was 1265 mm³ ± 1893 (0-8815 mm³), corresponding to a percentage of 17.4% ± 20 (0-88.7%).

Defining a cutoff between small or preserved caliber at 5 mm and between low or heavily calcified occlusions at 4% allowed the distinction of 4 groups: heavily calcified occlusions of normal caliber (56%), low calcified occlusions of preserved caliber (19%), low calcified occlusions of small caliber (15%) and heavily calcified occlusions of small caliber (10%). Proportions of these 4 groups were roughly the same regardless of TASC II classification.

CONCLUSION
TASC II classification is inadequate for SFA occlusions: quantitative CTA analysis with measurement of mean occluded diameter and percentage of calcifications can refine it. This could be particularly useful in the management of TASC II type D lesions, as new endovascular revascularization techniques are arising, and this CTA-based morphological classification could provide support in choosing between them.

CLINICAL RELEVANCE/APPLICATION
Not all SFA occlusions are the same: this morphological CTA study points out TASC II classification weaknesses and could be the basis of a more precise patient management.

LL-VIS-WE4B • Evaluation of Patients after Sclerotherapy for Venous Malformation Using MRI
Sebastien Bommart MD (Presenter); Helene Vernhet-Kovacsik MD, PhD; Valerie Monnin-Bares; Hamid Zarqane

PURPOSE
To define which MRI data correlate best with the clinical outcome of patients after sclerotherapy for peripheral venous malformations.

METHOD AND MATERIALS
DESIGN: Retrospective analysis of a series of consecutive cases. SETTING: Series of cases in a French medical center. SAMPLE: thirty five patients during 76 sessions were treated with Aetoxysclerol 3% mixed with contrast media and air as a foam with a ratio 60/10/30: from January 2010 to December 2012. All patients had MRI before and one month after completion of the treatment. MRI protocol includes STIR weighted sequences and T1 weighted sequences with fat saturation before and after injection of gadolinium. METHODS: we reviewed the MRI examinations obtained before and after treatment completion. Data studied on each examination were: size of the malformation on the STIR sequence (3 largest diameters) and % of enhancement on T1 sequences. A correlation was searched for between MRI data and clinical result. MAIN OUTCOME MEASURES: Data studied on MRI examination were: size of the malformation on the STIR sequence (3 largest diameters) and % of enhancement on T1 sequences Side effects; clinical result was scored from 0 (lack of improvement) to 5 complete improvement.

RESULTS
Clinical results were scored 0 (n=1) 2 (n=2) 3 (n=18) and 4 (n=12). MRI: decrease of the largest diameter was 75% n=11). All patients with a decrease of enhancement >75% had a clinical score at 4.

CONCLUSION
The percentage of decrease of enhancement on T1 fat sat sequence is reflects the best the clinical outcome after sclerotherapy for venous malformations.

CLINICAL RELEVANCE/APPLICATION
MRI evaluation of venous malformation after sclerotherapy should include T1 weighted sequences with fat saturation before and after injection of gadolinium.

LL-VIS-WE5B • Removal of the Grid during Routine Biliary Interventional Procedures Performed in a Flat Panel Interventional Suite: Preliminary Data on Image Quality and Patient Radiation Exposure
Kelvin Cortis MD, MRCS, FRCR (Presenter); Roberto Miraglia MD; Luigi Maruzzelli MD; Roberta Gerasia; Corrado Tafaro; Angelo Luca MD

PURPOSE
To determine whether grid removal during routine biliary interventional procedures performed in a flat panel interventional suite results in adequate image quality and in a significant reduction of the patient radiation exposure.

METHOD AND MATERIALS
Routine biliary interventional procedures were performed as those in which absence of fine image detail during fluoroscopy carries no procedural impact including change of internal-external biliary drains (BCC) or balloon dilatation of biliary anastomosis (bilioplasty). 10 consecutive patients were enrolled, 8 had a BCC and 2 bilioplasty. The study population consisted of 8 adults with an average Body Surface Area (BSA) of 1.64, and 2 children with an average BSA of 0.49. All patients had a previous procedure in which the grid was used. Constant object-to-detector and source-to-image distance were maintained in each patient during the grid/no-grid procedures. The same fluoroscopy protocol was used for all examinations. The dose area product (DAP given in cGy.cm²) and procedure fluoroscopy time (given in seconds) were recorded for each procedure. DAP was normalized per unit of fluoroscopy time (nDAP, cGy.cm²/s). In order to quantify the change in nDAP, the nDAP of the procedure done without the grill was divided by that done with the grill for each patient, and the change in dose expressed as a percentage.

RESULTS
In all procedures image quality was considered adequate by two different interventional radiologists and all procedures were successfully completed without significant changes in fluoroscopy time between the two groups (p=0.37). In every procedure without the grid nDAP was inferior as compared to the nDAP in procedures performed using the grid. The mean reduction in dose was 32.3% ± 21.1% (p=0.01).

CONCLUSION
Our preliminary data shows that removal of the grid in routine biliary procedures is feasible and results in a significant reduction of patient radiation exposure. Larger studies with more procedures are warranted to confirm this data.

CLINICAL RELEVANCE/APPLICATION
Most routine biliary procedures can be performed without a grid with reduction in radiation exposure. This seems of particular relevance since most of these patients require frequent re-intervention.

LL-VIE-W6GB • Hemoptysis in Hereditary Hemorrhagic Telangiectasia (HHT): A Single Symptom, Many Mechanisms
Jacques Sellier MD (Presenter); Mostafa El Hajjam MD; Stephen Binsse MD; Sophie Chagnon; Pascal Lacombe

PURPOSE
In HHT patients, hemoptysis in non-embolized patients is often due to ruptured pulmonary arterio-venous malformations (PAVM). In treated patients, the source of bleeding can originate from more complex mechanisms implying a careful study of the PAVM vascular supply. We illustrate those mechanisms and the way we treat them.
METHOD AND MATERIALS
During a 12-year period, 970 patients with HHT were evaluated at our center. 425 patients had PAVMs and 246 were embolized. Five percent of all patients presented hemoptysis. Patients with hemoptysis were prospectively investigated clinically in association with bronchial endoscopy, computed tomography and/or angiography. All imaging data were collected and reported to a potential cause. Each cause and its management are illustrated by case reports.

RESULTS
In patients with PAVM, hemoptysis was mostly due to parenchymal rupture of the malformation. Immediate embolization of the culprit PAVM was mandatory. In previously embolized patients, bleeding could originate from already embolized malformations. In this case, three different mechanisms of hemoptysis were encountered, that could occur concomitantly: - recanalization of a previously embolized artery mainly due to insufficient packing of coils, - reperfusion of the PAVM by growth of pulmonary-to-PAVM anastomoses, - and development of systemic supplies to the embolized area. Treatment of recanalized artery is based on packing complementary coils. Systemic supply needs other strategies of embolization to prevent any embolic complication because of direct connections between systemic arteries and PAVM. Finally, hemoptysis could be related to pulmonary hypertension or its life-threatening complication: rupture of pulmonary artery aneurysms.

CONCLUSION
Hemoptysis in HHT patients is a monomorphic presentation of polymorphic conditions that implies a careful strategy before interventional treatment.

CLINICAL RELEVANCE/APPLICATION
Hemoptysis is a potential life-threatening manifestation of HHT requiring emergency embolization. Identifying mechanism guides the therapeutic strategy.

LL-VIE-WE7B ● Minimally Invasive Imaging Guided Procedures for Pain Control or Relief in Oncological Patients: What Can We Do?

Mauricio R Moura MD, MD (Presenter) ; Eduardo Garcia ; Eduardo P Anastacio ; Felipe D Barbosa MD ; Marcos R Menezes MD ; Publio C Viana MD

PURPOSE/AIM
Pain control is an important tool in managing oncologic patients and have equal importance to the actual treatment of the disease. The main objective of this study is to share with Radiologists, Interventional especially, our experience in minimal invasive image-guided procedures focused on therapeutic control of pain.

CONTENT ORGANIZATION
We selected didactic and illustrative cases performed in ICESP (Cancer Institute of the State of São Paulo) of the following procedures: Celiac plexus neurolysis; thermal ablation of secondary bone lesions using Focused Ultrasound (FUS) guided by Magnetic Resonance Imaging (HIFU-MRI), Radiofrequency and Cryoablation associated with vertebroplasty; Infiltration of nerve roots guided by CT. Treated patients had pain that was unresponsive to other therapies and often presenting collateral effects.

SUMMARY
Interventional Radiology is a fundamental resource among the multidisciplinary involving therapies for pain control. Beside established procedures such as neurolysis of celiac plexus, Root Infiltration, percutaneous vertebroplasty, thermal ablation of bone primary or secondary lesions (with RFA or Cryoablation); novel therapeutic approaches, such as thermal ablation HIFU-MRI are gaining space in daily practice with a promising future.
**LEARNING OBJECTIVES**
View learning objectives under main course title.

**VSI041-03 • Novel Navigation Technique for Superselective TACE to Obtain 3D-safety Margin for HCC**

Toshihiro Tanaka MD (Presenter) ; Hideyuki Nishiofuku ; Hiroshi Anai MD, PhD ; Shinsaku Maeda ; Hiroshi Sakaguchi MD ; Kimihiko Kichikawa MD

**PURPOSE**
Our previous report presented at RSNA 2012 demonstrated the importance of the 3-dimensional embolization margin (3D-safety margin) in superselective transcatheter arterial chemoembolization (TACE), which could significantly prolong disease free survival. We developed novel navigation TACE using hybrid CT/Angio with a workstation to obtain 3D-safety margin, and prospectively evaluated the feasibility of this technique.

**METHOD AND MATERIALS**
Fifteen patients with small HCC (size: 1.2-2.9cm, mean 1.8cm) and good liver function (Child-Pugh score: 5-7, mean 5.5) were enrolled in this pilot study. Firstly, a maximum intensity projection (MIP) imaging of the hepatic arteriography was created using CT during hepatic arteriography (CTHA) via the common hepatic artery (CHA). Secondly, a catheter was superselectively inserted into the tumor feeding artery, and presence or absence of the 3D-safety margin was evaluated by the 3D-fusion images reconstructed using whole liver CTHA via CHA and superselective CTHA via the targeted artery. Thirdly, in the cases without 3D-safety margins, the regions, which lacked safety margins, were marked by a workstation (ZIOSTATION®). These markings automatically appeared on the MIP images, which showed the arterial branches supplying the tumor surrounding areas.

**RESULTS**
In 13 of 15 patients, 3D-safety margins were absent in the initial fusion images. In all 13 cases, the MIP images of the hepatic arteriography clearly showed the supplying branches into the marginal areas. Superselective TACE using lipiodol (mean volume 2.7ml) mixed with epirubicin (mean volume 23mg) were conducted via both the tumor feeding arteries and the marginal branches. 3D-safety margins were obtained in all 15 patients. No severe complications including liver dysfunction were observed. The mean Child-Pugh score after TACE was 5.5, and no local recurrence was seen during follow-up periods (mean 233 days, range: 171-344 days).

**CONCLUSION**
Superselective TACE using this novel navigation technique can achieve 3D-safety margin for HCC patients. Currently, a phase II study using this technique is ongoing to evaluate the local tumor recurrence rate for long term period.

**CLINICAL RELEVANCE/APPLICATION**
Superselective TACE using this navigation technique can achieve 3D-safety margin, which could prevent local recurrence.

**VSI041-04 • Combination Therapy**

Muneeb Ahmed MD (Presenter)

**LEARNING OBJECTIVES**
1) Demonstrate how understanding tissue responses in and around the ablative zone can be used to develop mechanism-based approaches to combination therapy. 2) Demonstrate how combination strategies for IO using nanoagents offer significant promise for improving minimally-invasive thermal therapy.

**ABSTRACT**

**VSI041-05 • Comparison of Transarterial Administration of Survivin siRNA Combined with Transarterial Chemoembolization (TACE) and TACE Alone in the Treatment of Rats with Hepatocellular Carcinoma (HCC): Experimental Study**

Thomas J Vogli MD, PhD (Presenter) ; Jun Qian MD ; Andreas Tran ; Elsie Oppermann ; Ulli Imlau ; Yousef Hamidavi ; Huedayi Korkusuz MD ; Wolf-Otto Bechstein

**PURPOSE**
To evaluate the effects of transarterial administration of survivin siRNA combined with transarterial chemoembolization (TACE) vs. TACE alone for treating hepatocellular carcinoma (HCC) in rats.

**METHOD AND MATERIALS**
Subcapsular implantation of a solid Morris hepatoma 3924A in the liver was carried out in 20 male ACI rats (day 0). Tumor volume (V1) was measured by MRI (day 12). After laparotomy and retrograde placement of a catheter into the gastroduodenal artery (day 13), the following different agents were injected into the hepatic artery: TACE (0.1mg of mitomycin + 0.1ml of lipiodol + 5.0mg of degradable starch microshperes) + 2.5nmol survivin siRNA (group A, n=10) or TACE alone (group B, n=10). Tumor volume (V2) was assessed by MRI (day 25), tumor growth ratio (V2/V1) was calculated. Western blot analysis was performed to assess the protein expression level of survivin in each treatment. The progressional potential of the tumors was assessed for quantification of positive VEGF tumor cells via immunohistochemical analysis.

**RESULTS**
Mean tumor growth ratio (V2/V1) was 1.1313 ± 0.1381 in group A, and 3.1911 ± 0.1393 in group B. Compared with group B, group A showed significant inhibition of tumor growth (p < 0.05). Combined TACE and transarterial administration of survivin siRNA is more effective than TACE alone for inhibiting the growth of HCC in rats.

**CONCLUSION**
Combined TACE and transarterial administration of survivin siRNA may be a relevant treatment option in hepatocellular carcinoma.

**CLINICAL RELEVANCE/APPLICATION**
Combined TACE and transarterial administration of survivin siRNA may be a relevant treatment option in hepatocellular carcinoma.

**VSI041-06 • Understanding Local and Systemic Ablation Biology**

Joseph P Erinjeri MD, PhD (Presenter)

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

**VSI041-07 • Adoptive Immunotherapy for Hepatocellular Carcinoma with MRI-monitored Transcatheter Delivery of Ferumoxytol Nanocomplexes-labeled Natural Killer Lymphocytes**

Kangan Li MD (Presenter) ; Zhuoli Zhang MD, PhD ; Andrew C Gordon BA ; Alexander Y Sheu BS ; Weiguo Li ; Reed A Omary MD * ; Gui-Xiang Zhang MD ; Andrew C Larson PhD *

**PURPOSE**
Natural killer (NK)-lymphocytes adoptive immunotherapy (AIT) has advantages over other immunotherapy approaches in being non-MHC-restricted, non-immunogenic and highly cytotoxic for Hepatocellular Carcinoma (HCC). To improve the AIT efficiency, it is essential to visualize and quantify both the biodistribution of NK cells and the AIT responses. The purpose of this study was to test the hypotheses that: 1) Magnetic resonance imaging (MRI) will allow quantitative visualization of transcatheter infusion for targeted delivery of ferumoxytol-heparin-proteamin(HPF) nanocomplexes-labeled NK cells to HCC; 2) NK cell AIT responses may be predicted based upon...
METHODOLOGY AND MATERIALS

NK-92M1s were labeled with HPF. 24 Sprague Dawley rats were implanted with Mc-A-RH7777 tumors; 6 rats each comprised intra-arterial (IA) NK, intraportal (IP) NK, IA+IP NK, and IA saline groups. Catheter was placed in hepatic artery or/and portal vein for IA NK/saline or/and IP NK infusions. MRI tumor size, T2*, apparent diffusion coefficient (ADC) and volume transfer constant (Ktrans) measurements were performed pre and 12 days post infusion. Tumor size changes, T2*, ADC, and Ktrans were compared; Prussian blue staining was used for histological identification of labeled NK cells; CD56 and CD34 staining qualitatively confirmed NK cells delivery and tumor angiogenesis. ANOVA and Pearson correlation coefficients were used for statistical analyses.

RESULTS

Initial tumor diameters were not different between groups (p=0.23), but final tumor diameters were different between all groups (p < 0.00001) with those estimated from gross pathologic assessment. Infiltration of red blood cells observed by histopathologic examination was greater in the peripheral rim of the ablation zone than in the central zone.

CONCLUSION

21.9, and 4.3 kPa ± 0.8, respectively. The ablation volumes obtained by 3D SWE showed the highest correlation (r = 0.9646; p < 0.00001) with those estimated from gross pathologic assessment. These measurements were compared pre and 12 days post infusion. Tumor size changes, T2*, ADC, and Ktrans were compared; Prussian blue staining was used for histological identification of labeled NK cells; CD56 and CD34 staining qualitatively confirmed NK cells delivery and tumor angiogenesis. ANOVA and Pearson correlation coefficients were used for statistical analyses.

CLINICAL RELEVANCE/APPLICATION

This technique has potential for in-vivo evaluation of the distribution of NK-cells and AIT responses which can help adjust the patient-specific therapeutic regimens during the clinical application.
LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO41-13 • Panel: Which Factors Will Most Drive Future Progress?

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO41-14 • When Should I Be Using that Specialized Device: MW Systems

Fred T Lee MD (Presenter) *

LEARNING OBJECTIVES
1) Explain basic microwave physics. 2) Demonstrate the differences between radiofrequency and microwave devices. 3) Show illustrative cases where microwave was either useful or contraindicated.

VSIO41-15 • Development of New Materials for Tissue Hydrodissection: An Analysis of Heat Transfer in Liquids and Gels

Alexander Johnson BS (Presenter) ; Christopher L Brace PhD *

PURPOSE
Hydrodissection is used during image-guided interventions to protect critical tissues from damage collateral to the treatment site. Liquids such as normal saline and 5% dextrose in water (D5W) have been used during thermal ablation, but thermoreversible poloxamer 407 (P407) gels may offer greater stability and robustness. The goal of this study was to evaluate the relative importance of conductive and convective heat dissipation in liquid P407, gel P407, and liquid D5W.

METHOD AND MATERIALS
Radiofrequency (RF) and microwave (MW) ablations were created in ex vivo bovine liver for 10 minutes adjacent to an 11 mm barrier of either gel P407, liquid P407 or liquid D5W. Temperatures were recorded at multiple locations inside the barrier using fiberoptic probes. All experiments were performed in triplicate. Temperature increases at each position within each setup were compared using two-tailed, unpaired Student’s t-tests.

RESULTS
All materials adequately protected the adjacent tissue during RF and MW ablation (mean temperature increase .05). Gel P407 reduced heat flow compared to liquids as indicated by a greater range in mean temperature elevation within the barrier (10.2 ± 0.5°C for gel P407, 1.3 ± 0.8°C and 1.1 ± 0.9°C for liquid P407 and D5W, respectively; P

CONCLUSION
Both P407 and D5W provided adequate thermal protection during RF and MW ablation. Heat dissipation in gel P407 was conduction dominated, but was convection domination in D5W and liquid P407. Additionally, P407 switches its primary mode of heat dissipation from convection to conduction after gelation. Thus, fluids convectively dissipate heat and may require a large reservoir for adequate protection while gel materials may need a greater thickness but provide more thermal protection due to lower heat dissipation rates. Further in vivo evaluation seems warranted.

CLINICAL RELEVANCE/APPLICATION
The clinical use of novel hydrodissection materials can now be educated by empirical evidence of protective ability and general guidelines for barrier creation.

VSIO41-16 • When Should I Be Using that Specialized Device: Cryo

Peter J Littrup MD (Presenter) *

LEARNING OBJECTIVES
1) Understand the different approaches and techniques for thorough cryoablation of nearly any tumor location (e.g., the 1-2 Rule). 2) Understand unique benefits of cryoablation for soft issue locations of head and neck, bone, intra/retroperitoneum and superficial locations (i.e., chest/abdominal wall), as well as more central locations for chest liver and renal ablations. 3) Understand techniques to minimize morbidity, assessing tumor location and approach. 4) Identify major imaging follow-up criteria for ablation success and any early failures. 5) Describe the overall cost-efficacy trade-offs for cryo vs. heat-based renal ablations vs. stereotactic body radiation therapy, in relation to tumor location, complications and recurrence rates.

ABSTRACT
Cryoablation of tumors in difficult-to-treat locations offers a lower pain alternative than heat-based modalities, especially for multiple soft tissue and central organ locations. Major cryoablation benefits include its excellent visualization of ablation zone extent, low procedure pain and flexible hydrodissection very close to skin surface and adjacent crucial structures. CT-guidance is the cryoablation guidance modality of choice due to circumferential visualization and ready availability. US-guidance can augment cryoablation, especially for smaller superficial masses and/or placement of interstitial metallic markers during biopsy for selected cases requiring better eventual CT localization. MR-guidance has little clinical benefit or cost-efficacy. For safety, cases will be considered for choosing the most amenable approach for a wide variety of anatomic locations. Imaging outcomes of complications and their avoidance will be shown. For optimal efficacy, tumor size in relation to number and size of cryoprobes emphasize the 1-2 Rule of at least 1 cryoprobe per cm of tumor diameter and no further than 1 cm from tumor margin, as well as cryoprobe spacing of

VSIO41-17 • When Should I Be Using that Specialized Device: IRE

Stephen B Solomon MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO41-18 • When Should I Be Using that Specialized Device: HIFU

David C Gianfelice MD (Presenter)

LEARNING OBJECTIVES
1) Introduction to technology of focused ultrasound ablation. 2) Review of thermal monitoring as an aid to treatment. 3) Review of FDA approved treatment protocols to date, uterine fibroids and bone metastases. 4) Update on research protocols in progress. 5) Future applications.

VSIO41-19 • RF Ablation: Still the Preferred Ablation Technology in Practice!

Alison R Gillams MBChB (Presenter) *

LEARNING OBJECTIVES
1) To learn the relative merits of radiofrequency ablation over other ablation technologies. 2) To understand the limitations of radiofrequency and how to overcome them.
SSM23-03 • Comparison of Radiation Exposure and Image Quality of 14 and 16 Bit Angiographic C-Arm CT and MDCT

Bernhard C Meyer (Presenter) * ; Thomas Wernccke MD, Dipl Phys ; Oliver A Meissner MD * ; Frank K Wacker MD * ; Christian Von Faich MD

PURPOSE
To compare image quality and radiation exposure of a 64-row CT (MDCT) and angiographic C-Arm CT (CACT) using 14 bit and 16 bit flat detector angiographic systems for abdominal imaging.

METHOD AND MATERIALS
An anthropomorphic phantom (AP) representing a 70kg male was used for this study. To assess contrast resolution, one high contrast...
Effectiveness of Using a Novel Lead Curtain Applied to the Image Detector to Protect Operator and Staff in the Angiography Suite

Zubin Irani MD (Presenter) ; Bailin Alexander BA ; Da Zhang PhD ; Bob Liu PhD ; Rahmi Oklu MD, PhD

PURPOSE
Recent research suggest that long-term low-dose radiation exposure in the interventional (angiographic) suite may lead to greater stochastic effects than previously believed. Sufficient shielding from scatter radiation during fluoroscopy still remains a formidable challenge. We designed and tested the utility of a disposable, sterile lead curtain applied to the image detector to reduce scatter radiation to healthcare workers.

METHOD AND MATERIALS
To simulate standard patient positioning on the angiography table, an anthropological phantom was used. We used a computer aided design software, a grid was overlaid on the procedure room. Using a high sensitivity radiation survey meter, measurements of scatter radiation outside the grid were made throughout the grid. Sequential measurements were made before and after the application of the curtain.

RESULTS
Scatter radiation was attenuated throughout the grid (room). The highest level of scatter radiation was detected immediately adjacent to the phantom at 2 feet distance. In this location, which would approximate the position of the operator, attenuation by the curtain was also maximal averaging at 60% less dose to the operator. The use of the curtain did not result in increase scatter radiation detection to the phantom (patient).

CONCLUSION
The use of this lead curtain significantly reduces scatter radiation in the procedure room. Specifically, the curtain leads to reduction in radiation exposure to the operator at levels averaging 60%.

CLINICAL RELEVANCE/APPLICATION
Radiation exposure is known to have detrimental sequelae. This curtain reduces radiation exposure to the operator and staff in the angiography room and may have significant impact on radiation safety.

Efficacy of Radiation Safety Glasses in Interventional Radiology

Bart Van Rooijen (Presenter) ; Michiel W De Haan MD, PhD ; Marco Das MD * ; Carsten Arnoldussen MD ; Rick De Graaf MD, PhD ; Wim Van Zwam MD ; Walter H Backes PhD ; Cecile R Jeukens PhD

PURPOSE
Recent evidence suggests that radiation-induced cataract to the eye occurs at a lower dose than previously thought. We have assessed
how the design of radiation protection glasses and positioning of the operator influence the reduction of the eye lens dose.

METHOD AND MATERIALS
The scatter free attenuation and the dose reduction with the glasses were determined for several different spectacle designs on an anthropomorphical head phantom. The phantom head was positioned at different locations relative to the radiation source to assess the effects of geometry and head rotation on the dose reduction.

The eye dose reduction achieved in clinical practice was measured using TLD dosimetry during 9 procedures with protective glasses and 13 procedures without.

RESULTS
The scatter-free attenuation of the glasses was approximately a factor of 100. For frontal irradiation of the phantom head, the dose reduction factor was in the range of 7.9 to 10.0. With the head phantom at a location typical for radiological interventions, the dose reduction factor was in the range of 3.4 to 8.3 (left eye) and 1.5 to 2.3 for the right eye. When the phantom head was rotated 45 degrees away from the tube in the axial plane, there was no significant dose reduction for the right eye and the dose reduction for the left eye was 1.1 to 2.5.

In clinical practice wearing ledged glasses resulted in a dose reduction of 2.1 (left eye) and 0.8 (right eye).

CONCLUSION
The dose reduction of radiation protection glasses reduces when incoming radiation faces the head laterally or inferiorly. Physicians performing x-ray guided interventions should be aware of these effects to optimize their posture and choose the appropriate model of glasses.

CLINICAL RELEVANCE/APPLICATION
- Protective eyewear should shield radiation entering from the side and below.
- The radiologist's posture and the room layout should be adjusted to prevent radiation entering from the side or below.

Vascular/Interventional (Vascular Ultrasound)

Wednesday, 03:00 PM - 04:00 PM • E450B

SSM24-01 • Contrast-enhanced Ultrasound Evaluation of Peripheral Microcirculation in Critical Limb ischemia Patients Undergoing Endovascular Revascularization

Costantino Del Giudice MD (Presenter) ; Fabrizio Chegai MD ; Roberto Gandini MD, PhD ; Antonio Orlacchio MD ; Giovanni Simonetti MD

PURPOSE
To evaluate peripheral microcirculation assessed with contrast-enhanced ultrasound (CEUS) in patients with critical limb ischemia undergoing endovascular recanalization in comparison to percutaneous oximetry.

METHOD AND MATERIALS
The study population comprised 14 diabetic patients (9 male, age 76±7.5 years old) with critical limb ischemia. Transectaneous oxygen (TCPO2) and carbon dioxide (TcPCO2) tension was evaluated in the perilesional area. A ultrasound Doppler of the artery directly feeding the ischemic angiosome was performed to confirm the presence of peripheral arteriopathy disease and to evaluate the peak systolic velocity (PSV) and the end diastolic velocity (EDV). Microvascular blood flow in the ischemic angiosome was evaluated with CEUS. The same parameters were evaluated in the contralateral healthy foot as control.

RESULTS
Time-to-peak (TTP) and mean tissue transit time (TTT) were significantly prolonged and derived intensity peak (dIP) was significantly lower in the ischemic foot than the healthy contralateral (TTP 48.76±9.38 s vs. 32.12±6.8 s, p=0.011, A/Ttt 6.81±4.52 s vs. 3.25±3.27 s, p=0.02 and dIP 4.8±3.23 db vs. 8.6±3.1 ). A significantly good correlation between transcutaneous parameters and CEUS parameters was observed.

CONCLUSION
Peripheral microcirculation may be evaluated with CEUS. TTP, TTT and dIP may be an alternative to percutaneous oximetry parameters to evaluate peripheral microcirculation in critical limb ischemia.

CLINICAL RELEVANCE/APPLICATION
Percutaneous oximetry may fail to evaluate peripheral microcirculation. CEUS may be an useful alternative in order to assess the degree of critical limb ischemia before endovascular revascularization.

SSM24-02 • Measurement of Peripheral Muscle Microperfusion (PMP) and Macroperfusion in an Animal Peripheral Artery Disease (PAD) Model Using Contrast-enhanced Ultrasound (CEUS) and Dopper Flow (DF) Measurement

Claas P Naehle MD (Presenter) * ; Verena A Steinberg ; Gottfried Mommmertz ; Dominik Krause ; Hans H Schild MD

PURPOSE
Non-invasive assessment of PMP could improve management of PAD patients and allow for evaluation of new therapies. However, currently only very limited data using outdated/discontinued CEUS technology for assessment of PMP exists.

METHOD AND MATERIALS
In a porcine animal model, PMP of the lower extremity was quantified using CEUS replenishment kinetics (mean transit time (mTT) and wash-in rate (WiR)) of the biceps femoris during i.v. steady-state infusion of an ultrasound contrast agent (INN-sulphur hexafluoride). In addition, macroperfusion was measured at the common femoral artery using a DF probe. PMP and DF measurements were performed bilaterally at rest and under vasodilatation by adenosine stress (infusion rate 70 ?g/kg body weight/min.) after unilateral creation of a moderate external iliac artery stenosis (mean gradient 14.4 ± 5.4 mmHg).

RESULTS
In all 10 pigs all measurements could be performed. During adenosine stress and after stenosis creation, PMP decreased significantly compared to baseline measurements (rest vs. adenosine stress: mTT: 7.8 ± 3.3 s vs. 21.2 ± 18.4 s; p < 0.05 - WiR: 58.4 ± 38.1 arbitrary units (AU) vs. 26.2 ± 15.7 AU; p < 0.05 - DF: 122.3 ± 31.4 ml/s vs. 83.6 ± 28.1 ml/s; p < 0.05 ) no stenosis vs. stenosis: mTT: 8.1 ± 3.1 s vs. 29.2 ± 18.0 s; p < 0.05 - WiR: 53.0 ± 22.7 AU vs. 13.6 ± 8.5 AU; p < 0.05 - DF: 120.3 ± 19.5 ml/s vs. 65.9 ± 40.0 ml/s; p < 0.05). After stenosis creation, adenosine stress lead to a further decrease of PMP, but had no effect on macroperfusion (stenosis rest vs. stenosis adenosine stress: mTT: 29.2 ± 18.0 s vs. 56.3 ± 38.7 s; p < 0.05 - WiR: 13.6 ± 8.5 AU vs. 6.0 ± 4.1 AU; p < 0.05 - DF: 65.9 ± 40.0 vs. 62.2 ± 33.2, p < 0.05).
CONCLUSION
In a porcine PAD model, CEUS for assessment of PMP is feasible. In addition, using mTT and WiR for quantification of PMP appears to be more sensitive compared to DF measurements.

CLINICAL RELEVANCE/APPLICATION
Measurement of PMP using CEUS may prove to be a useful tool in diagnosis of PAD and for evaluation of new therapies.

SSM24-03 • Non-invasive Prediction of Hepatic Transplant Portal Vein Stenosis - Experience at a Single High Volume Transplant Center

Marie A Vasher MD (Presenter) ; Danny R Lababidi MD ; Kamal Massis MD ; Bruce R Zwiebel MD ; Dana M Poletto MD ; Haydy Rojas RN ; Yougul Wu PhD

PURPOSE
We sought to compare Doppler ultrasound findings to transhepatic catheter portal venogram findings of hepatic transplant main portal vein stenoses, and to determine which Doppler ultrasound criteria are often the best non-invasive measures for diagnosing portal vein stenosis.

METHOD AND MATERIALS
32 post-hepatic transplant transhepatic catheter portal venograms following initial Doppler ultrasound were performed at our institution on 30 patients from November 1, 2004 to May 31, 2012 due to clinical, biochemical, Doppler ultrasound, CT and/or MRI abnormalities. Doppler ultrasounds and catheter portal venograms were retrospectively reviewed. Doppler ultrasound criteria of main portal vein peak velocity, velocity step-up ratio, and change in velocity across the anastomosis were correlated with catheter portal venogram. Narrowing of the main portal vein of at least 50% on portal venogram was considered stenotic. 54 randomly chosen patients without suspicion of hepatic transplant portal vein stenosis were assigned to our control group. Patients who underwent catheter portal venogram without findings of portal vein stenosis were also assigned to our control group.

RESULTS

CONCLUSION
Applying the Doppler ultrasound criteria yielded in our study will result in selecting the most appropriate hepatic transplant patients with main portal vein stenosis for catheter portal venogram.

SSM24-04 • Stenosis Index Is a Specific Secondary Screening Test for Patients with Suspected Transplant Hepatic Arterial Stenosis

Sherwin S Chan MD, PhD (Presenter) ; Thomas X Le MD ; Michael F McNeeley MD ; Manjiri K Dighe MD ; Theodore J Dubinsky MD

PURPOSE
Stenosis Index (SI) is a novel angle-independent quantitative measure that is computed using Fourier analysis of the spectral Doppler waveform. We evaluate the utility of stenosis index (SI) as a secondary measure after resistive index (RI) to increase the accuracy of diagnosing transplant hepatic artery stenosis using Doppler ultrasound (US).

METHOD AND MATERIALS
An institutional anonymized retrospective case-control study was performed. Patients who underwent US for suspected post-transplant hepatic artery stenosis and abdominal angiography within 30 days at a large academic center in 2006-2010 were included. Patients who had no imaging of the transplanted artery on their angiography and patients who did not have complete ultrasound evaluation of their hepatic arteries were excluded. These Spectral Doppler images were imported into MATLAB and SI was calculated for each artery in each patient by obtaining a ratio of the power in high frequency bands to fundamental frequency. Student t-test and receiver operator characteristic (ROC) analyses were used to characterize the performance of SI, with ROC analysis providing the optimal SI threshold for detecting clinically relevant stenoses.

RESULTS
63 patients (20 with clinically relevant stenoses) met the inclusion and exclusion criteria. The mean + standard deviation SI of the right and left hepatic arteries for stenotic arteries was 1.04 + 0.22 and normal transplant arteries was 1.18 + 0.19. The mean SI of these two groups were significantly different (p=0.01). In these patients, area under the ROC curve (AUC) was 0.71 for SI and a cutoff value of SI < 0.95, gave a specificity of 95% and sensitivity of 40%. In comparison, RI AUC = 0.6 and RI < 0.6 had a specificity of 20% and sensitivity of 93% for significant transplant hepatic artery stenosis.

CONCLUSION
In a subset of patients whom appeared suspicious enough on ultrasound to warrant angiography, SI is an excellent screening test for transplant hepatic artery stenosis.

SSM24-05 • Should Ultrasound Be Used as Prophylactic Screening for Venous Thromboembolism in High Risk Patients with Malignancy?

Katherine A Kaproth-Joslin MD, PhD (Presenter) ; Charles Francis MD ; Susan K Hobbs MD, PhD ; Alok Khorana ; Deborah J Rubens MD

PURPOSE
Using the previously described clinical risk score for venous thromboembolism (VTE) (Khorana et a, Blood 2008) to identify high risk patients, this study evaluates the utility of screening for thrombosis in a prospective cohort of initially asymptomatic cancer patients initiating outpatient chemotherapy.

METHOD AND MATERIALS
Asymptomatic cancer patients initiating a new chemotherapy regimen and found to be high-risk for VTE based on a predictive risk model (score = 3) were enrolled on an ongoing prospective cohort study with informed consent. Patients were evaluated with a baseline and an every 4 (± 1) week serial US study for up to 16 weeks. Additionally, CT scans obtained for restaging purposes were also evaluated for VTE.

RESULTS
Of the 35 high-risk patients enrolled, 8 (23%) were found to have VTE, 5 patients w/ DVT alone (14%), 1 w/ PE alone (3%) and 2 (6%) w/ both. 32 patients underwent a baseline US and 3 asymptomatic DVTs were identified (9%), w/ 1 patient also having an asymptomatic PE detected on staging CT. Subsequent US were performed in 23 patients at week 4 (0DVT), 21 patients at week 8 (0DVT) and 18 patients at week 12 (1 DVT, 6%). An additional 2 patients developed symptomatic DVT between screens. Restaging CT scans identified an asymptomatic PE in a patient at week 6 and an asymptomatic PE in a patient at week 9. Of the patients w/ isolated DVT, 2 had isolated unilateral calf clot, 2 had unilateral calf and thigh clot, and 1 had unilateral upper extremity clot.

CONCLUSION
In this prospective observational study, 23% of cancer outpatients deemed high-risk for VTE developed clot at a rate much higher than
found in both normal and acutely ill hospitalized populations (0.5 and 6% respectively). This study confirms the previously
described risk score developed by Khorana et al and makes this model highly predictive of identifying patients at risk for VTE. In addition,
these findings suggest that screening US for asymptomatic clot should be considered in high-risk patients based on this risk score. This
study highlights the importance of VTE screening in the calf, w/ 50% of patients w/ VTE having calf clot and 25% having isolated
unilateral calf clot, indicating that this region should be included in the assessment of DVT.

CLINICAL RELEVANCE/APPLICATION
Screening ultrasonography for asymptomatic thrombosis should be considered in high-risk patients based on this risk score with the goal
of reducing the morbidity and mortality associated with VTE.

SSM24-06 • A Comparison between Contrast-enhanced Ultrasound (CEUS) and Multi-slice Computer-tomography (MS-CT) in
Detecting and Classifying Endoleaks in the Follow-up after EVAR

Dirk-Andre Clevert MD (Presenter) *; Verena Guertler ; Wieland H Sommer MD ; Georgios Meimarakis ; Maximilian F
Reiser MD

PURPOSE
To compare Contrast-Enhanced-Ultrasound (CEUS) and Multislice-Computed-Tomography (MS-CT) angiography in detecting and
classifying endoleaks in the follow-up of patients following Endovascular-Aortic-Aneurysm-Repair (EVAR).

METHOD AND MATERIALS
In this retrospective study a cohort of 171 patients with both CEUS and MS-CT follow-up examinations after EVAR were included. In total
489 CEUS and 421 MS-CT examinations were assessed during the follow-up. B-scan, color Doppler and CEUS were performed in all
patients. MS-CT was performed with a 16- up to 128-slice-scanner.

RESULTS
Regarding our inclusion and exclusion criteria we obtained 200 contemporary examination pairs out of the 132 patients of our cohort.
MS-CT was used as the preferred examination in determining the presence of an endoleak.
The true positive rate for the detection of endoleaks with CEUS was 42% (84/200), the false positive rate was 4% (8/200), the true
negative rate was 52% (105/200), and the false negative rate was 2% (3/200). The sensitivity of CEUS was therefore 97%, and the
specificity was 93%. McNemar’s test value was 0.227 and kappa coefficient was 0.889.

CONCLUSION
CEUS appears to be as good as MS-CT in the detection of endoleaks in the
follow-up after EVAR, with the added advantages of no radiation dose and no
nephrotoxicity of the contrast agents. A switch of the preferred examination from
MS-CT to CEUS should be considered.

CLINICAL RELEVANCE/APPLICATION
CEUS appears to be as good as MS-CT in the detection of endoleaks in the follow-up after EVAR, with the added advantages of no
radiation dose and no nephrotoxicity of the contrast agents.

Controversy Session: The Heart of the Matter: Nuclear Stress Test vs CTA for Low to Intermediate Risk Cardiac Patients with
Chest Pain

Wednesday, 04:30 PM - 06:00 PM • S404CD

SPSC45 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

Suhny Abbara , MD *
Sharmila Dorbala , MBBS *

LEARNING OBJECTIVES
1) To review the current literature on cardiac CT in the setting of chest pain with low to intermediate risk. 2)To review the current literature
on radionuclide myocardial perfusion imaging in the setting of chest pain with low to intermediate risk. 3) To understand the strengths and
weaknesses of radionuclide imaging and MDCT in this particular situation.

ABSTRACT
URL
http://www.mgh-cardiovascimages.org/

Minicourse: Recording and Reporting Radiation Dose: Interventional/Angiography/Fluoroscopy

Thursday, 08:30 AM - 10:00 AM • N229

RC623 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

Director
J. Anthony Seibert , PhD

RC623A • Issues in Interventional Fluoroscopy Procedures

Stephen Balter PhD (Presenter)

LEARNING OBJECTIVES
1) Be able to describe effects on patient’s skin, hair, eyes, and other tissues resulting from fluoroscopically-guided interventional
procedures. 2) Be able to adequately communicate FGI radiation risk as part of the informed consent process. 3) Understand the use of
real-time displays of radiation quantities and their relation to radiation risks.

ABSTRACT
Some fluoroscopically-guided interventional procedures (FGI) require the use of a substantial amount of radiation for their completion.
Radiation can be regarded as a toxic agent in the same sense that contrast-media and drugs can be toxic if inappropriately used. The
interventional radiologist should have reasonable knowledge of the toxic effects of radiation on patients at dose levels that may occur during IR procedures. These include short-term tissue reactions on the skin, hair loss, and radiogenic cataracts. Longer term effects such as cancer induction are of importance for some patients. Because radiation is potentially toxic, its risks should be appropriately discussed during the informed consent process. The display of reference air kerma and kerma area product provide risk information to the radiologist while performing a procedure. This is intended to provide ongoing inputs into a continuous evaluation of benefit-risk.

**RC6238 • Measurements and Dose Calculations**

Beth A Schueler PhD (Presenter)

**LEARNING OBJECTIVES**
1) Review methods of measuring patient radiation dose during fluoroscopically-guided interventional procedures. 2) Compare the advantages and limitations of dose measurement methods. 3) Understand parameters that are used to describe patient entrance dose. 4) Learn about new methods for skin dose calculation and recording.

**ABSTRACT**

The measurement of patient dose during fluoroscopically-guided interventional procedures is an important tool for assessment of individual patient radiation risk. Moreover, the display of patient dose is valuable as feedback to the operator to aid in optimization of radiation exposure. Many different methods of measuring fluoroscopy dose have been developed, including direct methods (dosimeters and film) and indirect methods (fluoroscopy time, dose-area-product meters and reference point air kerma estimation). This presentation will review the advantages and limitations of each of these methods, along with common dose metrics that fluoroscopy operators, medical physicists and technologists should be familiar with. In addition, we will discuss skin dose mapping methods that are currently being developed.

**RC623C • Establishing an Interventional Radiology Patient Radiation Safety Program**

Aaron K Jones PhD (Presenter)

**LEARNING OBJECTIVES**
1) List the radiation dose descriptors that should be recorded at the conclusion of a fluoroscopy-guided procedure. 2) Describe the actions that may be taken during the three phases of a fluoroscopy-guided procedure to enhance patient safety. 3) Discuss how to recognize cases that are outside the normal control limits of an interventional radiology practice.

**ABSTRACT**

An interventional radiology patient safety program is essential to better educate patients who are scheduled to undergo fluoroscopically guided interventional radiology procedures; monitor radiation doses delivered during procedures and reduce the risk of tissue effects; ensure appropriate clinical management of patients experiencing significant peak skin doses; and for practice quality improvement through analysis of procedural data and exceptional cases. The program combines preprocedure evaluation and counseling, intraprocedure monitoring, and postprocedure documentation and counseling consistent with guidelines from the National Cancer Institute and the Society of Interventional Radiology. Implementation of a patient safety program is straightforward, requires little infrastructure and few resources, and can be applied in most interventional radiology practices.

**Tumor Ablation beyond the Liver: How-to and Preliminary Results**

**Thursday, 08:30 AM - 10:00 AM • S403A**

**RC631 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5**

Debra A Gervais, MD *

Terrance T Healey, MD

Anil N Kurup, MD

Muneeb Ahmed, MD

**LEARNING OBJECTIVES**
1) Gain knowledge as to how to approach tumor ablation in extrahepatic sites. 2) How to avoid and manage organ specific complications. 3) Review results of tumor ablation in the lung, kidney, and bone.

**ABSTRACT**

Pulmonary malignancies, and specifically lung cancer, are a leading cause of death worldwide. Utilization of best current therapies results in an overall five-year relative survival rate for all stages combined to be only 15%, necessitating the use of alternative therapies. Image-guided ablation of lung malignancies is a revolutionary concept whose clinical applications are just beginning to be developed. It has some advantages over traditional radiotherapy and chemotherapy. Its safety profile is similar to percutaneous image guided lung biopsy. Almost all image-guided ablative procedures can be performed in an outpatient setting, mostly with conscious sedation. Multiple applications can be performed without any additional risks. Contraindications are few and include uncontrollable bleeding diathesis and recent use of anticoagulants. Image-guided ablation of lung malignancies is performed with two basic rationales. In the first group it is used with an intention of achieving definitive therapy. These are patients who are not candidates for surgery because of co-morbid medical contraindications to surgery, like poor cardiopulmonary reserve or patients refusing to undergo operation. This cohort could potentially derive significant benefit from a minimally invasive alternative therapy. In the second group it is used as a palliative measure as follows: (a) to achieve tumor reduction before chemotherapy (b) to palliate local symptoms related to aggressive tumor growth, such as chest pain, chest wall pain or dyspnea (c) hemagenous painful bony metastatic disease (d) tumor recurrence in patients who are not suitable for repeat radiation therapy or surgery Image-guided ablation is expanding treatment options for the local control of non-small cell lung cancer and metastatic disease.

**Image-guided Biopsy of the Spine (Hands-on Workshop)**

**Thursday, 08:30 AM - 10:00 AM • E260**

**RC650 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5**

Moderator

John L Go, MD

**LEARNING OBJECTIVES**
1) Discuss and demonstrate spine biopsy techniques including CT and fluoroscopic approaches, anatomic landmarks, needle selection, special technical considerations for dealing with soft tissue masses, and fluid accumulations, lytic and blastic lesions, and hypervascular conditions. 2) Hands on exposure will be provided in order to familiarize participants with the vast number of biopsy devices that are clinically available. 3) Training models will also be used in order to teach technical skills with respect to approach and technique. 4) Advantages and disadvantages of various biopsy devices and techniques, and improve their understanding of how to maximize the reliability and safety of these spine biopsy procedures.

**ABSTRACT**

**RC650A • Pre- and Postbiopsy Assessment**
LEARNING OBJECTIVES
1) Be familiar with all required aspects of the pre-biopsy work-up, including medications, laboratory values, and review of relevant prior imaging. 2) Be familiar with solutions to address complications or other unexpected events which may arise during the course of spine biopsy. 3) Be comfortable in performing the post-procedure assessment of the patient after spinal biopsy.

RC650B • Equipment Used for Image-guided Biopsies of the Spine
Michele H Johnson MD (Presenter) *
LEARNING OBJECTIVES
1) Demonstrate the types of needles used for spine biopsy. 2) Selecting the proper types of needles used for spine biopsy. 3) Case demonstration of the proper use of single or coaxial needle sets for spine biopsy and the advantages or disadvantages of each.

RC650C • Thoracic and Lumbar Biopsies
John L Go MD (Presenter)
LEARNING OBJECTIVES
1) Review the anatomy of the thoracic and lumbar spine relevant to spine biopsy. 2) Describe the approaches used to approach various anatomical regions within the thoracic and lumbar spine. 3) Provide case examples of various approaches used to biopsy the thoracic and lumbar spine.

ABSTRACT

RC650D • Cervical Biopsies
A. Orlando Ortiz MD, MBA (Presenter) *
LEARNING OBJECTIVES
1) Demonstrate the various approaches used to biopsy lesions of the cervical spine. 2) Determine the selection of the proper needles to use to biopsy the spine. 3) Provide case examples of cervical biopsies and the thought process used to perform these procedures.

RC650E • Disk Biopsies
Chi-Shing Zee MD (Presenter)
LEARNING OBJECTIVES
1) Demonstrate the various approaches used to biopsy the disc. 2) Determine the selection of the proper needles to use to biopsy the disc. 3) Provide case examples of disc biopsies and the thought process used to perform these procedures.

ABSTRACT

Interventional Radiology Series: Non-Vascular Interventions
Thursday, 08:30 AM - 12:00 PM • E352

VSIR51 • AMA PRA Category 1 Credit ™:3.25 • ARRT Category A+ Credit:4
Moderator
Peter R Mueller , MD *
Moderator
Jonathan M Lorenz , MD
LEARNING OBJECTIVES
1) Describe evidence concerning timing emergent abscess drainage. 2) Explain the use of celiac plexus block. 3) Describe two techniques to safely perform dangerous biopsies. 4) Outline 3 controversies in non-vascular intervention. 5) List two catastrophic complications of non-vascular intervention. 6) Describe two techniques to facilitate difficult abscess drainage.

VSIR51-01 • Dangerous Biopsy - Spleen, Mediastinum, Capsular Lesions, Cavitary Lung Lesions
William W Mayo-Smith MD (Presenter) *
LEARNING OBJECTIVES
View learning objectives under main course title.

VSIR51-02 • CT-guided Biopsy of Pulmonary Nodules: Risk Factor Analysis for Pneumothorax in 650 Patients
Ahmed F Emam MBCh (Presenter); Thomas J Vogl MD, PhD; Nagy N Nagib MSc; Mohammed A Alsubhi BMBS; Nour-Eldin A Nour-Eldin MD, MSc
PURPOSE
To evaluate the significant risk factors involved in the development of Pneumothorax during CT-guided Lung of pulmonary Nodules.

METHOD AND MATERIALS
Institutional board approval for the current retrospective study. Patients provided an informed consent for CT-guided biopsy and the anonymous use of the data for research purposes. The study included 650 patients (221 females and 429 males with mean age 56.2 years SD: 5.2) who underwent CT-guided biopsy of pulmonary lesions in the period between January 2008 and January 2013. Factors associated with the development of pneumothorax were analyzed including: Age, emphysema, lesion size, lesion position, coaxial versus non coaxial system, fine needle vs trucut needle. Univariate analysis was performed. P value of < 0.05 was considered as statistically significant.

RESULTS
Significant risk factors involved in the development of pneumothorax were: patients age > 60 years (p=0.04), emphysema (p=0.035), lesion size < 1 cm (p=0.023), central lesions (5 cm (p=0.022), basal pulmonary lesions versus apical lesions (p=0.03). No significant correlation for development of pneumothorax was detected in coaxial versus no-coaxial technique, as well as and fine needle versus trucut needle (p > 0.08). The incidence of pneumothorax was 12% (78 out of 650). Manual evacuation was performed in 25 out of 78 patients (32.1%) and the need for intercostal chest tube was 6 out of 78 (7.7%).

CONCLUSION
Significant risk factors involved in the development of pneumothorax were old age, emphysema, subcentemetric lesions, central or basa lesions, and long intrapulmonary needle track.
**VSIR51-03 • US-guided Transhepatic Core Biopsy of Right Renal or Adrenal Masses: Safety and Short Term Follow Up**

Moon Young Kim MD (Presenter); Byung Kwan Park MD; Sung Yoon Park; Chan Kyo Kim MD, PhD; So Yoon Park

**PURPOSE**
To retrospectively evaluate the accuracy and safety of ultrasound (US)-guided trans-hepatic biopsy of right upper renal or adrenal masses.

**METHOD AND MATERIALS**
Ten US-guided trans-hepatic biopsies were performed in ten patients with six right upper renal masses and four right adrenal masses which were invisible or inaccessible via an extra-hepatic route. The control population comprised of 19 US-guided extra-hepatic biopsies that were performed in 19 patients with 16 right upper renal masses and one right adrenal mass. Trans-hepatic and extra-hepatic biopsies were compared with respect to the diagnostic or complication rates. The size of the mass, biopsy distance, number and length of cores as well as biopsy duration were also compared.

**RESULTS**
The diagnostic rates of trans-hepatic and extra-hepatic biopsies were 90% (9/10) and 89% (17/19), respectively (p=1.000). The complication rates of trans-hepatic and extra-hepatic biopsies were 10% (1/10) and 21% (4/19), respectively (p=1.000). None of these biopsies resulted in major complications. The sizes (mean ± standard deviation) of the mass, biopsy distances and number of cores for trans-hepatic and extra-hepatic biopsies were 33.0 ± 14.3 mm and 46.9 ± 18.5 mm, 100.5 ± 17.9 mm and 76.5 ± 9.9 mm, and 2.7 ± 0.9 and 4.0 ± 0.7, respectively (p=0.001-0.046). However, the length of cores and biopsy durations were not significantly different between these biopsies (p=0.077-0.91).

**CONCLUSION**
US-guided trans-hepatic core biopsy appears to be feasible and safe procedure for the histologic diagnosis of right upper renal or adrenal masses which are either invisible or inaccessible via an extra-hepatic route.

**CLINICAL RELEVANCE/APPLICATION**
Trans-hepatic core biopsy allows for better sampling of right renal or adrenal masses due to excellent US penetration of normal hepatic parenchyma compared to an extra-hepatic core biopsy.

**VSIR51-04 • Computer Assisted Electromagnetic Navigation Improves Accuracy in CT Guided Interventions: A Prospective Randomized Clinical Trial**

Pierre Durand MD, MSc (Presenter); Alexandre Moreau-Gaudry MD, PhD; Julien Frandon MD; Emilie Chipon PhD; Maud Medici MSc; Ivan Bricault PhD *

**PURPOSE**
To assess the accuracy and usability of a novel electromagnetic navigation system designed to assist CT guided interventions.

**METHOD AND MATERIALS**
The tested navigation system prototype uses an electromagnetic localizer in order to track the position and orientation of a needle holder; it can display the needle path in real-time on 2D reconstructed CT-images extracted from the 3D CT volume. This study was approved by the regional ethics committee and all patients gave written informed consent. From June 2010 to January 2012, 120 patients undergoing a routine percutaneous CT procedure (drainage, biopsy, tumor ablation, infiltration, sympathicolyis) were randomized between the conventional procedure (CT group) and a navigation-assisted procedure (NAV group). The main outcome was the distance between the planned trajectory and the actual needle trajectory after a first attempt at placement.

**RESULTS**
N=120 patients were analyzable in intention-to-treat analysis (CT: 60; NAV: 60). Nineteen radiologists participated in the study; their satisfaction score (0-10) shows that the help provided by the navigation system was favorably appreciated: CT=8[7; 9]; NAV=9[8; 9.5] (p=0.025). The accuracy was improved when the navigation system was used: distance error (mm) with CT=8.86[4.86; 15.09], vs. with NAV=4.07[2.7; 9.14] (p<0.001). The satisfaction score (0-10) shows that the help provided by the navigation system was favorably appreciated: CT=8[7; 9]; NAV=9[8; 9.5] (p=0.025). The accuracy was improved when the navigation system was used: distance error (mm) with CT=8.86[4.86; 15.09], vs. with NAV=4.07[2.7; 9.14] (p<0.001). The accuracy was improved when the navigation system was used: distance error (mm) with CT=8.86[4.86; 15.09], vs. with NAV=4.07[2.7; 9.14] (p<0.001). The accuracy was improved when the navigation system was used: distance error (mm) with CT=8.86[4.86; 15.09], vs. with NAV=4.07[2.7; 9.14] (p<0.001). The accuracy was improved when the navigation system was used: distance error (mm) with CT=8.86[4.86; 15.09], vs. with NAV=4.07[2.7; 9.14] (p<0.001).

**CONCLUSION**
Electromagnetic navigation, as compared with conventional CT procedures, provides significant improvement in accuracy. Usability in a real clinical setting is established.

**CLINICAL RELEVANCE/APPLICATION**
Improvements in accuracy and ability for the radiologist to plan optimal trajectories in any plane can lead to a security benefit for the patient, particularly in case of complicated targets.

**VSIR51-05 • Controversies in Non-Vascular Interventions**

George I Getrajdman MD (Presenter)

**LEARNING OBJECTIVES**
Three controversies will be discussed. The participants will learn about lymphocele drainage- ETOH vs iodine sclerosis vs none. Pre procedural antibiotics for chest wall ports- always, never, or sometimes. They will also learn about current management of pneumothorax in outpatients undergoing lung or mediastinal biopsies.

**VSIR51-06 • Tough Abscess Drainage**

Ronald S Arellano MD (Presenter)

**LEARNING OBJECTIVES**
1) Review anatomic consideration that impose challenges for image-guided percutaneous abscess drainage. 2) Discuss techniques that can be used to facilitate image-guided percutaneous drainage of technically challenging abscesses.

**ABSTRACT**
Image-guided percutaneous abscess drainage is one of the most commonly performed procedures in Interventional Radiology. Facility with the various techniques and modalities used for drainage is essential. While most abdominal abscess are readily accessible for image-guided percutaneous drainage, there can be situations when drainage is challenging due to anatomic or patient factors. The purpose of this refresher course is to discuss techniques, by way of case examples, that can be used to successfully drain challenging abdominal abscesses.

**VSIR51-07 • Drainage Catheter Flow Rate Related to the Number and Location of Sideholes: Does It Matter?**

David H Ballard MS (Presenter); Jeffery A Weisman JD; Mackenzie A Orchard; Jason T Williams MPH; Jonathan S Alexander PhD; Horacio R D'Agostino MD

**PURPOSE**
Currently, there is no evidence suggesting that the number or position of sideholes within drainage catheters has been based on fluid dynamics or clinical principles. The purpose of our study was to investigate the effect of varying catheter sidehole number and position on
Our data shows that flow rate is maximized at 3 sideholes in the single-sided model catheters. Single-sided model catheters with more than 3 sideholes showed no significant improvement in flow rate. All the double-sided model catheters had significantly better flow rates than their single-sided counterparts. Flow rate was maximal in the double-sided model catheter with 2 holes (one on each side) and there was no significant improvement in the catheters with more bilateral sideholes.

CONCLUSION
Our results suggest that optimal flow in drainage catheters can be achieved through a design consisting of a single pair of sideholes arranged opposite of each other and inclusion of additional sideholes does not significantly improve flow. These in vitro results illustrate that using fluid dynamics principles to redesign drainage catheters could serve to improve catheter performance.

CLINICAL RELEVANCE/APPLICATION
Clinical observations reveal that drainage catheter distal sideholes are often filled with debris that could be a source of sepsis. Our data suggests catheters with few sideholes achieve optimal flow.

Percutaneous Interventions for Management of Post-surgical Pelvic Abscesses in Patients with Rectal Cancer: Does Neo-adjuvant Chemo-radiation Impact Clinical Outcome?

Avinash R Kambadakone MD, FRCR (Presenter) ; Ashraf Thabet MD ; Diane Alagno ; Kara P Stasko MS ; Ronald S Arellano MD ; Debra A Gervais MD * ; Peter R Mueller MD *

PURPOSE
The purpose of this study was to evaluate the impact of peri-operative chemo radiation on the clinical outcome of percutaneous interventions for management of post surgical pelvic abscesses in patients with rectal cancer.

METHOD AND MATERIALS
In this retrospective study we included 54 patients (M: F-33: 21, mean age-65yrs, age range: 29-91yrs) with rectal cancer who underwent CT guided percutaneous drainage of pelvic abscesses developing after low anterior or abdomino-perineal resection. In this cohort, thirty-three patients (M: F-20: 13, mean age -65 yrs) had received neoadjuvant chemoradiation either prior to or after surgical resection (Group A) and 21 patients (12M:9F, mean age-64yrs) did not receive any chemoradiation (Group B). The electronic medical records and imaging studies in these patients were retrospectively evaluated to record the surgical details, chemo radiation details and details of abscess drainage. The technical success, primary and secondary success and treatment failure rates were compared between the two groups.

RESULTS
A total of 80 CT-guided percutaneous abscess drainage procedures were performed on the 54 patients (Group A, n=57 and Group B, n=33). The mean surgery to abscess drainage period was longer in Group A compared to Group B (210 days vs 39 days, p=0.02). The technical success rate was comparable between the two groups (96.5% vs 95.5%). The primary success was higher in Group B as compared to Group A (83.3% vs 54.5%). The total period of catheter drainage was higher in patients who received chemo-radiation (Group B) (105 days vs 26 days, p=0.02). The abscess recurrence rate (re-accumulation) and catheter malposition was also higher in patients with chemo-radiation (p=0.01). Enteric fistulas complicating drainage of pelvic abscesses were also more common in chemo-radiation group (A: 42% (21/50), B: 21% (4/19)).

CONCLUSION
Peri-operative chemoradiation adversely impacts outcome after percutaneous drainage of post surgical abscess in patients with rectal cancer necessitating prolonged drainage, frequent recurrences and multiple catheter manipulations.

CLINICAL RELEVANCE/APPLICATION
Percutaneous management of post surgical abscesses in patients with rectal cancer can be challenging particularly in patients receiving chemoradiation and therefore needs multidisciplinary management.

Debate - Emergent Abscess Drainage – Can It Wait Until Morning?

Ronald S Arellano MD (Presenter) ; Jonathan M Lorenz MD (Presenter)

LEARNING OBJECTIVES
The urgency of percutaneous catheter drainage depends on a number of factors such as the type of fluid collection, complications related to the fluid collection, and the clinical presentation. This interactive session reviews those factors in a point-counterpoint format.

ABSTRACT
An old surgical adage states: "Do not let the sun go down or rise on an abscess." Such is no longer the case. While all patients with abscesses will benefit from percutaneous drainage, not all abscesses require urgent or emergent drainage. Both anatomic as well as clinical scenarios factor into the decision making in how to appropriately triage abdominal abscesses. This workshop will present cases that illustrate examples of abscesses that require urgent drainage.

Celiac Plexus Block

Peter R Mueller MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

Controversies in Non-Vascular Interventions II

Jonathan M Lorenz MD (Presenter)

LEARNING OBJECTIVES
Controversies and solutions regarding triaging patients toward appropriate multidisciplinary therapeutic options will be addressed. In addition, decisions regarding the appropriate application, performance, and follow-up of therapeutic options offered by interventional radiology will be discussed in the context of appropriate supportive literature and expert opinion.

Catastrophic Complications of Non-Vascular Intervention

Thomas B Kinney MD (Presenter) *

METHOD AND MATERIALS
Ad hoc customized drainage catheters were constructed with various numbers of sideholes (1 to 6). To optimize flow, each sidehole was created with the same diameter as the lumen of the catheter (15 Fr). Drainage catheters were constructed with sideholes on one side (single-sided model), or pairs of sideholes on opposite sides of the shaft (double-sided model). The drainage reservoir consisted of a cylindrical container filled with water. The cylinder was constructed to maintain a constant pressure independent of catheter fluid evacuation. This constant pressure outflow system was established in the reservoir with a 500 mL pressure head using a fixed fluid inflow with a flow/overflow valve. After the catheters were inserted and the pressure gradient was established, fluid evacuation was evaluated using 10-second intervals by draining the fluid into a collection vessel and recording the volume. A total of 5 trials were performed for each catheter to account for measurement error.

RESULTS
Our data shows that flow rate is maximized at 3 sideholes in the single-sided model catheters. Single-sided model catheters with more than 3 sideholes showed no significant improvement in flow rate. All the double-sided model catheters had significantly better flow rates than their single-sided counterparts. Flow rate was maximal in the double-sided model catheter with 2 holes (one on each side) and there was no significant improvement in the catheters with more bilateral sideholes.

CONCLUSION
Our results suggest that optimal flow in drainage catheters can be achieved through a design consisting of a single pair of sideholes arranged opposite of each other and inclusion of additional sideholes does not significantly improve flow. These in vitro results illustrate that using fluid dynamics principles to redesign drainage catheters could serve to improve catheter performance.

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Clinical observations reveal that drainage catheter distal sideholes are often filled with debris that could be a source of sepsis. Our data suggests catheters with few sideholes achieve optimal flow.

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Avinash R Kambadakone MD, FRCR (Presenter) ; Ashraf Thabet MD ; Diane Alagno ; Kara P Stasko MS ; Ronald S Arellano MD ; Debra A Gervais MD * ; Peter R Mueller MD *

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CONCLUSION
Peri-operative chemoradiation adversely impacts outcome after percutaneous drainage of post surgical abscess in patients with rectal cancer necessitating prolonged drainage, frequent recurrences and multiple catheter manipulations.

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Debate - Emergent Abscess Drainage – Can It Wait Until Morning?

Ronald S Arellano MD (Presenter) ; Jonathan M Lorenz MD (Presenter)

LEARNING OBJECTIVES
The urgency of percutaneous catheter drainage depends on a number of factors such as the type of fluid collection, complications related to the fluid collection, and the clinical presentation. This interactive session reviews those factors in a point-counterpoint format.

ABSTRACT
An old surgical adage states: "Do not let the sun go down or rise on an abscess." Such is no longer the case. While all patients with abscesses will benefit from percutaneous drainage, not all abscesses require urgent or emergent drainage. Both anatomic as well as clinical scenarios factor into the decision making in how to appropriately triage abdominal abscesses. This workshop will present cases that illustrate examples of abscesses that require urgent drainage.

Celiac Plexus Block

Peter R Mueller MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

Controversies in Non-Vascular Interventions II

Jonathan M Lorenz MD (Presenter)

LEARNING OBJECTIVES
Controversies and solutions regarding triaging patients toward appropriate multidisciplinary therapeutic options will be addressed. In addition, decisions regarding the appropriate application, performance, and follow-up of therapeutic options offered by interventional radiology will be discussed in the context of appropriate supportive literature and expert opinion.

Catastrophic Complications of Non-Vascular Intervention

Thomas B Kinney MD (Presenter) *
LEARNING OBJECTIVES
View learning objectives under main course title.

VSIR51-13 • Wrap Up and Discussion

LEARNING OBJECTIVES
View learning objectives under main course title.

Vascular Imaging Series: CT Angiography-New Techniques and Their Application

Thursday, 08:30 AM - 12:00 PM • SS02AB

LEARNING OBJECTIVES
View learning objectives under main course title.

VSVA51 • AMA PRA Category 1 Credit ™:3.25 • ARRT Category A+ Credit:4
Moderator
Dominik Fleischmann , MD *

LEARNING OBJECTIVES
1) To describe and illustrate new techniques for CT angiography. 2) To show present and future clinical applications of these methods.

VSVA51-01 • Iterative Reconstruction for CTA

Sandra S Halliburton PhD (Presenter) *

LEARNING OBJECTIVES
1) Understand the basic principles of iterative reconstruction for CT. 2) Describe commercially available iterative reconstruction techniques. 3) Review the advantages and disadvantages of iterative reconstruction. 4) Discuss the incorporation of iterative reconstruction algorithms into clinical protocols for CT angiography.

ABSTRACT

VSVA51-02 • Model-based Iterative Image Reconstruction (MBIR) in CT Angiography of the Chest - A Dose Finding Cadaver Study

Stefan Wirth MD (Presenter) *; Fabian Mueck; Zsuzsanna Deak MD; Sonja Kirchhoff MD; Oliver Peschel; Maximilian F Reiser MD; Michael K Scherr MD

PURPOSE
To compare image quality (IQ) of 64-row CT angiography of the chest, respectively acquired at varying dose levels and reconstructed with model based iterative reconstruction (MBIR), to standard baseline examinations at full dose and using adaptive statistical iterative image reconstruction (ASIR).

METHOD AND MATERIALS
8 male and 3 female cadavers were included (79±18.5kg; 72.5±17.2y/o; BMI 26.3±5.1). Following injection of contrast media (Angiofil-Macro: Arterial=800ml; Venous=1200ml; Virtangio, Fumedica, Muri; Switzerland) a full-dose baseline reference (FBR) was acquired (CT HD750; GE Healthcare, Waukesha, IL) using a standard-of-care protocol (0.625mm helical, 0.984 pitch, 120kV, 10-400mA modulation, noise index NI=39 VS=0.625; NI = allowed procentual level of noise in a water phantom in virtual slices of varying thickness (VS) in mm; raw data were reconstructed in soft tissue kernel using ASIR 50%). These baseline raw data were also reconstructed with MBIR (D0). Additionally, each cadaver was scanned with varying dose levels D1-D5 by changing NI and VS (D1: NI=35, VS=2.5; D2: NI=70, VS=0.625; D3: NI=35, VS=5; D4: NI=70, VS=2.5; D5: NI=70, VS=5; all reconstructed with MBIR). Except for NI, VS and MBIR, all other parameters were identical to the FBR, all series reformatted in 3mm axial, coronal and sagittal slices. Two radiologists, blinded to the dose level, independently compared IQ for CT angiography of D0-D5 to the full-dose FBR (IQ: -2:diagnostically inferior, -1:inferior, 0:equal, +1:superior, +2:diagnostically superior; respectively). For statistical analysis ICC and Wilcoxon’s test were used.

RESULTS
Mean values were (CTDIvol in mGy: D0 = 10.4±0.9, D1 = 7.4±2.6, D2 = 6.6±2.5, D3 = 4.3±1.8, D4 = 2.1±0.9, D5 = 1.1±0.5); (IQ: D0 = +1.0±0.3, D1 = +0.9±0.3, D2 = +0.7±0.3, D3 = +0.5±0.3, D4 = +0.2±0.3, D5 = -0.5±0.6). All values were significant different from another one; p

CONCLUSION
Data reconstruction with MBIR instead of ASIR allows for significant dose reduction of 80% in CT angiography of the chest without impairment of the image quality, resulting in a calculated mean effective dose of 0.94±0.66 mSv.

CLINICAL RELEVANCE/APPLICATION
For standard CT angiography, MBIR allows for diagnostic imaging of the chest below 1mSv without loss of image quality (overall, vessel wall, thrombus material, calcifications).

VSVA51-03 • Evaluation of Diagnostic Quality and Image Adequacy of Low Dose CT Angiography with Model Based Iterative Reconstruction in Follow Up of Endovascular Aortic Aneurysm Repair

Neil Hansen MD (Presenter) ; Ravi K Kaza MD ; Katherine E Maturen MD ; Peter S Liu MD ; Joel F Platt MD

PURPOSE
To evaluate the image quality and overall adequacy of low dose Computed Tomographic Angiography (LD-CTA) with model based iterative reconstruction (MBIR) in patients evaluated following endovascular aortic aneurysm repair (EVAR) in comparison to standard dose CTA (SD-CTA) with Adaptive Statistical Iterative Reconstruction (ASIR).

METHOD AND MATERIALS
30 patients who had LD-CTA with MBIR and a prior SD-CTA with ASIR following EVAR were included. Two radiologists independently evaluated 60 CTAs in a random blinded fashion. Image quality for evaluation of stent configuration, stent lumen, aneurysm outline, vessel outline, and overall vascular and solid organ imaging adequacy were graded on a scale of 1 to 5 (1=poor, 2=acceptable, 3=good, 4=very good, 5=excellent). Maximal aneurysm sac diameter was measured, and the presence or absence of an endoleak was recorded. Image noise and contrast to noise ratio (CNR) were measured for all CTs. Scanner generated CT dose index (CTDI vol) and Dose Length Product (DLP) were recorded for the arterial and delayed phases.

RESULTS
Mean qualitative image score for LD-CTA averaged in the good to very good range in all categories. There was no significan difference between LD-CTA and SD-CTA in evaluation of stent lumen (4.1 vs. 3.9; p = .077). There was a significantly (p < .0001) higher score for the SD-CTA in the following categories: stent configuration (4.5 vs. 3.6), aneurysm outline (4.8 vs. 3.8), vessel outline (4.7 vs. 3.3), overall vascular adequacy (4.6 vs. 4.1), and overall solid organ imaging adequacy (4.6 vs. 3.3). Interobserver evaluation for endoleak detection was good for both groups, but higher for the LD-CTA (kappa = .92 vs .77). There was no significant difference in the mean aneurysm diameter between the two readers on LD-CTA and SD-CTA. The effective radiation dose for the LD-CTA was significantly (p < .0001) lower than SD-CTA during both the arterial (4.4 vs 16.2 mSv) and the venous (2.4 vs 6.7mSv) phases. As compared to SD-CTA with ASIR, the measured image noise was significantly lower (14.7 vs. 19.3; p < .001) and CNR was higher (25.6 vs. 17.1; p < .001) on
CONCLUSION
In patients being followed up after EVAR, low dose CTA with MBIR produces diagnostically acceptable image quality with significant radiation dose reduction.

CLINICAL RELEVANCE/APPLICATION
Low dose CTA with MBIR after EVAR produces diagnostic image quality with significant patient radiation dose reduction.

**VSVA51-04 • CT Angiography of the Chest and Abdomen: Image Quality, Interobserver Variability, and Diagnostic Accuracy for Iterative versus Filtered Back Projection Reconstruction**

Elizabeth George MBBS (Presenter); Kanako K Kumamaru MD, PhD; Pamela M Deaver MD; Katherine Mullen MD; Sachin S Saboo FRCSR, MD; Frank J Rybicki MD, PhD *; Kurt Schultz RT *; Ashish R Khandelwal MD; Michael L Steigner MD *; Dimitris Mitsouras PhD

PURPOSE
To test the hypothesis that CT angiography (CTA) images reconstructed with iterative method (AIDR3D) have superior image quality, lower interobserver variability in anatomical measurements, and higher diagnostic accuracy when compared to the same raw data reconstructed with filtered back projection (FBP).

METHOD AND MATERIALS
All 157 clinical chest and abdominal CTA (Table) acquisitions (320x0.5 mm CT) over 5 months (6/12-10/12) were performed at a reduced radiation dose (compared to standard at our institution) and the raw data was reconstructed with both AIDR3D and FBP. Quality of arterial phase images was assessed by two independent readers (4-point scale) for both reconstructions. For 1/3 of patients (n=53, randomly chosen), signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) was measured at the artery of interest. For renal donors (n=10), kidney size and renal artery length were measured by two readers for both reconstructions, and interobserver variability determined. For coronary CTA with reference standard catheter angiography (n=15), degree of coronary stenosis and level of confidence (3-point scale) in assessment was determined by two readers for both reconstructions, interobserver agreement and diagnostic accuracy was assessed.

RESULTS
Image quality score had good interobserver agreement (weighted $\kappa=0.67$) and was higher ($p=0.007$), and FOM (20.9±24.3, 44.0±44.7, $p=0.005$), objective IQ was measured by mean arterial attenuation, image noise, signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR). To adjust for differences in radiation exposure, a figure of merit (FOM) was calculated. Effective radiation dose equivalents were compared. All values are given as mean±standard deviation (SD) and were tested for significance using the Wilcoxon signed-rank test.

CONCLUSION
Reduced radiation exposure CTA images reconstructed with AIDR3D have higher objective and subjective image quality when compared to FBP, with a tendency towards lower interobserver variability among the CTA clinical indications tested.

**CLINICAL RELEVANCE/APPLICATION**
AIDR3D reconstruction for CTA acquisitions can reduce radiation dose with high image quality, supporting its routine use.

**VSVA51-05 • Dual-Energy and Low kVp CTA**

Sachio Kuribayashi MD (Presenter) *

LEARNING OBJECTIVES
1) Understand the basic principles and technical basics of dual energy CTA. 2) Describe two components of dual energy imaging including material decomposition and virtual monochromatic spectral imaging. 3) Review the experimental studies and discuss the potential clinical application to vascular systems.

**VSVA51-06 • Reduced Radiation Dose and Improved Diagnostic Image Quality at Cardiovascular CT Angiography by Automated, Individualized X-ray Tube Voltage Selection: Intra-individual Comparisons**

Aleksander Krazinski (Presenter); U. Joseph Schoepf MD *; Justin R Silverman; Christian Canstein *; Robin Brothers RT; Lucas L Geyer MD *; Felix G Meinel MD

PURPOSE
To evaluate radiation dose and image quality at cardiovascular CT angiography (CTA) with an automated x-ray tube voltage adjustment application by intra-individual comparison in patients undergoing CTA of the heart or aorta.

METHOD AND MATERIALS
The study was IRB approved and HIPAA compliant. We retrospectively analyzed paired studies in 64 patients (35 male, 60±16 years), who had undergone two 2nd generation dual-source CTA acquisitions of the heart or aorta before and after the implementation of an automated x-ray tube voltage adjustment application. Each study pair consisted of a baseline scan (scan1) where tube voltage was operator selected based on the patient's body mass index and a follow up scan (scan2) where tube voltage was automatically selected based on the anatomical attenuation of the topogram ( scout ) acquisition. Other parameters were kept identical between the two scans: 2x64x0.6mm collimation; 320mAs modulated reference tube current-time product. Subjective image quality (IQ) was rated and objective IQ was measured by mean arterial attenuation, image noise, signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR). To adjust for differences in radiation exposure, a figure of merit (FOM) was calculated. Effective radiation dose equivalents were compared. All values are given as mean±standard deviation (SD) and were tested for significance using the Wilcoxon signed-rank test.

RESULTS
All studies were considered diagnostic. A different kV level between scan1 and scan2 was automatically selected in 18 patients (28%). Overall subjective IQ (3.30±0.87, 3.56±0.85, $p=0.02$), SNR (14.6±5.93, 16.65±5.90, $p=0.005$), CNR (12.13±5.34, 14.08±5.30, $p=0.007$), and FOM (20.9±24.3, 44.0±44.7, $p=0.02$) was determined. For coronary CTA with reference standard catheter angiography (n=15), degree of coronary stenosis and level of confidence (3-point scale) in assessment was determined by two readers for both reconstructions, interobserver agreement and diagnostic accuracy was assessed.

CONCLUSION
Image quality score had good interobserver agreement (weighted $\kappa=0.67$) and was higher ($p=0.02$), and FOM (20.9±24.3, 44.0±44.7, $p=0.02$) was determined. For coronary CTA with reference standard catheter angiography (n=15), degree of coronary stenosis and level of confidence (3-point scale) in assessment was determined by two readers for both reconstructions, interobserver agreement and diagnostic accuracy was assessed.

CLINICAL RELEVANCE/APPLICATION
AIDR3D reconstruction for CTA acquisitions can reduce radiation dose with high image quality, supporting its routine use.

**VSVA51-07 • Utility of Iodine Extracted Images from Single Source Dual-energy CTA to Evaluate the Success of Endovascular Repair of Abdominal Aortic Aneurysm**

Mukta D Agrawal MBBS, MD (Presenter) *; Sanjeeva P Kalva MD *; George R Oliveira MD; Jorge M Fuentes MD; Yasar Andrahi MD, MPH; Koichi Hayano MD; Dushyant V Sahani MD

PURPOSE
To investigate if the iodine-extracted (IE) images from DE-CTA can enable confident assessment of stent patency and endoleak following endovascular repair of abdominal aortic aneurysm (EVAR).

METHOD AND MATERIALS
In this IRB approved prospective study, 51 consecutive patients with EVAR had follow-up CTA exam using ssDECT (GE discovery CT750 HD). The arterial (25-30 sec) and delayed phase (60 sec) DECT datasets were processed to create material density iodine extracted images (IE) and virtual monochromatic (VMC) images at 50 and 70 keV. Three-experienced radiologist independently evaluated only the IE images to assess stent patency and endoleak detection. The diagnostic evaluation based on combined unenhanced, multiphas
enhanced and processed VMC images served as the reference standard for comparison or performance and interpretation time. Number of endoleaks detected on IE images were compared to that detected on all other images.

RESULTS
All readers made their interpretations in 51 cases using IE except in 4 cases for R1 and 2 cases for R2, review of other image datasets was demanded but their interpretations remained unchanged. 15 endoleaks were confidently detected on IE images by all readers including those in 4 patients with Onyx embolization for type 2 endoleaks. Although arterial phase IE images detected all 15 leaks, in 3 patients delayed phase IE images were helpful. Average time spent per case was 5.34 minutes for IE images alone in comparison to 21.30 minutes for the entire processed DECT dataset.

CONCLUSION
Review of ssDE-CTA rendered IE images alone can enable confident assessment of stent patency and endoleak detection in patients with EVAR.

CLINICAL RELEVANCE/APPLICATION
ssDECT benefit vascular imaging but has introduced workflow challenge to process and interpret multiple dataset. IE combine the unique features to efficiently yield pertinent information for EVAR exam

VSVSA51-08 ● Implications for Contrast Medium Delivery
Hans-Christoph R Becker MD (Presenter)

LEARNING OBJECTIVES
1) Understand the basic principles and technical basics of dual energy CTA. 2) Describe two components of dual energy imaging including material decomposition and virtual monochromatic spectral imaging. 3) Review the experimental studies and discuss the potential clinical application to vascular systems.

VSVSA51-09 ● Utility of Dual Energy Spectral CT for Reducing Contrast Medium Dose in Abdominal CT Angiography: Initial Clinical Experience
Xin Lei (Presenter); Yang Xiaotang; Gao Jinfang; Zhao Zhikai; Chang Chao; Fan Lin

PURPOSE
To investigate the utility of dual energy spectral CT (DE-CT) for reducing contrast medium in abdominal CT angiography.

METHOD AND MATERIALS
This prospective study was approved by the institutional review board with patient informed consent. 22 consecutive patients (BMI =24, 13 men, 9 women; mean age, 45.4±12.6 years) with suspected abdominal occupied lesions underwent either conventional CTA with 120kVp and iodoxanol (Visipaque, 270mg/ml) (n=12) or spectral CTA with iohexol (Omnipaque, 350mg/ml) (n=10). The injection rate and amount for two groups were 3.5 ml/s and 1 ml/kg. Images of both groups had 0.625 mm slice thickness. Monochromatic images (40-140 keV) were generated from the spectral CTA, and from which an optimal energy level was selected for obtaining the best contrast-noise-ratio (CNR) for the abdominal aorta at the renal artery level relative to the erector spine muscle. The CT value and noise of the abdominal aorta and muscle at the optimal monochromatic image set of spectral CTA group and at conventional CTA group were measured. Two radiologists assessed all images with 5-points scale. CTDIvol was recorded. Data were analyzed using student T-test.

RESULTS
The mean CT value was lowest for the image at 120kVp after administration of 400 mg I/kg of contrast material. The mean CT value was significantly higher than that at 120 kVp (600 mg I/kg, 150.1 ± 19.9 HU vs. 121.8 ± 14.2 HU; 500 mg I/kg, 134.4 ± 19.4 HU vs. 108.7 ± 14.3 HU; and 400 mg I/kg, 115.9 ± 15.8 HU vs. 91.6 ± 12.2 HU, respectively). The mean CNR value was lowest for the 120 kVp after administration of 400 mg I/kg of contrast material. The proportion of patients with scores over 80 HU of 400 mg I/kg and at 120 kVp (15/21 [71.4%]) was significantly lower than that of the control group (600 mg I/kg at 120 kVp; 21/21 [100%]). There was no significant difference between the images obtained after administration of 400 mg I/kg of contrast material at 80 kVp and the control images (600 mg I/kg at 120 kVp). Moreover, in this study, the use of 80 kVp rather than 120 kVp showed a 30% reduction in radiation exposure (CTDIvol [10.4 vs. 14.9 mGy], respectively).

CONCLUSION
With 29% contrast medium reduce and similar radiation dose, spectral CTA provided better image quality than conventional CTA.

CLINICAL RELEVANCE/APPLICATION
Low-keV monochromatic CTA should be an optional choice for patients who have underlying renal function impairment.

VSVSA51-10 ● CT Venography with Dual Energy CT: Dose Reduction of Contrast Material with Low Tube Voltage
Shintaro Ichikawa MD (Presenter); Utaro Motosugi MD; Masato Imaizumi; Katsuhiro Sano MD; Hiroyuki Morisaka MD; Tomoaki Ichikawa MD, PhD *

PURPOSE
To assess whether dose of contrast material can be reduced in CT venography with low tube voltage (80 kVp) CT.

METHOD AND MATERIALS
This prospective study included 63 patients. They were randomly divided into 3 groups that were administrated different doses of contrast material (600, 500, and 400 mg I/kg). We used an area-detector CT scanner (Aquilion ONE; Toshiba Medical Systems, Japan) and iopamidol (Iopamiron, 300mg/ml; Bayer Yakuhin, Ltd., Japan). All patients underwent dual energy CTA at 80 and 135 kVp. Conventional image (120kVp) was made from them and 80 and 120 kVp were compared. We measured the average CT value of 4 regions of interests, namely, the left and right femoral and popliteal veins, and a value of ≥80 HU was considered sufficient contrast for detecting deep vein thrombosis (Goodman, et al. Radiology 2005). Two radiologists evaluated the contrast of veins and muscles with a 3-point confidence scale, and scores within ≥5 points of the total score were considered adequate.

RESULTS
The mean CT value of images taken at 80 kVp was significantly higher than that taken at 120 kVp (600 mg I/kg, 150.1 ± 19.9 HU vs. 121.8 ± 14.2 HU; 500 mg I/kg, 134.4 ± 19.4 HU vs. 108.7 ± 14.3 HU; and 400 mg I/kg, 115.9 ± 15.8 HU vs. 91.6 ± 12.2 HU, respectively). The mean CNR value was lowest for the 120 kVp after administration of 400 mg I/kg of contrast material. The proportion of patients with scores over 80 HU of 400 mg I/kg and at 120 kVp (15/21 [71.4%]) was significantly lower than that of the control group (600 mg I/kg at 120 kVp; 21/21 [100%]). There was no significant difference between the images obtained after administration of 400 mg I/kg of contrast material at 80 kVp and the control images (600 mg I/kg at 120 kVp). Moreover, in this study, the use of 80 kVp rather than 120 kVp showed a 30% reduction in radiation exposure (CTDIvol [10.4 vs. 14.9 mGy], respectively).

CONCLUSION
By using low tube voltage (80 kVp), the dose of contrast material can be reduced to at least 400 mg I/kg, while keeping sufficient contrast to diagnose deep venous thrombosis.

CLINICAL RELEVANCE/APPLICATION
This study showed that low tube voltage (80 kVp) CT can help reduce the dose of contrast material and radiation exposure.

VSVSA51-11 ● Feasibility of Low kv Settings CT-angiography with Ultra Low Contrast Medium Volume for the Assessment of Thoracic and Abdominal Aorta Disease
Camillo R Talei Franzesi (Presenter); Davide Ippolito MD; Pietro A Bonaffini MD; Davide Fior MD; Orazio Minutolo MD; Sandro Sironi MD

PURPOSE
To evaluate the image quality, the diagnostic performance and the radiation dose exposure of low-kV CT angiography (CTA) protocol (100 kV) with ultra low-contrast medium volume (40 mL) in the assessment of thoracic and abdominal aorta disease.
Liver Cryoablation: Maximizing Outcomes with Minimal Morbidity

Hussein D Aoun MD (Presenter) ; Peter J Littrup MD * ; Barbara A Adam MSN ; Evan N Fletcher MS, BA ; Mark J Krycia BS

PURPOSE
To assess local recurrence and complication factors for liver cryoablation. Tumor and ablation volume, location, vessel proximity, and complications were assessed in primary and metastatic tumors using updated techniques. Focus upon hematoletic complications was done to address prior bleeding fears.

METHOD AND MATERIALS
CT and/or CT-US fluoroscopic-guided percutaneous cryoablations were performed in 268 procedures on 357 tumors (59 primary hepatomas and 288 metastatic carcinomas) in 176 patients, noting tumor and ablation volumes, abutting vessels >3mm, procedure complications and recurrences. Complications were graded by the National Institutes of Health, Common Terminology of Complications and Adverse Events (CTCAE). Stress dose(s) of steroids were used in more recent procedures (n=68), which also limited ablation volume per session. Patients received CT or MRI at 1, 3, 6, 12, 18, 24 months and yearly thereafter.

RESULTS
All patients required only conscious sedation. Ablation zones and tumors averaged 5.2 and 2.9 cm, respectively. A total local recurrence rate of 9.8% (35/357) was noted. Differences in local recurrence rates showed no significance based on tumor size or vessel proximity for metastatic or HCC tumors. Grade >3 complications were associated with larger ablation volumes (>100cc margin) in earlier procedures and before steroid prophylaxis. A total of 25% patients also had low hemoglobin or platelets blood values prior to procedure yet still resulted in only 11/268 (4.1%) grade =3 total complications, again early in our series.

CONCLUSION
CT guided percutaneous hepatic cryotherapy provides a low morbidity alternative, especially for more central and peripheral tumors, where cryoablation produces minimal biliary damage and pain, respectively. Complications =3 did not occur in patients with tumors CLINICAL RELEVANCE/APPLICATION
Appropriately delivered liver cryoablation, appears less susceptible to tumor size and peri-vascular location, with low recurrence rates, and now complication rates comparable to heat-based ablations.
SSQ07-02 • Fusion Imaging-guided Percutaneous Radiofrequency Ablation of Hepatocellular Carcinomas with Local Tumor Progression

Jihye Min MD (Presenter) ; Min Woo Lee ; Hyunchul Rhim MD, PhD ; Sanghyeok Lim MD ; Tae Wook Kang MD ; Kyoung Doo Song MD ; Seo-Youn Choi MD ; Hyo Keun Lim MD

Purpose
To assess whether fusion imaging of real-time ultrasonography (US) with liver CT/MR images for planning US of radiofrequency ablation (RFA) can improve conspicuity of lesions and reduce false positive detection of hepatocellular carcinomas (HCCs) with local tumor progression (LTP).

Method and Materials
This retrospective study was approved by the institutional review board and informed consent was waived. A total of 50 patients with at least one HCC with LTP (mean ± SD, 1.5 ± 0.6 cm; range, 0.5-3.0 cm) before prior RFA or chemoembolization were included. Planning US was performed by two radiologists using conventional US first and fusion imaging later in the same session. We assessed false positive detection rate on conventional US based on the results of fusion imaging. We also evaluated how many cases of initially invisible tumors on conventional US became visible after image fusion. True positive detection rate and conspicuity scores of the index tumors were compared between conventional US and fusion imaging.

Results
On conventional US, 40 (80%) out of 50 HCCs with LTP were identified. However, false positive detection rate of conventional US was 12.5% (5/40). Out of 10 initially invisible HCCs with LTP on conventional US, 6 (60%) became visible after image fusion. True positive detection rate on conventional US was 70% (35/50) whereas it was increased to 92% (46/50) after image fusion (P=0.0026).

Conclusion
Fusion imaging of real-time US with liver CT/MR images can improve conspicuity of lesions and reduce false positive detection of HCCs with LTP.

CLINICAL RELEVANCE/APPLICATION
Fusion imaging of US and liver CT/MR images is useful for guidance of percutaneous RFA of HCCs with LTP. It can improve the lesion conspicuity and decrease the rate of false positive detection.

SSQ07-03 • The Diagnostic Accuracy of Dual Energy CT Performed within 24 Hours in the Detection of Residual Tumor Following RF Ablation

Steven Van Hedent MD (Presenter) ; Frederik Vandenbroucke MD ; Nico Buls DSc, PhD * ; Koenraad H Nieboer MD * ; Michel De Maeseneer MD ; Johan De Mey * ; Gert Van Gompel PhD

Purpose
To evaluate the diagnostic accuracy of single source dual energy CT (DECT) performed within 24 hours after RF ablation in the detection of residual tumor.

Method and Materials
Thirty-three patients with 38 malignant lesions (20 liver, 10 kidney, 8 lung) underwent DECT within 24 hours after RF ablation. DECT data were reconstructed as monochromatic 70 keV images, grayscale iodine (GI) density and color-coded iodine (CCI) density images. Two readers independently rated the presence of residual tumor. The gold standard for presence of residual tumor consisted of follow-up imaging after 8-10 weeks. Statistical analysis consisted of ROC analysis (multicase, multireader). A Bland-Altman plot was used to compare reader agreement and a t-test was performed to assess the significance of these results.

Results
Ten of 38 (26.3%) lesions showed tumor progression at 8-10 weeks. The mean AUC for both readers and all lesions was 0.87 (CI: 0.72-0.96) for 70keV, 0.80 (CI: 0.63-0.91) for CCI and 0.70 (CI: 0.53-0.84) for GI images. Pairwise comparison for the 3 reconstructions showed no significant differences, but interreader variability was high for all three reconstructions (p For liver and lung lesions AUC values were higher on 70 keV images (0.89 and 0.88 respectively), than on CCI (0.81 and 0.69) and GI images (0.78 and 0.50). Pairwise comparison showed no significant differences (P>0.05).

Conclusion
1. DECT may be a promising method for detection of residual tumor within 24 h after RF ablation.
2. Our study suggests that no difference in accuracy exists between monochromatic 70 keV images, GI, and CCI.

CLINICAL RELEVANCE/APPLICATION
Detection of residual tumor after RF ablation is clinically important, and DECT may play a role in this setting.

SSQ07-04 • Clinical Implications of Negative and Inconclusive Percutaneous Ultrasound-guided Biopsy of Focal Liver Lesions

Jason A Pietryga MD (Presenter) ; Alison J Kim MD ; Rendon C Nelson MD *

Purpose
To describe our clinical experience with ultrasound-guided biopsies of focal liver lesions and to determine if small lesion size (≤3cm), patient body habitus, or history of cirrhosis affect the rate of inconclusive/negative biopsy results.

Method and Materials
This is an IRB-approved HIPAA-compliant study. A retrospective search identified 283 consecutive adults who underwent US-guided biopsy of a focal liver lesion with pathology results from 1/1/2011 to 7/31/2012. Medical records/PACS were reviewed to identify the data were reconstructed as monochromatic 70 keV images, grayscale iodine (GI) density and color-coded iodine (CCI) density images. Two readers independently rated the presence of residual tumor. The gold standard for presence of residual tumor consisted of follow-up imaging after 8-10 weeks. Statistical analysis consisted of ROC analysis (multicase, multireader). A Bland-Altman plot was used to compare reader agreement and a t-test was performed to assess the significance of these results.

Results
Of patients with a known cancer were diagnosed with a new additional cancer (i.e. new primary).

Conclusion
1. DECT may be a promising method for detection of residual tumor within 24 h after RF ablation.
2. Our study suggests that no difference in accuracy exists between monochromatic 70 keV images, GI, and CCI.

CLINICAL RELEVANCE/APPLICATION
Detection of residual tumor after RF ablation is clinically important, and DECT may play a role in this setting.

SSQ07-05 • Usefulness of a Second Biopsy after a First Inconclusive One for the Diagnosis of Small Hepatocellular Carcinoma in Cirrhotic Patients

Jihye Min MD (Presenter) ; Min Woo Lee ; Hyunchul Rhim MD, PhD ; Sanghyeok Lim MD ; Tae Wook Kang MD ; Kyoung Doo Song MD ; Seo-Youn Choi MD ; Hyo Keun Lim MD

Purpose
To assess whether fusion imaging of real-time ultrasonography (US) with liver CT/MR images for planning US of radiofrequency ablation (RFA) can improve conspicuity of lesions and reduce false positive detection of hepatocellular carcinomas (HCCs) with local tumor progression (LTP).

Method and Materials
This retrospective study was approved by the institutional review board and informed consent was waived. A total of 50 patients with at least one HCC with LTP (mean ± SD, 1.5 ± 0.6 cm; range, 0.5-3.0 cm) before prior RFA or chemoembolization were included. Planning US was performed by two radiologists using conventional US first and fusion imaging later in the same session. We assessed false positive detection rate on conventional US based on the results of fusion imaging. We also evaluated how many cases of initially invisible tumors on conventional US became visible after image fusion. True positive detection rate and conspicuity scores of the index tumors were compared between conventional US and fusion imaging.

Results
On conventional US, 40 (80%) out of 50 HCCs with LTP were identified. However, false positive detection rate of conventional US was 12.5% (5/40). Out of 10 initially invisible HCCs with LTP on conventional US, 6 (60%) became visible after image fusion. True positive detection rate on conventional US was 70% (35/50) whereas it was increased to 92% (46/50) after image fusion (P=0.0026).

Conclusion
Fusion imaging of real-time US with liver CT/MR images can improve conspicuity of lesions and reduce false positive detection of HCCs with LTP.

CLINICAL RELEVANCE/APPLICATION
Fusion imaging of US and liver CT/MR images is useful for guidance of percutaneous RFA of HCCs with LTP. It can improve the lesion conspicuity and decrease the rate of false positive detection.

SSQ07-02 • Fusion Imaging-guided Percutaneous Radiofrequency Ablation of Hepatocellular Carcinomas with Local Tumor Progression

Jihye Min MD (Presenter) ; Min Woo Lee ; Hyunchul Rhim MD, PhD ; Sanghyeok Lim MD ; Tae Wook Kang MD ; Kyoung Doo Song MD ; Seo-Youn Choi MD ; Hyo Keun Lim MD

Purpose
To assess whether fusion imaging of real-time ultrasonography (US) with liver CT/MR images for planning US of radiofrequency ablation (RFA) can improve conspicuity of lesions and reduce false positive detection of hepatocellular carcinomas (HCCs) with local tumor progression (LTP).

Method and Materials
This retrospective study was approved by the institutional review board and informed consent was waived. A total of 50 patients with at least one HCC with LTP (mean ± SD, 1.5 ± 0.6 cm; range, 0.5-3.0 cm) after prior RFA or chemoembolization were included. Planning US was performed by two radiologists using conventional US first and fusion imaging later in the same session. We assessed false positive detection rate on conventional US based on the results of fusion imaging. We also evaluated how many cases of initially invisible tumors on conventional US became visible after image fusion. True positive detection rate and conspicuity scores of the index tumors were compared between conventional US and fusion imaging.

Results
On conventional US, 40 (80%) out of 50 HCCs with LTP were identified. However, false positive detection rate of conventional US was 12.5% (5/40). Out of 10 initially invisible HCCs with LTP on conventional US, 6 (60%) became visible after image fusion. True positive detection rate on conventional US was 70% (35/50) whereas it was increased to 92% (46/50) after image fusion (P=0.0026).

Conclusion
Fusion imaging of real-time US with liver CT/MR images can improve conspicuity of lesions and reduce false positive detection of HCCs with LTP.

CLINICAL RELEVANCE/APPLICATION
Fusion imaging of US and liver CT/MR images is useful for guidance of percutaneous RFA of HCCs with LTP. It can improve the lesion conspicuity and decrease the rate of false positive detection.
Fluoroscopically-guided Jejunal Extension Tube Placement through an Existing Gastrostomy Tube in Patients Requiring Nutrition beyond the Ligament of Treitz: Analysis of 391 Procedures Performed over 3 Years

André Ufflacker MD (Presenter) ; Yujie Qiao ; Genevieve G Easley BS ; James Patrie MS ; Drew L Lambert MD ; Eduard E De Lange MD

PURPOSE
To evaluate outcomes of fluoroscopic placement of a jejunal extension (J-arm) in patients with an already existing gastrostomy (G) tube.

METHOD AND MATERIALS
Retrospective review of 391 J-arm placements over a 3-year period was performed in 174 patients requiring nutrition post ligament of Treitz [M/F 94/80, age range 1-89 y (mean 55.9 y)]. IRB approval and HIPAA compliance were maintained. Indications for jejunal nutrition were aspiration risk (35%), pancreatitis (17%), gastroparesis (13%), gastric outlet obstruction/mass/leak (12%) and other (23%). Technical success, procedure-related complications, tube malfunction rate and tube patency were assessed. G-tube location, tube placement was successful in 303/391 (78%). Complications occurred in 3 (0.8%) [1 perforation (0.27%), 1 hematoma (0.27%), 1
hypotension (0.27%). Malfunction occurred in 197 (50%). Overall patency was 51 days (95%CI:42,58 days) following placement. There was no association between successful J-arm placement and G-tube position in the stomach (p=0.677) or indication for jejunal nutrition (p=0.349); between J-arm trajectory in the stomach and incidence of tube malfunction (p=0.365); and between risk of coiling/kinking in the stomach and G-tube position (p=0.173) or J-arm length (p=0.987). Fluoroscopy time placement was negatively associated with procedure success (p

**CONCLUSION**

Fluoroscopy guided J-arm placement was safe, with low procedural complication rate. Fluoroscopy time was the only predictor of technical success. Tubes replaced after 90 days had higher rates of tube malfunction.

**CLINICAL RELEVANCE/APPLICATION**

Fluoroscopic guided J-arm placement is safe for patients requiring jejunal nutrition. Tubes should be replaced within 90 days.

**SSQ07-09 • Biliary Drainage in 30 Patients with Undilated Bile Ducts Affected by Biliary Fistula due to Pancreatobiliary Surgical Treatment: Technique, Feasibility, Complications, and Clinical Outcome**

Massimo Venturini MD (Presenter) ; Francesco A De Cobelli MD ; Stefano Cappio MD ; Marco Salvioni ; Giulia Agostini ; Alessandro Del Maschio MD

**PURPOSE**

To evaluate technique, feasibility, complications, and clinical outcome of percutaneous biliary drainage in 30 patients with undilated biliary ducts and normal bilirubin levels affected by biliary fistula due to pancreateobiliary surgical treatment.

**METHOD AND MATERIALS**

From 2006 to 2012, Percutaneous Transhepatic Colangiography (PTC) and placement of a percutaneous biliary drainage (8-French) was attempted in 30 patients affected by biliary fistula, demonstrated by the presence of bile in abdominal surgical drainage, with bilirubin normal levels and ultrasonographic evidence of undilated biliary ducts. Under ultrasonographic (and fluoroscopic) guidance, the puncture attempt with Chiba needle (21G) was performed using a right approach puncturing along the course of the sixth segment portal branch, or a left approach in case of aerobilia and adequate volume of the left hepatic lobe.

**RESULTS**

PTC was successfully performed in 28/30 patients (21 cases with right approach, 7 with left approach) with radiological demonstration of biliary fistula (direct opacification of the fistula adjacent to the biliary-digestive anastomosis and fluoroscopic demonstration of contrast material in the surgical drainage). Biliary drainage was placed in 27/30 patients (90%) at first attempt, in 1/30 patients (3.3%) at second attempt two days later, placing in 23 patients an external-internal drainage, in 5 patients an external drainage, obtaining complete resolution of the fistula in all cases. No perioperative complications were recorded. In 2/30 patients, biliary drainage couldn’t be placed: surgical retreatment was necessary in one case while in the other case biliary fistula spontaneously resolved.

**CONCLUSION**

Percutaneous biliary drainage under ultrasonographic/fluoroscopic guidance in patients with undilated biliary ducts affected by biliary fistula is feasible, effective, without significant periprocedural complications and represents the first choice of treatment; furthermore PTC is an accurate tool to confirm the diagnosis of biliary fistula after pancreateobiliary surgical treatment

**CLINICAL RELEVANCE/APPLICATION**

PTC and percutaneous biliary drainage represent the first therapeutic option in case of biliary fistula due to pancreateobiliary surgery.
**SSQ21-02 • PET/MRI of Hepatic 90Y Microsphere Uptake: Correlation of Angiographic and Radiologic Findings with Microsphere Deposition**

Kathryn J Fowler (Presenter) *; Nael E Saad MMBC*; Akash Sharma MD; Christina K Speirs MD, PhD; Jeffrey R Olsen MD *; Jose Garcia-Ramirez; Richard Laforest PhD; Ananya Benegal; Parag Parikh MD *

PURPOSE
Y90 radioembolization provides preferential delivery of radioactive microspheres allowing higher doses delivered over a limited range. Pre-embolization work-up with angiography +/- coil embolization, and Tc-99m MAA SPECT is done to assess suitability. Despite importance of optimal technique, there is limited literature on imaging the biodistribution of microsphere delivery. The purpose of this prospective study was to evaluate the post-radioembolization distribution of particles with PET/MR (Siemens Biograph, Erlangen, Germany).

METHOD AND MATERIALS
PET/MRI was performed within 48 hours (range 3.5-24 hours) of radioembolization for 4 patients with HCC and 7 patients with metastases (5 colorectal, 1 anal squamous cell carcinoma, and 1 neuroendocrine). Microsphere type included resin (n = 8) and glass (n = 3) with delivery to the left (n = 8), right (n = 3), and proper hepatic artery (n = 1). Biodistribution was qualitatively assessed as discrete within the tumor, ill-defined, and assigned as whole liver, lobar or sectional distribution. Comparison with pre-treatment angiography, Tc-99m MAA, and gadoteric acid enhanced MRI with diffusion weighted imaging was performed to analyze distribution, non-target delivery, and tumoral coverage.

RESULTS
PET/MRI demonstrated intrahepatic Y90 microsphere distribution in all patients following radioembolization (n = 11). PET biodistribution localized to tumor for 9 patients. Peripheral uptake was observed in metastatic lesions, correlating with enhancement and diffusion restriction. Uptake in HCC was more uniform and was observed within tumor thrombus as well. Heterogeneous distribution within a treatment region was observed in 2 cases of colorectal cancer metastases, which correlated with differential perfusion on pre-treatment workup.

CONCLUSION
PET/MRI allows localization of 90Y microsphere biodistribution following radioembolization. The pattern of distribution correlates with pre-treatment angiography, Tc-99m MAA SPECT, enhancement and diffusion imaging. Future work will focus on correlating biodistribution of particles with tumor response and outcomes with possible validation of 90Y PET/MRI as an indicator of adequate tumor coverage and early predictor of treatment response/failure potentiating adaptive treatment regimens.

CLINICAL RELEVANCE/APPLICATION
PET/MR imaging of Y90 distribution provides confirmation of delivery to the expected region, tumor coverage, and validation of pre-treatment planning results.

**SSQ21-03 • Yttrium-90 Radioembolization for Neuroendocrine Tumor Liver Metastases**

Katherine Y Fan BS (Presenter) *; Aaron T Wild BA; Vivek Gowdra Halappa MD; Rachit Kumar MD; Susannah Yovino MD; Timothy Pawlik MD *; David O Cosgrove MMBC, FRCP *; Ihab R Kamel MD, PhD *; Joseph M Herman MD, MSc; Jean-Francois H Geschwind MD *

PURPOSE
Surgical resection remains the only curative option for neuroendocrine tumor liver metastases (NETLM). However, 90% of patients have unresectable disease. Limited data currently exists for yttrium-90 (Y-90) radioembolization, an emerging treatment option for unresectable NETLM. This study evaluates the efficacy, tolerability, and prognostic factors of Y-90 radioembolization in NETLM patients.

METHOD AND MATERIALS
Thirty-eight patients underwent glass-based Y90 radioembolization for NETLM at a single institution between April 2004 and February 2012. Patients were assessed radiographically (using magnetic resonance imaging), serologically, and clinically at 1 month and then every 3 months post-treatment for tumor response, toxicity, and survival outcomes.

RESULTS
Median length of follow-up was 17 months (IQR, 9-37). Median survival was 29 months. On imaging follow-up, 3 patients (9%) had a complete response (CR) to treatment, 6 (17%) had a partial response (PR), 21 (60%) had stable disease (SD), and 5 (14%) developed progressive disease (PD). Multivariate analysis with backward elimination revealed 2 factors to be independently associated with good tumor response (CR/PR): histological subtype (p = 0.037) and hepatic tumor burden (p = 0.038). Inferior overall survival (OS) was observed in patients requiring more than one Y-90 treatment (HR 7.384, p = 0.003) and in patients with ≥ 1 ECOG performance status (HR 3.139, p = 0.04) on multivariable proportional hazards regression models for OS. Development of grade 3 serologic toxicities was observed in only 2 patients (one with elevated bilirubin, the other elevated alkaline phosphatase) after treatment. Grade 3 non-serologic toxicities experienced included abdominal pain (11%), fatigue (11%), nausea/vomiting (5%), ascites (5%), dyspnea (3%), diarrhea (3%), and peripheral edema (3%).

CONCLUSION
Our institutional experience demonstrates Y90 radioembolization to be an efficacious, safe, and tolerable treatment for NETLM.

CLINICAL RELEVANCE/APPLICATION
Y90 radioembolization can safely and effectively target liver metastases from neuroendocrine tumors and is recommended for patients with unresectable liver metastases.

**SSQ21-04 • Intratumoral Vascular Shunting: The Missing Link between Circulating Tumor Cells and Metastasis?**

Amy R Deipolyi MD, PhD (Presenter) *; Patrick D Sutphin MD, PhD; Siddharth Govindan MD; Susvrana Ganguli MD *; Rahmi Oklu MD, PhD *

PURPOSE
Colorectal carcinoma is a leading cause of cancer mortality mostly due to metastasis. It is unclear how large circulating tumor cells (CTCs) shed from the tumor traverse capillary beds to establish distant lesions. Intratumoral vascular shunting, however, may provide a conduit for CTCs to access distant sites. To determine whether intratumoral shunting is associated with the presence of disseminated disease and to clinical outcome.

METHOD AND MATERIALS
61 colorectal cancer patients with liver metastases (30 F, 31 M; mean age 63 yr) were evaluated for selective internal radiation therapy (SIRT) from 5/07 to 8/12. Following transcatheter injection of radioactive particles (99mTc-MAA), lung shunt fractions (LSF) were calculated reflecting the amount of intratumoral shunting of MAA particles, which can measure up to 150 microns. Medical records were reviewed for other metastases and the size of liver lesions before and after SIRT, the time between SIRT and disease progression, and patient survival after SIRT. Liver tumor size was estimated using the largest dimension of the largest lesion. The relationship of LSF and estimated tumor size to outcomes was assessed using linear regression and student’s t test.

RESULTS
Patients with lung metastases at the time of SIRT had significantly higher LSF (mean 9.2%) than patients without lung metastases (mean 6.1%) (p<br>CONCLUSION
LSF may be a more robust marker of metastatic potential than tumor size. Increased LSF due to vascular shunting within liver metastasis is an indicator of distant lesions and is associated with more rapid disease progression after SIRT. Intratumoral shunting may provide a
Vascular shunting in liver metastases from colorectal cancer is a robust indicator of more distant metastases and future disease progression, and may be a more useful clinical marker than tumor size.

SSQ21-06 • Boosted Selective Internal Radiation Therapy (B-SIRT) Using 90Y-loaded Glass Microspheres Induces Prolonged Overall Survival for PVT Patients

Etienne Garin MD (Presenter) *; Laurence Lenoir; Julien Edeline; Eveline Boucher; Yan Rolland MD, PhD *

PURPOSE
Evaluation of the response rate and survival of hepatocellular carcinoma PVT patients treated with Therasphere\textsuperscript{\textregistered} using the boost concept.

METHOD AND MATERIALS
Therasphere\textsuperscript{\textregistered} was administered in 40 PVT hepatocellular carcinoma patients (main=11, lobar=23, segmental=6). MAA SPECT/CT quantitative analysis was used for the calculation of the tumour dose (TD), the healthy injected liver dose (HLD) and the injected liver dose (LD). Response was evaluated at 3 months using EASL criteria. OS was evaluated using Kaplan and Meyer tests.

RESULTS
Mean 90Y-loaded microspheres injected activity was 3.1±1.5 GBq. Mean LD was 143±49 Gy. Median TD was 316 Gy for responding lesions versus 133 Gy for non-responding lesion (p 205Gy with a LD > 150 Gy and a HLD205Gy. OS was 12m [3-8] for patients with main PVT versus 21.5m [12-28.7] for patients segmental or lobar PVT (ns). Finally Os was 23.2m for patients with a TD>205Gy and a good PVT targeting (n=34).

CONCLUSION
Boosted selective internal radiation therapy using 90Y-loaded glass microspheres induces prolonged overall survival for PVT patients without increasing liver toxicity.

CLINICAL RELEVANCE/APPLICATION
Boost selective internal radiation therapy using 90Y loaded glass microsphere allows a fully customized oncological therapy for PVT patients inducing prolonged survival.

SSQ21-07 • Sorafenib versus Y90-radioembolization in Cirrhotic Patients with Hepatocellular Carcinoma (HCC): Cohort and Nested Control-case Study with Propensity Analysis

Alberta Cappelli MD (Presenter); Cristina Mosconi; Annagiulia Gramenzi; Sara Marinelli; Alessandro Granito; Virginia Erroi; Silvia Fiumana; Mauro Bernardi; Luigi Bolondi; Franco Trevisani; Rita Golferi MD

PURPOSE
Sorafenib and Transarterial Y90-radioembolization (TARE) are treatments currently available for advanced (BCLC stage C) HCC not amenable or resistant to curative options and transarterial chemoembolization (TACE). No study comparing the outcome of these patients (pts) is yet available. We performed a case-control, retrospective study to compare the survival in both groups comparing the two treatments after patients' matching for the independent prognostic factors.

METHOD AND MATERIALS
67 Sorafenib pts and 63 TARE pts were selected. The two groups did not significantly differ for gender, aetiology, previous HCC treatments, portal vein thrombosis, Child-Pugh class, MELD score, BCLC stage, alpha-fetoprotein levels, ascites, creatinine, platelet count. 67 Sorafenib pts and 63 TARE pts were selected. The two groups did not significantly differ for gender, aetiology, previous HCC treatments, portal vein thrombosis, Child-Pugh class, MELD score, BCLC stage, alpha-fetoprotein levels, ascites, creatinine, platelet count. Median survival did not differ between Sorafenib (13.1 months; 95% CI: 3.1-23.2) and TARE (13.2; 6.1-20.2; P=0.854) and mortality rate at 1, 2 and 3 years was respectively 48%, 70% and 86% vs 48%, 73% and 80%. Propensity model matched 34 pts for independent non co-axial prognostic factors: PS, MELD, portal thrombosis, tumour gross pathology. Median survival was 13.1 months (1.3-25.0) for Sorafenib and 9.0 months (3.7-14.3) for TARE (P=0.214).

CONCLUSION
In advanced HCC not otherwise treatable, Sorafenib provides, after adjustment for the confounding factors, a not statistically significant better survival than TARE.

CLINICAL RELEVANCE/APPLICATION
In advanced HCC treated with Sorafenib or TARE, the propensity analysis demonstrates that median survival is better after Sorafenib but not statistically different (13.1 vs 9.0 months: P=0.214).

SSQ21-08 • A New Model to Estimate Prognosis after Yttrium-90 Radioembolization in Patients with Hepatocellular Carcinoma

Thomas C Lauenstein MD (Presenter); Judith Ertle; Stefan P Mueller MD *; Andreas Bockisch; Guido Gerken; Joerg Schlaak

PURPOSE
A prognostic model to estimate the survival in hepatocellular carcinoma (HCC) patients treated with transarterial hepatic selective internal radiotherapy (SIRT) is not fully characterized. We aimed to establish a new scoring model including assessment of both tumor responses and therapy-induced systemic changes in HCC patients to predict survival at an early time point post-SIRT.

METHOD AND MATERIALS
149 HCC patients treated with SIRT (TheraSphere, MS Nordion, Canada) were included into this study. CT images and biomarkers in blood tested at one month post-SIRT were analyzed and correlated with clinical outcome. Tumor responses were assessed by RECIST 1.1, mRECIST, and Choi criteria. Kaplan-Meier methods were used to estimate survival curves. Cox regression was used in uni- and multivariable survival analyses and in the establishment of a prognostic model.

RESULTS
A new model including imaging and non-imaging parameters may predict survival of HCC patients at an early time point after SIRT. In this model, Choi criteria should be applied rather than RECIST or mRECIST.

CLINICAL RELEVANCE/APPLICATION
Efficacy of SIRT can be predicted one month after therapy.
**LL-VIS-THA** • AMA PRA Category 1 Credit ™:0.5

**Host**
Dmitry J Rabkin, MD, PhD

**LL-VIS-TH1A** • Effect of Hypoxia-Inducible Factor (HIF)-1 alpha Upgrade on Vasculogenic Mimicry (VM) and Angiogenesis in Rabbit VX2 Liver Tumors after Transcatheter Arterial Embolization (TAE)

**Jingfeng Zhang** PhD, MD (Presenter); **Bingying Lin**; **Lingxiang Ruan** PhD, MD; **Shunliang Xu**

**PURPOSE**
TAE could result in more severe hypoxia, which activated HIF-1? pathway and angiogenesis, and affected the effect of treatment. VM was found as a new model of tumor micro-circulation, which has a close relationship with the growth, development, invasion, metastasis and prognosis of hepatic carcinoma. This study was to verify the hypothesis that upgrading of HIF-1? expression after TAE could lead to much more formation of both VM and angiogenesis in hepatic carcinoma. Therefore, our purpose was to investigate the expression of HIF-1? and its relation to VM and angiogenesis in Rabbit VX2 liver tumors after TAE.

**METHOD AND MATERIALS**
A total of twenty-four New Zealand White rabbits were successfully implanted with VX2 tumor in liver and divided into three group at random, such as Lipiodol-based TAE group (n = 8), Polyvinyl alcohol (PVA)-based group (n = 8) and Control group (n = 8). Tumors in each group were received TAE with Lipiodol, PVA particles (diameter: 300?m -500?m) and Saline respectively after implanting for two weeks. One, three and seven days after TAE, animals were humanely killed, and tumor samples were collected for immunohistochemical staining with HIF-1? and double staining with CD34 and PAS. Expression level of HIF-1? protein was evaluated, and VM density (VMD) and micro vascular density (MVD) was calculated.

**RESULTS**

**CONCLUSION**
Upgrading of HIF-1? expression is associated with the increasing of VM and angiogenesis after TAE, which has made a new challenge to the interventional therapy of hepatic carcinoma. HIF-1? might represent promising therapeutic targets for anti-microcirculation in combination with TAE against liver tumors.

**CLINICAL RELEVANCE/APPLICATION**
HIF-1? might represent promising therapeutic targets for anti-microcirculation in combination with TAE against liver tumors.

**LL-VIS-TH2A** • Therapeutic Effect of Intra-arterial Chemotherapy with DDP and 5-FU via Bilateral Uterine Arteries for Advanced Uterine Cervical Cancer

**Kang Zhou** MD (Presenter); **Xiaoguang Li** MD; **Zhengyu Jin** MD

**PURPOSE**
To evaluate the response rate of patients with advanced uterine cervical cancer who were treated with neoadjuvant intra-arterial chemotherapy (NAIC) using a combination of DDP and 5-FU.

**METHOD AND MATERIALS**

**RESULTS**
54 patients received 1 course and 18 patients received 2 courses. The overall response rate was 77.78%. The response rates of patients with IB2, IIA and IIB cervical cancer were 92.86%, 83.33% and 62.50%(p<0.05).

**CONCLUSION**
NAIC using a combination of DDP and 5-FU via bilateral uterine artery can safely reduce the tumor volume of advanced cervical cancer, suppress the lymph node metastasis and parametral infiltration. NAIC is effective for preoperative treatment of advanced cervical cancer with easier radical hysterectomy. NAIC is more effective to stage IB2 cervical cancer than stage IIa and IIb, and also to SCC than adenocarcinoma.

**CLINICAL RELEVANCE/APPLICATION**
NAIC is effective for preoperative treatment of advanced cervical cancer.

**LL-VIE-TH5A** • Thoracic Tumor Ablation: Review of Anatomic Considerations and Adjunctive Techniques

**Bradley B Pua** MD (Presenter) *; **Adam D Talenfeld** MD; **David Li** MD, PhD; **Ronald S Winokur** MD; **David C Madoff** MD

**PURPOSE/AIM**

- To review important anatomic considerations when performing thermal ablation in the thorax.
- To provide a detailed pictorial of neurovascular anatomy and describe clinical findings if these sites are injured during thermal ablation.
- To describe adjunctive techniques to avoid injury to these structures.

**CONTENT ORGANIZATION**
- Pictorial review utilizing CT images and figures to describe the anatomic course of important neurovascular structures.
- Content will be organized by each neurovascular structure: with a figure of its anatomy, the CT correlate, then a description of its course and treatment if injured. An associated case is presented if applicable.
- A section will discuss adjunctive techniques to avoid these complications.

**SUMMARY**
Teaching points:
- To be able to describe and identify areas corresponding to important neurovascular structures in the thorax such as the phrenic nerve, vagus nerve, internal mammary vessels and course of the intercostal neurovascular bundle in varying ages.
- To be able to describe and treat complications associated with inadvertent injury to these structures.
- The viewer should be able to describe adjunctive techniques such as creation of an artificial pneumothorax or infusion of a saline/fluid buffer to protect these structures from thermal injury.

**LL-VIE-TH6A** • Inject or Reject: Today’s Role of the Sinogram

**Ann Packard** MD; **Chad J Fleming** MD; **Stephanie K Carlson** MD *; **Claire E Bender** MD (Presenter)

**PURPOSE/AIM**
There is controversy as to the value of the sinogram in the management of patients with percutaneously or surgically placed drainage catheters. At our institution, our Interventional Radiology division performed 2532 sinograms in 2012. The purpose of this exhibit is to share our experience and describe its value to our patients.

**CONTENT ORGANIZATION**
MR Image Characteristics during and after Cryoablation of Uterine Fibroids

Tadashi Shimizu MD (Presenter) ; Noriko Nishioka MD ; Daisuke Abo MD ; Yusuke Sakuhara MD

PURPOSE
To demonstrate characteristics of MR images of uterine fibroids during and after cryoablation.

METHOD AND MATERIALS
Symptomatic uterine fibroids were ablated percutaneously using a MR compatible high-pressure argon-based cryoablation system under open MR imaging guidance. Follow up T1-weighted, T2-weighted and Gd-DTPA enhanced T1-weighted MR images were taken over at one day, two week, and six week intervals in 6 patients and in 4 weeks in one patient.

RESULTS
Eight fibroids in 7 patients were treated. Six fibroids were intramural and two were submucosal. The maximum diameters of the fibroids ranged from 3.4 to 9.5 cm and the mean was 7.4 cm. The maximum diameters of the frozen area ranged from 4.8 to 8.5 cm and the mean was 6.6 cm. The average freezing time was 18.9 min. In five patients of intramural fibroids, the non-contrast enhanced areas in Gd-DTPA enhanced T1-weighted images after cryoablation were larger than the frozen area. In two cases of submucosal fibroids, normal mean was 6.6 cm. The average freezing time was 18.9 min. In five patients of intramural fibroids, the non-contrast enhanced areas in Gd-DTPA enhanced T1-weighted images after cryoablation were larger than the frozen area. In two cases of submucosal fibroids, normal mean was 6.6 cm. The average freezing time was 18.9 min. In five patients of intramural fibroids, the non-contrast enhanced areas in Gd-DTPA enhanced T1-weighted images after cryoablation were larger than the frozen area. In two cases of submucosal fibroids, normal mean was 6.6 cm. The average freezing time was 18.9 min. In five patients of intramural fibroids, the non-contrast enhanced areas in Gd-DTPA enhanced T1-weighted images after cryoablation were larger than the frozen area. In two cases of submucosal fibroids, normal mean was 6.6 cm. The average freezing time was 18.9 min. In five patients of intramural fibroids, the non-contrast enhanced areas in Gd-DTPA enhanced T1-weighted images after cryoablation were larger than the frozen area. In two cases of submucosal fibroids, normal mean was 6.6 cm. The average freezing time was 18.9 min. In five patients of intramural fibroids, the non-contrast enhanced areas in Gd-DTPA enhanced T1-weighted images after cryoablation were larger than the frozen area. In two cases of submucosal fibroids, normal mean was 6.6 cm. The average freezing time was 18.9 min. In five patients of intramural fibroids, the non-contrast enhanced areas in Gd-DTPA enhanced T1-weighted images after cryoablation were larger than the frozen area. In two cases of submucosal fibroids, normal mean was 6.6 cm. The average freezing time was 18.9 min. In five patients of intramural fibroids, the non-contrast enhanced areas in Gd-DTPA enhanced T1-weighted images after cryoablation were larger than the frozen area. In two cases of submucosal fibroids, normal mean was 6.6 cm. The average freezing time was 18.9 min.

CONCLUSION
MR images after cryoablation indicate the necrotic area is larger than the frozen area in the uterine fibroid and we can expect spontaneous recovery of normal myometrium in the frozen area.

CLINICAL RELEVANCE/APPLICATION
MR images show ablation zone in the uterine fibroid is larger than frozen area after cryoablation and signal intensity of frozen normal structure of the uterus recovers in 6 weeks.

Looking beyond International Normalized Ratio (INR) in Liver Interventions

Archana T Laroia MD (Presenter) ; Sandeep T Laroia MD

PURPOSE
INR remains a much used laboratory parameter to evaluate bleeding diathesis in patients with liver disease. Based on elevated INR value, the patient is often treated with either Vitamin K or fresh frozen plasma (FFP), especially if the patient has to undergo a guided invasive intervention like liver biopsy or TIPS procedure. However clinically significant bleeding from the intervention site remains rare. FFP infusions, retain a routine clinical practice despite the potential for significant adverse effects as well as significant resource utilization. A more reliable test is Thromboelastography (TEG), which is evaluated against INR.

METHOD AND MATERIALS
Thirty one patients with liver disease induced bleeding diathesis (defined as INR> 1.5) were studied. TEG was obtained and patients clinical course was followed. Various parameters of TEG test as well as other anticoagulant protein levels were studied where available.

RESULTS
Twenty two (73%) of the patients with elevated INR had TEG parameters within normal limits. These patients also maintained normal hemostasis during their clinical course. Remaining nine (27%) patients had abnormal INR as well as abnormal TEG parameters. Three (33%) of these patients showed evidence of clinically significant bleeding.

CONCLUSION
Measuring TEG parameters is a better way to assess hemostasis in patients with liver injury rather than relying solely upon INR. INR is a measure of procoagulants only whereas TEG is more comprehensive as it measures both the procoagulant and anticoagulant proteins. This change in Interventional Radiology practice would not only avoid potential harm from aggressive FFP infusions but also be cost effective.

CLINICAL RELEVANCE/APPLICATION
Using Thromboelastography (TEG) instead of INR alone in Interventional Radiology practice would not only avoid potential harm from aggressive FFP infusions but also be cost effective.

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Tadashi Shimizu MD (Presenter) ; Noriko Nishioka MD ; Daisuke Abo MD ; Yusuke Sakuhara MD

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Clinical Relevance/Application
MR images show ablation zone in the uterine fibroid is larger than frozen area after cryoablation and signal intensity of frozen normal structure of the uterus recovers in 6 weeks.

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CLINICAL RELEVANCE/APPLICATION
Using Thromboelastography (TEG) instead of INR alone in Interventional Radiology practice would not only avoid potential harm from aggressive measures like FFP infusions, but also be cost effective.

MR Image Characteristics during and after Cryoablation of Uterine Fibroids

Tadashi Shimizu MD (Presenter) ; Noriko Nishioka MD ; Daisuke Abo MD ; Yusuke Sakuhara MD

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CLINICAL RELEVANCE/APPLICATION
MR images show ablation zone in the uterine fibroid is larger than frozen area after cryoablation and signal intensity of frozen normal structure of the uterus recovers in 6 weeks.
 LL-VIS-TH4B ● Comparing a Volumetric Post-processing Analysis Technique to Orthogonal Measurement of Ascending Thoracic Aortic Aneurysms Using ECG-gated CTA

Arvin R Akhavan BA (Presenter); Audrey Sigmund; Matthew A Stratton; Pegah Entezari MD; Jeremy D Collins MD *; James C Carr MD *

PURPOSE
Are ascending thoracic aortic aneurysm (TAA) volumetric measurements with a novel volumetric method strongly correlated to, more sensitive than, and more reproducible than conventional orthogonal measurements?

METHOD AND MATERIALS
ECG-gated CT angiography of subjects between 18 and 89 years old who were diagnosed with TAA and who had undergone at least two ECG-gated CTAs of the thoracic aorta at Northwestern Memorial Hospital as a standard of care were used for this study. Exclusion criteria included a history of known aortic dissection, non-diagnostic imaging studies, or a history of cardiac surgery or surgery on the aorta or aortic valve between or before two serial scans. Orthogonal diameter measurements were taken from CTA image reports. Volumetric measurements were obtained from the same CTA scans using a semi-automated Vitrea software.

RESULTS
Volumetric and orthogonal measurements were successfully obtained from 108 CTA imaging studies. The Pearson product-moment correlation coefficient demonstrated a Pearson r of 0.823 and 0.856 between maximum orthogonal and volumetric measurements in both the aortic sinus and the ascending aorta, respectively. Based on the paired t-test, both orthogonal and volumetric measurements demonstrated significant changes in aneurysm size to a confidence level of at least 95%. The comparison of inter-observer and intra-observer agreement showed high intra- and inter-observer reliability over both volumetric and orthogonal measurements. Intra-observer correlation coefficients for volume measurements ranged from 0.98 to 0.99 for measurements taken at different levels of the aorta, compared to 0.97-0.98 for diameter measurements at the same levels. Inter-observer correlation coefficients ranged from 0.94-0.98 for volumes and 0.92-0.97 for diameters.

CONCLUSION
Volumetric analysis of ascending TAA is highly correlated to the conventional two-dimensional method, there seems to be no significant difference in sensitivity between the two methods, and both methods demonstrated strong measurement reproducibility. From this research, the time-intensive volumetric analysis does not add a significant benefit over orthogonal analysis.

CLINICAL RELEVANCE/APPLICATION
The results of this study suggest that volumetric analysis does not provide a significant advantage over the less time intensive, conventional orthogonial method of ascending TAA measurement.

 LL-VIS-TH4B ● Development and Evaluation of a MR-compatible Guidewire with a Diameter of 0.018?: Preliminary Results

Robin Bruhn (Presenter); Miriam Ariens; Christian Wasiak *; Paul Borm *; Matthias Von Walter *; Christiane K Kuhl MD *; Nils A Kraemer

PURPOSE
In spite of many challenges, MRI guided vascular interventions may offer advantages because they may allow the depiction of not only the target vessel, but also the surrounding anatomy of the target organ. For all types of vascular procedures, a guidewire is needed to navigate the catheter to the target vessel. In trans-arterial tumor therapies, small vessels need to be selectively engaged with microcatheters. Purpose of this research was to evaluate a new 0.018Ø MR-compatible guidewire (GW) in an in-vitro phantom.

METHOD AND MATERIALS
We developed a MR-compatible GW consisting of a non-ferromagnetic fibre glass core and two surrounding layers of agamid fibre. Using the micropullwinding technique, stiffness and flexibility of the GW can be varied individually along the shaft. Iron oxide nanoparticles in 3 different concentrations (M1, M2, M3) applied along the tip at distances of 1 cm are used for visualization in MRI. A hydrophilic coating assures gliding of the GW (sliding friction coefficient Two different gradient echo sequences with a temporal resolution of 0.30 sec and 0.78 sec, respectively, were used to visualize navigation of this GW in an in-vitro vessel phantom with and without flow simulation. Visibility of the GW was assessed by measuring marker susceptibility artefacts (a total of n=56) on the MR images. To evaluate clinical GW steerability, different phantom vessels were engaged under MR guidance.

RESULTS
On both real-time sequences the markers attached to the GW tip allowed precise visualization. The mean diameters of the marker susceptibility artefacts in pulse sequences acquired horizontal (X) and along B0 (Y) were 5.5/8.4mm (X/Y) (standard deviation (SD) 1.1/1.2mm) for M1; 7.5/9.3mm (SD 0.8/0.8mm) for M2 and 9.4/12.1mm (SD 1.0/1.2mm) for M3. On both real-time sequences the markers attached to the GW tip allowed precise visualization. The mean diameters of the marker susceptibility artefacts in pulse sequences acquired horizontal (X) and along B0 (Y) were 5.5/8.4mm (X/Y) (standard deviation (SD) 1.1/1.2mm) for M1; 7.5/9.3mm (SD 0.8/0.8mm) for M2 and 9.4/12.1mm (SD 1.0/1.2mm) for M3. Under MRI guidance, all target vessels of the phantom could be engaged successfully in adequate time.

CONCLUSION
The new micropullwinding technique offers the opportunity to build a thin (0.018Ø) MR-compatible GW that appears to be useful for superselective vascular MR-guided interventions. Animal experiments are in preparation.

CLINICAL RELEVANCE/APPLICATION
With the new production technique an adjustable 0.018Ø MR-compatible guidewire with a Diameter of 0.018Ø?: Preliminary Results

 Robin Bruhn (Presenter); Miriam Ariens; Christian Wasiak *; Paul Borm *; Matthias Von Walter *; Christiane K Kuhl MD *

 LL-VIS-TH5B ● Cone-Beam Computed Tomography in the Interventional Radiology Suite: Technical Optimization and Clinical Application

Katherine Bruschk BA (Presenter); Laurence Donahue MD; Ramona Gupta MD; Robert K Ryu MD; Robert J Lewandowski MD *

PURPOSE/AIM
Cone-beam computed tomography (CBCT) offers improved spatial/contrast resolution over conventional digital subtraction angiography (DSA) and is being increasingly utilized by interventional radiologists (IRs) to provide intra-procedural information. This educational exhibit aims to provide a comprehensive analysis of the technical optimization and increasing clinical application of CBCT in the IR suite.

CONTENT ORGANIZATION
This exhibit will review technical aspects of CBCT, highlighting potential advantages/disadvantages of CBCT versus DSA and conventional CT-angiography. Tips for optimizing imaging/clinical applications of CBCT will also be presented. The exhibit will then provide a comprehensive clinical/pictorial review of current vascular and non-vascular applications of CBCT in the IR suite. A critical review of the published medical literature will support the clinical impact of CBCT.

SUMMARY
CBCT is being increasingly applied during IR procedures because it provides improved intra-procedural imaging, patient safety, and efficacy of minimally invasive procedures. This exhibit will feature clinical examples to demonstrate the utility of CBCT and review techniques to optimize its utilization.

 LL-VIE-TH6B ● Stop the Bleeding! A Review of Current Embolization Techniques and Materials

Jenan Vairavamurthy MD (Presenter); Marcin K Koiber MD; Adam R Zybulewski; James E Silberzweig MD
1. To review the clinical indications and technique for percutaneous embolization.
2. To educate the reader on the various agents used in embolization.
3. To review the embolization materials used in different clinical cases with an emphasis on why certain agents are used in specific clinical scenarios.

**CONTENT ORGANIZATION**
1. Review of percutaneous embolization.
   a. Clinical indications.
   b. Embolization techniques.
   c. Postembolization considerations.
2. Review of different embolization agents.
   a. Autologous clot.
   b. Absorbable bioprothestic material.
   c. Nonabsorbable particles.
   d. Coils.
   e. Detachable balloons.
   f. Sclerosant agents.
   g. Polymers.
   h. Amplatzer plug.
3. Case-based review of which embolization agents are used for each indication.
   a. Trauma.
   b. Gastrointestinal hemorrhage.
   c. Hemoptysis.
   d. Uterine fibroid embolization.
   e. Prostatic artery embolization.
   f. Arteriovenous malformations.
   g. Hepatic neoplasm.

**SUMMARY**
Embolution therapy is a standard interventional procedure. Successful therapy is predicated on technical skills, knowing disease pathology, and an understanding of the various embolic agents used. A case based review of the different embolic agents presented in this pathology exhibit will allow the reader to have a deeper understanding of embolotherapy and be better prepared for successful treatment in emergent and non-emergent settings.

**Interventional Oncology Series: Liver Metastases and Bone**

**Thursday, 01:30 PM - 06:00 PM ● S405A**

**VSIO51 • AMA PRA Category 1 Credit ™: 4.25 • ARRT Category A+ Credit: 5**

**Moderator**
Matthew R Callstrom, MD, PhD *

**LEARNING OBJECTIVES**
1) Describe the characteristics of liver metastases and bone tumors amenable to interventional oncologic treatment.
2) Describe new techniques for the percutaneous treatment of liver metastases and bone tumors.
3) Describe the role of percutaneous ablation for liver metastases and bone tumors in the context of other treatments including surgery and radiation oncology.

**ABSTRACT**
1) To learn the optimal timing of ablation and chemotherapy in different clinical situations.
2) To understand the use of image-guided ablation in focal cancer therapy.
3) To understand the role of image-guided ablation with respect to surgical and medical treatments.
4) To learn the survival results for patients treated with ablation, chemotherapy and combinations of ablation and chemotherapy.

**VSIO51-01 • Which Ablation - Where and Why**

Riccardo A Lencioni, MD (Presenter)

**LEARNING OBJECTIVES**
1) To describe the different methods and techniques used for image-guided tumor ablation.
2) To understand the use of image-guided ablation in focal cancer therapy.
3) To understand the role of image-guided ablation with respect to surgical and medical treatments.

**VSIO51-02 • IRE for Liver Metastases**

Govindarajan Narayanan, MD (Presenter) *

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

**VSIO51-03 • Chemo ± RFA; Does RFA Provide a Benefit?**

Alison R Gillams, MBCHB (Presenter) *

**LEARNING OBJECTIVES**
1) To learn the survival results for patients treated with ablation, chemotherapy and combinations of ablation and chemotherapy.
2) To learn the optimal timing of ablation and chemotherapy in different clinical situations.

**ABSTRACT**
Chemotherapy regimes in the 80's and early 90's using 5 fluorouracil (5FU) based regimens did not improve survival. They did result in a morphologic response on imaging in just 30% of patients. Median survival was about 9 months. It was not until the late 90's with the introduction of oxaliplatin and irinotecan produced a further small increase in survival. The introduction of Cetuximab and Bevacizumab saw a further increase in response rates to approximately 75% and a further increase in survival. This improvement was further honed with the realisation that only Kras wild type patients responded and Kras testing is now routine prior to Cetuximab administration. Kras status may differ between the primary lesion and the metastatic disease but the difference is small. Median survival for patients who receive all the possible chemotherapeutic options is now approximately 21 months, 5 year survival remains exceptional. Ablation is generally used in small volume, liver only disease in inoperable patients The median survival is of the order of 36 months with 5 year survival of 30%. This is better than has been achieved with any chemotherapy regime and so ablation should be offered to all suitable patients. Adjuvant chemotherapy has been shown to be useful in post resection patients and there is some anecdotal evidence that it is useful post ablation. Neo adjuvant chemotherapy is used to downsize metastases in patients who are not initially resectable or ablatable in the hope that they will become suitable for definitive treatment. Although some tumours will disappear on imaging, the chances of recurrence are very high (96%) and therefore treatment should be aimed to encompass all the original sites of disease.

**VSIO51-04 • Microwave Ablation (MWA) Therapy of Liver Metastases from Colorectal Carcinoma Post Systemic Chemotherapy**
To evaluate the safety, efficiency, effectiveness, and overall outcome in patients treated with microwave thermal ablation of colorectal metastases post systemic chemotherapy.

METHOD AND MATERIALS
An institutional review board-approval was obtained with informed consent of all patients. Retrospective analysis of prospective intention to treat study was performed from January 2008 to January 2013, and included 92 patients (mean age 56 years SD: 2.6) with 132 liver metastases measuring 0.7\sim 5.0cm, who were treated with microwave ablation (MWA). Local tumor control, complications, and long-term survival were analyzed.

RESULTS
The mean follow-up period was 32.5 months. Complete ablation was achieved in 117 of 132 (88.6%) nodules. Seventeen of the 117 (14.5%) successfully treated nodules developed local recurrence. Univariate analysis showed that tumor size of < 3 cm is a significant risk factor (P = 0.03). Multivariate analysis showed that number of cycles of chemotherapy (FOLFOX) was a significant prognostic factor for overall recurrence (P=0.03), whereas disease-free interval was the significant prognostic factor for distant recurrence (P=0.03). Major complications occurred in 1.1% of patients. No procedure-related mortalities were observed. The 1, 2, 3, and 5-year overall survival rates after the initial ablation were 82, 61.2, 51.2, and 38.3%, respectively. The main cause of death was systemic tumor progression in 65.3% of the patients.

CONCLUSION
MWA is a safe and effective treatment therapeutic option for patients with liver metastases from Colorectal Carcinoma post systemic chemotherapy.

CLINICAL RELEVANCE/APPLICATION
Thermal ablative techniques such as MWA are safe and effective minimally invasive therapeutic option in the management of patients with hepatic metastasis, especially after systemic chemotherapy.

S8051-05 • Surgery for CRC Liver Mets - When Is Ablation Indicated?
Yuman Fong MD (Presenter) *

LEARNING OBJECTIVES
1) To understand the available ablative options for metastatic colorectal cancer. 2) To understand the determinants of success and failure for ablative treatment for colorectal metastases. 3) To understand the use of ablative therapy as an adjunct to surgery in the care of patients. 4) To understand the use of ablative therapy in the treatment of recurrent liver metastases.

S8051-06 • Treatment of Difficult Liver Metastases
Thierry J De Baere MD (Presenter) *

LEARNING OBJECTIVES
1) To know what are the most difficult situations when treating liver metastasis with percutaneous ablation techniques. 2) To know tips and tricks that can help to improve quality of targeting during percutaneous ablation of liver metastases. 3) To know what are the limitations of different ablation technologies of percutaneous ablation according to tumor size and location.

ABSTRACT
Percutaneous ablation of liver metastases allows for complete ablation in approximately 90% in well selected indications. Some metastases are more difficult to ablate due to either difficulty in targeting, or their location close to large vessels, close to fragile neighboring organs, or in proximity to the liver hilum. Difficulties in targeting are often due to poor visualization of the targeted tumor with image guidance. We will present possible benefit of fusion imaging between US and enhanced CT and discuss accuracy of such technique. We will described technique end results of tumor tagging with either percutaneously inserted metallic coils or tagging with intra-arterial injection of Lipiodol. Location close to large vessels favors convective tissue cooling and is responsible for lower rate of complete ablation with RFA for such tumor. Combining RFA with percutaneous balloon occlusion of hepatic or portal veins can improve results and the technique will be presented. Other ablative technologies can improve results of ablation close to large vessels and will be discussed namely with regards to microwaves ablation and irreversible electroproparation. Neighboring organ can be preserved from any damage by using aerodissection (air or carbon dioxide) or hydrodissection (dextrose, G5%, G10%) for shielding, and tips and tricks to achieve such dissection will be presented.

S8051-07 • Assessing Geometric RF Ablation Accuracy and Predicting Outcome within 24h after Treatment by Mapping the Preprocedure Liver Lesion to the Postprocedure Ablation Zone
Frederik Vandenbroucke MD (Presenter) ; Jef Vandememeulebroucke PhD, MSc ; Nico Buls DSc, PhD * ; Pablo R Ros MD, PhD * ; Johan De Mey *

PURPOSE
In RF ablation, complete coverage of the lesion by the ablation zone, is considered the primary indicator for treatment success. The purpose of this study was to evaluate the predictive value of early assessment of the geometrical accuracy of the procedure by using contrast enhanced CT images acquired before and within 24h after ablation.

METHOD AND MATERIALS
Twenty-three patients, with a total of 45 liver lesions, received a CT scan before and 24 hours after RF ablation. Follow up PET/CT scans were performed every 2-3 months after the intervention. Pre- and post-ablation CT images were aligned using commercial registration software. Lesion and ablation zone were semi-automatically segmented and masked during registration. A global, rigid registration based on mutual information was performed. If required, this was followed by an interactive local registration based on a smaller region of interest. Using the registered images, we verified the geometrical accuracy of the RF ablation treatment by measuring the minimal distance between the lesion and the outer edge of the ablation zone, and correlated this to local tumor progression (LTP) as recorded during follow up.

RESULTS
Eleven lesions (24.4%) showed LTP during a mean follow up of 62 weeks. Registration was successful for all lesions, although 5 were perceived as challenging. Based on the registered images, 29 lesions were completely covered by the ablation zone, while 10 were not. For 6 lesions, the edge was found to coincide with the edge of the ablation zone. Incomplete coverage of the lesion was found to be a powerful predictor for LTP (Se = 100%, Sp = 85%, PVV = 69%, NPV = 100%). Interestingly, two lesions only showed LTP after 5-6 months, and both belonged to the group were the edges of lesion and ablation zone coincided.

CONCLUSION
Verifying the coverage of liver metastases by an ablation zone through registration of pre- and early post-ablation CT images is feasible and has a strong predictive power for treatment outcome. Increasing the robustness and degree of automation of the procedure could further improve the accuracy and reproducibility of the method.

CLINICAL RELEVANCE/APPLICATION
Early and accurate detection of RF ablation failure may allow for reablation and will ultimately improve the efficacy of this minimally invasive procedure.
Cryoablation is a well-tolerated technique according to mid-term results. Mid-term efficacy of cryoablation was close to that of formal CLINICAL RELEVANCE/APPLICATION in case of inoperable extra-abdominal desmoid tumors. Despite high rate of partial ablation, percutaneous image-guided cryoablation appears to be safe and effective for mid-term local control CONCLUSION 0% at 6, 12 or 24 months. However, 10 patients (59%) presented asymptomatic residual tumors surrounding the ablative site on mean follow-up was 14.1 months (range: 4-27 months). The disease-free survival rates based on clinical evaluation and imaging (according to RECIST criteria) follow-up, respectively. The Kaplan-Meier method was used for calculation of volumes were between 0.8 to 127.2 mm³ (median: 28 mm³). Disease free survival (DFS) and local control were calculated on clinical study included 2 patients with Gardner syndrome and 12 recurrences on ablative site after initial surgical treatment. Maximal tumor recurrence and resorption was calculated from ablation zone measurements, grouped into 1-, 3-, 6-, 12-, 18- and =24-month statistical bins. RESULTS Tumor and procedure numbers for each site are: 75, 69 - retroperitoneal; 76, 62 - superficial; 39, 32 - intraperitoneal; 34, 34 – bone; and 27, 26 - head and neck. Average diameters of tumor and visible ice during ablation were 3.4 and 5.5 cm, respectively. Major complications (CTCAE Grade >3) occurred after procedures (3.2%). At 11 months average follow-up (range: 0-82), 10% local recurrence rates (26/251) were noted, of which 3 occurred within the ablative zone for a PCA procedural failure rate of 1.2%. Average time to recurrence was 4.9 months. At 21 months following the procedure, the initial ablation zone had reduced in volume by 93%. CONCLUSION CT-guided PCA is a broadly safe, effective local cancer control option for oligo-metastatic patients with soft tissue tumors in most anatomic sites. Other than bowel and nerve proximity, PCA also shows good healing if proper visualization and precautions are followed. Cryoablation thus allows highly successful tumor control with minimal morbidity and healing, especially near skin, subcutaneous and osseous locations that would not be readily amenable for heat-based ablations. CLINICAL RELEVANCE/APPLICATION Oligometastatic disease is becoming widely recognized with improved systemic treatments. Soft tissue cryoablation contributes to improved cancer-specific survival for many tumor types, despite loco}\n\nRESULTS Cryoablation was technically possible for all lesions under general (n=15) or local (n=2) anesthesia. Two probes were used in mean (range: 1-4) per procedure. Mean follow-up was 14.1 months (4-27 months). The disease-free survival rates based on clinical evaluation were 100%, 92% and 73% at 6, 12 and 24 months, respectively. The rates of local tumor progression based on RECIST criteria were 0% at 6, 12 or 24 months. However, 10 patients (59%) presented asymptomatic residual tumors surrounding the ablative site on imaging follow-up. The major complications rate was 5.8% per session (1/17). CONCLUSION Despite high rate of partial ablation, percutaneous image-guided cryoablation appears to be safe and effective for mid-term local control in case of inoperable extra-abdominal desmoid tumors. CLINICAL RELEVANCE/APPLICATION Cryoablation is a well-tolerated technique according to mid-term results. Mid-term efficacy of cryoablation was close to that of formal conservative surgery
RESULTS

Grade 3 or greater complications were observed; there were no deaths related to the ablation.

The 5-year estimated cancer-specific survival rates (95% CI; number still at risk) at 1, 2, 3, 5, and 7 years following ablation were: 87% (79–97; 31), 83% (73–94; 19), 76% (63–87; 15), 66% (54–78; 6), and 75% (65–84; 3), respectively. The 5-year estimated overall survival rates (95% CI; number still at risk) at 1, 2, 3, 5, and 7 years following ablation were: 94% (88–99; 22), 93% (88–100; 19), 90% (83–97; 15), 82% (71–95; 12), and 80% (70–93; 8), respectively. Four (5%) CTCAE grade 3 or greater complications were observed; there were no deaths related to the ablation.

ABSTRACT

Bone is one of the most frequent sites of spread for many common cancers. In such cases, when appropriate systemic treatment for the underlying cancer fails, patients should be considered for specific treatment, the principal modalities being radiotherapy and bisphosphonates. These therapies leave approximately one third of cases with inadequate pain control. This failure prompted the search for other strategies aimed at bone pain control through local bone augmentation such as percutaneous cementoplasty (PC).

PC can be performed under combined Computed Tomography (CT) and Fluoroscopic guidance; flat panel angiographic suite with integrated CT can also be used. Both systems allow precise positioning of the needle within the bone lesion. Most frequently PC is executed in sacrum, hip and femur but this procedure is also successful and feasible in fingers, astragalus, calcaneus, ribs, sternum, etc. Local anesthesia is employed in most cases.

Bone lesions are localized on CT and the most adequate access point is identified. A dedicated vertebroplasty beveled needle is then advanced into the bone lesion. Bone cement is injected under continuous fluoroscopic control. After PC a CT scan of the treated region is carried out to assess the extent of lesion filling and to visualize possible leakage.

Patients are discharged the same day of the procedure.

In our experience PC was successfully performed in all cases with no immediate severe complications. In lesions with lost integrity of the cortical bone, asymptomatic leakage of PMMA in the soft tissues can occur but, normally, it does not require any treatment.

Delayed complications such as fractures in metastases of the femoral diafysis can occur; lytic lesions of the long bones should not be treated with PC due to high risk of fracture during ambulation. PC, in our opinion, should be proposed in all patients with painful or invalidating bone lesions when conventional therapies fail or surgery is not feasible.

RESULTS

Chondrolysis or femoral head osteonecrosis developed in 31% (4 of 13) of periacetabular lesions. Of the remaining patients with non-periacetabular lesions that underwent cryoablation, none subsequently developed osteonecrosis. Patients who developed chondrolysis or osteonecrosis had ablation zones closer to the joint. There was no difference in ablation times or cycle distribution. Chondrolysis or osteonecrosis developed within a 5 month period, with a mean of 89 days. 3 of the 4 patients who developed chondrolysis and osteonecrosis had ablation zones closer to the joint. There was no difference in ablation times or cycle distribution.

RESULTS

Chondrolysis or femoral head osteonecrosis developed in 31% (4 of 13) of periacetabular lesions. Of the remaining patients with non-periacetabular lesions that underwent cryoablation, none subsequently developed osteonecrosis. Patients who developed chondrolysis or osteonecrosis had ablation zones closer to the joint. There was no difference in ablation times or cycle distribution. Chondrolysis or osteonecrosis developed within a 5 month period, with a mean of 89 days. 3 of the 4 patients who developed chondrolysis and osteonecrosis had ablation zones closer to the joint. There was no difference in ablation times or cycle distribution.

CLINICAL RELEVANCE/APPLICATION

Periarticular cryoablation can be associated with osteonecrosis and chondrolysis, and therefore, careful pre-ablation planning and risk/benefit analysis should be performed prior to proceeding.

METHOD AND MATERIALS

Between 2008 and 2013, 41 patients with a total of 100 musculoskeletal lesions were treated by cryoablation at our institution. 12 patients were referred to our department specifically for treatment of periacetabular osseous malignancies. There were a total of 15 lesions, with 3 of the 12 patients having bilateral lesions. Follow-up clinical notes and imaging of the patients were retrospectively reviewed for a minimum of 2 months. Generalized estimating equations were performed to assess the effect that patient demographics and treatment parameters (including ablation time, cycle distribution, and probe proximity to the femoral head and fovea) had on development of chondrolysis and osteonecrosis.

RESULTS

Chondrolysis or femoral head osteonecrosis developed in 31% (4 of 13) of periacetabular lesions. Of the remaining patients with non-periacetabular lesions that underwent cryoablation, none subsequently developed osteonecrosis. Patients who developed chondrolysis or osteonecrosis had ablation zones closer to the joint. There was no difference in ablation times or cycle distribution. Chondrolysis or osteonecrosis developed within a 5 month period, with a mean of 89 days. 3 of the 4 patients who developed chondrolysis and osteonecrosis had ablation zones closer to the joint. There was no difference in ablation times or cycle distribution.

CONCLUSION

Chondrolysis or femoral head osteonecrosis developed in 31% of periacetabular malignancies treated by cryoablation, ultimately requiring joint replacement in 3 of 4 patients. Careful pre-ablation planning and risk/benefit analysis should be undertaken before performing periarticular cryoablation, and patients should subsequently be monitored for developing chondrolysis and osteonecrosis.

METHOD AND MATERIALS

A retrospective review of 61 patients who underwent 74 ablation procedures to treat 82 mRCC lesions with intent of local control (i.e. not palliative). Technical success, safety, local control, complications, and survival were analyzed according to standard criteria.

RESULTS

Four (4.9%) technical failures were observed. Time to recurrence was assessed for the subset of 76 (93%) tumors that were followed past ablation (7.9%) tumors recurred at a mean of 1.6 years following ablation (median 1.4; range 0.6 -2.9). The mean duration of follow-up for the 70 tumors that did not recur was 1.9 years (median 1.2; range 10 days - 7.5 years). Estimated local recurrence-free survival rates (95% CI; number still at risk) at 1, 2, 3, 5, and 7 years following ablation were: 94% (88 – 100; 41), 94% (88 – 100; 32), 83% (70 – 97; 17), 83% (70 – 97; 5), and 83% (70 – 97; 3), respectively. Estimated overall survival rates (95% CI; number still at risk) at 1, 2, 3, 5, and 7 years following ablation were: 87% (79 – 97; 42), 83% (73 – 94; 31), 76% (63 – 87; 15), 52% (35 – 76; 6), and 52% (35 – 76; 2), respectively. Recognizing this highly selected patient population and additional concurrent or subsequent treatment, estimated cancer-specific survival rates (95% CI; number still at risk) at 1, 2, 3, 5, and 7 years following ablation were: 91% (83 – 99; 42), 86% (76 – 96; 31), 82% (71 – 95; 19), 62% (46 – 85; 6), and 62% (46 – 85; 2), respectively. Four (5%) CTCAE grade 3 or greater complications were observed; there were no deaths related to the ablation.
CONCLUSION
Image guided ablation of mRCC is a relatively safe procedure with acceptable local control rates. In carefully selected patients, adjunct ablation with systemic therapy, radiation, and surgery may confer a survival benefit, although further follow-up and validation are needed.

CLINICAL RELEVANCE/APPLICATION
In carefully selected patients, adjunct ablation with systemic therapy, radiation, and surgery may confer a survival benefit, although further follow-up and validation are needed.

VSIO51-17 • Bone Metastases Tumor Board
Matthew R Callstrom MD, PhD (Presenter) *

LEARNING OBJECTIVES
1) Describe the characteristics of bone tumors amenable to interventional oncologic treatment in the context of other treatments including surgery and radiation oncology.
2) Describe the techniques to avoid complications in the percutaneous treatment of metastatic bone tumors.
3) Describe characteristics of metastatic bone tumors that benefit from combination treatments.

Case-based Review of Neuroradiology: Interventional Image-based Diagnosis (An Interactive Session)
Thursday, 03:30 PM - 05:00 PM • S100AB

MCSN54 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Director
Pina C Sanelli, MD

MCSN54A • Spine Interventional
A. Orlando Ortiz MD, MBA (Presenter) *

LEARNING OBJECTIVES
1) A comfortable handle on the approach to the typical spine patient. 2) An understanding of the commonly present variations that can affect diagnostic or treatment outcome.

MCSN54B • Neurovascular Interventional
Michele H Johnson MD (Presenter) *

LEARNING OBJECTIVES
1) An understanding of the variety of endovascular interventions. 2) Comprehension of how diagnostic neuro-imaging affects intervention. 3) Knowledge of the common variations that can affect diagnostic or treatment outcome.

Advancements in Renal Tumor Treatment: What We Need to Know Before and After Therapy
Thursday, 04:30 PM - 06:00 PM • S105AB

RC707 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Coordinator
Erick M Remer, MD
Ronald J Zagoria, MD
Debra A Gervais, MD *

LEARNING OBJECTIVES
1) Attendees will learn the current treatment options for RCC, including partial nephrectomy and tumor ablation. 2) Attendees will be able to articulate the benefits and drawbacks of treatment options, specifically complications and outcomes. 3) Attendees will understand the steps of renal tumor ablation and considerations for ablation success. 4) Attendees will be able to report salient imaging findings before and after RCC treatment, especially partial nephrectomy and tumor ablation.
ABSTRACT
This course will provide an introduction to the incidence of RCC, trends in imaging, and the distinction of tumor types. Current treatment options (partial nephrectomy, tumor ablation) and how they are performed will be discussed and the benefits and drawbacks of each will be detailed. Findings that are important to report when interpreting studies before and after treatment will be reviewed.

Interactive Game: Interventional
Thursday, 04:30 PM - 06:00 PM • E353A

RC714 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Moderator
Steven M Zangan, MD
Brian S Funaki, MD
Rakesh C Navuluri, MD

LEARNING OBJECTIVES
1) Recognize vascular and non-vascular conditions and their image-guided treatment in the chest, abdomen and pelvis. This interactive session will use RSNA Diagnosis Live®. Please bring your charged mobile wireless device (phone, tablet or laptop) to participate.

Common Spinal Injection Procedures for Diagnosis and Treatment of Back Pain (Hands-on Workshop)
Thursday, 04:30 PM - 06:00 PM • E263

RC731 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
A. Orlando Ortiz MD, MBA *
John M Mathis MD, MSc
LEARNING OBJECTIVES
1) Describe and demonstrate methods for patient selection, evaluation and technique for Image-guided injection procedures used in spine pain management. 2) These procedures will include epidural steroid injections, nerve root blocks, facet blocks, sacroiliac joint injections, lumbar synovial cyst therapy, radiofrequency ablations, and discography. 3) Review procedural complications and how to avoid them. 4) Discuss pertinent anatomy, instruments and pharmacology. 5) These objectives will be accomplished using didactic lectures complemented by procedure videos, supervised hands on lab work with training models and round table case discussions.

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

IR Management of Biliary Obstruction: What You Didn’t Learn in Fellowship (How-to Workshop)
Thursday, 04:30 PM - 06:00 PM • E261

LEARNING OBJECTIVES
1) Describe an appropriate imaging work up for malignant bile duct obstruction (MBDO). 2) List the indications for percutaneous biliary intervention in the setting of MBDO. 3) Formulate a plan to achieve clinical goal of drainage based on imaging and clinical data. 4) Understand potential complications of biliary drainage in MBDO and their management.

ABSTRACT
BILIARY COMPLICATIONS FOLLOWING ORTHOPTOPIC LIVER TRANSPLANTATION Roy Gordon MD, Interventional Radiology, University of California, San Francisco Transplant patients are different for a number of reasons as listed below: 1. Most liver transplant patients have benign disease and a potential for long-term survival 2. Resources (livers and financial) are limited, so every effort must be made to salvage the transplanted liver 3. Immunosuppression alters both response to infection and the healing process Participants in this course will learn about the incidence, nature and management of biliary complications following liver transplantation both from the diagnostic and the therapeutic approach. The following questions will be addressed: 1. Should bile leaks be treated surgically or non-operatively? 2. Should anastomotic strictures be treated surgically or dilated? 3.How should non-anastomotic strictures be managed? In addition some other biliary problems in the liver transplant recipient will be presented detailing diagnosis and management

INDICATION FOR BILIARY DRAINAGE
1. Biliary sepsis
2. Intractable pruritus
3. Lower bilirubin for chemotherapy
4. Biliary diversion (leak)
5. ? Improve QOL

INDICATION FOR PERCUTANEOUS DRAINAGE MBO
1. Failed endoscopy
2. High obstruction
3. Obstructed Roux loop
4. Access for additional therapies (stone removal, dilation, brachytherapy)

PRE PROCEDURE WORK UP IMAGING
1. Obstructive vs. non obstructive jaundice
2. Level of obstruction
3. Portal vein status
4. Atrophy
5. Parenchymal lesions
6. Ascites
7. Liver anatomy

LABS
1. Platelet count
2. INR
3. LFTs

PROCEDURE ISSUES
1. Right vs left drain
2. Atrophy/portal vein compromise
3. Ascites
4. Catheter vs stent

Techniques for Interventional Sonography and Thermal Ablation (Hands-on Workshop)
Thursday, 04:30 PM - 06:00 PM • E264

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

ABSTRACT
Neck and back pain complaints are very common in the general population. Radiologists can contribute to the diagnosis and management in patients who are not responding to conservative management. Spine injection procedures can frequently be performed on an outpatient basis with a brief recovery phase. These procedures are performed with imaging guidance, often a multi-directional fluoroscope, in order to correctly localize the specific anatomic sites in or about the spine for diagnostic and or therapeutic needle localization. An understanding of patient selection, indications and contraindications, are paramount to the safety and success of these procedures. The diagnostic and therapeutic potential of these procedures is also facilitated by a thorough evaluation of the spine, with respect to both anatomy and potential pathology, with cross sectional imaging techniques as well as other radiologic tests. Communication of these results between the Radiologist and the spine proceduralist will contribute to optimal patient outcomes.
LEARNING OBJECTIVES
1) Identify basic skills, techniques, and pitfalls of freehand invasive sonography. 2) Discuss and perform basic skills involved in thermal tumor ablation in a live learning model. 3) Perform specific US-guided procedures to include core biopsy, abscess drainage, vascular access, cyst aspiration, soft tissue foreign body removal, and radiofrequency tumor ablation. 4) Incorporate these component skill sets into further life-long learning for expansion of competency and preparation for more advanced interventional sonographic learning opportunities.

ABSTRACT
Targeted Treatment and Imaging of Liver Cancers: Basic to Advanced Techniques in Minimally-Invasive Therapies and Imaging (How-to Workshop)
Friday, 08:30 AM - 10:00 AM  •  E260

RC850  •  AMA PRA Category 1 Credit ™:1.5  •  ARRT Category A+ Credit:1.5
John J Park, MD, PhD
Jinha Park, MD, PhD
Jonathan M Kessler, MD
Steven S Raman, MD
Marcelo Guimaraes *

LEARNING OBJECTIVES
1) Discuss the role of the interventional radiologist in the treatment and management of patients with primary and metastatic liver cancer as part of the multidisciplinary team. 2) Learn best practice techniques in the treatment of liver cancers, with emphasis on both locoregional and focal therapeutic approaches, and indications for treatment. 3) Explore various tips and tricks for each treatment modality and learn how to avoid complications through good patient selection, choosing the appropriate techniques, and knowing what common mistakes to avoid. 4) Learn about newer and developing techniques and devices, their potential roles and indications, and potential pitfalls. 5) Explore advanced imaging modalities in the detection of tumors and for monitoring treatment response.

ABSTRACT
Advanced Image Analysis, including Applications such as Automated Stent Planning and Multimodality Image Fusion and Treatment Planning (Hands-on Workshop)
Friday, 08:30 AM - 10:00 AM  •  S401CD

RC853  •  AMA PRA Category 1 Credit ™:1.5  •  ARRT Category A+ Credit:1.5
Gary J Wendt, MD,MBA *

LEARNING OBJECTIVES
1) To get hands-on experience using 3D / 4D tools to process huge data sets, specifically multislice CT and MR using data sets. 2) How to effectively deal with the following data: CT and MR angiograms, perfusion, and bone. 3) Getting hands on experience using 3D / 4D tools to process data in near realtime. 4) Introduce the basic 3D tools that are available and how they can be used both within radiology as well as how they apply to referring clinicians.

ABSTRACT
This course will focus on how to get hands-on experience using 3D / 4D tools to process huge data sets, specifically multislice CT and MR using data sets. How to effectively deal with the following data: CT and MR angiograms, perfusion, and bone. It will also focus on providing hands on experience using 3D / 4D tools to process data in near realtime for emergencies like stroke work-up. It will also introduce the basic 3D tools that are available and how they can be used both within radiology as well as how they apply to referring clinicians

Interventional Radiology Series: Top 5 Complications in Interventional Oncology - Avoidance, Recognition and Management
Friday, 08:30 AM - 12:00 PM  •  E451A

VSIR61  •  AMA PRA Category 1 Credit ™:3.25  •  ARRT Category A+ Credit:3.75
Moderator
Charles E Ray, MD, PhD *

LEARNING OBJECTIVES
1) List 2 important recent publications in interventional oncology. 2) Explain the mechanism of one complication related to thermal ablation. 3) Describe pros and cons of chemoembolization versus radioembolization of hepatocellular carcinoma with portal vein thrombosis. 4) Outline 3 complications in combination therapy for hepatocellular carcinoma. 5) List three complications of chemo-embolization. 6) Describe rationale for and against interventional oncology as a distinct specialty.

VSIR61-02  •  Chemo-Embolization Cxs
Charles E Ray MD, PhD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIR61-03  •  Tc-99m Macroaggregated Albumine Lung Shunt Calculation Overestimates the Lung Dose in Radioembolization
ABSTRACT
1) Techniques to avoid complications with thermal ablation. 2) How to manage complications of thermal ablation.

LEARNING OBJECTIVES
1) Discern the impact of transcatheter intra-arterial embolotherapy in patients with hepatocellular carcinoma and portal vein thrombosis. 2) Understand the microembolic effects of radioembolization, and the potential advantages of this treatment over other intra-arterial embolotherapies. 3) Become familiar with the current literature regarding radioembolization of patients with unresectable hepatocellular carcinoma with portal vein thrombosis.

METHOD AND MATERIALS
Fourteen patients were treated with radioembolization using holmium-166-loaded microspheres (166Ho). These particles can be quantified with SPECT and can be used for scout dose and treatment. During preparatory angiography, 99mTc-MAA (150 MBq) was injected, followed by (planar) scintigraphy and SPECT-CT. At the day of treatment, a scout dose of 166Ho-microspheres (250 MBq) was first injected, followed by SPECT-CT imaging. Subsequently, a treatment dose of 166Ho-microspheres was injected and imaged with SPECT-CT. Lung shunting was calculated on 99mTc-MAA scintigraphy. Mean lung doses were calculated on quantitative SPECT images for all three procedures and also on scintigraphy for 99mTc-MAA. The activity in the lungs was converted into absorbed dose (Gy) corresponding to the net injected treatment dose. The pre-treatment estimations were compared to the dose after actual treatment, as measured with post-treatment SPECT.

RESULTS
No signs of radiation pneumonitis were seen in any patient during three months follow up. The median lung shunt based on 99mTc-MAA scintigraphy was 4.1% (range 2.2 ± 11.3%). The median lung dose after 166Ho-radioembolization was 0.2 Gy (range 0 ± 0.7 Gy), based on quantitative SPECT. This lung dose was significantly overestimated by 99mTc-MAA scintigraphy (median difference (?) 5.1 Gy, range 1.4 ± 17.1 Gy, p < 0.001) and by 99mTc-MAA SPECT (? 2.3 Gy, range 0.5 ± 11.8 Gy, p < 0.001). The estimations on SPECT images of the 166Ho-scout dose did not differ significantly from treatment (0.0 Gy, range -0.7 ± 0.3 Gy, p = 0.542).

CONCLUSION
99mTc-MAA lung shunt calculations significantly overestimate the mean lung dose after radioembolization with 166Ho microspheres. In contrast, a scout dose of 166Ho-microspheres accurately predicts the mean lung dose after treatment.

CLINICAL RELEVANCE/APPLICATION
The mean absorbed dose to lung parenchyma of patients treated with 166Ho radioembolization is significantly overestimated by 99mTc-MAA planar scintigraphy and SPECT-based lung dose calculations.

VSIR61-05 • Y-90 Cxs

Robert J Lewandowski MD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIR61-06 • Trans-arterial Radioembolization (TARE) of Intermediate-advances HCC: Does Portal Vein Thrombosis Affect Survival?

Francesco Fiore MD (Presenter); Francesco Somma MD; Roberto D’Angelo MD; Rosa Ambrosio MD; Sergio Setola; Francesco Izzo MD

PURPOSE
Our purpose is to assess and compare the survival of patients with portal vein thrombosis (PVT) and patients without PVT after a TARE using Y-90 microspheres of unresectable HCC, not responsive to other loco-regional treatments.

METHOD AND MATERIALS
Between November 2005 and February 2013, 81 TARE were performed in 74 patients (43% male; 57% female; range of age 28-84years) with unresectable HCC (size of lesions 1.1 to 5.5cm) and bilirubine values up to 2.6 mg/dl, 21 with PVT. Every patient was studied with Multislice Computed Tomography (MSCT) scans and angiography while just 12 of them underwent the embolization of the Gastro-duodenal artery, using micro-coils. In these cases, a previous study was performed with the injection of TC-99MAA through a 3F microcatheter. Proton-Pump Inhibitors (PPI) were administered to prevent gastritis and ulcers.

RESULTS
The average dose administered was 1.7GBq. After the treatment, fever and abdominal pain were found in 29 and 19 patients, respectively. No other side-effect was observed. According to the mRECIST criteria at least a partial response was found in 70% of patients. No other side-effect was observed. According to the mRECIST criteria at least a partial response was found in 70% of patients.

CONCLUSION
TARE using Y-90 microspheres showed to be a safe and effective technique even in patients with PVT. Among the loco-regional treatments of intermediate-advanced HCC, TARE is extremely useful in case of relapse after trans-arterial embolization (TAE) or chemoembolization (TACE) in improving the survival of these patients.

CLINICAL RELEVANCE/APPLICATION
Portal vein thrombosis does not affect survival of patients who undergo the Y-90 TARE of intermediate-advanced HCC not responsive to other loco-regional treatments.

VSIR61-07 • Debate: HCC With Portal Vein Thrombosis

Charles E Ray MD, PhD (Presenter) *; Robert J Lewandowski MD (Presenter) *

LEARNING OBJECTIVES
1) Discern the impact of transcatheter intra-arterial embolotherapy in patients with hepatocellular carcinoma and portal vein thrombosis. 2) Understand the microembolic effects of radioembolization, and the potential advantages of this treatment over other intra-arterial embolotherapies. 3) Become familiar with the current literature regarding radioembolization of patients with unresectable hepatocellular carcinoma with portal vein thrombosis.

VSIR61-08 • Thermal Ablation Cxs

Daniel B Brown MD (Presenter) *

LEARNING OBJECTIVES
1) Techniques to avoid complications with thermal ablation. 2) How to manage complications of thermal ablation.

ABSTRACT
Complications are unusual with thermal ablation but can be severe. This presentation is designed to avoid complications as well as identify untoward events early after therapy to optimize management.

VSIR61-09 • Evaluation of Thrombotic Risk in Hepatic Vessels during Microwave Tumor Ablations: Does Size Really Matter?
PURPOSE
Microwave tumor ablation is a powerful tool that can more effectively overcome the \textit{heat-sink} effect of nearby vasculatures. Such power may also increase the risk of thrombosing larger vessels, which can have devastating consequences for a patient whose liver is already compromised. The goal of this study is to correlate the risk of vascular thrombosis with vessel size, blood velocity and proximity to heating zone during microwave ablations.

METHOD AND MATERIALS
Microwave antennas were placed in-vivo, 5-20 mm away from a portal vein, hepatic vein and hepatic artery in a porcine liver (n=6). Vessel sizes, flow velocities and distance from antenna were measured under Doppler and ultrasound imaging. Microwave ablations were then created at 100 W for 5 minutes. Post-ablation ultrasound was used to determine presence of thrombus in each vessel. Uni- and multivariable logistic regressions were fitted to model the relationship predictors to thrombotic events in each kind of vessel. Fitted models were compared to each other using the area under the receiver operator characteristic curves (AUC); 95% confidence intervals for AUC were also obtained.

RESULTS
Thrombus formation was detected in 53.3% of portal veins (8/15), 13.3% of hepatic veins (2/15) and 0.0% in hepatic arteries (0/15). The hepatic vein AUC of velocity, spacing and diameter were 0.885 [95% CI: 0.617-0.989], 0.923 [0.667-0.997] and 0.904 [0.641-0.994], respectively. Portal vein AUC of velocity, spacing and diameter were 0.509 [0.163-0.853], 0.643 [0.340-0.946] and 0.536 [0.168-0.814], respectively. Multivariate prediction models of both hepatic and portal veins did not show significant increase in AUC over their respective individual univariate models.

CONCLUSION
The risk of thrombosis decreased with increasing vessel velocity, size and spacing in hepatic veins. Portal veins thrombosed at a rate four times higher than hepatic veins, but our analysis was not able to discriminate which factors were most relevant. Further study is required to elucidate the physical and biochemical mechanisms behind this discrepancy in thrombotic rates.

CLINICAL RELEVANCE/APPLICATION
Portal veins have greater, but less predictable risk for thrombosis compared to hepatic veins in microwave tumor ablation procedures.

**VSIR61-10 ● The Effect on Renal Function Following Image Guided Radiofrequency Ablation (RFA) of Renal Tumors**

Tze M Wah MBChB, FRCP (Presenter) ; Walter Gregory PhD ; Henry C Irving MBBS ; Jon Cartledge MD ; Adrian D Joyce MD ; Peter J Selby MD, DSc

PURPOSE
To analyse changes in GFR in patients who had image-guided RFA of their renal tumors and to correlate the percentage GFR change (% GFR change) with tumor size, polar position, tumor treatment location, the total size of the tumor treated per ablation session, number of tumors treated, and solitary kidney status.

METHOD AND MATERIALS
From June 2004-2012, a total of 165 patients (109 men, 56 women; mean age 67.7 years) had image-guided RFA of 200 renal tumors with size ranging from 1-5.6cm (mean= 2.9cm). The position of the renal tumors was: upper (n=63), middle (n=86) and lower (n=51). The tumor location was: upper (200), parenchymal (n=63) and central (n=16). All patients had renal function measured immediately before and at 24 hours post-RFA. Multivariate logistic regression analysis was performed to determine any association between % GFR change with the tumor size, polar position (upper, middle and lower pole of the kidney), tumor treatment location (exophytic, mixed, parenchymal and central), the total size of the tumor treated per ablation session, number of tumors treated and solitary kidney status.

RESULTS
The mean GFR pre- and post-RFA were: 54.7 ml/min/1.73m2 (+/- SD 18.2 ml/min/1.73m2) vs. 52.7 ml/min/1.73m2 (+/- SD 18.5 ml/min/1.73m2). There is a significant difference between the pre- and post-RFA GFR measurements (p < 0.05) with a 25% decrease in GFR whilst in the majority (96%) of the patients renal function was preserved. The mean % change of GFR pre- and post-RFA was 2.3% (+/- SD 15.2%). However, using multivariate logistic regression analysis there is no association between the % of GFR change with tumor size, polar position, tumor treatment location, the total size of the tumor treated per ablation session, number of tumors treated and solitary kidney status.

CONCLUSION
Preservation of the renal function can be achieved following image-guided RFA of renal tumors and the percentage of GFR change was not influenced by tumor factors or solitary kidney status.

CLINICAL RELEVANCE/APPLICATION
Any change in renal function following image-guided renal RFA is not influenced by tumors factors (size, polar position, treatment location, number of tumors treated) or solitary kidney status.

**VSIR61-11 ● Combination Therapy Cxs**

Thuong G Van Ha MD (Presenter) *

LEARNING OBJECTIVES
View learning objective under main course title.

ABSTRACT
Combination therapy utilizing both transarterial chemoembolization and thermal ablation will be discussed with an emphasis on complications. Different techniques of TACE will be shown, in combination with either radiofrequency ablation or microwave ablation. Management of complications will also be discussed.

**VSIR61-12 ● Debate: Interventional Oncology - A Distinct Specialty/Interventional Oncology - We Are Radiologists, Not Oncologists**

Daniel B Brown MD (Presenter) * ; Charles E Ray MD, PhD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

**VSIR61-13 ● Literature Review: The Most Important IO Papers from 2012-13**

Charles E Ray MD, PhD (Presenter) *

LEARNING OBJECTIVES
View learning objectives under main course title.

**VSIR61-14 ● Panel Discussion: Unknown Case Presentation**
Renal impairment displays a relative contraindication to the application of Gadolinium-based contrast-agents. Hence, contrast dose reduction has become an important issue in the clinical setting. The aim of this trial was to determine whether contrast agent (CA) dose adjustment is feasible in patients with renal impairment.

METHOD AND MATERIALS

43 cases with suspected or known soft tissue diseases of the ankle and foot were examined retrospectively by conventional MR sequences and TRICKS sequence on GE Signa 1.5T HD echospeed MRI. MIP reconstruction was done to evaluate the image quality of arterial branches on ADW4.4 workstation and the evaluated criteria was divided into 4 grades according to the visualization of dorsalis pedis artery (grade 1−2), FDMA and toe web network (grade 3−4). FDMA was dissected and categorized according to its location (superficial, intramuscular, inframuscular, absent), diameter (large (>1.5mm), medium (1.0−1.5mm), small (≤1.0mm)), and small (second to first toe) branching pattern at the toe web: ramifying type (11 cases), main trunk type (5 cases), fine small branch types (14 cases).

RESULTS

8 cases (18.6%, 8/43) in grade 4, 22 (51.16%, 22/43) in grade 3, 8 (18.6%, 8/43) in grade 2 and 5 (11.62%, 5/43) in grade 1. In the grade 1 cases (arterial scales = 3 point) showed branching pattern at the toe web of FDMA: 1) Location: superficial (8), intramuscular (22 cases), inframuscular (8 cases), absent (0 cases); 2) Diameter: large (2 cases), medium (25 cases), and small (11 cases); 3) Branching pattern at the toe web: ramifying type (11 cases), main trunk type (5 cases), fine small branch (14 cases).

CONCLUSION

MR angiography of the dorsalis pedis artery and FDMA was achievable with MR TRICKS sequences, and it was useful for clinical evaluation of arterial branches on ADW4.4 workstation and the evaluated criteria was divided into 4 grades according to the visualization of dorsalis pedis artery (grade 1−2), FDMA and toe web network (grade 3−4). FDMA was dissected and categorized according to its location (superficial, intramuscular, inframuscular, absent), diameter (large (>1.5mm), medium (1.0−1.5mm), small (≤1.0mm)), and small (second to first toe) branching pattern at the toe web: ramifying type (11 cases), main trunk type (5 cases), fine small branch (14 cases).

CLINICAL RELEVANCE/APPLICATION

Type 2 diabetics have an elevated risk of cardiovascular events which can occur in apparently healthy patients. Screening with WBCVMR may identify those at increased risk of future events.
METHOD AND MATERIALS

12 healthy subjects underwent renal MR angiographic examinations on a 7T MR system (Magnetom 7T), utilizing a custom-built 8-channel RF body coil. Dynamic 3D FLASH data sets were obtained pre contrast and in arterial phase after the application of contrast agent. Examinations were performed at three different time points for injection of three dosages of CA (Gadobutrol, Bayer Healthcare): (1) 0.1 mmol/kg body weight (BW), (2) 0.05 mmol/kg BW and (3) 0.025 mmol/kg BW. Contrast ratios (CR) were measured pre and post contrast in the aorta and both renal arteries in correlation to adjacent psoas major muscle. Qualitative analysis with regard to delineation of the pre-contrast and post-contrast renal arterial vasculature was performed by two radiologists using a five-point-scale (5=excellent to 1= non diagnostic).

RESULTS

Non-enhanced T1W MRI provided an inherently high signal intensity of vasculature, yielding a good overall pre-contrast arterial delineation (mean 3.65). The application of contrast agent showed improved vessel delineation in subjective ratings of qualitative analysis for all three dosages, yielding comparable results with only minor improvement associated to increased dosage (mean aorta: 0.025Gd 4.4; mean0.05Gd 4.6; mean0.1Gd mean 4.80). Accordingly, quantitative analysis of contrast ratios showed minor increase of mean values with increasing Gadolinium dosage (mean right renal artery: 0.025Gd 0.36; mean0.05Gd 0.38; mean0.1Gd mean 0.42).

CONCLUSION

Our results demonstrate the successful facilitation of a significant dose reduction to one-quarter of the standardized dosage, while maintaining high image quality.

CLINICAL RELEVANCE/APPLICATION

The facilitation of a significant dose reduction to one-quarter while maintaining high image quality, may be of high diagnostic value for MRA examinations in patients with renal impairment.

VSVA61-05 ● MR Contrast Agents for Vascular Imaging

Tim Leiner MD, PhD (Presenter) *

LEARNING OBJECTIVES

1) To understand the different classes of contrast agents available for vascular imaging as well as their strengths and weaknesses. 2) To understand both acute and delayed safety concerns associated with administration of MR contrast agents for vascular imaging. 3) To understand proper contrast agent dosing for vascular MR imaging. 4) To understand basic principles underlying successful contrast injection.

ABSTRACT

VSVA61-06 ● Gadofosveset-enhanced MR Venography of the Lower Extremities for Evaluation of Venous Reflux Disease: Feasibility and Comparison of Perforator Vein Imaging with Duplex Ultrasound

Andrew R Lewis MD (Presenter); Daniele Marin MD; Holly L Nichols BS; Daniel Geersen; Cynthia K Shortell MD; Charles Y Kim MD *

PURPOSE

Duplex ultrasound (U/S) is the gold standard for imaging of venous reflux disease. CT and direct MR venography (MRV) have shown promising results, but are limited in the degree and extent of superficial vein opacification. Gadofosveset, a blood-pool agent, is uniquely well suited for venous imaging. The purpose of this study is to assess the feasibility of MRV of the deep and superficial venous system and to determine its accuracy in detection of perforator veins.

METHOD AND MATERIALS

Retrospective review of our imaging database from 9/2010 to 9/2012 yielded 58 patients (40 females, mean age 54) who underwent MRV of the abdomen, pelvis, and lower extremities as well as dedicated U/S evaluation of venous reflux disease of one or both legs. Axial MRV images were acquired during the equilibrium phase, approximately 5 minutes after IV gadofosveset injection. The lower extremity deep, superficial, and perforator veins were divided into 11 segments for evaluation. Two radiologists independently rated the visualization score of each venous segment on a scale of 1-4 with 4 being highest. Signal and contrast-to-noise ratios were calculated for the venous segments. The detection of enlarged perforator veins was assessed and compared to sonography.

RESULTS

Analysis was performed on 80 legs that underwent both MRV and U/S. The mean visualization scores for all analyzed venous segments were excellent (3.8-3.9 on a scale of 1-4). The SNR/CNR values were 280/165 for the femoral vein, 230/144 for the above-knee GSV, 394/237 for the below-knee GSV, 303/177 for the small saphenous vein, and 385/240 for superficial varices. 100% of pathologic perforator veins were identified on dedicated U/S were detected on MRV. Additional occult enlarged perforator veins were identified on MRV measuring up to 6mm in diameter.

CONCLUSION

MRV with gadofosveset allowed excellent visualization of varices, superficial, and perforator veins of the legs with a high SNR and CNR that was not previously possible with other contrast agents. The exceptional sensitivity for detection of perforator veins may enable improved treatment of venous reflux disease. Additional studies are warranted to correlate MRV findings with disease characterization and treatment outcomes.

CLINICAL RELEVANCE/APPLICATION

The excellent imaging quality of the entire venous system of the lower extremities with gadofosveset-enhanced MR venography may enable a new system for evaluation of venous reflux disease.

VSVA61-07 ● MRA at 3T in Peripheral Arterial Occlusive Disease: Comparison of Gadoterate Meglumine - to Gadobutrol-MRA Using DSA as a Standard of Reference: A Randomized European Multicenter Trial

Christian Loewe MD (Presenter) *; Javier Arnaiz Garcia MD; Denis Krause MD; Luis Marti-Bonmati MD, PhD; Manuela Aschauer MD; Armando Tartaro MD; Massimo Lombardi MD *; Marta Burrel MD, PhD; Reynald Izzillo; Michael M Lell MD *

PURPOSE

To assess the diagnostic value of two contrast agents in CE-MRA at 3T in peripheral arterial occlusive disease (PAOD).

METHOD AND MATERIALS

189 patients were included in this double-blind trial. Patients randomly underwent peripheral CE-MRA with 0.1mmol/kg of either gadoterate meglumine (Dotarem®) or gadobutrol (Gadavist®). The primary endpoint was degree of agreement to DSA in stenosis detection and grading of both CE-MRA examinations. A non-inferiority analysis was performed based on two independent central readings. Secondary endpoints were specificity, sensitivity, positive/negative predictive values, diagnostic confidence, stenosis length, vessel diameter, signal-to-noise ratio and contrast-to-noise ratio. Safety and treatment recommendation were also recorded.

RESULTS

The non-inferiority was demonstrated for the primary endpoint. The sensitivity in the detection of significant stenosis for Reader 1 was 69.9% in gadoterate meglumine group compared to 71.0% in gadobutrol group (p=0.72), whereas the specificities were 85.0% and 85.2% (p=0.84), respectively. For Reader 2, sensitivities were 61.5% and 62.0% (p=0.77) and specificities were 91.4% and 91.2%.
Performance of Unenhanced MRA Using Spatial Labeling with Multiple Inversion Pulses Sequence to Depict Transplant Renal Vascular Anatomy and Complications

Hao Tang (Presenter) ; Daoyu Hu MD, PhD ; Zi Wang

PURPOSE
To prospectively evaluate the performance of a new unenhanced magnetic resonance angiography (Unenhanced MRA) sequence, labeling with multiple inversion pulses (SLEEK), to depict transplant renal vascular anatomy and complications in comparison to color labeling with multiple inversion pulses (SLEEK), to depict transplant renal vascular anatomy and complications in comparison to color

CLINICAL RELEVANCE/APPLICATION
Our study has demonstrated that there is no significant difference in terms of diagnostic accuracy when comparing Gd-DOTA-enhanced MRA and gadobutrol-enhanced MRA in an equimolar manner.

VSV61-08 • Non-contrast MRA: TOF and SSFP Based Techniques

James C Carr MD (Presenter) *

LEARNING OBJECTIVES
1) Understand the technical issues underlying non contrast MRA based on TOF and SSFP. 2) Become familiar indications and guidelines for using non contrast MRA. 3) Illustrate applicability of non contrast MRA in a variety of relevant clinical scenarios.

VSV61-09 • Comparison of Non-contrast Enhanced SSFP MRA with Gadolinium Enhanced MRA in the Evaluation of the Post-operative Ascending Aorta

Emily Pang MD (Presenter) ; Gregory P King MD ; Simin Jeddiyan MD ; Anna E Zavodni MD, MPH

PURPOSE
The objective of this study was to evaluate the comparability of non-contrast SSFP and gadolinium enhanced MRA sequences in the quantitative and qualitative assessment of the post-operative ascending aorta.

METHOD AND MATERIALS
After obtaining Research Ethics Board approval, we conducted a single center retrospective review of the 59 consecutive patients sent for MRI follow-up post ascending aortic replacement surgery between 2007 and 2012. Our analysis included 51 patients (mean age 67 +/- 3 years) with both non-contrast SSFP and gadolinium enhanced MRA sequences (8 patients were excluded due to not having one or both sequences performed). The images were independently evaluated by two cardiovascular fellowship trained radiologists with at least 2 years of experience, who measured the diameter of the thoracic aorta at several points including the root, ascending aorta, arch and descending aorta, as well as assessed for qualitative abnormalities. The datasets were compared using paired T-test, Bland-Altman, and kappa coefficient analysis (statistical significance was determined using a Bonferroni correction for multiple comparisons). Intra and inter-observer variability was also determined.

RESULTS
There was no statistically significant difference in measurements between non-contrast SSFP and gadolinium sequences, with the exception of the aortic annulus in patients who did not have valve replacement (p < 0.001). We postulate that this finding was because the 3D gadolinium sequences allowed for measurements of the normally ovoid annulus in more than one dimension. Kappa analysis also demonstrated good agreement with regards to the quantitative observations. Inter and intra-observer variability was excellent (ICC >0.8).

CONCLUSION
Our results suggest that using an unenhanced SSFP MRA sequence is comparable to gadolinium enhanced MRA in the quantitative and qualitative evaluation of the post-operative ascending aorta. Adequate and accurate information is obtained from the non-contrast SSFP sequence such that intravenous gadolinium may be rendered unnecessary for surgical follow-up imaging, reducing the risk and inconvenience to the patient, as well as health care costs.

CLINICAL RELEVANCE/APPLICATION
Using unenhanced SSFP MRA may be sufficient in the post-operative MR imaging follow up of ascending aorta replacements, omitting the risks and costs associated with IV gadolinium administration.

VSV61-10 • Performance of Non-enhanced ECG-gated Quiescent-interval Single Shot MRA (QISS-MRA) at 3 Tesla. A Comparison with Contrast-enhanced MRA and DSA

Jan Hansmann MD (Presenter) ; John N Morelli MD ; Henrik J Michaely MD * ; Thomas Riester MD ; Johannes Budjan MD ; Stefan O Schoenberg MD, PhD * ; Ulrike I Attenberger MD *

PURPOSE
To evaluate the diagnostic accuracy of a non-enhanced ECG-gated quiescent-interval single shot MR-Angiography (QISS-MRA) at 3T with contrast-enhanced MRA (CE-MRA) and digital subtraction angiography (DSA) serving as the standard of reference.

METHOD AND MATERIALS
16 consecutive patients (9 male,7 female, mean age 70±12 years) with peripheral arterial disease stages II-IV underwent a combined peripheral MRA protocol consisting of a large-field-of-view QISS-MRA (acquisition time 18 min), continuous-table-movement MRA (acquisition time 62 sec), and an additional time-resolved MRA (acquisition time 96 sec) of the calves. DSA correlation was available in 8 patients. Image quality and degree of stenosis was assessed. Sensitivity and specificity of QISS-MRA was evaluated with CE-MRA and DSA serving as the standards of reference by two readers.

RESULTS
328 total segments were assessed. Overall sensitivity and specificity were, respectively, 81.1% and 83.5% for QISS-MRA vs CE-MRA. Relative to DSA, sensitivity for QISS-MRA was high (100% versus 91.2% for CE-MRA) in the evaluated segments; however, specificity was substantially less than that of CE-MRA (76.5% vs 94.6%). There was no significant difference in image quality between QISS-MRA and CE-MRA at the calf station (p=0.17). For the vasculature of the pelvis and thigh QISS-MRA was rated significantly lower compared to CE-MRA (p<0.05).

CONCLUSION
Overall image quality and specificity of QISS-MRA at 3T are diminished relative to CE-MRA, potentially due to long acquisition times. However, when image quality is adequate, the high sensitivity of QISS-MRA may render it useful as a screening examination in patients with contraindications to gadolinium chelate administration.

CLINICAL RELEVANCE/APPLICATION
Due to its high sensitivity at 3 Tesla, QISS might serve as screening tool to rule out significant stenoses in patients with impaired renal function.

VSV61-11 • Performance of Unenhanced MRA Using Spatial Labeling with Multiple Inversion Pulses Sequence to Depict Transplant Renal Vascular Anatomy and Complications

Hao Tang (Presenter) ; Daoyu Hu MD, PhD ; Zi Wang

PURPOSE
To prospectively evaluate the performance of a new unenhanced magnetic resonance angiography (Unenhanced MRA) sequence, spatial labeling with multiple inversion pulses (SLEEK), to depict transplant renal vascular anatomy and complications in comparison to color
75 patients with renal transplant were examined with Unenhanced MRA using SLEEK and CDUS, DSA was performed in 14 patients. Surgery was performed for 7 patients. The ability to present transplant renal vascular anatomy and complications with SLEEK were evaluated by two experienced radiologists, and to correlate the results with CDUS, DSA and intraoperative findings.

RESULTS

CONCLUSION
Unenhanced MRA using SLEEK is a reliable diagnostic method for depicting transplant renal vascular anatomy and complications. It is relatively inexpensive and is not associated with renal complications. It can be as a good choice for screening renal vascular anatomy and complications, especially in patients with renal insufficiency.

CLINICAL RELEVANCE/APPLICATION
Unenhanced MRA using SLEEK is a reliable diagnostic method for depicting transplant renal vascular anatomy and complications, especially in patients with renal insufficiency.

VSA61-12 • Hemodynamic Outcome Following Aortic Root Replacement with or without Hemiarchi Replacement Assessed by 4D Flow MRI

Edouard Semaan (Presenter) ; Michael Markl PhD ; Chris Malaisrie * ; Alex Barker ; Bradley D Allen MD ; Zoran Stankovic MD ; Patrick McCarthy ; James C Carr MD * ; Jeremy D Collins MD *

PURPOSE
To evaluate aortic hemodynamics using 4D flow MRI following aortic root replacement (AR) or aortic root and hemiarchi replacement (AR+HA), comparing to patients following non-mechanical aortic valve replacement (AVR) alone.

METHOD AND MATERIALS
IRB approval was obtained. 31 patients were recruited following open AVR (group 1: AR, n=16, 51±13 yrs; group 2: AR+HA, n=4, 60±10 yrs; group 3: AVR alone, n=11, 69±11 yrs). Aortic blood flow was measured using ECG and respiration synchronized 4D flow MRI (3-directional venc = 150cm/s, 2.0-2.8mm3, temp res 40-44msec) at 1.5 or 3T (Aera, Avanto, or Skyra, Siemens, Erlangen, GE) post-contrast administration. Data analysis included 3D blood flow visualization (EnSight, CEI, USA) based on time-resolved 3D pathlines and systolic 3D streamlines. Helical flow was assessed in the Ascending aorta (AAo), arch, and descending aorta on a 3-point Likert scale (360°). 3D pathlines qualitatively identified the existence of flow jets and the quadrant of flow impingement in the proximal, mid, and distal AAo. Flow uniformity was analyzed by quadrant dichotomizing systolic peak velocities at 1m/s. Peak systolic velocities and acceleration were quantified in 9 planes distributed throughout the thoracic aorta. Groups were compared using the students t-test.

RESULTS
4D flow MRI revealed similar helical flow across groups (p>0.05). 72 % (8 of 11) of patients in group 3 demonstrated outflow jets impinging on the right anterior proximal aortic wall. Jet flow was seen in 52% (10 of 20) of patients in groups 1 and 2 and was preferentially directed towards the anterior wall. Flow profiles were asymmetric in 62%, 100%, and 72% of groups 1-3, respectively. There were significant differences between groups 1 and 2 compared to group 3 for peak acceleration and significant differences between groups 1 and 3 for peak velocities (p < 0.05). 4D flow MRI characterized flow in AVR patients. Our preliminary findings demonstrate elevated peak systolic velocities and acceleration in patients with aortic grafts compared to patients with AVR alone. Follow-up studies are warranted to investigate the influence of these findings on ventricular loading and patient outcome.

CLINICAL RELEVANCE/APPLICATION
4D flow MRI demonstrates increased aortic peak velocities and acceleration status-post aortic replacement with graft material, suggesting increased ventricular loading with altered aortic compliance.

VSA61-13 • 3D Cine PC VIPR as a Sensitive Indicator of Post-prandial Hyperemia with an Added Value of Avoiding Vortex and Helical Flow Portions

Masatake Sugiyama (Presenter) ; Yasuo Takehara MD ; Kevin M Johnson * ; Oliver Wieben PhD ; Tetsuya Wakayama PhD * ; Hiroyuki Kabasawa ; Shuhei Yamashita MD ; Harumi Sakahara MD ; Atsushi Nozaki ; Naoki Ooishi

PURPOSE
3D cine PC with vastly undersampled isotropic projection steady-state free precession imaging (VIPR) is a recently developed MR method that can cover full spatial and temporal data of the blood flow velocity. The purpose of our study is two folds i.e., 1) to test if 3D PC VIPR can be used for dietary stress test in detecting the post-prandial hyperemia of the SMA, and 2) to assess the flow patterns within SMA with streamline analysis for finding out the optimum plane to measure correct blood flow.

METHOD AND MATERIALS
All studies were conducted on a 3.0T MR imager with phased array coil. Five healthy volunteers (23 to 53 y.o.) were enrolled. Under 8 hr fasting , 2D cine PC and 3D cine PC VIPR were repeated before and after the intake of 400 Kcal supplementary diet. The measuring planes for the 2D cine PC were placed at the proximal portion, mid curved portion and the distal straight portion of the main trunk of SMA. With 3D cine PC VIPR, retrospective measurements at the corresponding planes were performed and the values were compared.

RESULTS
Newly developed 3D cine PC VIPR can be used for dietary stressed SMA flow measurement with an added value of delineating the vortex and helical flow portions in the SMA where the measurement should be avoided.

CLINICAL RELEVANCE/APPLICATION
3D cine PC VIPR is feasible as a dietary stress test for non-obstructive mesenteric ischemia by detecting the post-prandial hyperemia. The beauty of the method is retrospective flow analysis.

VSA61-14 • Non-contrast MRA: Phase-contrast MRA

Scott B Reeder MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Understand the underlying principles of phase velocity MRA. 2) Be familiar with the currently available methods for phase velocity MRA. 3) Be familiar with important applications and examples of phase velocity MRA. 4) Understand current limitations and pitfalls associated with phase velocity MRA.
SST13-01 • Long-term Outcome of Percutaneous Interventions of Hepatic Venous Outflow Obstruction after Pediatric Living Donor Liver Transplantation

Minoru Yabuta MD (Presenter) ; Toshiya Shibata MD ; Ken Shinozuka ; Toyomichi Shibata MD ; Hiroyoshi Isoda MD ; Kaori Togashi MD, PhD *

PURPOSE
To evaluate retrospectively the long-term outcome of percutaneous interventions of hepatic venous outflow obstruction (HVOO) after pediatric living donor liver transplantation (LDLT).

METHOD AND MATERIALS
Between October 1997 and December 2012, 48 patients (24 male, 24 female; median age, 6 years) who had undergone LDLT were confirmed to have HVOO at percutaneous hepatic venography and manometry, and underwent percutaneous interventions, including balloon angioplasty with / without stent placement. Technical success, patency rates, stent placement and major complications were evaluated.

RESULTS
Technical success was achieved in 92 of 93 sessions (99.0%). During follow-up periods ranged from one to 182 months (median, 51.5 months), 28 patients were treated with a single session of balloon angioplasty and 20 who developed recurrent stenosis were treated with repeated balloon angioplasty or stent placement. The rate of primary, primary assisted, and secondary patency at 1-, 3-, 5-, 10-years after the initial balloon angioplasty were 0.64, 0.57, 0.57 and 0.52 respectively, 0.98, 0.95, 0.95 and 0.95 respectively, and 1.0, 1.0, 1.0 and 1.0 respectively. A major complication was seen in a session of a patient, where a stent was migrated to the right atrium.

CONCLUSION
Balloon angioplasty with / without stent placement was an effective treatment for HVOO after LDLT.

CLINICAL RELEVANCE/APPLICATION
Percutaneous interventions such as balloon dilation and stent placement were effective in patients with HVOO after LDLT.

SST13-02 • The Influence of Liver and Spleen Volume Changes after Percutaneous Transhepatic Angioplasty for Portal Venous Stenosis in Pediatric Living-donor Liver Transplant Recipients

Manabu Nakata MD (Presenter) ; Waka Nakata MD ; Hideharu Sugimoto MD

PURPOSE
To quantify the changes in liver and spleen volumes after percutaneous transhepatic angioplasty (PTA) for portal venous stenosis (PVS) occurring in patients after pediatric living-donor liver transplantation.

METHOD AND MATERIALS
Twenty consecutive patients (8 males, 12 females; mean age 4.8 years) who underwent PTA for PVS from August 2005 to September 2011 after pediatric liver transplantation were included. Liver and spleen volumes (LV, SV) were quantified using computed tomography (CT) before PTA, 3 months, 12 months, 24 months, and 36 months after PTA. Spleen volume-to-standard spleen volume ratio (SV/SSV) and LV/SV were calculated at each time point. Statistical analyses of comparison between pre- and postoperative data were performed. The correlation of LV and SV at each time point was analyzed.

RESULTS
LV significantly increased by an average of 28% within 6 months after PTA and remained increased significantly through 36 months. SV/SSV significantly decreased an average of 24% within 6 months and remained decreased significantly through 36 months, although SV had no significant difference between pre- and post-operative data. LV/SV significantly increased by an average of 36% within 6 months after PTA, and thereafter had no significant differences. SV at each follow-up time point significantly negatively correlated with LV.

CONCLUSION
Improvement of splenomegaly and liver enlargement occur and continue during 36 months after PTA, with negative correlations between liver and spleen volumes. These data indicate that liver and spleen volumes are influenced by portal venous flow and recovery of these volumes may take at least 36 months.

CLINICAL RELEVANCE/APPLICATION
Splenomegaly is improved within 6 months after PTA, although the decrease in spleen volume may continue at least 36 months. This information may be utilized for application and evaluation of PTA.

SST13-03 • Non-invasive Measures that Guide Indication, Pathology and Outcome of Percutaneous Biliary Intervention in Paediatric Transplantation

Anushka Lijutikov MBBS, FRCR (Presenter) ; Navaratne Subhachandra MBBS, FRCR ; Pauline A Kane MBBS, FRCR ; John B Karani MBBS, FRCR ; Maria E Sellars MD, FRCR ; Anil Dhawan MD, FRCP ; Nigel Heaton

PURPOSE
Biliary complications adversely impact on graft survival following transplantation in paediatric recipients. Interventions are technically challenging and carry risk in infants and children; therefore, selection is critical. The purpose of this study was to evaluate the diagnostic utility of non-invasive parameters which singularly, or in combination, guide the need for intervention.

METHOD AND MATERIALS
Reference to pre-procedural non-invasive imaging and graft function from the transplant database between 2008-2012 formed the study cohort. This retrospective study reviewed these parameters in predicting findings, pathology and outcome of intervention.

RESULTS
There were 49 interventions in 40 recipients (ages 4 months-16 years, M:F 21:19) transplanted between 1997-2012. (Total transplant cohort 582). Indications included EHBA, PFIC, ALF. Operative technique was left lateral segment (37) including live related (22) and whole grafts (3). Key findings were non-cholestatic enzyme rise (34), increasing duct calibre on ultrasound (34), MRCP diagnosis of anastomotic strictures (27) and cholangiopathy (7). Diagnostic PTC was successful in all with findings of anastomotic strictures (24), cholangiopathy (7), bile leaks (4). Balloon dilatation of strictures was successful in 20. External biliary drains were placed in 4. The positive predictive values (PPV) in diagnosing anastomotic stricture and cholangiopathy are non-cholestatic enzyme rise 70.3% and 34.6%, USS duct calibre 63% and 30%, MRCP 78% and 43%. The combined tests PPVs are 85% and 55.5%.

CONCLUSION
The combination of non-invasive measures of graft assessment allows most appropriate selection for biliary intervention in paediatric liver transplant recipients but MRCP is the best single predictor of biliary complications.

CLINICAL RELEVANCE/APPLICATION
SST13-04 • Pediatric Soft Tissue Tumors: Deterministic Factors for Safety and Accuracy of Diagnostic Yield in Image-guided Percutaneous Core-needle Biopsies

Michael R Acord MD (Presenter) ; Raja Shaikh MD ; Gulraiz A Chaudry MBChB

PURPOSE
To assess lesion-related and technical factors that affect diagnostic yield and safety in image-guided percutaneous core-needle biopsies (PCNB) of soft tissue tumors in children.

METHOD AND MATERIALS
Institutional review board approval was obtained for a retrospective study of 150 PCNB performed at our institution from January 2003 to January 2013. Medical records and radiologic data were evaluated on all PCNB performed on soft tissue lesions, excluding vascular malformations. Technical details of the procedure, demographic characteristics of the patients, and radiologic features of the lesions such as the location, size, imaging nature and enhancement were recorded. Procedure-related complications (i.e., PCNB or other testing due to poor or non-diagnostic yields) were noted. Associations between the radiologic characteristics of the lesion, technical factors and diagnostic yield were evaluated using bivariate and multivariate logistic regression.

RESULTS
Mean patient age was 11.4 ± 7.1 years. Ultrasound guidance was used in 80% of cases. General anesthesia was the most common form of sedation (86% of cases). Mean number of core biopsies was 6.4 ± 3.2 per case. The overall diagnostic yield was 80%. On bivariate analysis, procedures taking less number of cores (OR 0.75 95% CI 0.57 to 0.99, p=0.04) and involving benign lesions (OR 0.14 94% CI 0.03 to 0.71, p=0.03) were associated with non-diagnostic biopsies. Using a lower gauge needle showed a trend toward improving diagnostic success (OR 1.87 95% CI 0.93 to 3.71, p=0.08). On multivariate analysis, the only factor that predicted low diagnostic yield was whether the lesion was benign (OR 0.14 95% CI 0.02 to 1.00, p=0.05).

CONCLUSION
Image guided PCNB is a safe and accurate method for the diagnosis of pediatric soft tissue tumors. Particular attention should be paid toward lesions that appear benign on pre-procedure imaging in order to improve diagnostic yield.

CLINICAL RELEVANCE/APPLICATION
Percutaneous core needle biopsy of soft tissue tumors is a minimally invasive technique compared to open biopsy and has a low complication rate providing an early diagnosis.

SST13-05 • Pilot Study Evaluating Parenchymal Perfusion and Renal Blood Flow Using Color-coded Imaging in Pediatric Renal Artery Angioplasty

Tiffany Hwang (Presenter) * ; Erin Girard PhD * ; Anne Marie Cahill MBCh

PURPOSE
syngo iFlow is a color-coded imaging adjunct used to interpret digital subtraction angiography (DSA). This study investigates the ability of syngo iFlow to evaluate changes in flow and parenchymal perfusion in patients undergoing angioplasty for renal artery stenosis (RAS).

METHOD AND MATERIALS
20 children underwent 30 percutaneous angioplasty procedures for RAS. For each stenotic artery that underwent angioplasty, pre- and post-stenotic regions of interest (ROI) were chosen. The difference in time to peak (dTTP) maximum contrast opacification values (given by iFlow) between these 2 ROIs represented flow rate across the stenosis. ROIs were drawn in the relevant parenchymal pole (upper, middle, and/or lower) to assess perfusion. 44 poles from the 20 patients were assessed for time to peak (TTP) opacity values. Only 35 of these poles had sufficient data to compute inflow rate, measured by the slope of the linear regression of contrast opacification vs time, representing contrast values between 15-75% of maximum opacity.

RESULTS
iFlow measured significantly improved flow across stenosis following angioplasty as indicated by dTTP (p=0.0001). dTTP decreased in 23/30 cases, of which 12 demonstrated dTTP=0 seconds post-angioplasty, possibly due to complete flow restoration. No change in dTTP was demonstrated in 5/30 cases. TTP increased in 2/30 cases, correlating with mural dissection and intraluminal thrombus. iFlow measured significantly improved perfusion following angioplasty as indicated by TTP (p=0.0008). TTP decreased in 31/44 poles, indicating an improvement in flow. No change in TTP was seen in 6/44 poles. An increase in TTP was demonstrated in 7/44 poles, 3 of which correlated with dissection and thrombus. Using inflow slope as a second measure, iFlow demonstrated improved perfusion in 20/35 poles, but this was not significant (p>0.05).

CONCLUSION
This pilot study demonstrates the ability of iFlow to quantitatively and significantly assess differences in parenchymal perfusion and flow rates across stenotic vessels following angioplasty procedures. Thus, iFlow in general may provide the physician with more objective evidence of improved vascular flow and perfusion in other vascular interventions.

CLINICAL RELEVANCE/APPLICATION
The ability of iFlow to quantify vascular parameters can provide the physician with objective measurements of altered vascular flow during angioplasty procedures and can guide the interventional plan.

SST13-06 • Implementation of a Fluoroscopy Competency Check-off for Radiology Trainees: Impact on Reducing Radiation Dose in the Pediatric Population

Sweta Shah (Presenter) ; Stephane Desouches DO ; Lisa H Lowe MD ; Brenton D Reading MD

PURPOSE
The purpose of this study is to determine the impact of implementing a fluoroscopy competency check-off aimed at decreasing radiation dose in three common pediatric fluoroscopic studies.

METHOD AND MATERIALS
A fluoroscopy competency check-off form was developed for PGY 2-6 radiology trainees performing pediatric procedures. Techniques used to limit radiation exposure for three common pediatric radiologic studies were discussed. Additionally, a pediatric radiologist supervised and assessed each trainee’s competency and technical skill prior to independent performance of the three procedures. Radiation dose and exposure time were recorded for 171 oropharyngeal motility (OPM), 176 voiding cystourethrogram (VCUG), and 171 upper GI (UGI) exams in 24 trainees for the six months preceding implementation of the competency check-off and in 114 OPM, 145 VCUG, and 132 UGI exams in 23 trainees for the six months after implementation. A paired t-test was then used to compare the mean radiation dose for each procedure in the two groups.

RESULTS
A statistically significant reduction in radiation dose was found for OPM and VCUG exams after competency implementation. The mean radiation dose of the OPM exam decreased from 7.75 to 5.33 mGy pre- and post- competency implementation respectively, with a total reduction of 31% (P = 0.023). The mean radiation dose of the VCUG exam decreased from 3.90 to 2.59 mGy pre- and post- competency implementation respectively, with a total reduction of 33% (P = 0.033). No statistically significant reduction was seen for the UGI exam.

CONCLUSION
Implementation of a fluoroscopy competency check-off for radiology trainees reduced radiation dose in pediatric patients undergoing both
CLINICAL RELEVANCE/APPLICATION
This study demonstrates that exposing trainees to a competency check-off can help decrease the radiation dose, thereby reducing the risk of excess radiation exposure in the pediatric population.

**SST13-07 • A System for Real-time Mapping of Pediatric Skin Dose during Fluoroscopic Cardiac Procedures**

**Daniel Bednarek** PhD (Presenter) *; **Vijay Rana** *; **Stephen Rudin** PhD *

**PURPOSE**
To provide the clinician with a real-time visual graphic display showing the distribution of skin-dose for pediatric patients undergoing fluoroscopic cardiac interventional procedures.

**METHOD AND MATERIALS**
We have developed a software system to track skin dose during fluoroscopic interventional procedures and to provide a graphic representation of the cumulative dose distribution in real time. Originally the program and graphics were developed and verified for adult patients. To use the system with pediatric patients, an open-source software application was used to create a series of 3D patient graphic models with varying heights ranging from 60 to 128 cm and with three weight ranges for each height. The model most closely matching the patient is selected at the beginning of the procedure and the skin dose is calculated at each point on the graphic within the x-ray beam for exposure pulse and the cumulative distribution is displayed in a color-coded mapping. To verify that the correct dose is calculated, measurements were made with a 6 cc ionization chamber placed on the surface of a pediatric phantom (Kyoto Kagaku PBU-70, 105 cm height, 20 kg weight) at various locations on the torso; exposures were made for a range of projections with the heart at C-arm gantry iso-center and chamber readings were compared with those of the tracking system. Similar measurements were made with a water-filled phantom of similar dimensions.

**RESULTS**
Using a matching patient graphic, the ratio of dose tracking system reading to ionization chamber reading had an average value of 1.08 +/- 0.05 for fluoroscopy and 0.99 +/- 0.05 for DA mode with the pediatric phantom, while the values agreed with the chamber within 2% for the water phantom over a range of cardiac RAO/LAO and CRA/CAU projections.

**CONCLUSION**
With the newly developed patient graphic models, accurate tracking of skin dose is possible in real-time during pediatric fluoroscopic interventional procedures, enabling the clinician to reposition the C-arm to avoid exceeding the threshold for deterministic skin effects.

**CLINICAL RELEVANCE/APPLICATION**
The system developed facilitates the management of risk for deterministic skin effects for pediatric patients during interventional fluoroscopic procedures.

**SST13-08 • MRI of Vascular Anomalies: Value of Diffusion Imaging**

**Sebastien Benali** MD (Presenter); **Josee Dubois** MD; **Francoise F Rypens** MD; **Chantale Lapierre** MD; **Gilles P Soulez** MD *

**PURPOSE**
MRI diffusion-weighted imaging (DWI) is a new method to evaluate the diffusion of intra and extracellular water. The goal of this study is to characterize diffusion imaging parameters in vascular anomalies (VA) and compare them to malignant soft tissue tumors.

**METHOD AND MATERIALS**
RESULTS
The mean ADC values at b=1000-500 were estimated at 3.05±0.08, 3.37±0.24 and 3.01±0.09 respectively for VM, LM and hemangiomas and at 2.96±0.08 for soft tissue tumors. At b=1000-500, ADC values were significantly higher for LM as compared to VM (p=0.01) and hemangiomas (p=0.03). However, no significant difference could be demonstrated between VM, hemangiomas and soft tissue tumors. At b=1000, ADC values were estimated at 3.82±0.14, 4.23±0.18 and 3.74±0.15 respectively for VM, LM and hemangiomas and at 3.46±0.11 for soft tissue tumors. The latter displayed significantly lower ADC values than VM and LM (p=0.0001) and hemangiomas (p=0.02). No significant correlation between contrast enhancement and ADC values was observed (r=−0.056).

**CONCLUSION**
All VA presented high ADC values. At b=1000-500, LM displayed significantly higher values as compared to VM and hemangiomas. At b=1000, malignant soft tissue tumors showed significantly lower ADC values than VM, LM and hemangiomas. DWI could be a useful tool to characterize VA and discriminate them from malignant lesions.

**CLINICAL RELEVANCE/APPLICATION**
Diffusion imaging can characterize and differentiate vascular anomalies from soft tissue malignant tumors. Soft tissue malignant tumors display higher ADC coefficient than brain and organ tumors.

**SST13-09 • Novel Use of MRI/X-ray Overlay for Interventional Radiology Sclerotherapy Procedures in the Pediatric Population**

**Tiffany Hwang** (Presenter) *; **Erin Girard** PhD *; **Anne Marie Cahill** MBBC

**PURPOSE**
Fluoroscopic imaging is used for navigation during lesion-targeting interventional radiology procedures, such as sclerotherapy for vascular malformations, as it provides real-time information. However, fluoroscopy provides only a 2D image of 3D anatomy and does not visualize the lesion. On the other hand, magnetic resonance imaging (MRI) provides quality soft tissue contrast for lesion visualization. syngo 3D/3D fusion and iPilot dynamic software programs (Siemens Healthcare AG, Forchheim, Germany) allow 3D MR images to be overlaid on real-time fluoroscopy images, enhancing lesion visualization during interventional procedures. This study describes our experience using this software to target lesions and compares procedure and fluoroscopy times between software assisted and unassisted cases.

**METHOD AND MATERIALS**
20 children, mean age 11.5 years, underwent sclerotherapy procedures with MRI/x-ray image overlay assistance for vascular malformations. Their average procedure and fluoroscopy times were compared to those of 100 software-unassisted sclerotherapy procedures using a z-tailed t-test (p

**RESULTS**
Both average procedure and fluoroscopic times of software-assisted cases (47.11; 4.97 min) were higher than those of unassisted cases (42.54; 4.72 min), but not to a statistically significant degree (p=0.37; 0.84). The physician reported that MRI overlay increased therapeutic confidence in 17/20 cases and determined the interventional plan in 10/20 cases. Of these 10 cases, changes made included adding a clarifying ultrasound (1), not performing a post-procedural DynaCT (2), determining post-procedural extubation (3), or a combination of these changes (3). The 3/20 cases that did not confer useful knowledge occurred with diffuse vascular malformations, where MR overlay was suboptimal due to unclear lesion boundaries.

**CONCLUSION**
In this study we showed that MRI/x-ray overlay during sclerotherapy can confer additional information to improve treatment confidence and guide the interventional plan while not significantly increasing procedure or fluoroscopy time.

**CLINICAL RELEVANCE/APPLICATION**
MRI/x-ray overlay during sclerotherapy procedures may improve clinical care by providing physicians with additional information on the
Vascular/Interventional (MR Guidance/Topics of Interest)

Friday, 10:30 AM - 12:00 PM  ●  E350

SST16  ●  AMA PRA Category 1 Credit ™:1.5  ●  ARRT Category A+ Credit:1

Moderator
Dmitry J Rabkin, MD, PhD

Moderator
Elizabeth M Hecht, MD

SST16-01  ●  Utilization of the iPad for Patient Education during Informed Consent in Interventional Radiology: A Randomized Controlled Trial

Sahil V Mehta MD (Presenter); Lauren E Ferrara MD; Seth J Berkowitz; William C Lo; Salomao Faintuch MD *

PURPOSE
To evaluate if interactive media presented on an iPad improves patient understanding and confidence during the informed consent process in interventional radiology.

METHOD AND MATERIALS
Patients were randomized into 4 groups. The control group (C) received an electronic consent form on the iPad. The second group was shown their radiology images (I) on an iPad. Dynamically displayed images were used to explain the patient’s disease and planned intervention. The third group was shown interactive anatomic drawings (D) of their disease and planned intervention. The final group was shown a short video animation about the procedure to be performed (V). Patients completed a survey to rate their experience.

RESULTS
Fifty-six consecutive patients completed the study, 14 in each group. Procedures included venous access, nephrostomy, gastrostomy, fibroid and chemo embolization, tumor ablation, angiogram and biopsy. Use of the iPad was graded as significantly helpful to understand the reasoning for the procedure by 86% of patients in the imaging group (I), 79% in the drawing group (D) and 71% in the video group (V), compared to 43% of controls (p < 0.001). Patients reacted positively to use of the iPad during informed consent, even when used as a simple replacement for a paper form. Nonetheless, clinical images and interactive drawings significantly improved patient understanding and confidence in the procedure to be performed. While videos were considered helpful, they were received less positively by patients, perhaps due to a reduction in interactivity with the provider. The iPad is a useful tool to help build a patient-physician relationship before an interventional procedure.

CLINICAL RELEVANCE/APPLICATION
The iPad can be very helpful during informed consent for interventional radiology procedures. It can significantly increase patient understanding, confidence and satisfaction.

SST16-02  ●  Radiology Milestones: A Multiyear Study of Resident Experience with Radiologic Procedures at a Large Academic Medical Center

Adam B Prater MD (Presenter); Bradley S Rostad MD; Emily Ebert BS; Rachel Kearns BS; Thomas W Loehfelm MD, PhD; Brent Little MD; Christopher P Ho MD; Mark E Mullins MD, PhD

PURPOSE
The American College of Graduate Medical Education (ACGME) and the American Board of Radiology (ABR) initiated the Radiology Milestones Project in 2012 to create a framework for assessing the competency of radiology residents. An analysis of procedures performed by prior residents might help guide the assessment of procedural competency of current and future residents. Our study documented the most common types and numbers of procedures performed by radiology residents in a large academic center over a ten year period.

METHOD AND MATERIALS
Institutional review board approval was obtained. Resident procedure logs from graduating class years 2002 to 2012 were de-identified and organized into a secure electronic database. Summary statistics for each procedure type were calculated.

RESULTS
Resident procedure logs consisted of both paper and electronic forms, which varied in the number of resident participation and in the types and numbers of procedures documented. Over a ten year period, 110 residents recorded a total of 13,678 procedures consisting of 70 different procedure types. The most common recorded procedures were vascular catheter insertion, CT-Guided abdominal biopsies and drain placement, fluoroscopic Lumbar puncture, and ultrasound guided thoracentesis, paracentesis and thyroid biopsies. However, the numbers and types of procedures recorded for each resident varied considerably (mean 124 ± 75, max 331, min 15).

CONCLUSION
Although a wide variety of procedures are performed by residents during residency, resident procedural experience, as measured by procedure log data, varies significantly between residents even within the same program. This may be due to variability in resident procedure logging practices and procedures performed as data are manually entered by residents and are possibly underreported. Given the future directions suggested by the Radiology Milestones Project, our findings highlight the need for national guidelines regarding procedure requirements, and a more accurate method of acquiring radiology procedure data.

CLINICAL RELEVANCE/APPLICATION
The future of graduate medical education is geared towards data-driven metrics that can accurately depict resident progress and competence.

SST16-03  ●  Magnetically Assisted Remote Controlled Endovascular Catheter for Interventional MRI: In Vitro Navigation at 1.5T

Aaron D Losey MS (Presenter); Prasheel Lillaney; Alastair Martin *; Daniel L Cooke MD; Mark W Wilson MD; Maythem Saeed DVM, PhD; Steven W Hets MD *

PURPOSE
Using real-time MRI for interventional procedures affords a wealth of physiologic and structural information. The promise of endovascular MR guided procedures remains unrealized in part because of the lack of MR compatible catheters and guide wires. Innovative techniques for guiding a catheter in the magnetic field of the MR scanner have been proposed, but limited functionality has been described to date. This study evaluates navigation of a magnetically assisted remote controlled (MARC) catheter compared to guidance without magnetic assistance in vitro at 1.5T.

METHOD AND MATERIALS

RESULTS
CONCLUSION
We have developed and tested MARC catheters for endovascular navigation. At angles of 45 degrees or greater magnetic assistance was significantly faster than non-assisted guidance. The MARC catheter provides a novel opportunity to navigate effectively in interventional MRI environment. Preclinical in vivo studies are underway.

CLINICAL RELEVANCE/APPLICATION
Real-time MR guided catheter navigation with the MARC catheter could revolutionize minimally invasive procedures by advancing local treatment of stroke, cardiac arrhythmias and solid tumors.

SST16-04 • Non-enhanced T1-weighted Imaging of the Visceral Arteries at 7 Tesla
Anja Fischer MD (Presenter) ; Oliver Kraff MSc ; Stefan Maderwald PhD, MSc ; Karsten J Beiderwellen MD ; Thomas C Lauenstein MD ; Lale Umutlu MD *
PURPOSE
Aim of the study was to assess the feasibility of different non-contrast-enhanced T1-weighted (w) sequences for imaging of the visceral arteries of the upper abdomen at 7 Tesla.

METHOD AND MATERIALS
12 healthy volunteers were examined on a 7 T whole-body MR-system utilizing a custom-built 8-channel transmit/receive coil and radiofrequency shimming. The following non-enhanced sequences were acquired: (1) T1w 2D FLASH, (2) T1w 3D FLASH and (3) Time of flight (TOF)-MRA in transversal orientation. The following visceral arteries were evaluated (1) both common hepatic arteries, (2) coeliacal and splenic artery, (3) superior and (4) inferior mesenteric artery. For qualitative analysis, image quality and the presence of artifacts were assessed using a five-point scale (image quality: 5 = excellent vessel delineation to 1 = non-diagnostic; artifacts: 5 = no artifact to 1 = non-diagnostic). Contrast Ratios (CR = (Svesseli-Sliver)/(Svesseli+Sliver)) of the above named arteries in correlation to adjacent visceral tissue or psoas muscle were calculated for quantitative assessment. For statistical analysis, a Wilcoxon Rank Test was applied.

RESULTS
All three sequences provided a homogenous hyperintense delineation of the assessed visceral arteries. Qualitative image analysis showed a superiority of TOF MRA, providing best overall image quality (TOF 4.17, 2D FLASH 3.42, 3D FLASH 3.46) and highest mean values for image quality for all analyzed vessel segments. TOF MRA showed least impairment due to artifacts (overall artifacts TOF 4.08, 2D FLASH 3.50, 3D FLASH 3.46). Quantitative image analysis confirmed the superiority of the TOF sequence showing significant higher CR values for all visceral arteries due to an effective suppression of background signal (e.g. right hepatic artery TOF 4.25, 2D FLASH 3.54, 3D FLASH 3.33; p

CONCLUSION
Non-contrast-enhanced T1w imaging in general and, TOF MRA in particular, appear to be promising techniques for good quality assessment of visceral arteries without the need of contrast media at 7 Tesla.

CLINICAL RELEVANCE/APPLICATION
Non-enhanced MRA of visceral arteries at 7 T may bear the potential to be a good alternative to contrast-enhanced MRA, particularly for examination of patients with renal insufficiency.

SST16-05 • MR Lymphangiography in Clinical Diagnostics of Focal Lesions of the Lymphatic Vessel System in Peripheral Lymphedema
Frederik F Strobl MD (Presenter) ; Carolin Burgard ; Mayo Weiss ; Maximilian F Reiser MD ; Mike Notohamiprodjo
PURPOSE
Lymphoceles or focal dermal backflow form part of focal lesions of the peripheral lymphatic system. Focal dermal backflow is a frequent drainage pattern in the imaging of primary and secondary lymphedema and stands for a diffuse leakage of the tracer into subcutaneous tissue. In addition to lymphoscintigraphy, the magnetic resonance (MR) lymphangiography provides a valuable morphological and anatomical gain in information. Patients with this aforementioned disease pattern can benefit from this kind of information in pre- and postsurgical diagnostic procedures. The purpose of this study was to compare findings of MR lymphangiography with those of lymphoscintigraphy in the assessment of focal lesions of the lymphatic vessel system in peripheral lymphedema.

METHOD AND MATERIALS
In this study, 44 consecutive patients with uni- or bilateral lymphedema and lymph vessel transplants of the lower extremities were included. MR lymphangiographies were performed with a 3.0-T fat-saturated three-dimensional gradient-echo MR after gadopentetate dimeglumine injection. Results of MR lymphangiography and lymphoscintigraphy were reviewed separately by a radiologist and a nuclear physician and concordance of the two techniques regarding existence, localization, distribution and confidence were examined.

RESULTS
With lymphoscintigraphy, which constituted the standard diagnostic procedure, focal lesions like lymphoceles or focal dermal backflow could be diagnosed in 23 patients. This result was confirmed by MR lymphangiography in 19 patients. Thus, there exists an excellent sensitivity of 83% and a specificity of 84% for MR lymphangiography. In addition, MR lymphangiography depicted auxiliary information about the anatomical constitution of lymph vessels or lymphoceles and showed a better differentiation between focal multiple or diffuse lesions.

CONCLUSION
Imaging findings of both techniques, the MR lymphangiography and the lymphoscintigraphy, showed an excellent correlation. Due to superior morphological and anatomical resolution, MR lymphangiography provides supplementary information for pre-surgical work-up in patients with focal lesions of the lymphatic vessel system in peripheral lymphedema.

CLINICAL RELEVANCE/APPLICATION
MR lymphangiography can provide 3D anatomical information without radiation exposure. Therefore it is a valuable alternative to lymphoscintigraphy in patients with peripheral lymphedema.

SST16-06 • Thermal versus Mechanical Disruption of Mice Melanoma due to MR Guided HIFU, a Feasibility Study
Martijn Hoogenboom MSc (Presenter) ; Martin J Van Amerongen MSc ; Iringo Kovacs ; Gosske Adema ; Arend Heerschap PhD ; Jurjen J Futterer MD, PhD
PURPOSE
MR guided HIFU is an upcoming technique for non-invasive tumor treatment, however the differences in pathologic and immunologic effects by thermal or mechanical HIFU treatment is uncertain. The purpose of this feasibility study is to differentiate between mechanical and thermal MR guided HIFU ablation and to visualize the different pathologic and immunologic effects.

METHOD AND MATERIALS
Nine C57Bl/6n wild type mice were subcutaneously injected with B16F10 tumor cells at the right femur. After 9-10 days the tumor size was >8x8 mm. A 3MHz, 16 channel phased array HIFU system with an acoustic energy of 43-46W, was placed in a 7T animal MR scanner. An in-house made gelpad and degassed water was used for acoustic coupling.

The ablation process was visualized using MR guided thermometry (FLASH sequence, proton resonance frequency shift method: TR/TE=40/4ms, flip angle 25°, 5slices, 0.3mm inter-slice distance, voxel size 0.78x0.78x1.5mm³, 3.8s/dynamic, 0.5°C temperature accuracy).

Three different treatment strategies (3-6 spots) were applied in each tumor, 3 mice per strategy, respectively. First, continuous wave (CW) mode, 4 seconds ablation. Second, pulsed wave (PW) mode, 120shots of 20ms, pulse repetition frequency (PRF) of 4. Third, PW-mode, 500shots of 5ms, PRF 4. The mice are sacrificed 3 days after treatment, the tumor is removed for pathological evaluation,
using HE-staining.

RESULTS
Temperatures of >35,

CONCLUSION
Thermal and mechanical HIFU treatment create different pathologic and immunologic responses, further research is necessary for quantification of these differences.

CLINICAL RELEVANCE/APPLICATION
Pathologic and immunologic effects due to HIFU are still uncertain, before testing on humans a mice set up is created for a good evaluation of these effects.

SST16-07 • MR-guided Focused Ultrasound Ablation of Pancreatic Cancer: A Totally Non-invasive Treatment for Pain Palliation and Tumor Control of Locally Advanced Lesions (Stage III)

Fulvio Zaccagna MD (Presenter) ; Alessandro Napoli MD ; Gaia Cartocci ; Giulia Brachetti ; Fabrizio Boni ; Vincenzo Noce MD ; Luca Bertaccini ; Maurizio Del Monte ; Carlo Catalano MD

PURPOSE
To evaluate the feasibility of MR-guided focused ultrasound (MRgFUS) ablation for pain palliation and local tumor control in selected patients with unresectable primary pancreatic adenocarcinoma.

METHOD AND MATERIALS
6 patients with histologically proven unresectable pancreatic adenocarcinoma, who were clinically unable (n 4) or refused (n 2) to undergo chemo-radiation therapy, underwent MRgFUS treatment on a dedicated 3T unit featuring the ExAblate 2100 system (InSightec). All lesions were evaluated for device accessibility prior to treatment. MRgFUS procedures were performed in general anesthesia with constant breath control. Clinical assessment included evaluation of symptoms severity with visual analogue scale (VAS) before and after treatment. After treatment all patients underwent CHT with the same chemotherapy scheme. Imaging follow-up, including both CT and MR examinations, was performed immediately after treatment and at 3 and 6 months in order to evaluate the effects of MRgFUS on the targeted tumor and the absence of procedure-related complications.

RESULTS
CONCLUSION
Our preliminary clinical experience suggests that MRgFUS is a feasible and repeatable ablative technique in selected patients with unresectable and device-accessible pancreatic adenocarcinoma.

CLINICAL RELEVANCE/APPLICATION
MRgFUS treatment for locally advanced pancreatic tumor is a safe procedure and could be repeated without increase of adverse event risk.

SST16-08 • The Synergy of High-intensity Focused Ultrasound and Low-dose Generic Chemotherapeutic Virtually Eliminates Multi-drug Resistant Solid Tumor Cells

Howard Q Vo MD, MS (Presenter) ; Yoo-Shin Kim PhD ; Brian E O'Neill PhD

PURPOSE
Despite medical advances, multidrug-resistant (MDR) cancers continue to challenge the patients. Their clinical prognoses may further be complicated by the need for additional surgical procedures and/or radiotherapy. In this study, we seek to evaluate a new strategy in which the synergy of high-intensity focused ultrasound (HIFU) and a single low dose of a generic chemotherapeutic is utilized to attack MDR solid tumor cells.

METHOD AND MATERIALS
This strategy is partly an outgrowth of an in-house Phase 4 clinical trial in which MRI-guided HIFU was used to treat uterine fibroids. The clinical procedure was adapted for the 3-day in vitro study during which human uterine sarcoma cell line (MES-SA/Dx5 (ATCC CRL1977™)), known for resistance to multiple drugs such as Doxorubicin (Dox), was paradoxically treated with Dox.

Day 1: Each data sample consisted of ~20K cells grown inside a well of 8-well glass slides (Lab-Tek). The well was then filled with McCoy's media and incubated at 36 °C for 4h. Afterward each well was sealed and secured onto a fixture before being submerged in a warm degassed water bath. The targets for HIFU therapy are the center points of the 4 quadrants of each well's base. The constant HIFU parameters for each well were acoustic pressure 7 MPa, RF 1 Hz, focal-zone depth and 30 sec/sonication/center point while duty cycle (DC) ranged 0-60% between the wells. 2h after HIFU treatment, the wells were unsealed and incubated overnight.

Day 2: Cell media for each well was replaced with fresh media containing [Dox] 0-1 ug/mL prior to repeating the HIFU procedure from 24h earlier.

Day 3: After 24h of exposure to Dox, cell survivability study was performed to determine the contributions of HIFU-mediated necrosis and Dox-mediated apoptosis.

RESULTS
Cell survivability decreased by increasing [Dox] or DC. In the Dox-only group (DC 0%), average survivability was 93% for [Dox] 0.5 ug/mL while in the HIFU-only group ([Dox] 0 ug/mL), average survivability was 42% for DC 50%. In contrast, there was virtually no survivability of sarcoma cells for [Dox] 0.5 ug/mL and DC = 50%.

CONCLUSION
The synergy of HIFU and low-dose Doxorubicin was successful in virtually eliminating MDR uterine sarcoma cells.

CLINICAL RELEVANCE/APPLICATION
A combination of HIFU and a low-dose generic chemotherapeutic may be a promising alternative to existing treatments (regular-dose multidrug regimen, surgery or radiotherapy) against some MDR cancers.

SST16-09 • Non-Vascular Interventional Procedures in an Urban General Hospital: Analysis of 2001-2010 with Comparison to the Previous Decade

Peter F Hahn MD, PhD (Presenter) ; Alexander R Guimaraes MD, PhD * ; Ronald S Arellano MD ; Peter R Mueller MD * ; Debra A Gervais MD *

PURPOSE
Non-vascular image-guided procedures such as biopsy and fluid drainage are accepted medical care. Having previously reported an analysis of the 21324 cases in the 1991-2000 fiscal years, we undertook a comparative study of procedures performed by the same abdominal interventional group from October, 2000 through September, 2010.

METHOD AND MATERIALS
With IRB approval a 20-year quality assurance database verified against the radiology information system was queried for procedure location (eg. pleura, liver, bowel, abdomen) and type (eg. biopsy, catheter insertion, transient drainage), demographics and trends. New hospital numbers assigned each year served to normalize for overall hospital activity.
RESULTS
We performed 50195 IR procedures in 24309 distinct patients (M:F 12625:11684; average age 60), 940 procedures in under-20s and 571 in patients 90 or older. 15345, 4377 and 1754 patients had 1, 2 or 3 procedures; 470 had 10 or more. 27 supervising radiologists and 277 individuals participated as operators, double the previous decade. Biopsy (4.8% average yearly increase), abdominal drainage (7.3%), paracentesis (12.9%), tube manipulation (13.0%), suprapubic tube insertion (21.0%), and gastrostomy (44.6%) all increased strongly.

CONCLUSION
Referrals for non-vascular IR procedures have doubled over two decades, outpacing growth in new hospital patients and requiring increased resource allocation.

CLINICAL RELEVANCE/APPLICATION
Since some specialized procedures like biliary and renal drainage have not increased proportionately, newly trained operators may have diminished experience with these more demanding cases.

Disclosure Index

A

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