Quality Control of Ultrasonography System for Breast Screening

**PURPOSE/AIM**

In order to apply ultrasonography for breast cancer screening, it is essential to maintain QC of the ultrasonography scanner and probe. The phantom and ultrasonography system were produced in 2009. Three targets are in the phantom. The Mass target evaluates LUT, and the Dot target clarifies the range resolution. The Cyst target was able to measure the circle degree. All phantom was able to be evaluated as a result of evaluating 100 images. We made the evaluation image by dividing a movie into each frame. To avoid the influence of a target edge and posterior echoes, the measurement region of the Mass target decided 80% and half the upper part region from an initial outline. As for the other targets, the detection was possible by simple technique.

**SUMMARY**

The Mass target clarified the relation between the pixel value and impedance. The Dot target clarified the range resolution and the angular resolution. The Cyst target was able to measure the circle degree. All phantom was able to be evaluated as a result of evaluating 100 images. Phantom by the proposal technique. This technique is effective as the evaluation of universality of a normal system, and because an insufficient adjustment of the ultrasonography system is detected, effective.

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**Quality Control of Ultrasonography System for Breast Screening**

**LL-BRE1146**

**Norimitsu Shinohara**, PhD  
**Naoki Kamiya**, PhD  
**Takako Morita**, MD

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Sonographic Appearance of Ductal Carcinoma In Situ: Correlation with Mammography, Magnetic Resonance Imaging and Pathologic Findings

**LL-BRE1153**
Luciana Graziano, MD
Almir Bitencourt, MD
Elvira F Marques
Juliana A Souza
Mirian R Poli, MD
Camila Guatelli
Caroline B Da Silva

**PURPOSE/AIM**
To summarize the sonographic features of ductal carcinoma in situ (DCIS) detected by ultrasound (US) and correlate them with mammography, magnetic resonance imaging (MRI) and pathologic findings.

**CONTENT ORGANIZATION**
DCIS: - Pathologic changes - Types of DCIS Sonographic Appearance of DCIS: - Size - Shape - Margins - Echogenicity - Posterior acoustic characteristics Correlation with Mammography: - DCIS with microcalcifications - DCIS without microcalcifications Correlation with MRI: - Enhancement patterns - Second-look US Correlation with pathology: - Architectural pattern (micropapillary, papillary, solid, cribriform, and comedo) - Nuclear grade - Presence of necrosis

**SUMMARY**
US technique is critical for demonstrating DCIS. The main benefit of identifying a US abnormality in women with suspected DCIS on mammography or MRI is to allow the use of US to guide interventional procedures. Besides, US may be helpful in detecting DCIS without calcifications and in evaluating disease extent in women with dense breasts.

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Supporting the Multi-modal Breast Reading Workflow by an Automatic Position Correlation Method for Tomosynthesis and Breast Volume Ultrasound Images

**LL-BRE1163**
Joachim Georgii
Fabian Zoeher
Horst K Hahn, PhD *

**PURPOSE/AIM**
Tomosynthesis in combination with the 3D breast ultrasound modality ABVS (automated breast volume scanner) has the potential to increase the diagnostic accuracy of breast cancer detection and diagnosis by correlating findings in both modalities. However, the manual position correlation between these differently and highly deformed 3D images is time-expensive and requires complex thinking. We will show how our automatic real-time position correlation method can support the simultaneous navigation of these different datasets.

**CONTENT ORGANIZATION**
The presented workstation will simultaneously show a patients tomosynthesis and 3D ultrasound image. When the user navigates through one of the images with a cursor position, our method will automatically show the correlated cursor position in the other view. Additionally, the user has the option to deactivate the automatic method, which will illustrate the difficulties of manually correlating corresponding positions in these images.

**SUMMARY**
We present an automatic real-time position correlation method for tomosynthesis and 3D ultrasound images. We will show how our method supports the reading workflow by position correlation between those highly different modalities.
Unilateral Breast Enlargement

LL-BRE2452
Sung Hee Park, MD
Bomi Chung
So Hyun Cho, MD
Seung Joon Choi

PURPOSE/AIM
The purpose of the exhibit are: 1. To illustrate ultrasonographic, mammographic and MR imaging findings of unilateral breast enlargement 2. To discuss the various etiologies that result in unilateral breast enlargement 3. To review the pathophysiology of unilateral breast enlargement in each case 4. To learn characteristic imaging findings of unilateral breast enlargement for differential diagnosis

CONTENT ORGANIZATION

SUMMARY
The major teaching point of this exhibit are: 1. To aware the various causes of unilateral breast enlargement 2. To understand the pathophysiology of unilateral breast enlargement 3. To learn characteristic imaging findings and differential diagnostic points
PURPOSE/AIM

The purpose of the exhibit are: 1. To illustrate ultrasonographic, mammographic and MR imaging findings of unilateral breast enlargement. 2. To discuss the various etiologies that result in unilateral breast enlargement. 3. To review the pathophysiology of unilateral breast enlargement in each case. 4. To learn characteristic imaging findings of unilateral breast enlargement for differential diagnosis.

CONTENT ORGANIZATION


SUMMARY

The major teaching point of this exhibit are: 1. To aware the various causes of unilateral breast enlargement. 2. To understand the pathophysiology of unilateral breast enlargement. 3. To learn characteristic imaging findings and differential diagnostic points.
Create a pictorial atlas of 3D ultrasound appearance of axillary lymph nodes.
Correlate the ultrasound appearance with pathological findings in metastatic lymph nodes.

SUMMARY
Staging of invasive breast cancer requires pathologic evaluation of the ipsilateral axillary lymph nodes. A pre-operative diagnosis of axillary lymph node metastasis obtained via ultrasound guided sampling can allow a patient to skip sentinel node biopsy and move directly to one-stage surgery with axillary node dissection. We present the 3D ultrasound appearance of abnormal axillary lymph nodes. This may complement 2D ultrasound imaging and better guide radiologists in selecting patients who would benefit from pre-surgical biopsy. In addition, this emerging technique in lymph node imaging may prove helpful in imaging lymph nodes in other anatomic sites.

Breast Cancer Screening with Sonography: What the Radiologist Must Know to Improve Performance and Avoid Misinterpretations

PURPOSE/AIM
- To describe the technical errors that can produce false-negative or false-positive interpretations.
- To review the minimal signs suggestive of malignancy and benign lesions beyond the simple cysts.

CONTENT ORGANIZATION
- Summary of the current barriers to widespread use of breast screening sonography - Equipment requirements and examination technique: a brief discussion of key issues - Technical related errors: sample cases with discussion on how to avoid them. - Illustrate the major and minimal signs of malignancy and benign lesions on sonography beyond simple cyst. - Review common benign lesion that can appear suspicious on sonography and present with typically benign features on mammography and / or clinical correlation. - Conclusions and future directions

SUMMARY
- The main limitations in breast cancer screening sonography include operator dependency, high number of false positives and false negatives, especially in ductal carcinoma in situ, and time-consuming examination. - Prevent errors related to technique, recognize minimal signs of malignancy and know benign lesions beyond the simple cyst is very important to minimize these limitations and to avoid mistakes on use of breast cancer screening sonography

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You're in Good Hands with ABVS: Tips and Pitfalls of Automated Breast Volume Scanner

PURPOSE/AIM
To familiarize radiologists with a variety of false positive and false negative findings on automated breast volume scanner (ABVS) for making an accurate diagnosis.

CONTENT ORGANIZATION
1. Introduction
A. Clinical application of ABVS (Automated Breast Volume Scanner)
B. Pros and cons of ABVS
- Diagnostic value compared with hand-held ultrasound
2. Evaluation methods using ABVS
A. Image acquisition
- Patient factors
- Technical factors
B. Image reconstruction
C. Interpretation methods
- Locate the lesion: directions and diameters
3. Practical cases that radiologists should know
A. Typical cases
B. Pitfalls
- False positive findings
- False negative findings
C. Tips to deal with BI-RADS category 4 lesions

SUMMARY
Automated breast volume scanner (ABVS) is a rapidly emerging imaging modality with increasing adoption in both the screening and
diagnostic setting. Although image interpretation is in some ways similar to hand-held ultrasound, there remain vast differences and specific training is required for radiologists. The overview of image acquisition techniques and interpretation methods of ABVS would help radiologists to understand and use of ABVS. To make an accurate diagnosis, tips and pitfalls of ABUS with various false positive and false negative cases will be presented.

You’re in Good Hands with ABVS: Tips and Pitfalls of Automated Breast Volume Scanner

Hyun Jung Koo, MD
Joo Hee Cha
Hak Hee Kim, MD
Hee Jung Shin, MD
Eun Young Chae

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Mammography, Ultrasound and MR Imaging in Breast Disorders Related to Pregnancy and Lactation: Literature Review and Personal Experience

Sandra Bednarova, MD
Orazio Pennisi
Micaela De Lorenzo Poz, MChir
Viviana Londero, MD
Chiara Zuliani, MD
Massimo Bazzocchi, MD

PURPOSE/AIM
To review imaging findings and management of breast disorders related to pregnancy and lactation.

CONTENT ORGANIZATION
1. Gestational and postgestational changes in human breast
2. Breast disorders during pregnancy and lactation
   - Inflammatory and infectious disease
   - Benign tumors
   - Malignant tumors
   - Imaging findings
      - Mammography
      - Ultrasonography
      - MR Imaging
3. Management
   - Diagnostic work-up
   - Indications for biopsy
   - Issues in radiation protection and Gadolinium-based MR Contrast Agents administration

SUMMARY
Breast can be affected by a variety of breast disorders during pregnancy and lactation, as illustrated in this paper. The diagnostic work-up is based on US because of its greater sensitivity in increased parenchymal density. Mammography and MRI should be reserved for undetermined cases at US and/or for staging malignancy.
3. Imaging findings
- Mammography
- Ultrasonography
- MR Imaging
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Translation of Preoperative Breast MRI Findings into the Surgical Field Using Real-time Virtual Sonography

Hiroko Satake, MD
Satoko Ishigaki, MD
Mariko Kitano
Hisashi Kawai
Shinji Naganawa, MD

PURPOSE/AIM
Real-time virtual sonography (RVS) is a fusion imaging system which displays real-time US images synchronized with the previously acquired MRI volumetric data. Aim of this exhibit is to explain the RVS technique for translating preoperative MRI findings into the surgical field to optimize resection margins in breast conservative therapy (BCT).

CONTENT ORGANIZATION
1. Principles of breast RVS system
2. Preoperative procedure of breast RVS
   - Localization of breast lesions detected by preoperative MRI
3. Three dimensional mapping of tumor extent based on preoperative MRI
4. Case presentations with illustrated images and short videos
   - Patients with negative resection margins
   - Patients with positive resection margins
5. Discussions on the utility and limitation of breast RVS

SUMMARY
In order to maximize the benefits of preoperative MRI, how to translate MRI information of tumor extent into the surgical environment is a key point. RVS can project MRI findings on the surgical field with real-time US guidance, and has a potential to improve the accuracy of surgical excision in BCT.

Ultrasonographic Features with Pathologic Correlation of Ductal Diseases

Lise P Berner
Christophe Tourasse
Jean François Denier
Agnes Coulon

PURPOSE/AIM
Describe, for residents and specialized radiologists, the most common imaging features of normal and abnormal ductal diseases.

CONTENT ORGANIZATION
1. Describe the imaging appearance of normal ductal anatomy.
2. List the imaging appearance of benign and malignant diseases of the ducts.

SUMMARY
Ductal disease is an important issue in breast imaging, but it is often not well know and difficult to understand. US is becoming the new standard for evaluation of suspected ductal disease. Benign diseases of the ducts include duct ectasia, blocked ducts, inflammatory, periductal mastitis, apocrine metaplasia, intraductal papillomas. Malignant diseases of the ducts include ductal carcinoma in situ, invasive ductal carcinoma, and Paget disease.
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Malignant diseases of the ducts include ductal carcinoma in situ, invasive ductal carcinoma, and Paget disease.

Ultrasound Elastography in Detecting Breast Neoplasms

Faiezeh Sodagari, MD
Pedram Golnari, MD
Hamid R Baradaran, MD, PhD

PURPOSE/AIM
Ultrasound elastography is a newly developed ultrasound method which is based on the degree of tissue distortion in response to an external force. It has been shown to be diagnostic in malignancies, especially in conjunction with the conventional B-mode ultrasound. Both qualitative and quantitative methods of assessments are currently used in clinical and research settings. We present the concept, techniques, equipments, interpreting and technical difficulties that need more caution in clinical use.

CONTENT ORGANIZATION
- Clinical importance of the diagnosis of breast cancer
- Current available modalities used in breast imaging
- Brief introduction of the ultrasound elastography technique
- Quantitative vs. qualitative ultrasound elastography methods in breast imaging
- Summarize advantages and shortcomings of ultrasound elastography
- Addressing the current role of ultrasound elastography in the available diagnosis guidelines and standards
- Reviewing the cost of establishing this modality
- Training courses and the learning curve
- Ultrasound elastography training in the current curriculums of residency and fellowship training

SUMMARY
Ultrasound elastography demonstrates strong potential to become the frontline modality of choice in conjunction with the conventional B-mode ultrasound for detecting malignancy in breast findings.

Unveiling the Bewildering Papillary Neoplasm of the Breast: Clues that Radiologists Should Know Beforehand

Haesung Yoon
Min Jung Kim, MD

PURPOSE/AIM
To aid the understanding of spectrum of papillary lesions in the breast through sonographic and pathological findings with illustrations, presenting the strategy of diagnosis and management before, at, and after the biopsy.

CONTENT ORGANIZATION
1) Introduction
- Understanding lesion with wide spectrum of imaging-pathologic findings
- the difficulty and importance of diagnosis associated with breast malignancy.
2) Before the biopsy: How to suspect breast lesions as papillomas
- Illustration for the spectrum of US findings
3) At the biopsy: A. Pathologic diagnosis with H-E and immunohistochemistry staining

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**LL-BRE2507**

**Haesung Yoon**

**Min Jung Kim**, MD

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- Understanding lesion with wide spectrum of imaging-pathologic findings
- The difficulty and importance of diagnosis associated with breast malignancy.
2) Before the biopsy: How to suspect breast lesions as papillomas
- Illustration for the spectrum of US findings
3) At the biopsy:
A. Pathologic diagnosis with H-E and immunohistochemistry staining
- Illustration for the spectrum of pathologic diagnosis
B. Diagnostic accuracy comparison (14gauge automated core-needle vs vacuum-assisted biopsy): Pros and Cons
4) After the biopsy:
A. How to predict the malignancy at surgery when papillary lesion was diagnosed at 14G-automated CNB- clinicopathologic factors associated with the upgrade at surgery.
B. Should we recommend further excision or follow-up? Based on the literature.

**SUMMARY**
- Suspecting papillary lesions on breast ultrasound can be challenging and certain US appearances can be useful.
- For the pathologic diagnosis, the overall area of a lesion should be evaluated and larger sampling can be useful.
- To predict upgrade at surgery, clinicoradiologic factors can be helpful.

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Ultrasound Case of the Day

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**LL-EDE3014**

**Moderator**

**Jeanne M Horowitz**, MD

**Lori A Goodhartz**, MD

**Maneesh Gupta**, MD, BEng

**Ravi Guttikonda**

**Joseph A Meranda**, MD

**Nicholas Morley**, MD

**Meghan F Single**, MD

**PURPOSE/AIM**
1) Recognize the diagnosis and differentiate specific conditions using Ultrasound. 2) Learn characteristic imaging findings for the diagnosis. 3) Learn about clinical implications and treatment of the diagnosis.
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**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.

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

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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 benefit from this technique.
### Sonazoid-CEUS during Radiofrequency (RFA) for Small Hepatocellular Carcinoma (HCC)

**LL-VIE2946**

**Toshiya Shibata**, MD  
**Minoru Yabuta**, MD  
**Ken Shinozuka**  
**Toyomichi 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.

### 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**  
**Bettina 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 interpretive 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.

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

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**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 interpretive 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.
Doppler Ultrasonography of Arteriovenous Fistula in Hemodialysis Patients ... Far More than Just a Pure Diagnosis Purpose

LL-VIE2970
Jose R Fortuno, MD
Anna Alguersuari, MD
Eva Criado
Joan Falco
Carlos Serrano Burgos
Juan Perendreu, MD, PhD
Jordi Branera, MD
Cristina Maria Spiniu, MD
Marta Cufi Quintana

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).

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 plannification, monitoring and outcome assessment of any intravascular intervention.

Applications of Contrast Enhanced Ultrasound for Radiofrequency Ablation of Hepatocellular Carcinoma

LL-VIE2978
Atul Gera, MD *
Ilya Lekht, MD
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) 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.

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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

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

Anu Obaro, MBBS
Venus Hedayati, MBBS, MRCP
Mohammad Daneshi, MBBS
Dean Y Huang, MBBS, FRCP
Maria E Sellars, MD, FRCP
Paul S Sidhu, MRCP, FRCP *

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 of 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.

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

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

LL-VIE4012

Hamid Reza Sadeghi Neshat, MSc
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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.

Breast Imaging (Diagnostic Ultrasound)

Sunday, 10:45 AM - 12:15 PM • Arie Crown Theater

SSA01 • AMA PRA Category 1 Credit™•1.5 • ARRT Category A+ Credit:1.5
Moderator
Wendie A Berg, MD, PhD *
Moderator
Jung Min Chang, MD
Moderator
Regina J Hooley, MD *

SSA01-01 • Utility of Targeted Ultrasound in the Evaluation of Breast MRI-detected Non-mass Enhancement (NME)

Adrienne R Newburg MD (Presenter); Chloe M Chhor MD; Jiyon Lee MD; Samantha L Heller MD, PhD; Hildegard B Toth MD; Linda Moy MD

PURPOSE
Prior studies showed the likelihood of identifying an ultrasound (US) correlate for an MRI-detected abnormality depends on lesion type. NME was less likely to be seen on US compared to a mass or focus. Targeted second-look US may result in prolonged work-up time, added expense, and false reassurance in the setting of a negative US. Our study was performed to determine the utility of targeted US and to determine how often a MRI-US discordant lesion was found.

METHOD AND MATERIALS
An IRB-approved retrospective review was performed for breast MRI examinations performed from 2005-2008. Data regarding patient demographics, MRI findings and subsequent sonographic and pathologic results were recorded. Of 2,222 breast MRI exams, 70 (3.2%) NME lesions were identified for which targeted US was recommended. An additional 85 NME lesions went directly to an MRI biopsy because the interpreting radiologist felt it unlikely that an US correlate would be seen. The rate of subsequent malignancy was analyzed.

RESULTS
Targeted US was performed in 59 of 70 (84%) women. In the remaining 11 (16%) cases, targeted US was not performed because 5 women underwent mastectomy or had metastatic disease. MRI-guided biopsy was pursued directly in 2 women and 4 women did not undergo further imaging at our institution. Mean age was 46.7 years, range was 25 to 99 years. In 14 (24%) of 59 sonograms, an US correlate was seen. An US-guided biopsy was performed in 7 (50%) of 14 cases. None yielded cancer. One of 7 (14%) yielded palpable masses which were subsequently excised. One of 7 (14%) yielded atypia. Three benign biopsies were discordant with the MRI findings. At subsequent MRI biopsy, one lesion was an invasive ductal carcinoma (IDC). Forty-five of 99 (76.3%) cases had no US correlate; 15 proceeded to MRI-guided biopsy. Two (13%) yielded cancer, 1 IDC and 1 DCIS. An additional 2 (13.3%) cases demonstrated atypia/ADH. In the 11 remaining cases, pathology was benign. The cancer yield for the 85 NME lesions that went directly to MRI biopsy was 12% (12/85); 2 were IDC and 10 were DCIS.

CONCLUSION
The yield for detecting an US correlate for an MRI-detected NME is low (24%) with no detection of malignancy.

CLINICAL RELEVANCE/APPLICATION
Confident MRI-US correlation for an MRI-detected abnormality can be challenging. It may be advisable to forego targeted US and proceed directly to MRI-guided core biopsy.
SSA01-02 • 3D Breast Ultrasound: Diagnostic Yield Compared to MR Imaging and Histopathology

Mathijn D De Jong MD (Presenter) ; Gerrit J Jager MD, PhD ; Ivo Dubelaar MD ; Thomas A Fassaert MD ; Matthieu Rutten MD

PURPOSE
To prospectively assess the performance characteristics of 3D ultrasound (3DUS) for the detection and classification of breast tumors compared to breast magnetic resonance imaging (MRI) and histopathology.

METHOD AND MATERIALS
Two hundred twentyone patients with an indication to undergo breast MRI provided informed consent were enrolled in an institutional review board-approved 3DUS study protocol. Patients underwent 1.5T MRI and 3DUS within 10 days. 3DUS was performed with a 5-14 MHz broadband transducer featuring Harmonic Imaging and compound scanning. The 3D US findings were reviewed by 2 observers independently, who were blinded for histopathological diagnoses and prior imaging findings such as mammography, handheld 2D US and MRI. Histopathological findings or MRI with 12 months clinical follow-up were used as reference standard. Diagnostic yield, sensitivity, specificity, positive (PPV) and negative (NPV) predictive values were determined.

RESULTS
3DUS scanning was technically successful in 220 patients. One patient was excluded due to erroneous data transfer. Each breast was evaluated with 3 to 5 scans. The overall examination time was 15-20 (mean 14) minutes per patient. Mean patient age was 48 years (range 19-78). 194 and 191 benign and 43 and 46 malignant breast tumors were detected with 3D-US and MRI, respectively. In 61 patients 67 histopathological findings were available as reference standard. The sens, spec, PPV and NPV of 3D US was compared to MRI 85, 97, 91, 96, respectively, and compared to the histopathological findings 93, 96, 91, 98, respectively.

CONCLUSION
3D US is a reliable imaging technique for the detection and classification of benign and malignant breast tumors.

CLINICAL RELEVANCE/APPLICATION
3DUS can reliably be used in a clinical setting and can probably be feasible for dense breasts in a screening program.

SSA01-03 • Breast Cancer Detection with CD276-targeted Ultrasound Imaging

Sunita Bachawal PhD (Presenter) ; Ferdinand Knieling ; Amelie M Lutz MD ; Lu Tian ; Juergen K Willmann MD *

PURPOSE
CD276 has been shown to be differentially expressed in various cancers including human breast cancer. Our goal was to compare the potential of ultrasound (US) molecular imaging using microbubbles (MB) targeted to CD276 with vascular endothelial growth factor receptor type2 (VEGFR2)-targeted MB for assessment of breast tissue progression to early breast cancer in transgenic mice (FVB/N Tg (MMTV/PyMT634Mul)).

METHOD AND MATERIALS
A transgenic mouse model of breast cancer (FVB/N-Tg(MMTV-PyMT634Mul)) was used in this study. The progression of breast tissue from normal to invasive cancer was examined using US molecular imaging (Vevo2100, Visualsonics) with VEGFR2- and CD276- targeted MB in 160 mammary glands. Ex vivo expression levels of VEGFR2 and CD276 were examined using immunofluorescence staining followed by confocal microscopy.

RESULTS
There was a significant (p

CONCLUSION
US molecular imaging of tumor angiogenesis using tumor specific endothelial markers in breast cancer may help improve accuracy of US in breast cancer detection in future clinical trials.

SSA01-04 • Sonographic Findings in 691 Pure Ductal Carcinoma in Situ Lesions with Histopathologic and Biologic Correlation

Marion E Scoggins MD (Presenter) ; Gaiane M Rauch MD, PhD ; Patricia S Fox MS ; Ana Paula Benveniste MD ; Henry M Kuerer MD ; Wei T Yang MD ; Young Mi Park MD, PhD ; Sara Lari ; Savitri Krishnamurthy MD

PURPOSE
Sonographic (US) findings in 691 pure ductal carcinoma in situ (DCIS) lesions were retrospectively analyzed by estrogen receptor (ER) status, nuclear grade, and comedonecrosis to evaluate the prognostic value of US as an adjunct to mammography (M).

METHOD AND MATERIALS
An institutional review board approved retrospective single institution database search performed for patients with pure DCIS evaluated from January 1996 to July 2009 who underwent pre-operative M and whole-breast US. Images were reviewed per ACR BI-RADS lexicon. Pathologic features recorded were ER status, nuclear grade, and comedonecrosis. ER+ was defined as nuclear staining in at least 1% of cells. Statistical comparisons were made using t-test, Chi-square, Fisher’s exact test, Kruskal-Wallis or Wilcoxon rank-sum test.

RESULTS
There were 1911 pure DCIS patients identified; those with incomplete data (n=5), lacking pre-operative US (n=1214) or M (n=1) were excluded leaving 691 patients for analysis. Of 691 lesions, 304 (44%) were visible on M and US, 315 (46%) visible on M only, 58 (8%) visible on US only, and 14 (2%) visible on neither M nor US. There were 425 (62%) ER+, 104 (15%) ER-, and 162 (23%) lesions with unknown ER. Comedonecrosis was present in 296 (43%) lesions, absent in 395 (57%). There were 334 (48%) non-high grade (nuclear grade I/II) lesions, 353 (51%) high-grade (III), and 4 (1%) of unknown grade. ER+ lesions were more frequently visible on US than ER- lesions (62% vs. 48%, p

CONCLUSION
ER+ DCIS lesions are more likely visible on US than ER- DCIS. A shadowing US mass is more frequently high grade or ER- while a mass is the most common US finding of DCIS regardless of histopathologic features, nonmass lesions are less likely to be associated with high-grade tumors and comedonecrosis.

CLINICAL RELEVANCE/APPLICATION
A shadowing mass on US should raise suspicion for ER- DCIS which provides imaging-based prognostic and biologic information during cancer diagnosis and work-up.

SSA01-05 • Detectability and Diagnostic Performance of ABVS in Suspicious Calcifications in Comparison with Hand-held US

Eunjeong Kim (Presenter) ; Sung-Hun Kim MD ; Chang Suk Park

PURPOSE
To prospectively evaluate the detectability and performance of automated breast US scanner and compare it with handheld breast US in suspicious calcifications on mammography.

METHOD AND MATERIALS
Forty-two patients with 43 breast lesions, scheduled for US guided or stereotactic biopsy for suspicious calcifications on mammography,
Patients with invasive breast cancer treated by primary surgery, who had undergone shear wave elastography examination at the time of underwent automated breast US and hand-held US examination. Two radiologists reviewed the automated breast US data in consensus. A radiologist who had not performed the hand-held US examination reviewed hand-held US data. Detectability and diagnostic performance of automated breast US and hand-held US were calculated.

RESULTS
Among 43 lesions, 25 (58.1%) were malignant and 18 (41.9%) were benign. Detection on ABVS was more frequent for lesions; malignant vs. benign (96.0% [24/25] vs. 44.4% [8/18], p=0.002), of maximal extent more than 10mm (86.7% [26/30] vs. 46.2% [6/13], p=0.009), or lesions with fine pleomorphic or fine linear shape vs. round or amorphous or coarse heterogeneous shape (94.7% [18/19] vs. 58.3% [14/24], p=0.021) at mammography. No significant difference was found in AUC between automated breast US (0.758, 0.603-0.875) and hand-held US (0.786, 0.634-0.896) (p=0.571).

CONCLUSION
Automated breast US detected 96.0% (24/25) of malignant classifications on mammography. Detection was found to be related to the pathology, to calcification extent, and shape at mammography.

CLINICAL RELEVANCE/APPLICATION
This study is the first study to compare the detectability and diagnostic performance for suspicious microcalcifications between ABVS and HHUS. ABVS showed similar diagnostic performance to HHUS.

SSA01-06 • Clinical Application of Shear Wave Elastography (SWE) in the Differential Diagnosis of Small (≤2cm) Breast Lesions

Kyung Hee Ko (Presenter) ; Hae Kyong Jung MD ; Junghyun Yoon MD ; Hye Rin Kim

PURPOSE
To evaluate the usefulness of SWE for the differential Diagnosis of small (=2cm) breast lesions

METHOD AND MATERIALS
From June 2012 to December 2012, of 215 women who had been performed conventional US and SWE, 165 masses of 155 women (mean age: 44.97±9.54 years, range 22-87 years) who had 2cm and smaller lesions were included in this study. All patients underwent US guided core biopsy or surgical excision. US BI-RADS final assessment and quantitative SWE parameters were recorded. Final assessments of the 165 breast lesions were categorized as follows: category 3 in 23, category 4a in 119, category 4b in 11, category 4c in 8, and category 5 in 4. Histopathologic diagnosis was used as reference standard. Optimal cutoff value for each quantitative SWE parameter was calculated by ROC curve. Calculated cutoff value was used to upgrade BI-RADS 3 lesions to category 4a and downgrade BI-RADS 4a lesions to category 3.

RESULTS
Of the 165 small breast masses, 20 masses (12%) were malignant and 145 masses (88%) were benign. Mean Emax of malignant masses (141.97±98.03kPa) was significantly higher than that of benign (49.14±39.89kPa). Emax with a cutoff value of 87.5kPa had the highest Az value (0.796, sensitivity 75.0%, specificity 85.5%, PPV 41.7%, NPV 96.1%). However, for small masses equal or smaller than 1cm, Az values of all quantitative SWE parameters were lower than 0.6. After adding SWE to conventional US, there was no improvement of diagnostic performance (sensitivity 80%, specificity 95.2%, PPV 69.6%, NPV 97.2%). When applying Emax

CONCLUSION
Small malignant masses=2cm were significantly stiffer than small benign lesions. However adding SWE parameters to conventional US showed no improvement of diagnostic performance. SWE could give US BI-RADS some help for reducing benign biopsy rate.

CLINICAL RELEVANCE/APPLICATION
SWE could give conventional US BI-RADS some help on differential diagnosis of small breast masses 2cm or smaller with reducing benign biopsy rate.

SSA01-07 • Indications for Biopsy of Imaging-detected Intramammary and Axillary Lymph Nodes in the Absence of Concurrent Breast Cancer

Christine Westra BS ; Vandana M Dialani MD ; Shambhavi Venkataraman MD ; Valerie J Fein-Zachary MD ; Alexander Brook PhD * ; Tejas S Mehta MD, MPH (Presenter)

PURPOSE
To evaluate prevalence and identify features predictive of malignancy in imaging-detected lymph nodes (LNs) in women without concurrent cancer.

METHOD AND MATERIALS
Retrospective review of all image-guided LN fine needle aspirations (FNA) and core needle biopsies (CNB) from 1/1/08-12/31/10. LNs in patients without concurrent cancer comprised our study group (SG; n=80) and with concurrent breast cancer our control group (CG; n=66). FNAs were sent for flow cytometry in addition to cytology at discretion of breast imager. Blinded to cytology/histology, imaging features of LNs including size, loss of fatty hilum, and/or focal/diffuse cortical thickness were recorded. BI-RADS category was assigned by reviewer based on LN appearance.

RESULTS
In 80 SG cases, 63 (78%) had FNA and 17 (22%) had CNB; in all CG had FNA. Of the 80 SG cases, 69 (86%) were negative, 2 (3%) positive, 6 (7%) atypical and 3 (4%) non-diagnostic (ND). Of 8 atypical/positive LNs, 3 had breast cancer, 2 had lymphoma, and 3 negative on excision. Of 66 CG cases, 30 (45%) were negative, 30 (45%) positive, 5 (8%) atypical and 1 (2%) ND. There were 6 false negative FNAs in CG; all atypical/positive LNs in CG were positive for breast cancer on excision. ND LNs were negative on follow up/excision in both groups. Prevalence of malignancy in LNs in SG was 6% (5/80) and in CG 62% (41/66); p=0.009 and/or eccentric/focal cortical thickening were negative and not predictive of malignancy. If BI-RADS 4C/5 were used as threshold to biopsy, the sensitivity, specificity, PPV, and NPV for cancer in SG would have been 100%, 99%, 83% and 100% respectively, higher than CG results of 73%, 92%, 93% and 68% respectively.

CONCLUSION
In the absence of concurrent breast cancer, using loss of fatty hilum as criterion to biopsy image-detected LNs keeps sensitivity of 100% but lowers false positives. FNAs should also be sent for flow cytometry to diagnose lymphoma.

CLINICAL RELEVANCE/APPLICATION
Without concurrent breast cancer, loss of fatty hilum as criterion to biopsy LNs has 100% sensitivity with low false positives. Flow cytometry is also needed in these patients to exclude lymphoma.

SSA01-08 • Are Shear Wave Ultrasound Findings an Independent Predictor of Lymph Node Involvement in Women with Invasive Breast Cancer?

Andrew Evans MRCP, FRCR (Presenter) ; Patsy Whelehan MSc * ; Petra Rauchhaus ; Colin Puride ; Lee Jordan ; Kim Thomson ; Sarah J Vinnicombe MRCP, FRCR

PURPOSE
Shear wave elastography shows promise as an adjunct to greyscale ultrasound in assessing breast masses. In breast cancer, higher lesion stiffness values have been shown to be associated with poor prognostic features. The purpose of this study was to assess whether higher lesion stiffness at shear wave elastography is an independent predictor of lymph node involvement

METHOD AND MATERIALS
Patients with invasive breast cancer treated by primary surgery, who had undergone shear wave elastography examination at the time of
Biopsy (Bx) of Prostate MRI Lesions

Comparison with Galactography

SSA21-09 • Diagnostic Usefulness of Breast Ultrasonography in the Evaluation of the Patients with Pathologic Nipple Discharge: Comparison with Galactography

Jun Ho Park; Young Mi Park MD, PhD; Suk Jung Kim; Hyun Kyung Jung (Presenter); Ji-Hwa Ryu; Sun Joo Lee MD; Hye Jung Choo MD; Young Jun Cho

PURPOSE
The purpose of this study was to evaluate the usefulness of breast ultrasonography (US) for the evaluation of pathologic nipple discharge, as compared with galactography.

METHOD AND MATERIALS
117 cases in 105 patients (all women; mean, 43.2 years; range, 20 - 76years) with pathologic nipple discharge were enrolled in this study, who had undergone US and galactography between 2004 and 2012. Eighty three cases were pathologically proved by surgical excision (n=66), or US-guided core needle biopsy (n=17), and the remaining cases were followed up for mean 24 months by US and mammography. Two radiologists retrospectively reviewed and compared US and galactography images with regard to detectability of lesion and evaluation of disease extent.

RESULTS
The lesions were depicted at galactography in 98 cases (83.8%), at US in 96 cases (82.1%) and both examinations in 85 cases (72.6%). Eight cases (6.8%) showed poor visualization of lesions at both examinations. The lesions were depicted at galactography only in 13 cases (11.1%) and US only in 11 cases (9.4%), of which galactograms were negative (n=1), only ducat dilatations (n=3), or failure of procedure (n=7). In 85 cases which abnormalities were visualized at both examinations, the evaluation of lesion extent was superior at US in 19 cases and superior at galactogram in 12 cases. Of 117 cases, US was superior or equal to galactography in 88 cases (75.2%) with respect to detection of lesion and extent evaluation. Galactography was superior or equal to US in 57 cases (48.7%).

CONCLUSION
Breast US is useful to detect the causes of pathologic nipple discharge and to evaluate the lesion extent exactly. Therefore, in the evaluation of patients with pathologic nipple discharge, we suggest that galactography may be skipped if the lesion is well detected at US.

CLINICAL RELEVANCE/APPLICATION
Galactography may be skipped in the evaluation of patients with pathologic nipple discharge if the lesion is well detected at ultrasonography.

RESULTS
Median age was 62 years, median invasive tumour size was 19 mm and 28% of patients had lymph node involvement. At univariate analysis, invasive size, histological grade, HER-2 status, vascular invasion, tumour type and mean stiffness were significantly associated with nodal involvement. At multivariate analysis, invasive size, tumour type, vascular invasion and mean stiffness maintained independent significance.

CONCLUSION
Mean stiffness at shear wave elastography is an independent predictor of lymph node metastasis in women with invasive breast cancer.

CLINICAL RELEVANCE/APPLICATION
High tumor stiffness at shear wave elastography increases the risk of lymph node metastasis in women with invasive breast cancer.

SSA01-09 • Diagnostic Usefulness of Breast Ultrasonography in the Evaluation of the Patients with Pathologic Nipple Discharge:

SSA21-01 • Simulator-based Comparison of 2D, 3D and Fusion 3D Transrectal Ultrasound (TRUS) Needle Guidance Accuracies for Biopsy (Bx) of Prostate MRI Lesions

Derek W Cool MD, PhD (Presenter) *; Xuli Zhang BSc; Cesare Romagnoli MD; Walter M Romano MD; Jonathan Izawa; Aaron Fenster PhD *

PURPOSE
Prostate MRI’s high sensitivity to early stage prostate cancer (PCa) permits targeted biopsy as an alternative to the current non-targeted systematic TRUS biopsy. The planning accuracy of sampling MRI lesions is 2D and 3D TRUS and 3D TRUS fusion is quantified.

METHOD AND MATERIALS
Three experts performed simulated biopsies on 12 patients (Pros. Vol=37±11g, PSA=9.0±5.1ng/ml) with a total of 15 Bx-confirmed PCa MRI lesions (0.8±0.8g) who were selected from 90 patients undergoing MRI-3D TRUS fusion biopsy. Two core-biopsies were targeted at each MR lesion using 2D TRUS, 3D TRUS and MRI-3D TRUS fusion for needle guidance, using a validated Bx simulator. Additional single core-biopsies were directed toward common regional targets defined for all patients. Regions included: left-anterior transition zone (TZ), left mid-gland, right apex and right base. The simulated Bx core locations were compared to the original MRI to evaluate the sampling accuracy.

RESULTS
The 15 PCa tumors were distributed as follows: Base=4, Mid-gland=5, Apex=6, with 7 lesions along the anterior prostate. Only 44±4% and 51±14% of tumors were sampled with 2D and 3D TRUS, respectively, compared to 98±4% with fusion biopsy. Bx sampling errors for the regional targets were significantly higher (p<0.05).

CONCLUSION
Biopsy of prostate MRI lesions under 2D or 3D TRUS without MR-fusion may be inaccurate and lead to a falsely negative biopsy.

CLINICAL RELEVANCE/APPLICATION
Targeting biopsies at suspicious lesions seen on prostate MRI using 2D or 3D TRUS without image fusion is likely not accurate enough to
adequately detect many significant prostate cancers.

SSA21-02 • Quantifying Tendon Damage with Ultrasound (US) Shear Wave Elastography Using a Porcine Flexor Tendon Tear Model

Ryan J DeWall PhD (Presenter) ; Jingfeng Jiang ; John Wilson MD, MS ; Kenneth S Lee MD *

PURPOSE
Shear wave imaging (SWI) is an US elastography technique that measures tissue elasticity, a tissue property that often correlates with pathology. The purpose of this study was to evaluate the ability of SWI to visualize partial tears and quantify damage in porcine flexor tendons.

METHOD AND MATERIALS
Thirty porcine flexor tendons were pre-loaded to 1.25 N and stretched from 0%-2% strain using a Mark-10 (Mark-10 Corp; Copiague, NY) testing system while being imaged using SWI (Aixplorer®; Supersonic Imagine; Aix-en-Provence, France). After imaging the normal tendon, the deep portion was cut to 25% (n = 10), 50% (n = 10), and 75% (n = 10) of the tendon thickness and reassessed with SWI. The deep-to-superficial wave speed ratio of the deep third (cut) and superficial third (uncut) of the tendon were compared in regions-of-interest (ROIs) centered on (C), proximal to (P), and distal to (D) the tear, excluding the area within the tear. Tukey multiple comparisons were used to assess differences between normal and torn tendons.

RESULTS
Shear wave speed (i.e. elasticity) increased significantly with increasing tissue strain in normal and cut tendons, except in the deep third of the 75% tear (0%, 6.7 ± 1.2 m/s; 2%, 7.7 ± 1.4 m/s). The deep-to-superficial wave speed ratio decreased significantly between normal and cut tendons in the 50% tear in ROIs centered on (0%, 0.98 ± 0.06 vs. 0.91 ± 0.09; 1%, 0.97 ± 0.06 vs. 0.81 ± 0.09; 2%, 0.99 ± 0.07 vs. 0.84 ± 0.10) and distal to (1%, 0.95 ± 0.08 vs. 0.85 ± 0.08) the tear and in the 75% tear proximal to (1%, 1.00 ± 0.07 vs. 0.82 ± 0.12; 2%, 1.00 ± 0.07 vs. 0.81 ± 0.16), centered on (0%, 1.03 ± 0.09 vs. 0.70 ± 0.10; 1%, 0.99 ± 0.06 vs. 0.60 ± 0.11; 2%, 0.95 ± 0.10 vs. 0.61 ± 0.13), and distal to (1%, 0.96 ± 0.15 vs. 0.79 ± 0.14) the tear.

CONCLUSION
The decrease in deep-to-superficial wave speed ratio in cut tendon relative to normal tendon suggests loading changes in the damaged fibers. SWI demonstrates the potential for assessing tendon damage in partially torn tendons.

CLINICAL RELEVANCE/APPLICATION
SWI has the potential to add quantitative information to validated US outcome measures, providing a powerful tool for future outcomes analysis using US to monitor and assess tendon injuries.

SSA21-03 • Optimizing Microbubble Formulation for Indirect Lymphosonography: Quantitative Comparison of Nanobubbles vs. Standard Microbubbles

Chan Kyo Kim MD, PhD (Presenter) ; Boem Ha Yi MD, PhD ; Omid Yeganeh MD ; Wenjin Cui ; Christopher Barback ; Robert F Mattrey MD *

PURPOSE
Indirect lymphosonography where microbubbles (MB) are injected subcutaneously within the sentinel lymph nodes (SLN) drainage field was developed to non-invasively detect, mark and possibly stage the SLN pre-operatively. Early clinical data suggest accurate localization but limited characterization. Since entry into the lymph duct (LD) is limited to particles ≤50 µm, the largest MBs (∼9 µm) were injected in either footpad of 6 normal rabbits. The Siemens Sequoia 15L8 probe was fixed over the popliteal node that was imaged with 5 MHz. Immediately after injection, a few MBs entered the LD to place an ROI over the SLN and its afferent LD. The US field was cleared and the footpad massaged for 20 sec. A time-intensity curve (TIC) was constructed in real-time using a prototype Siemens software that analyzes the linearized CPS data but also uses the B-mode data to correct for motion while scanning at low MI and 15 frames/sec. At 20 minutes or when the TIC returned to baseline, the US field was cleared and the 20-sec massage repeated until peak enhancement and the process repeated until no enhancement occurred. The TIC following the 1st massage and the number of massages that refilled the SLN following each injection were recorded.

RESULTS
Both agents enhanced the SLN and LD after massage. NBs caused greater SLN (p=0.003) and LD (p=0.001) enhancement that lasted for 20min vs. 8 min. The SLN refilled >20 times following a NB dose but only 8 times following a MB dose (p= 0.001).

CONCLUSION
NBs not only improve the filling of the duct and SLN, but also provided more functional bubbles at the injection site. We will next compare their ability to characterize nodes.

CLINICAL RELEVANCE/APPLICATION
Nanoscale bubbles increase duct filling and node enhancement and provide more functional bubbles at the injection site to refill the duct and node to improve detection and possibly characterization.

SSA21-04 • Ultrasound Shear Wave Speed Estimation in Elastic Phantoms: Sources and Magnitude of Variability in a QIBA Multicenter Study

Andy Milkowski MS (Presenter) ; Timothy J Hall PhD * ; Michael P Andre PhD * ; Paul L Carson PhD * ; Shigao Chen PhD ; Claude Cohen-Bacrie * ; Stephanie Franchi-Abella MD ; Brian S Garra MD ; Stephen McAleavey PhD * ; Steve Metz * ; Kathryn Nightingale PhD * ; Mark Palmeri MD, PhD ; Anthony E Samir MD ; Laurent Sandrin PhD * ; Mickael Tanter PhD *

PURPOSE
To test commercial and research ultrasound SWS systems to identify the sources and magnitude of bias and variability in SWS measurements.

METHOD AND MATERIALS
Eleven phantom pairs were built from stiff and soft batches of Zerdine® by CIRS. Larger phantoms were also prepared for correlative testing using magnetic resonance elastography. All phantoms were initially tested by one lab to determine manufacturing variation and were then shipped to 11 different labs for SWS measurements. At each site, 3-5 operators measure each phantom at three times at each of three depths according to a randomized schedule. Each measurement consists of the average of ten valid SWS acquisitions as has been reported in the clinical literature. The data are analyzed using crossed Gage R and R methodology with ANOVA. Bias is estimated by comparing the results with known values of elastic modulus (converted to SWS) from the manufacturer and from mechanical testing performed across a broad range of shear wave frequencies at two sites. Estimates of linearity can also be obtained since stiff and soft phantoms are tested at each site.

RESULTS
Mechanical test results from the two sites performing those measurements were in excellent agreement. Initial analysis of US SWS measurements shows overall variability of 5-7% in SWS mean values for several sites. ANOVA shows that site and measurement depth are the most common sources of variation with operator variability being a minor component. Variation in SWS for all phantoms was 3-5% on initial testing of all phantoms. A 5-10% depth dependence (lower SWS at deeper depths) was also seen. Also, a small bias in SWS estimates of 5-6% was seen. Similar variability and bias are seen for both stiff and soft phantoms.

CONCLUSION
Initial results show a relatively small amount of variability in SWS estimates and also show that operator variability contributes little to total measurement variation. Phantom variation may be a significant source of the variability in measurements. Given these encouraging results, we will add measurements from additional sites, explore the causes of the depth dependence of SWS, and extend our work to lossy (viscoelastic) phantoms which more closely mimic human liver tissue.

**CLINICAL RELEVANCE/APPLICATION**
This work by QIBA is the first step in development of a protocol for US SWS measurement that gives accurate and repeatable results across a range of instruments for drug testing, clinical and research use.

**SSA21-05** • **Visualization of Vascularity in Breast Lesions Using US Contrast Enhanced 3D Subharmonic Imaging**

**Anush Sridharan** PhD; **John R Eisenbrey** PhD; **Flemming Forsberg** PhD (Presenter) *; **Priscilla Machado** MD; **Daniel A Merton**; **Kirk Wallace** PhD *; **Carl Chalek** PhD *; **Kai E Thomenius** PhD *

**PURPOSE**
To develop a method for improving visualization of vascularity in breast lesions using 3D contrast-enhanced subharmonic imaging (SHI).

**METHOD AND MATERIALS**
A modified Logiq 9 (GE Healthcare, Milwaukee, WI) scanner with a 4D10L probe was used for 3D harmonic imaging (HI) and SHI of breast lesions in 72 patients after bolus injection of an ultrasound contrast agent (UCA; Definity, Lantheus Medical Imaging, N Billerica, MA; dose: 0.25mL for HI and 20?L/kg for SHI). Fifteen biopsy-proven malignant cases were selected for image processing. A region-of-interest (ROI) corresponding to UCA flow (within the lesion) and tissue in both 3D HI and SHI were selected for each case. A volumetric map of the time-intensity curve for each slice within the volume was generated over time. Slices showing presence of UCA were identified and isolated. To improve visualization of flow a volumetric background template was generated (from baseline) and used to filter out tissue signals. Contrast-to-tissue ratios (CTR) were calculated for 3D HI and SHI before and after background subtraction for vessel-tissue ROIs and also compared between the isolated slices and the entire volume.

**RESULTS**
Both 3D HI and SHI showed significant suppression of tissue signal after background filtering (p < 0.01). HI images were better visualized in breast lesions in all cases via increased tissue suppression and sensitivity to UCA flow. The improvement in visualization of vasculature based on isolation of slices demonstrates the importance of 3D imaging to visualize breast cancer flow.

**CLINICAL RELEVANCE/APPLICATION**
Visualizing the vascular structure of breast lesions may help improve characterization.

**SSA21-06** • **Quantitative Biomarkers for the Assessment of Fibrosis Using M-Mode US and Shear Wave Elastography**

**Lauren Rosenblum** BSc; **Priscilla Machado** MD; **Patrick L O’Kane** MD *; **Andrej Lyshchik** MD; **Flemming Forsberg** PhD (Presenter) *

**PURPOSE**
To determine if M-mode or Shear Wave Elasticity (SWE) imaging (independently or combined) provide quantitative markers of liver fibrosis compared to conventional grayscale ultrasound (US) imaging and pathology (the reference standard).

**METHOD AND MATERIALS**
Twelve subjects scheduled for an US-guided liver biopsy and 5 healthy volunteers were scanned with a broad bandwidth curvi-linear array using an IU22 (Philips Medical Systems, Bothell, WA; for grayscale and M-mode imaging) and an Aixplorer scanner (SuperSonic Imagine, Aix-en-Provence, France; for SWE imaging). The M-mode images were quantified using the scanners' existing calculation software package and by a novel algorithm (implemented in Matlab; Mathworks, Natick, MA) extracting distances between lines of similar intensities (L2LD) as a quantitative biomarker of liver status. Liver stiffness (in kPa) was recorded from the SWE images, while a radiologist (blinded to the other results) scored the grayscale US for degree of fibrosis on a 0-4 scale. ANOVA and Wilcoxon’s signed rank tests were used to compare the classification of liver fibrosis by SWE, M-mode (i.e., L2LD) and radiologists scoring with fibrosis determined by pathology as the reference standard.

**RESULTS**
In this pilot study, the radiologist was correct in 53% of assessments, which was not different from pathology when using a non-parametric test (p = 0.3). SWE did not differentiate between degrees of fibrosis (p > 0.71), while the new L2LD biomarker was able to perform a correct classification (p = 0.044). The best differentiation was achieved between normal subjects (fibrosis score = 0) and the subjects with fibrosis scores greater than or equal to 1 (0.30 ± 0.041 vs. 0.43 ± 0.085; p < 0.005).

**CONCLUSION**
A new biomarker for noninvasive US evaluation of liver status, based on extracting distances between lines of similar intensities from M-mode images, has been developed. Initial results indicate this parameter can correctly classify degree of fibrosis; albeit based on a limited sample size.

**CLINICAL RELEVANCE/APPLICATION**
If these results are reproducible in a larger patient population, it may be possible to replace some liver biopsies with evaluations based on noninvasive, quantitative US biomarkers.

**SSA21-07** • **Dynamic Contrast-enhanced Ultrasound Parametric Maps for the Evaluation of Intratumoral Vasculature: Preclinical Study**

**Stephanie Pitre-Champagnat**; **Ingrid Leguerney**; **Jacques Bosq**; **Fabian Kliessing** MD; **Benedicte Coiffier** (Presenter); **Nathalie B Lassau** MD, PhD *

**CONCLUSION**
Parametric maps from raw linear data can be performed in short process time with moving average model, and reflect reliably the heterogeneous histological measures within tumor by considering the contribution of the vessel size in the variations of intratumoral blood volume.

**Background**
Parametric maps from Dynamic Contrast-Enhanced Ultrasoundography (DCE-US) appear as a useful tool to describe the intratumoral vasculature and its heterogeneity. This study was designed to identify the best processing of parametric maps from raw data and to compare the results to histologic vascularity measurement.

**Evaluation**
DCE-US was performed on 17 melanoma-bearing nude mice after a 0.1mL bolus injection of SonoVue (Bracco, Italy). Parametric maps treated time intensity curves (TIC) from raw linear data to extract pixelwise two parameters related to blood volume that were area under the curve (AUC) and peak intensity (PI). Three mathematical models were compared to fit the TIC in each pixel: a polynomial model used in clinical routine, a moving average model and a combination of two linear regressions. Parametric maps performed from the best fit approach were compared with histology for both region of interest (ROI) of whole tumor and several subROIs of 15mm2 within each tumor to reflect intratumoral vascular heterogeneity. As ground truth correlate, microvessel densities (MVD) were determined, and vessels size only for subROIs.

**Discussion**
Renal Doppler

Sunday, 02:00 PM - 03:30 PM • E450B

**RC110 • AMA PRA Category 1 Credit™: 1.5 • ARRT Category A+ Credit: 1.5**

**RC110A • Masses and Parenchymal Diseases**

**John J Cronan MD (Presenter)**

**LEARNING OBJECTIVES**

1) Optimize the information available from ultrasound related to chronic renal disease. 2) Assess the finding related to acute renal injury. 3) Define ultrasounds role in assessment of renal masses.

**ABSTRACT**

Ultrasound is the primary imaging technique to evaluate the kidneys when acute kidney injury occurs (AKI). We will look at techniques to optimize the evaluation of the kidneys and help clinical decision processes. Identification of chronic/irreversible renal signs is critical in patient management. Renal mass assessment remains simple, cyst vs. non-cyst.
**ABSTRACT**

Evaluation of the renal arteries and kidneys is an integral component of the workup of renal insufficiency and hypertension. Doppler ultrasound and examination is proven valuable in the detection of renal artery stenosis and occlusion. Doppler ultrasound has multiple advantages over CT or MR angiography: noninvasive, no radiation and does not require administration of contrast material. This program will discuss the techniques and protocols needed for successful renal artery evaluation with Doppler ultrasound. Tips to optimize the examination will be provided. There will also be a discussion of the evaluation of renal artery stents.

**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 vascular stenosis and occlusion, parenchymal perfusion, and planning and assessing organ biopsy. Doppler techniques to avoid false negative and false positive studies will be emphasized. Controversial parameters will be stressed, in particular the use of absolute velocities versus ratios in the diagnosis of renal artery stenosis. Surgical emergencies will be highlighted, and the role of correlative imaging with CT, MR and/or angiography will be addressed.

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**Techniques for Interventional Sonography and Thermal Ablation (Hands-on Workshop)**

**Sunday, 02:00 PM - 03:30 PM**

**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) Review the normal parenchymal and vascular anatomy of renal transplants including their normal Doppler parameters. 2) Identify the most common causes of renal transplant complications and criteria for their diagnosis. 3) Outline some of the pitfalls in transplant ultrasound imaging and when to use CT, MR and/or angiography in addition to ultrasound.

**ABSTRACT**

This lecture will review the anatomy and pathophysiology of renal transplants. The role of ultrasound imaging in assessment of acute as well as chronic renal transplant dysfunction will be elucidated. The performance of Doppler ultrasound will be highlighted regarding vascular stenosis and occlusion, parenchymal perfusion, and planning and assessing organ biopsy. Doppler techniques to avoid false negative and false positive studies will be emphasized. Controversial parameters will be stressed, in particular the use of absolute velocities versus ratios in the diagnosis of renal artery stenosis. Surgical emergencies will be highlighted, and the role of correlative imaging with CT, MR and/or angiography will be addressed.

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**First Trimester Ultrasound**

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

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

**RC210A • Diagnosis of Nonviable Pregnancy**

Peter M Doubit, MD, PhD (Presenter)

**LEARNING OBJECTIVES**

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

**ABSTRACT**

1. Sonographic Criteria for Diagnosing Pregnancy Failure (Miscarriage) in an Intrauterine Pregnancy of Uncertain Viability [Note: an intrauterine fluid collection with rounded edges in a woman with positive hCG is almost certainly a gestational sac; it is definitely a gestational sac if it contains a yolk sac or embryo.] 1. Criteria for definite miscarriage (i) CRL = 2 weeks after a scan that showed a gestational sac without yolk sac; (iv) Absence of embryo with heartbeat >=11 days after a scan that showed a gestational sac with yolk sac 2. Criteria suspicious for miscarriage (i) CRL =6 weeks after LMP; (vi) Empty amnion (amnion seen adjacent to yolk sac, with no visible embryo); (vii) Enlarged yolk sac (>7 mm); (viii) Small gestational sac size in relation to the embryo II. Guidelines Related to the Possibility of a Viable Intrauterine Pregnancy in a Pregnancy of Unknown Location (positive pregnancy test and no intrauterine or ectopic pregnancy seen on ultrasound) 1. A single hCG, regardless of its level, does not reliably distinguish between ectopic and intrauterine pregnancy (viable or nonviable) 2. If a single hCG is >3000 mIU/ml, a viable intrauterine pregnancy is possible but unlikely. However, the most likely diagnosis is nonviable IUP, so it is generally appropriate to get at least one followup hCG before treating for ectopic pregnancy.

**RC210B • Diagnosis and Treatment of Ectopic Pregnancy**

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

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

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

LEARNING OBJECTIVES
1) Use ultrasound during the first trimester to confirm the normal development of various fetal structures at specific gestational ages. 2) acquire the correct transvaginal sonographic image to measure the fetal nuchal translucency between 11 and 14 weeks gestation and recognize when the nuchal translucency is abnormal. 3) use ultrasound to detect certain serious anomalies of the fetal cranium and brain during the latter half of the first trimester. 4) distinguish between normal physiologic herniation of the bowel into the base of the umbilical cord from a ventral wall defect, such as an omphalocele or gastrochisis in the first trimester.

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

Master Class in Musculoskeletal Ultrasound (How-to Workshop)
Monday, 08:30 AM - 10:00 AM • E258

RC231 • AMA PRA Category 1 Credit ™•1.5 • ARRT Category A+ Credit:1.5
Marnix T Van Holshbeek, MD *
Kenneth S Lee, MD
Catherine B Brandon, MD *
Michael A Dipietro, MD
Alberto S Tagliafico, MD
Joseph H Introcaso, MD

LEARNING OBJECTIVES
1) Recognize the spectrum of findings at transvaginal ultrasound in ectopic pregnancy. 2) Perform skills for scanning difficult patients. 3) Follow rigorous protocols for the examination of different anatomic regions. 4) Position patients for more complicated musculoskeletal ultrasound examinations. 5) Recognize and integrate the importance of tissue movement in judging the functionality of the extremities.

ABSTRACT
In this Musculoskeletal Ultrasound Master class, an opportunity will be given to participants to start a written dialogue in advance to RSNA 2012. The electronically submitted questions will be sorted by instructor and organized per topic. A select number of recurrent themes in these questions will be prepared for dialogue on stage. When the questions focus on a particular scanning skill, the authors of the questions will be invited on the examination platform to show problems they encounter in their practice. By using a step-by-step approach in solving the scanning issues, all who are present should benefit from the technical interactions on stage. Cameras will project scanning details on large screens. The seating in the master class will guarantee close proximity for an enriching interaction between audience and stage. At the end of the master class, the audience will be broken up in smaller groups for a more personal interaction with the instructors with the intent of improving scanning skills on an individual level.

US-guided Intervventional Breast Procedures (Hands-on Workshop)
Monday, 08:30 AM - 10:00 AM • E264

RC252 • AMA PRA Category 1 Credit ™•1.5 • ARRT Category A+ Credit:1.5
Gary J Whiteman, MD *
Annamaria Wilhelm, MD *
Richard M Chesbrough, MD *
Michael N Linver, MD *
Paula B Gordon, MD *
Stamatia V Destounis, MD
Anna I Holbrook, MD
Alice S Rim, MD
Alda P Cassi, MD
Eren D Yeh, MD
Gary W Swenson, MD
LEARNING OBJECTIVES
1) Describe the 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.

ABSTRACT
This course is intended to familiarize the participant with equipment and techniques in the application of US guided breast biopsy and needle localization. Participants will have both basic didactic instruction and hands-on opportunity to practice biopsy techniques on tissue models with sonographic guidance. The course will focus on the understanding and identification of: 1) optimal positioning for biopsy 2) imaging of adequate sampling confirmation 3) various biopsy technologies and techniques 4) potential problems and pitfalls.

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 M 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.

Second and Third Trimester Obstetrical Ultrasound

Tuesday, 08:30 AM - 10:00 AM • S405AB

RC310 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
RC310A • Support Structures

Vickie A Feldstein MD (Presenter)

LEARNING OBJECTIVES
1) Understand normal development and anatomy of the placenta and umbilical cord. 2) Optimize sonographic techniques for correct assessment of the placenta and cord. 3) Enhance knowledge of common and clinically important abnormalities of the placenta and cord to improve skills for accurate detection by ultrasound. 4) Recognize abnormal placentation, detect placenta accreta, plaenca previa, and vasa previa in effort to optimize clinical care and management.

ABSTRACT
Normal placental and umbilical cord development and anatomy will be reviewed. Sonographic manifestations of common abnormalities of the placenta and cord will be presented. Ultrasound (US) findings will be demonstrated, highlighted with pathologic correlation. Attention to the placenta, an often-overlooked crucial structure, is important in the optimal performance and interpretation of 2nd and 3rd trimester obstetrical US. Placental thickness, morphology and echotexture will be addressed. Retroplacential hematomas, which may present clinically as abruption, pose risk to the fetus and impact management. Placenta previa, a placenta that over lies or is proximate to the internal cervical os, is the most common cause of bleeding in the 3rd trimester. US detection and suggested terminology regarding previa will be reviewed. Vasa previa is rare, but clinically important condition related to placenta previa in which umbilical cord and/or fetal vessels are positioned between the presenting fetal part and cervix. Possible consequences of this condition, including hemorrhage and potential fetal exsanguination, are devastating. Improved outcomes depend upon accurate prenatal diagnosis and delivery by cesarean section. Placenta accreta refers to abnormal adherence of the placenta to the uterus with subsequent failure to separate after delivery of the fetus. Careful assessment of at-risk pregnancies is indicated as this condition may lead to massive obstetric hemorrhage. Prenatal diagnosis allows effective delivery management planning to minimize morbidity. Umbilical cord abnormalities can be found and have clinical implications. The most common abnormality of the cord is a single umbilical artery (SUA). Discovery of SUA prompts a search for any other detectable fetal malformation. Velamentous cord insertion, with attachment of the cord beyond the placental edge into the free membranes of the placenta, is associated with increased risk and this too can be detected by US.

RC310B • Fetal Genitourinary Anomalies

Roya Sohaey MD (Presenter) *

LEARNING OBJECTIVES
1) Recognize the appearance of the normal fetal adrenal gland, kidney, bladder and genitalia in the first, second and third trimester. Anomalies of these structures will be shown and strategies for making accurate diagnoses of anomalies will be taught. 2) Current in utero and post natal treatment plans for fetal genitourinary anomalies will be discussed, particularly for prenatal and postnatal workup and evaluation of fetal hydronephrosis. The Society of Fetal Urologists grading system of hydronephrosis will be reviewed and it’s utility in clinical practice discussed.

ABSTRACT
Genitourinary (GU) abnormalities are common in fetal life and range in severity from idiopathic, as in most cases of pelviectasis, to lethal, as in renal agenesis. A systematic approach to evaluation of the GU tract is important in order to make an accurate diagnosis. The fetal kidneys should be documented in two orthogonal planes. The adrenal gland can mimic the kidney if only the axial plane is obtained. The fetal bladder should be seen filling and emptying during the study. The adrenal glands are often easily identified and the fetal genitalia should be assessed whenever GU anomalies are seen. The approach to the abnormal urinary tract starts with identifying both kidneys and evaluating renal echogenicity and morphology. If hydronephrosis is present then quantitative and qualitative assessment of the whole collecting system, from calyces to urethra is performed. The anterior-posterior renal pelvis is measured and the SPV grade of hydronephrosis is estimated. If renal cysts are present then the differential diagnosis of multicystic dysplastic kidney vs renal cystic
dysplasia (either primary or secondary) is explored. An abnormal fetal bladder is one which is either consistently ‘too small’ or ‘too large’, and the cause can be anatomic or physiologic. Adrenal masses can occur in utero or more often, the adrenal gland may be displaced by a suprarenal mass that is not adrenal in origin, such as an exophytic or pulmonary sequestration. Congenital adrenal hyperplasia presents as enlarged adrenal glands and is associated with ambiguous genitalia in female fetuses. Genitalia anomalies can be isolated or associated with syndromes and aneuploidy. Making an accurate diagnosis of fetal GU anomalies results in better prenatal counseling and postnatal treatment. Some fetuses with GU anomalies may benefit from in utero intervention as well, such as bladder drainage. Most need prenatal and postnatal surveillance which is often determined by the prenatal findings.

**RC310C • Multiple Gestations**

Anne M Kennedy MD (Presenter)

**LEARNING OBJECTIVES**

1) Determine chorionicity and amnionicity and understand why it is important to do so in all multiple gestations. 2) Understand and diagnose specific complications of monochorionic twinning such as twin to twin transfusion syndrome and twin reversed arterial perfusion. 3) Recognize the indications for more frequent surveillance and intervention in complicated twin pregnancies.

**ABSTRACT**

The prognosis in multiple gestations is dependent on chorionicity therefore it is essential that this be documented in all cases. The easiest time to do this is in the first trimester but we will review tips for diagnosis in the second and third trimesters as well. Specific complications of monochorionic twinning include twin to twin transfusion syndrome (TTTS) in which there is an arteriovenous shunt from the donor twin to the recipient. The donor is oligemic and the recipient is hypovolemic thus there is oligohydramnios in the donor sac and polyhydramnios in the recipient sac. Untreated the outcome is poor but laser ablation of the vascular connections in the placenta has markedly improved prognosis. In twin reversed arterial perfusion (TRAP) there is an artery to artery anastomosis between the pump twin and the malformed co-twin which can become very large. It is important to recognize TRAP sequence early in pregnancy as the abnormalities in the malformed twin are lethal. The pump twin is at risk for hydrops due to the high output state. Early intervention prevents continued growth of the abnormal twin and protects the pump twin such that the patient has a good prognosis for one live birth. Multiple gestations are at risk for growth restriction and discordant growth; the incidence of fetal anomalies and maternal complications of pregnancy is also increased. Because of this multiple gestations are followed more intensively that singletons and, when monochorionic, surveillance for specific complications is increased. The prognosis for TTTS and TRAP is much improved with intervention but there is finite window of opportunity in which interventional procedures can be performed thus appropriate referral is essential. Accurate diagnosis of chorionicity and early recognition of complications in multiple gestations will result in better management and improved outcomes.

**MR-Guided High Intensity Frequency Ultrasound (HIFU)**

Tuesday, 08:30 AM - 10:00 AM • SS04CD

**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 a combination of tumor targeting, real-time monitoring during treatment, and immediate verification of successful treatment. The results of the pivotal Phase III trial that led to FDA approval of the ExAblate MR guided focused ultrasound device for the palliation of painful metastases to bone will be reviewed. In particular, patient selection, the technical aspects of successful patient treatment, and post-treatment assessment of results will be described. Concepts for future development of this technology with regard to the management of osseous metastatic disease will also be presented.

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

Kim R Butts Pauly, PhD (Presenter) *

**LEARNING OBJECTIVES**

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

**ABSTRACT**

Focused ultrasound uses a large area array, typically outside the body, that is geometrically or electronically focused to a point. Such focusing 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 of MR thermometry is straightforward: changes in hydrogen bonding with temperature result in a change in the proton resonant frequency, seen in the phase of gradient echo images. Temperature standard deviations less than 1°C are readily achievable and thermal dose 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 aberrations from the skull. Considerations for MR thermometry are motion of the target tissue or motion of other organs such as occurs during respiration. In addition, metallic hardware from prior surgeries reduce the visualization on MR temperature maps. Further, there is little visualization of temperature rises in adipose tissue, and in some cases the FUS equipment prevents the use of local coils. Nonetheless, recent developments in MRgFUS are overcoming these challenges.

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

Jeff Elias (Presenter)

**LEARNING OBJECTIVES**

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

**ABSTRACT**

Recent advances in ultrasound transducer technology have now enabled the precise delivery of acoustic energy to deep regions of the
brain with 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 Gedroc** 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 nonperfused volume of greater than 60% is achieved symptomatic response is well over 80% at one year and that the requirement for further fibroid related treatment is 11% at two years. Because of the outpatient non-invasive nature of the procedure FUS becomes highly cost-effective Percutaneous destruction of liver tumours in a completely non-invasive manner would 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 currently addressed by controlled ventilation during FUS. Technological improvements are slowly being implemented to address these areas.

The hands-on component of the course.

**LEARNING OBJECTIVES**

1) Understand basic concepts associated with abdominal, extremity and carotid Doppler. 2) Describe ultrasound techniques, protocols, and diagnostic criteria for evaluation of the carotid arteries. 3) Gain experience in Doppler techniques through personalized hands-on scanning of models with a variety of ultrasound machines. 4) Describe common pitfalls in Doppler examinations.

**ABSTRACT**

This hands-on course will focus on the details that constitute good Doppler technique in the evaluation of vascular flow, specifically within the neck, extremities and abdomen. Technical considerations for optimization of Doppler images will be discussed and the concepts will be applied to abnormalities commonly encountered in patients. Initial brief lectures will begin by discussing common pitfalls in vascular imaging and then followed by basic concepts and techniques of renal Doppler. The majority of the session will give participants an opportunity to scan live models to improve technical skills in color and spectral Doppler. Faculty will be available at multiple stations using a variety of ultrasound machines. Participants will be encouraged to inquire about any areas of interest in the neck, abdomen, pelvis, or extremities during the hands-on component of the course.

**URLs**

umhamper@jhu.edu

**Doppler US: Visceral, Extremity and Carotid Applications (Hands-on Workshop)**

**Tuesday, 08:30 AM - 10:00 AM • E264**

**RC352 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5**

**Shweta Bhatt**, MD, MBBS

**Wui K Chong**, MD *

**M. Robert Dejong** *

**Vikram S Dogra**, MD *

**Corinne Deurdulian**, MD

**Edward G Grant**, MD *

**Ulrike M Hamper**, MD, MBA

**Felix A Hester**

**Mark E Lockhart**, MD

**Mani Montazemi**

**Michelle L Robbin**, MD *

**Ravinder Sidhu**, MD

**Leslie M Scoutt**, MD *

**Sadhana Verma**, MD *

**LEARNING OBJECTIVES**

1) Be familiar with ultrasound examination and anatomy of the shoulder and common pathology.

**VSMK31-01 • Shoulder Ultrasound (Demonstration)**

**Jon A Jacobson** MD (Presenter) *

**LEARNING OBJECTIVES**

1) Be familiar with ultrasound examination and anatomy of the shoulder and common pathology.

**VSMK31-02 • Ultrasound Assessment of the Rotator Cable and Correlation with Functional Outcome, Tear Size and Muscle Fatty Atrophy**

**Etienne Blain Pare**, MD, FRCP (Presenter) ; **Karim Basile** MD ; **Nicola Hagemeister** * ; **Patrice Tetreault** MD, MSc ; **Dominique Rouleau** MD, MSc ; **Nathalie J Bureau** MD
Diagnostic Performance of Conventional Ultrasonography Combined with US Strain Elastography for Differentiation between Benign and Malignant Subcutaneous Soft Tissue Mass Lesions

Tharakeswara Kumar Bathala MD (Presenter) ; Gaiane M Rauch MD, PhD ; Melanie Bass ; Deborah Borst ; Brian Hobbs PhD ; Deepak G Bedi MBBCch *

PURPOSE
To evaluate diagnostic performance of conventional ultrasonography (US) combined with US Strain Elastography (USE) for differentiation between benign and malignant subcutaneous soft tissue mass lesions, with the pathology as reference standard.

METHOD AND MATERIALS
After Institutional IRB approval, we identified 74 patients with a subcutaneous soft tissue mass who had US and USE from January 2009 to May 2012. Three radiologists retrospectively reviewed US and USE images in consensus. Gray scale US imaging features were classified as benign, malignant and indeterminate. USE images were assessed according to tissue elasticity based on color scale and classified as soft, intermediate and hard. Pathological diagnosis obtained either by percutaneous biopsy or surgical excision was used as reference standard. The statistical analysis included evaluation of the diagnostic performance of USE for US and USE for US + USE. Bowker’s test was used for evaluation of matched US and USE outcomes for symmetry.

RESULTS
Out of 74 lesions, US 37 were classified as benign, 8 indeterminate, 29 malignant. USE found 35 benign, 14 indeterminate, 25 malignant. The estimated sensitivity and 95% CI for US, USE and US+USE were 71% (57-82%), 67% (53-79%), and 77% (63-87%) respectively. Specificity for the diagnosis of malignancy was 100% for US, 96% for USE and 98% for USE+USE. There was significant difference in accuracy, sensitivity, specificity and positive and negative likelihood ratios between USE and USE+USE. The AUC for USE+USE was 0.97 while for USE it was 0.91.

CONCLUSION
In the presence of an indeterminate result on conventional US, USE may improve specificity for diagnosing subcutaneous soft tissue lesions. Combination of US and USE could provide a better diagnostic performance than conventional US alone.

CLINICAL RELEVANCE/APPLICATION
Addition of USE evaluation to conventional gray scale US imaging improves imaging-based diagnostic information for soft tissue nodule work up.
VSMK31-05 • Value of Real-time Sharewave Elastography in Achilles Tendinopathy: Is the Abnormal Tendon Softer?

Jean-Philippe Nueffer MD (Presenter) ; Fabio Becce MD ; Fabrice Michel MD, PhD ; Benoit Barbier-Brion MD ; Adrian Kastler MD, MSc ; Sebastien L Aubry MD, PhD

PURPOSE
To determine if the viscoelastic properties of Achilles tendon assessed by real-time sharewave elastography (SWE) are modified in tendinopathy

METHOD AND MATERIALS
Twenty-six abnormal tendons (16 unilateral and 5 bilateral tendinopathies) from 21 patients with Achilles tendinopathy and 176 normal tendons (from 16 patients and 80 healthy volunteers) were prospectively included and compared. Mean sharewave velocity (Vmean) was measured on axial and sagittal SWE images at two degrees of passive ankle flexion (position 1: complete planar flexion; and position 2: 0 degree flexion). Tendon maximum anteroposterior and lateral diameters, cross sectional area and the presence of tears were also noted.

RESULTS
In position 1, the abnormal tendons Vmean was significantly lower than for contralateral normal tendons on sagittal (?=1.23m/s, p=0.004) and axial elastograms (?=0.68m/s, p=0.03); and significantly lower than for normal tendons only on axial images (?=0.49m/s, p=0.01). In position 2 and on axial elastograms, the abnormal tendons Vmean was 1.14m/s lower than for contralateral normal tendons however without reaching statistical significance (p=0.07). In position 2, the abnormal tendons Vmean was significantly lower than for normal tendons on sagittal (?=1.26 m/s, p=0.02).

CONCLUSION
Abnormal Achilles tendons have lower Vmean and are therefore softer than normal tendons. There is no SWE signal into tendon tears.

CLINICAL RELEVANCE/APPLICATION
Tendon softening, assessed by real-time SWE, is a new helpful tool in the evaluation of Achilles tendinopathy. SWE may also provide quantitative parameters to assess the severity of tendinopathy.

VSMK31-06 • Ultrasound-guided Shoulder Injection

Etienne Cardinal MD (Presenter)

LEARNING OBJECTIVES
1) Be familiar with ultrasound examination and anatomy of the hip and common pathology.

VSMK31-07 • Ultrasound-guided (US) Percutaneous Treatment of Rotator Cuff Calcific Tendinitis (RCCT): Randomized Comparison between One- and Two-needle Procedure

Davide Orlandi MD (Presenter) ; Giulio Ferrero ; Francesca Lacelli MD ; Enzo Silvestri MD ; Giovanni Serafini MD ; Luca Maria Sconfienza MD, PhD

PURPOSE
US-Guided percutaneous treatment of RCCT has been widely demonstrated to be effective using one or two needles, but direct comparison between the two methods has never been performed. Our aim was to compare the technical and one-year clinical outcome of these two different approaches.

METHOD AND MATERIALS
IRB approval and patients' informed consent were obtained. One hundred patients to be treated for RCCT diagnosed with ultrasound (77 females, mean age 46y, range 32-70 years) were randomized into two groups. Group A (50 patients; mean visual analogue scale [VAS]=7.8) was treated using an US-guided 16G double-needle technique (local anesthesia, washing with warm saline, intrabursal steroid), while group B (50 patients; mean VAS=7.4) was treated using a 16G single-needle technique. Calcification appearance at US (fluid, soft, hard), procedure time and ease of calcium dissolution (subjectively scored as easy=1, intermediate=2, difficult=3) were recorded. VAS follow-up was performed at 1,3,6 and 12 months. Complication rate was noted. Mann-Whitney U and Chi-square statistics were used.

RESULTS
CONCLUSION
One- and two-needle procedures are equally effective in treating RCCT with no major complications. Two-needle procedure allows for significantly reducing treatment time and appears to be much easier when dealing with soft and hard calcium deposits.

CLINICAL RELEVANCE/APPLICATION
Two needles US-guided percutaneous treatment of RCCT seems to be the treatment of choice in patients affected by soft and hard calcifications, compared to one needle technique.

VSMK31-08 • Postoperative Monitoring of Local and Free Flaps with Contrast Enhances Ultrasound (CEUS)- Analysis

Ernst Michael Jung MD (Presenter) ; Janine Rennert MD ; Lukas Prantl MD

PURPOSE
Tissue defects are a common problem in trauma surgery or oncology. Flap transplantation is often the only therapy to cover these extensive wound defects. To date several monitoring systems exist but none has made it to clinical day work. Objective: Aim of this study was to assess perfusion disturbances of local and free flaps using contrast enhanced ultrasound (CEUS).

METHOD AND MATERIALS
112 patients were examined after local or free flap transplantation during the first 72 hours after operation. CEUS was performed by one experienced examiner with a linear transducer (6-9 MHz, LOGIQ E9/GE) after a bolus injection of 2.4 ml sufohexa-fluoride microbubbles (SonoVue, Bracco, Italy). Retrospective vascular perfusion was quantified by evaluating the stored DICOM cine loops using the perfusion software QONTRAST (Bracco, Italy). Over a total penetration depth of 3 cm every centimetre was analysed separately. The measured perfusion parameters were: peak (peak time), time to peak (TTP), reciprocal value of time to peak (1/TTP), maximum time (RTmax), time to maximum (RTmax), area under curve (AUC), and time under curve (TUC).

RESULTS
Regarding the complete flap size quantitative analysis showed significant higher perfusion values in patients without complications compared to patients with complications: PEAK 16.5 vs. 10.0 (p=0.001), TTP 32.6 vs. 22.2 (p=0.001), RBV: 738.8 vs. 246.2 (p=0.001), MTT: 112.0 vs. 69.7 (p=0.001). The highest correlation was found for PEAK and MTT (r(2)=0.49, p=0.001). The ROC curve showed a sensitivity of 91% and a specificity of 91% for PEAK with a cut-off value of 16.5. The second best parameter was RBV with a sensitivity of 88% and a specificity of 91%.

CONCLUSION
CEUS was capable of detecting vascular disturbances after flap transplantation. TTP, RBV and MTT seem to be the most accurately parameters and are very unsusceptible to malfunction during measurement.

CLINICAL RELEVANCE/APPLICATION
CEUS offers an excellent imaging method to detect early reduction of the tissue transplants microvascularization also if MRI is not available or not realizizable.

VSMK31-09 • The Effects of US-guided Injection of Platelet-rich-Plasma (PRP) on the Degenerative Disease of the Achilles and Patellar Tendon in Athletes

Alice La Marra MD (Presenter) ; Lorenzo Maria Gregori ; Silvia Mariani MD ; Luigi Zugaro ; Antonio Barile ; Carlo
Preliminary Results of a Randomized Controlled Trial

VSMK31-12 • Magnetic Resonance Imaging in 40 Normal Volunteers and 10 Cadaveric Specimens with Surgical Correlation

METHOD AND MATERIALS
In the last three years we evaluated 50 athletes with degenerative tendinosis of Achilles tendon and 30 athletes with degenerative tendinosis of patellar tendon. All the patients were first evaluated through diagnostic testing (MRI and US guided) and then through clinical follow-ups (VAS for pain and VISA-A and VISA-P for functionality). The patients underwent a cycle of platelet rich plasma US-guided infiltrations every 21 days for a total of three treatments. Another MRI was performed 30 days and one year after the last infiltration.

RESULTS
In the patients with tendinosis of Achilles tendon we have found an improved overall by 80% (VAS) and 53% (VISA-A). Relatively to the patellar tendon, the VAS value is increased of 75% (VAS) and 50% (VISA P). We observed partial or complete morphological recovery and normalization of MRI signal in 90%. We observed a reduction of sectional area in the Achilles tendon in 39/50 cases and in the patellar tendon in 18/30 cases. Eight patients with tendinosis of Achilles tendon presented an area increased by 10% and five patients with tendinosis of patellar tendon presented an area increased by 15%. The mean VAS at one year of treatment improved in all cases overall by 70%.

CONCLUSION
Our study showed that in patients who underwent PRP treatments there was an improvement of the functionality, a decrease in pain and a normalization of the signal intensity seen on MRI. Therefore, our experience proves that PRP infiltration may be a good therapeutic alternative for the treatment of Achilles and patellar tendinopathy in athletes.

CLINICAL RELEVANCE/APPLICATION
The US-guided PRP treatment in case of degenerative tendon diseases may increase Achilles’ and Patellar tendons functionality and reduce recovery times in athletes.

VSMK31-10 • Ultrasound-guided Percutaneous Injection for De Quervain’s Disease Using Three Different Techniques: Preliminary Results of a Randomized Controlled Trial

Luca Maria Sconfienza MD (Presenter) ; Davide Orlandi MD ; Emanuele Fabbro MD ; Giovanni Mauri MD ; Giovanni Serafini MD ; Francesco Sardanelli MD *

PURPOSE
To evaluate and show the result of injection with Platelet Rich Plasma (PRP) of tendinosis of Achilles and Patellar tendon in athletes.

METHOD AND MATERIALS
In the last three years we evaluated 50 athletes with degenerative tendinosis of Achilles tendon and 30 athletes with degenerative tendinosis of patellar tendon. All the patients were first evaluated through diagnostic testing (MRI and US guided) and then through clinical follow-ups (VAS for pain and VISA-A and VISA-P for functionality). The patients underwent a cycle of platelet rich plasma US-guided infiltrations every 21 days for a total of three treatments. Another MRI was performed 30 days and one year after the last infiltration.

RESULTS
In the patients with tendinosis of Achilles tendon we have found an improved overall by 80% (VAS) and 53% (VISA-A). Relatively to the patellar tendon, the VAS value is increased of 75% (VAS) and 50% (VISA P). We observed partial or complete morphological recovery and normalization of MRI signal in 90%. We observed a reduction of sectional area in the Achilles tendon in 39/50 cases and in the patellar tendon in 18/30 cases. Eight patients with tendinosis of Achilles tendon presented an area increased by 10% and five patients with tendinosis of patellar tendon presented an area increased by 15%. The mean VAS at one year of treatment improved in all cases overall by 70%.

CONCLUSION
Our study showed that in patients who underwent PRP treatments there was an improvement of the functionality, a decrease in pain and a normalization of the signal intensity seen on MRI. Therefore, our experience proves that PRP infiltration may be a good therapeutic alternative for the treatment of Achilles and patellar tendinopathy in athletes.

CLINICAL RELEVANCE/APPLICATION
The US-guided PRP treatment in case of degenerative tendon diseases may increase Achilles’ and Patellar tendons functionality and reduce recovery times in athletes.

VSMK31-11 • High-resolution Ultrasonography of the Dorsal and Palmar Extrinsic Wrist Ligaments in Correlation with 3T Magnetic Resonance Imaging in 40 Normal Volunteers and 10 Cadaveric Specimens with Surgical Correlation

Miha S Tjaljanovic MD (Presenter) ; Dean Holden MD, FRCP ; Elizabeth A Krupinski PhD ; Joseph E Sheppard MD

PURPOSE
To confirm that high-resolution ultrasonography (HRUS) has comparable results with 3T Magnetic Resonance Imaging (MRI) in visualization of the extrinsic wrist ligaments.

METHOD AND MATERIALS
HRUS and 3T MRI of the extrinsic wrist ligaments were performed on 10 fresh frozen cadaveric wrist specimens and on 40 wrists in normal volunteers. Dorsal radiocarpal—DRCL, dorsal intercarpal—DICL and dorsal ulnotriquetral—DUTL, radioscaphocapitate—RSCL, long radiolunate—LRL, short radiolunate—SRL, radioscapholunate—RSCL, palmar radiolunate—PULL, palmar ulnotriquetral—PUTL, ulnocapitate—UCL, and palmar scaphotriquetral—PSTL ligaments were evaluated. The ligaments were graded by two examiners in consensus, using the following grading system: Grade 1- ligament completely seen, Grade 2- ligament partially seen (< 100 % but > 50% of the ligament clearly seen) and Grade 3- ligament not seen (< 50% of the ligament clearly seen). Visibility on US and 3T MRI was compared using the following grading system: A- ligament equally well seen on US and MRI, B- ligament better seen on MRI, and C- ligament better seen on US. All cadaveric wrists were dissected by an orthopaedic hand surgeon. The results for each of the ligaments were shown in percentages. Differences between the distributions of percentages were tested for significance using the X2 test.

RESULTS
None of the examined 550 ligaments received grade 3. For MRI there was a significant difference in visualization of the ligaments (X2 = 143.04, p < 0.0001) with DUTL, RSCL and UCL receiving significantly more scores of Grade 2 than the other ligaments. There was a significant difference (X2 = 335.72, p < 0.0001) with DUTL, PUTL, and PSTL receiving significantly more scores of Grade 2 than the other ligaments. On surgical dissections in 10 cadavers all dorsal and palmar extrinsic wrist ligaments were intact.

CONCLUSION
HRUS enables satisfactory visualization of the extrinsic wrist ligaments with results that are at least comparable to 3T MRI.

CLINICAL RELEVANCE/APPLICATION
High-resolution ultrasonography enables good visualization of the extrinsic wrist ligaments and can be utilized in evaluation of these structures in routine clinical practice and sports medicine.

VSMK31-12 • Ultrasound-guided Percutaneous Injection for De Quervain’s Disease Using Three Different Techniques: Preliminary Results of a Randomized Controlled Trial

Luca Maria Sconfienza MD, PhD (Presenter) ; Davide Orlandi MD ; Emanuele Fabbro MD ; Giovanni Mauri MD ; Giovanni Serafini MD ; Francesco Sardanelli MD *

PURPOSE
To confirm that high-resolution ultrasonography (HRUS) has comparable results with 3T Magnetic Resonance Imaging (MRI) in visualization of the extrinsic wrist ligaments.

METHOD AND MATERIALS
HRUS and 3T MRI of the extrinsic wrist ligaments were performed on 10 fresh frozen cadaveric wrist specimens and on 40 wrists in normal volunteers. Dorsal radiocarpal—DRCL, dorsal intercarpal—DICL and dorsal ulnotriquetral—DUTL, radioscaphocapitate—RSCL, long radiolunate—LRL, short radiolunate—SRL, radioscapholunate—RSCL, palmar radiolunate—PULL, palmar ulnotriquetral—PUTL, ulnocapitate—UCL, and palmar scaphotriquetral—PSTL ligaments were evaluated. The ligaments were graded by two examiners in consensus, using the following grading system: Grade 1- ligament completely seen, Grade 2- ligament partially seen (< 100 % but > 50% of the ligament clearly seen) and Grade 3- ligament not seen (< 50% of the ligament clearly seen). Visibility on US and 3T MRI was compared using the following grading system: A- ligament equally well seen on US and MRI, B- ligament better seen on MRI, and C- ligament better seen on US. All cadaveric wrists were dissected by an orthopaedic hand surgeon. The results for each of the ligaments were shown in percentages. Differences between the distributions of percentages were tested for significance using the X2 test.

RESULTS
None of the examined 550 ligaments received grade 3. For MRI there was a significant difference in visualization of the ligaments (X2 = 143.04, p < 0.0001) with DUTL, RSCL and UCL receiving significantly more scores of Grade 2 than the other ligaments. For US, there was a significant difference in visualization of the ligaments (X2 = 143.04, p < 0.0001) with DUTL, PUTL, and PSTL receiving significantly more scores of Grade 2 than the other ligaments. There was a significant difference (X2 = 335.72, p < 0.0001) with DUTL, PUTL, and PSTL receiving significantly more scores of Grade 2 than the other ligaments and the other 8 ligaments receiving more scores of Grade 3. On surgical dissections in 10 cadavers all dorsal and palmar extrinsic wrist ligaments were intact.

CONCLUSION
HRUS enables satisfactory visualization of the extrinsic wrist ligaments with results that are at least comparable to 3T MRI.

CLINICAL RELEVANCE/APPLICATION
High-resolution ultrasonography enables good visualization of the extrinsic wrist ligaments and can be utilized in evaluation of these structures in routine clinical practice and sports medicine.
VSMK31-10 • Ultrasonography of the Radial and Ulnar Collateral Ligaments of the Wrist with Surgical Correlation

Miha S Tjaljanovic MD (Presenter); Stephen Johnston; Wynter N Phoenix MD; Joseph E Sheppard MD

Purpose
To re-evaluate the utility of high-resolution sonography (HRUS) in the assessment of collateral ligaments of the wrist.

Method and Materials
HRUS of the radial (RCL) and ulnar (UCL) collateral ligaments of the wrist was performed on 56 cadaveric wrists on the General Electric Logiq 9 ultrasound machine, with a 9-12 MHz linear hockey stick transducer. Both ligaments were primarily scanned in the longitudinal axis using the anatomic landmarks. The visibility of these ligaments was assessed during the sonographic examination by the examiner and additional 3 observers (radiology resident, medical student and ultrasound technologist). The ligaments were classified as well seen, adequately seen or not seen on sonography. Surgical dissections of 12 RCLs and 12 UCLs in 6 cadavers with their surrounding relationships to the extensor tendons and dorsal compartments of the wrist were subsequently performed. The ligaments were classified as present or absent and graded I or II depending on the surgeon's subjective assessment of ligamentous thickness (I- thick, II- thin). HURS and dissection results were then compared.

Results
The RCLs were seen on sonography in all cadaveric wrists in their anatomic locations between the radial styloid and radial aspect of the scaphoid, dorsal to the radial artery and deep and somewhat dorsal to the 1st extensor compartment. They had an echogenic fibrilar appearance. All UCLs had an appearance of a thick echogenic band and were seen between the ulnar styloid and triquetrum abutting the deep aspect of the 6th extensor compartment. In 9 cadavers, 18 right and left RCLs were well seen and in the remaining 19 cadavers they were adequately seen. In 8 cadavers, 16 right and left UCLs were well seen and in the remaining 20 cadavers they were adequately seen. On sonography, the investigators were uncertain if what they called UCLs represent true ligaments or thickening of the joint capsule. On surgical dissections all RCLs and UCLs were proven to be true ligaments. On dissections, 9 of 12 RCLs were graded I and 3 were graded II. All UCLs were graded I on dissections. All of the dissected ligaments were well seen on sonography.

Conclusion
The RCL and UCL of the wrist are true ligaments that can be well seen on HRUS.

Clinical Relevance/Application
The collateral ligaments of the wrist are true ligaments and can be well seen on HRUS which can be utilized in clinical practice in evaluation of these structures.

VSMK31-14 • Prognosis Value of Ultrasonographic Assessment in Muscle Strain Injuries: Longitudinal Study of a 70 Elite Athletes Cohort

Jerome Renoux MD (Presenter); Jean-Louis Brasseur; Philippe Thelen; Christian Dibie

Purpose
To evaluate prognosis value of ultrasonography performed in the first days of muscle strain injuries.

Method and Materials
A prospective cohort study was lead between 2010 and 2012 in the French National Sport Institute. Ultrasonographic assessment of muscle strain lesions was performed between the 2nd and the 8th day. Return to play (total or best clinical recovery) was evaluated with a benefit of a six months hindsight. Correlation between ultrasonographic signs and clinical prognosis was statistically evaluated. Echographic signs included the local semiology (Rodineau and Durey’s 5 classifications system was used), lesion size, lesion type (myofascial vs. pure fascial), and location of the lesion (muscular group, centromuscular vs. perimuscular, proximal vs. distal).

Results
70 patients were recruited. 67% of the lesions were located at the lower limbs, 20% at the upper limbs and 13% at the abdominal or thoracic walls. Mean delay between trauma and ultrasonography was 4.5 days. 3 percents were grade 0 injuries, 33% grade 1, 42% of grade 2, 20% of grade 3 and 2% of grade 4. Return to play time differed between the 5 grades of injuries (respectively 1.2±0.8; 3.1±1.2; 4.8±1.8; 8.5±3.8; 18±10 weeks; p=0.03). Myofascial lesions were correlated with a better lay-off time compared to pure fascial lesions (4.7 vs. 5.8 weeks; p=0.02). Proximal lesions had a poorer prognosis compared to distal lesions (5.2 vs. 3.9 weeks; p=0.009). Recurrence occurred in 16%.

Conclusion
Ultrasonography has a good prognosis value for muscle strain lesions. For this purpose, ultrasonography has to describe precisely the grade, the lesion type and its precise location.

Clinical Relevance/Application
Ultrasonography can help clinicians to determine prognosis of muscle strain lesions. It helps to distinguish two types of lesions (pure fascial and myofascial) with different treatments.

VSMK31-15 • Interesting Musculoskeletal Ultrasound Cases

Jon A Jacobson MD (Presenter)*

Learning Objectives
1) Be familiar with important topics in musculoskeletal ultrasound.

Essentials of Ultrasound

Tuesday, 10:30 AM - 12:00 PM • S100AB

MSES32 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

MSES32A • US Evaluation of the Aorta

Leslie M Scoutt MD (Presenter)*

Learning Objectives
1) Describe the role of ultrasound in screening for abdominal aortic aneurysms. 2) Discuss the role of ultrasound in the follow up of patients s/p endovascular aortic repair (EVAR). 3) Demonstrate examples of other common and uncommon aortic pathology on ultrasound.

Abstract
This lecture is part of the essentials of radiology series and will focus on reviewing the role of ultrasound in screening for abdominal aortic aneurysms and in the follow up of patients who have undergone endovascular aortic repair (EVAR). The ultrasound appearance of endoleaks will be presented and the ultrasound findings in a range of aortic pathology will be discussed including aortic dissection and
Vascular Doppler (An Interactive Session)

Tuesday, 04:30 PM - 06:00 PM • E353B

MSES32B • US of Multiple Gestations

Peter M Doubilet MD, PhD (Presenter)

LEARNING OBJECTIVES
1) Understand the limitations of determining pregnancy number (singleton, twin, triplet, etc.) in the early first trimester. 2) Understand how to determine chorionicity and amnionicity of twins. 3) Diagnose twin-twin transfusion syndrome and other complications of multiple gestations.

ABSTRACT
1. Assessment of Fetal Number (Singleton, Twin, ...)
   Pregnancy number before 6 weeks gestational age is determined by counting gestational sacs and yolk sacs. After 6 weeks, pregnancy number is determined by counting embryos/fetuses in the uterus. Pregnancy number diagnosed on the initial ultrasound in the early first trimester may change on subsequent scans, due to two phenomena: ‘vanishing twin’ and ‘appearing twin’. II. Measurements:
   1. Gestational age (GA) assignment
      (i) Initial sonogram: If the two GA's (determined from measurements as per singleton GA determination) are concordant, assign GA as the average of these two values. If the two GA's are discordant, assign GA as the greater of the two values, and consider the possibility that the smaller twin is abnormal.
      (ii) On all subsequent sonograms, GA is assigned as the sum of the GA by first sonogram plus the number of intervening weeks
   2. Fetal weight estimation and comparison (=24 weeks): Compute an estimated weight and weight percentile for each fetus, and compare the fetal weights by computing the relative weight difference (difference in estimated weights divided by larger twin’s estimated weight). Findings suggesting abnormal growth include: either twin’s weight is 1. Chorionicity is determined by membrane thickness, number of placents, and fetal sex concordance/discordance.
   3. Amnionicity: diamniotic if intertwin membrane seen; monoamniotic if no membrane visible and cords are intermingled IV. Complications
      1. preterm delivery
      2. low birth weight
      3. twin-twin transfusion syndrome (if monochorionic)
      4. acardiac twin (if monochorionic)
      5. conjoinment

MSES32C • US of the Gallbladder and Biliary Tract

Helen Bungay MBBCh (Presenter)

LEARNING OBJECTIVES
1) To be familiar with the normal ultrasound appearances of the gall bladder and biliary tract, including normal variants. 2) To know the wide differential of causes of abnormalities of the gall bladder wall. 3) To recognize the variety of appearances of common benign and malignant processes involving the gall bladder and biliary tract, especially adenomyomatosis, polyps and carcinoma. 4) To be able to use specific features of the biliary ducts in the differential diagnosis of abnormalities of the gall bladder. 5) To have a management strategy for gall bladder polyps. 6) To know the ultrasound appearances of acute cholecystitis and the important signs and complications to look for, including perforation, abscess formation, emphysematous cholecystitis, and Mirizzi's syndrome.

ABSTRACT
Ultrasound remains the first line modality for imaging the gall bladder and biliary tract. It is of utmost importance in guiding the clinician in the investigation of jaundice and obstructive liver function tests. Whilst having limitations in demonstrating some causes of biliary obstruction, the presence or absence, and level of obstruction, of dilated ducts dictates further imaging and management choices. With its high spatial resolution, and real time multiplanar capabilities, ultrasound is ideal for examining the gall bladder. This session will review the multiple causes of abnormalities of the gall bladder wall, and clinical and imaging features useful in the differential diagnosis. The imaging appearances of acute cholecystitis, and especially features of particular clinical import, such as emphysematous change, perforation, abscess and Mirizzi’s syndrome, will be reviewed. Patients presenting less acutely with abnormalities of the gall bladder wall can be a diagnostic challenge. The typical features of adenomyomatosis and carcinoma will be examined, together with features aiding the differential diagnosis. Gall bladder polyps are common and a management dilemma. Their significance and a strategy for management will be discussed. Apart from the presence or absence of biliary dilatation, the use of ultrasound in evaluation of the biliary ducts is limited, with other modalities, such as magnetic resonance cholangiography and endoscopic retrograde cholangiography, prevising. However, the ducts can actually be well seen in patients of appropriate physique. Changes seen in primary sclerosing cholangitis, cholangiocarcinoma, intrahepatic duct calculi, and some unusual and rarer conditions will be demonstrated.
calf veins be evaluated; is it appropriate to do unilateral exams. 4) Describe the role of US in identifying other causes of extremity pain and swelling.

**ABSTRACT**

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

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

**Tuesday, 04:30 PM - 06:00 PM • E264**

**RC452** • **AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5**

Christopher A Molvar, MD
Kent T Sato, MD
Albert A Nemcek, MD *
Robert J Lewandowski, MD *
Ramona Gupta, MD
Terry D Wilkin, MD
Kevin L Keele, MD
Michael H Hamblin, MD
Terence A Matalon, MD

**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.

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**Advances in Gynecologic Ultrasound**

**Wednesday, 08:30 AM - 10:00 AM • S405AB**

**RC510** • **AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5**

**RC510A** • **3D Ultrasound in Gynecology**

Beryl R Benacerraf MD (Presenter) *

**LEARNING OBJECTIVES**

1) To learn about the multiplanar reconstruction technique in scanning the pelvis, including its usefulness of looking at the coronal view of the uterus to evaluate the endometrium for polyps, fibroids and mullerian duct anomalies. 2) To learn to use 3D to determine the position of an IUD in the uterus. 3) To learn how 3D can help on detecting the causes of pelvic pain.

**ABSTRACT**

Three-dimensional (3D) ultrasound allows us to acquire a volume and display any plane of section within that volume regardless of the scanning orientation. The ability to display a 3D image of any type or plane has been one of the most powerful recent advances in sonography, particularly in the field of obstetrics and gynecology. In gynecology, 3D has allowed visualization of coronal view of the uterus, enabling us to diagnose mullerian duct anomalies without using MRI. We can also easily diagnose malpositioned IUDs (a common cause of pelvic pain and bleeding), polyps, submucous fibroids and other abnormalities related to the uterine cavity. 3D ultrasound also greatly facilitates the correct diagnosis of hydrosalpinges because of the infinite planes in which the tubal areas can be displayed.

**RC510B** • **Ovarian Masses and Cysts**

Phyllis Glanc MD (Presenter)

**LEARNING OBJECTIVES**

1) Analyze ultrasound imaging features of ovarian masses and apply this knowledge to discriminate benign from malignant lesions. 2) Demonstrate some practical tips and hints for problem solving. 3) Apply appropriateness criteria to determine when additional imaging techniques, such as MRI or CT , are indicated.

**ABSTRACT**

The first line of imaging when an ovarian lesion is suspected is ultrasound. In this session we will review classical imaging features on ultrasound, demonstrate some tips and pitfalls and evaluate some less common findings. We will utilize this information to triage patients into different management strategies. We will incorporate current consensus and appropriateness criteria guidelines into our critical thinking. The role of additional imaging techniques such as MRI, CT and PET will also be discussed.

**RC510C** • **Uterus and Endometrium**

Ruth B Goldstein MD (Presenter)

**LEARNING OBJECTIVES**

1) Be able to state the acceptable standards for endometrial assessment in women with abnormal vaginal bleeding. 2) Be able to recognize a uterine abnormality in a postmenopausal woman that warrants further evaluation including tissue sampling or MRI. 3) Be able to recognize and diagnose adenomyosis. 4) Be able to diagnose a Mullerian Duct Anomaly of the uterus.

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**Small Parts Interventional Ultrasound (Hands-on Workshop)**

**Wednesday, 08:30 AM - 10:00 AM • E263**

**RC531** • **AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5**

William E Shiels, DO *
Peter L Cooperberg, MD
Veronica J Rooks, MD
LEARNING OBJECTIVES
1) Describe the ultrasound anatomy and scanning technique for examination of neck (i.e. brachial plexus, spinal accessory, long thoracic, phrenic, vagus) and shoulder (i.e. suprascapular, axillary, musculocutaneous) nerves. 2) Illustrate the main anatomic landmarks to identify these nerves. 3) Master technical approaches to nerve ultrasound including the recognition of pitfalls.

ABSTRACT
In recent years, ultrasound of the musculoskeletal and peripheral nervous systems is becoming an increasingly imaging tool with an expanding evidence base to support its use. However, the operator dependent nature and level of technical expertise required to perform an adequate ultrasound assessment means that appropriate training is required. For this purpose, the present course will demonstrate the basic principles of musculoskeletal ultrasound with a special focus on the examination of small (Case-based Review of US (An Interactive Session) Wednesday, 01:30 PM - 03:00 PM • S406A

MSCU41 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5
Director
Sharlene A Teefey, MD

MSCU41A • Contrast-enhanced Ultrasound of the Liver
Stephanie R Wilson MD (Presenter) *

LEARNING OBJECTIVES
Attendees will recognize the importance of washout and the timing washout on contrast enhanced ultrasound of the liver allowing for the differentiation of malignant and benign liver masses and differentiation of hepatocyte based malignancy from others.

MSCU41B • Transplant Ultrasound of the Liver, Pancreas and Kidney
Myron A Pozniak MD (Presenter) *

LEARNING OBJECTIVES
1) Several challenging cases of transplant dysfunction will be presented. They will focus on the role of Doppler Ultrasound in making a quick confident diagnosis.

MSCU41C • Peripheral Vascular Ultrasound
When a suspicious breast MRI lesion has an ultrasound correlate, it is more likely to represent invasive carcinoma of higher histological grade (p=0.052). A grade III tumor was more likely to be present in the group with an ultrasound correlate (p<0.001). There was no significant difference in the size of tumors with or without an ultrasound correlate (p=0.163). In histological grade I, II, and III, respectively, 8 without correlate (4/50%), 3 (37.5%) and 1 (12.5%) were histological grade I, II, and III, respectively. There was no statistically significant difference in the size of tumors with or without an ultrasound correlate (p=0.052). A grade III tumor was more likely to be present in the group with an ultrasound correlate (p<0.001).

CONCLUSION

When a suspicious breast MRI lesion has an ultrasound correlate, it is more likely to represent invasive carcinoma of higher histological grade. Targeted ultrasound demonstrated a correlate in 181/350 (52%) suspicious MRI lesions yielding 63/181 (35%) malignant lesions. The remaining 169 (48%) lesions were sonographically occult, yielded 25/169 (15%) malignant lesions. Sonographic correlates were seen for 72% (63/88) of malignant lesions. Of these, 87% (55/63) were invasive carcinomas and 13% (8/63) were ductal carcinomas in situ. Histological grading was available for 46 invasive ductal carcinomas with ultrasound correlate (36.5%, 13(28.3%) and 30(65.2%) were histological grade I, II, and III, respectively) and 8 without correlate (450%), 3(37.5%) and 1(12.5%) were histological grade I, II, and III, respectively. There was no statistically significant difference in the size of tumors with or without an ultrasound correlate (p=0.163). In the group with an ultrasound correlate, no significant difference was observed in tumor size between the recorded histological grades (p=0.052). A grade III tumor was more likely to be present in the group with an ultrasound correlate (p<0.001).
Investigate the US appearance of regions with positive MR scans later proven to be cancer.

METHOD AND MATERIALS
In our experience of 373 total MR directed biopsies, 33 patients were found who 1) had suspicious areas discovered on an MR and 2) had a second look US that was negative and 3) subsequently had a malignant diagnosis as a result of MR biopsy. This patient group is interesting because they were examined with prior knowledge of the precise locality of a suspicious lesion; nevertheless, the ultrasound was negative.

RESULTS
Of the 33 patients, 13 had a final diagnosis of DCIS, MR imaging size range 0.6 to 5.4 cm. 15 had a final diagnosis of invasive ductal carcinoma (IDC), MR imaging size range 0.7 to 12.0 cm. 4 had a final diagnosis of invasive lobular carcinoma (ILC), MR imaging size range 0.6 to 8.4 cm. There was one adenoid cystic carcinoma of 1.0 cm. On US examination by dedicated breast sonographers and experienced radiologists the pattern seen was judged to be not sufficiently suspicious to be certain of correlation with the MR. These were regarded as "negative" US exams. The pattern present on the ultrasound was closely examined in 30 patients (3 sets of images were not available), and divided by appearance into two groups: Group Q: which were in retrospect Questionably Positive, and Group B: Benign. In Group Q, two distinct patterns were observed: low echogenicity area (6 patients) and shadow without mass (8 patients). In Group B, three distinct patterns were seen: Normal tissue (7 pts), Heterogeneous without mass (4 pts), and small mass with benign characteristics (5 pts). Why, histologically confirmed by histology, the following was observed: IDC: Group Q: 10 pts Group B: 4 pts. ILC: Group Q: 2 pts Group B: 2 pts. DCIS: Group Q: 3 pts Group B: 10 pts.

CONCLUSION
Even when positive MR images direct the radiologist specifically to the area of high suspicion for malignancy, thus eliminating search errors, those malignancies may remain subtle or totally undetectable by the usual US criteria, even for tumors up to 12 cm in size. The ultrasonographic tissue characteristics of these tumors are simply indistinguishable from that of normal breast.

CLINICAL RELEVANCE/APPLICATION
Many breast cancers are unrecognizable on ultrasound. Even a normally normal ultrasound does not rule out breast malignancy.

PURPOSE
Despite accounting for only 3% of mammographically detected findings, architectural distortion (AD) may be caused by a wide range of benign and malignant breast lesions, and it is the 3rd most common presentation of non palpable breast cancer. Because of its indefinite mammographic and ultrasonographic features, percutaneous or surgical biopsy is mandatory.

In our study we evaluated the potential role of dynamic Breast MRI including diffusion-weighted imaging (DWI) as a problem-solving tool in mammographically and ultrasonographically detected AD

METHOD AND MATERIALS
Out of 232 patients undergoing MRI for problem solving, 34 were examined for a mammographic or ultrasonographic AD. MRI (1.5T) included T2-TSE sequences, dynamic study and DWI (b-values: 0, 900 s/mm2). For each lesion detected we evaluated morphology, dynamic and diffusion patterns and final histopathological result. A cut-off ADC value differentiating benign from malignant breast lesions had been previously established in a large population of women. The difference between the mean Apparent Diffusion Coefficient (ADC) values and the mean T2 signal in malignant and benign findings was evaluated with Mann-Whitney U test. Univariate and multivariate analyses of ADC values, T2 signal and time-enhancement curves (T-Ec) were performed for prediction of malignancy.

RESULTS
MRI confirmed all 38 known findings. At histopathology 25 lesions were benign and 13 malignant. The most represented T-Ec in malignant AD were type 3 (n=7) and 2 (n=3), while no benign lesions showed a washout kinetic. Univariate and multivariate analysis showed that T-Ec were significant predictors of malignancy (p

CONCLUSION
Time-enhancement curves were the most predictive MRI feature to distinguish benign from malignant AD. The contribution of DWI to their differential diagnosis is limited due to ADC borderline values. MRI low negative predictive value, however, suggests to avoid MRI to strengthen the diagnosis after a benign core biopsy.

CLINICAL RELEVANCE/APPLICATION
MRI could not replace breast biopsy to confirm the nature of architectural distortions.

PURPOSE
To evaluate the accuracy of DM, combined with DBT, US and MRI in predicting residual tumour size and pathological response after NC for locally advanced breast cancer.

METHOD AND MATERIALS
44 patients (mean age 49.2 years; range 31-71) with locally advanced breast cancer who underwent NC were enrolled in the study. We retrospectively evaluated size and response of tumors to NC by DM, combined with DBT, US and MRI before, during and at the end of treatment. We assumed as gold standard the tumour size measured at pathology. Patients were divided into responders (with pathological complete (pCR) or partial response (pPR)) and non-responders (NR). Measurements were considered concordant if they were ±10 mm. Tumour size assessments were statistically analyzed with paired t-test, regression line and Pearson’s linear correlation coefficient and Bland-Altman Plots; categorical variables were arranged in contingency tables and analyzed with chi square test or Fisher’s test; 95% Confidence Intervals were estimated for all percentages.

RESULTS
For pCR patients (16/44), size estimates by all modalities showed an exponential decrease during treatment (r=0.9; p=0.005). The size agreement with pathology was 29 (95%CI 10-55)% for US, 36(14-62)% for DM, 33(12-62)% for DM+DBT, 54(27-79)% for MRI. For pPR patients (18/44), size estimates by imaging showed a linear decrease during treatment (r=0.9; p=0.008). The size agreement was 69(41-89)% for US, 54(27-79)% for DM, 70(38-92)% for DM+DBT, 87(62-98)% for MRI. For NRs (10/44), US, DM and DM+DBT...
overestimated tumour size, while MRI measurements agreed with pathology. For the responders, the agreement between pCR predictions at mid-treatment and pathological responses was 71(0.4-90.5)% for both US and DM, 11.1(15.7-65.9)% for DM+DBT, 38.5(15.7-65.9)% for MRI; pPR prediction was 54.5(25.9-81)% for US, DM and DM+DBT, 84.6(57.8-97.3)% for MRI. NR prediction at mid-treatment was 80(47-99)% for US, 80(33-98)% for DM, 82(47-99)% for DM+DBT, 86(47-99)% for MRI.

CONCLUSION
Predictions of response and residual tumour size made on MRI showed a better agreement with pathology than DM, DM+DBT, US. DBT in addition to DM improved conventional imaging in pPR and NR predictions.

CLINICAL RELEVANCE/APPLICATION
Breast MRI can be considered the most reliable imaging modality for pathological response evaluation after neoadjuvant chemotherapy, but the addition of DBT improves conventional imaging performances.

SSM02-06 • Analysis of the Influence of Surrounding Fat Tissue in the Detection Rate of Ultrasound and Digital Breast Tomosynthesis after Normal Mammography

Pedro Slon MD ; Jon Etzano MD (Presenter) ; Maria Paramo Alfaro MD ; Romina Zalazar MD ; Arlette Elizalde ; Luis Pina MD, PhD ; Fernando Martinez Regueira ; Natalia Rodriguez-Spiteri

PURPOSE
To assess the features of the tissue surrounding the additional detected cancers by US and DBT after normal Mammography.

METHOD AND MATERIALS
We retrospectively analyzed 75 histologically confirmed tumors in 55 patients (13 ductal carcinomas in situ and 62 invasive carcinomas). All the patients underwent Digital Mammography, US and Tomosynthesis. The tumors were classified in four categories according to the amount of peritumoral fat (I = >75%, II = 50-75%, III =25-75% and IV = Gold Standard) was established with histological study obtained after surgery.
The detection rate of additional tumors by US and DBT was compared regarding to the percentage of peritumoral fat using the McNemar test (SPSS, 15.0).

RESULTS
Out of the 75 tumors, DM detected 42 (56%) and 33 (44%) were detected by additional techniques. The number of additional tumors detected by US was 14 (+18.6%) and by DBT was 17 (+22.6%). Out of these additional tumors, 7 (9.3%) were only detected by US, 4 (5.3%) only detected by DBT and 10 (13.3%) were detected by both. The remaining 9 tumors were diagnosed with second look US after presurgical MRI. All of the additional tumors were invasive carcinomas. We did not find statistical differences between both techniques in Group I (US= 2 , DBT=2; p=1.00), Group II (US= 5 , DBT= 8; p=0.375) and Group III (US= 3, DBT= 2; p= 1.000). In Group IV (US=7, DBT=2; p=0.06) we found a trend to statistical significance, with 5 tumors detected on US and missed on DBT and no additional tumors diagnosed by DBT not detected by US.

CONCLUSION
Both US and DBT present similar results in the detection of additional breast cancers when they are predominantly surrounded by fat (more than 25%). However, we found that in tumors with less than 25% of peritumoral fat, US seems to be more sensitive than DBT.

CLINICAL RELEVANCE/APPLICATION
This study supports that US seems to be better than DBT in the detection of tumors with a low quantity of surrounding fat, i.e, in dense breast (ACR density pattern IV).

Vascular/Interventional (Vascular Ultrasound)

Wednesday, 03:00 PM - 04:00 PM • E450B

SSM24 • AMA PRA Category 1 Credit ™: 1 • ARRT Category A+ Credit: 1
Moderator
Christopher A Binkert, MD *
Moderator
Robert A Morgan, MD *

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. Transcutaneous 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±2.3 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 Doppler Flow (DF) Measurement

Claas P Naehle MD (Presenter) * ; Verena A Steinberg ; Gottfried Mommertz ; 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 μg/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) in stenosis vs. non-stenosis.

**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; Yougui 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, CECT 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**
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.

**CLINICAL RELEVANCE/APPLICATION**
Stenosis Index is an excellent secondary confirmatory test for transplant hepatic artery stenosis and its use can reduce the number of equivocal and false positive cases who proceed to invasive workup.

**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 al, 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 validity of 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.

Case-based Review of US (An Interactive Session)

Wednesday, 03:30 PM - 05:00 PM • S406A

MSCU42 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

Director
Sharlene A Teeffey, MD

MSCU42A • Ultrasound of Adnexal Pathology

Deborah J Rubens MD (Presenter)

LEARNING OBJECTIVES
1) Review the common causes of acute ovarian pathology including hemorrhagic cysts and their differential diagnoses. 2) Underscore the various features of ovarian torsion including grayscale and Doppler findings and pitfalls. 3) Identify those gynecologic lesions which require surgery vs. clinical or imaging follow-up, either with sequential ultrasound or with another modality.

ABSTRACT
As the medical community is encouraged to rely more upon ultrasound in the diagnosis of pelvic pain, many more women are encountered first for pelvic ultrasound, rather than CT. Frequently, ultrasound can answer the clinical question, saving time, money and
We will explain the ultrasound findings of acute kidney injury (AKI), the evaluation of pelvic masses and the necessary follow-up. Finally, a

ABSTRACT

1) The learner will be made aware of the importance of acute kidney injury (AKI) and associated ultrasound findings. 2) Ultrasound criteria including subtypes and sonographic features. 4) To discuss other thyroid pathologies including thyroiditis, and Grave's disease.

LEARNING OBJECTIVES

1) Discuss the incidence, different histologic subtypes of thyroid carcinoma. 2) Review the sonographic features of the different subtypes of thyroid carcinoma and the sonographic appearance of benign nodules and how to differentiate the two. 3) Discuss thyroid lymphoma including subtypes and sonographic features. 4) To discuss other thyroid pathologies including thyroiditis, and Grave's disease.

ABSTRACT

Thyroid carcinoma has an incidence between 9.2 and 13%. There are several subtypes of carcinoma including papillary carcinoma that accounts for 75-80% of the cases. Less common types include follicular carcinoma, medullary carcinoma and anaplastic carcinoma. Grey scale sonographic features that are suggestive of papillary carcinoma include a solid, very hypoechoic lesion with micro or eggshell calcifications, lobulation, and a focal bulge. Follicular lesions are solid and iso/hyperechoic with a thin hypoechoic halo and central cystic spaces. Most of these lesions are adenomas though ultrasound cannot differentiate between a follicular carcinoma and adenoma. Carcinomas tend to occur in older males and are solid hypoechoic lesions. Benign thyroid nodules, in particular nodular hyperplasia have a spongy appearance and inspissated colloid. Anaplastic carcinoma is rare but very aggressive locally invading structures in the neck. Distant metastases are present in 20-50% of patients at presentation. At ultrasound, anaplastic carcinomas are solid and hypoechoic but may contain cystic spaces and amorphous calcification. Lymphoma of the thyroid is rare and may be aggressive or indolent (MALT lymphoma). It is typically heterogeneous and can invade surrounding tissues. Thyroiditis can be acute, subacute, and chronic. Subacute thyroiditis is a post viral disorder. At ultrasound, focal hypoechoic area(s) may be seen that are ill defined and have little if any vascularity. Hashimotos thyroiditis is an autoimmune disorder causing gland enlargement with characteristic hypoechoic micronodules and echogenic septae. Vascularity may be increased, normal, or decreased. Grave's disease is also an autoimmune disease. Ultrasound shows a heterogeneously enlarged gland and diffuse increased vascularity and increased PSV in the thyroidal arteries.

GU Ultrasound 2013: The Expert's Update on Kidney, Gynecologic and Testicular US

Thursday, 08:30 AM - 10:00 AM • N228

MUSC42B • Musculoskeletal US

Nirvikar Dahiya MD (Presenter)

LEARNING OBJECTIVES

1) Learn to identify Normal Sonographic anatomy of the musculoskeletal system. 2) Learn to recognize the abnormal sonographic appearance of the musculoskeletal system in disease. 3) Learn the correct Sonographic technique and pitfalls for optimal scan results.

ABSTRACT

Cases have been chosen for this refresher course keeping in mind their instructive and educational value. The discussion will include diseases associated with the rotator cuff, wrist joint, Hip, knee and ankle. Ultrasound images and cine clips will be used to highlight the salient features of musculoskeletal disorders. Examples will be shown to demonstrate the advantage of using dynamic evaluation as a problem solving aspect of musculoskeletal sonography.

MSCU42C • Ultrasound of Thyroid

Sharlene A Teefey MD (Presenter)

LEARNING OBJECTIVES

1) Discuss the incidence, different histologic subtypes of thyroid carcinoma. 2) Review the sonographic features of the different subtypes of thyroid carcinoma and the sonographic appearance of benign nodules and how to differentiate the two. 3) Discuss thyroid lymphoma including subtypes and sonographic features. 4) To discuss other thyroid pathologies including thyroiditis, and Grave's disease.

ABSTRACT

Thyroid carcinoma has an incidence between 9.2 and 13%. There are several subtypes of carcinoma including papillary carcinoma that accounts for 75-80% of the cases. Less common types include follicular carcinoma, medullary carcinoma and anaplastic carcinoma. Grey scale sonographic features that are suggestive of papillary carcinoma include a solid, very hypoechoic lesion with micro or eggshell calcifications, lobulation, and a focal bulge. Follicular lesions are solid and iso/hyperechoic with a thin hypoechoic halo and central cystic spaces. Most of these lesions are adenomas though ultrasound cannot differentiate between a follicular carcinoma and adenoma. Carcinomas tend to occur in older males and are solid hypoechoic lesions. Benign thyroid nodules, in particular nodular hyperplasia have a spongy appearance and inspissated colloid. Anaplastic carcinoma is rare but very aggressive locally invading structures in the neck. Distant metastases are present in 20-50% of patients at presentation. At ultrasound, anaplastic carcinomas are solid and hypoechoic but may contain cystic spaces and amorphous calcification. Lymphoma of the thyroid is rare and may be aggressive or indolent (MALT lymphoma). It is typically heterogeneous and can invade surrounding tissues. Thyroiditis can be acute, subacute, and chronic. Subacute thyroiditis is a post viral disorder. At ultrasound, focal hypoechoic area(s) may be seen that are ill defined and have little if any vascularity. Hashimotos thyroiditis is an autoimmune disorder causing gland enlargement with characteristic hypoechoic micronodules and echogenic septae. Vascularity may be increased, normal, or decreased. Grave's disease is also an autoimmune disease. Ultrasound shows a heterogeneously enlarged gland and diffuse increased vascularity and increased PSV in the thyroidal arteries.

Abdominal Vasculature: Ultrasound and Doppler

Thursday, 08:30 AM - 10:00 AM • S103CD

RC610 • AMA PRA Category 1 Credit ™:1.5 • ARRT Category A+ Credit:1.5

Kathryn A Robinson MD (Presenter)

LEARNING OBJECTIVES

1) Identify normal hepatic hemodynamics. 2) Identify hemodynamic alterations in portal hypertension. 3) Identify portal and hepatic vein thrombosis. 4) Identify normal sonographic and Doppler findings as well as complications of Transjugular Intrahepatic Portosystemic Shunt (TIPS).

ABSTRACT
LEARNING OBJECTIVES

1) Understanding the indications of contrast enhanced ultrasound (CEUS) in different abdominal organs. 2) Learning about the importance of the three contrast phases and how CEUS performs in detecting and characterizing focal liver lesions. 3) Learning the potential value as well as the limitations of CEUS in renal disorders. 4) Learning how CEUS performs in diseases of other solid organs including the intestine and major abdominal vessels.

ABSTRACT

Liver: In patients with favorable scanning conditions CEUS is at least as sensitive as contrast enhanced CT (CECT) in detecting malignant liver lesions. Due to a high temporal resolution, even a short hyper-enhancement of a few seconds can reliably be detected, thus improving the characterization of focal liver lesions. A majority of malignant lesions can therefore be characterized as iso- or hyper-enhancing. During the arterial phase the tumor`s vessel architecture and direction of contrast filling is important for characterizing a lesions character. Due to a high spatial resolution, novel contrast imaging techniques allow detection of washed out lesions down to 3mm in size. CEUS characterizes focal liver lesions with a much higher diagnostic confidence than conventional US and is comparable to CT and MRI. CEUS also improves intraoperative tumor detection and characterization. Using time intensity analysis a change in contrast enhancement and kinetics helps in estimating tumor response to chemotherapy. CEUS is also used to monitor local ablation therapy and is a useful imaging tool to detect early tumor recurrence. Gallbladder: CEUS can be used to better visualize ulceration, perforation, and tumors of its wall. Pancreas: CEUS can be used to reliably image necrosis in acute pancreatitis. It helps to differentiate neuroendocrine tumors from ductal adenocarcinoma. Kidney: CEUS adds great value in detecting and characterizing complicated cysts and is believed to be more accurate than CECT. However, its value in differentiating solid renal tumors is limited. Parenchymal changes due to infectious diseases can be diagnosed by using CEUS. It is highly sensitive in detecting organ infarctions as well. Intestine: CEUS is of great value in characterizing inflammatory diseases and especially in imaging complications. CEUS improves visualization of abdominal vascular disorders

RC610C ● Aorta and Its Branches

Mary C Frates MD (Presenter)

LEARNING OBJECTIVES

1) Understand the gray scale and Doppler techniques useful for evaluating the aorta and its branches. 2) Recognize the presence of vascular stenosis, aneurysm and malformations. 3) Understand the challenges in the sonographic evaluation of aortic stent grafts.

ABSTRACT
1) Understand the roles of medical physicists and other providers of ultrasound system QC, performance evaluation and user education.  
2) Gain an understanding of the longer term potential of medical ultrasound to aid in medical physics planning and training.

**ABSTRACT**

A very brief overview is given of the innovations that have led to current medical ultrasound systems and QC thereof. A clear connection to clinical performance/cost effectiveness has not been established, but the ratio is improving. To aid in medical physics planning and training, more distant (beyond 10 years) and less robust predictions are ventured than in Dr. Hangiandreous’ talk. The reduction in artifacts and improvement in resolution will be surprisingly large. It is posed that ultrasound will be headed toward almost ubiquitous use in personal hands as well as those of medical personnel, for monitoring and control of chronic conditions, for direct treatment and for precisely localized drug delivery and enhancement of radiation therapy. Medical physicists who can help keep the computer controls integrated, the systems properly calibrated and the users properly trained will find a substantial role in society.

**RC621B • Ultrasonography 1.0**

Zheng Feng Lu PhD (Presenter)

**LEARNING OBJECTIVES**

1) Describe the current role of ultrasound medical physics in clinical practice. 2) Explain the ultrasound image quality metrics utilized in current ultrasound QA/QC testing. 3) Outline the methods and tools available for ultrasound system QA/QC in current clinical practices. 4) Survey the available standards and voluntary accreditation guidelines for medical ultrasound imaging systems. 5) Understand the need for QC at different levels of time and financial investment.

**ABSTRACT**

This talk will focus on the present role of ultrasound medical physics in clinical practices. It will review the ultrasound image quality metrics currently utilized in ultrasound QA/QC testing. It will describe testing procedures required and/or recommended by accreditation programs and advisory organizations. General guidelines and available standards will be discussed regarding tolerances for acceptance testing and commissioning of these devices, as well as periodic quality control tests, as applicable to diagnostic B-mode imagers. A brief review of ultrasound phantoms used in these testing procedures will be presented.

**RC621C • Ultrasonography 2.0**

Nicholas J Hangiandreous PhD (Presenter)

**LEARNING OBJECTIVES**

1) Identify the roles expected for medical physics to play in future clinical ultrasound practices. 2) Demonstrate understanding of emerging ultrasound imaging performance metrics that are expected to be in routine practice in the future. 3) Demonstrate understanding of emerging ultrasound imaging technologies that are expected to be in routine practice in the future. 4) Identify approaches for implementing comprehensive medical physics services in future clinical ultrasound practices.

**ABSTRACT**

Ultrasound imaging is evolving at a rapid pace, adding new imaging functions and modes that continue to enhance its clinical utility and benefits to patients. This talk will look ahead 10-15 years and consider how medical physicists can bring maximal value to the clinical ultrasound practices of the future. The roles of physics in accreditation and regulatory compliance, image quality and exam optimization, clinical innovation, and education of staff and trainees will all be considered. A detailed examination of expected technology evolution and impact on image quality metrics will be presented. Clinical implementation of comprehensive physics services will also be discussed.

**Dynamic Musculoskeletal US of the Lower Extremity (Hands-on Workshop)**

**Thursday, 08:30 AM - 10:00 AM • E264**

**RC652 • AMA PRA Category 1 Credit ™: 1.5 • ARRT Category A+ Credit: 1.5**

Viviane Khoury, BSC,MD  
Etienne Cardinal, MD  
Jon A Jacobson, MD *  
Carlo Martinoli, MD  
J. A Bouffard, MD  
Ruth Y Ceulemans, MD  
Joseph G Craig, MD  
David P Fessell, MD  
Ghiyath Habra, MD  
Joseph H Introcaso, MD  
Marnix T Van Holsbeeck, MD *  
Ximena L Wortsman, MD  
Kenneth S Lee, MD *  
Thomas Moser, MD *  
Humberto G Rosas, MD

**LEARNING OBJECTIVES**

1) Identify the roles expected for medical physics to play in future clinical ultrasound practices. 2) Demonstrate understanding of emerging ultrasound imaging performance metrics that are expected to be in routine practice in the future. 3) Demonstrate understanding of emerging ultrasound imaging technologies that are expected to be in routine practice in the future. 4) Identify approaches for implementing comprehensive medical physics services in future clinical ultrasound practices.

**ABSTRACT**

This course will demonstrate standardized techniques of performing the dynamic examination of hip and ankle lesions that are only or best demonstrated dynamically. These include the snapping hip, peroneal tendon subluxation/dislocation, flexor hallucis longus impingement, and ankle ligament instability. In the first portion of the course, probe posibility will be demonstrated on a model patient with overhead projection during live scanning. In the second portion of the course, an international group of expert radiologists will assist participants in learning positioning and scanning of hip and ankle joint lesions described. An emphasis on dynamic maneuvers and ergonomic documentation of tissue dynamics will be taught. Participants will be encouraged to directly scan model patients.

**Breast Imaging (Ultrasound Screening)**

**Thursday, 10:30 AM - 12:00 PM • Arie Crown Theater**

**SSQ01 • AMA PRA Category 1 Credit ™: 1.5 • ARRT Category A+ Credit: 1.5**

**Moderator**  
Ellen B Mendelson, MD *  
Moderator  
Paula B Gordon, MD *

**SSQ01-01 • Initial Experience of Technologist Performed Whole Breast Screening Ultrasound**
To evaluate the added cancer detection and false positive rate of a technologist-performed handheld screening breast ultrasound program. In this study, ABVS shows comparable diagnostic performance when compared with HHUS in the detection of breast cancer in a large population group with a long-term follow-up, and to investigate whether different ultrasound systems may influence the estimation of cancer detection.

RESULTS
Of the 890 women, 299 (34%) were pre-menopausal and 591 (66%) peri/post-menopausal. 288 (32%) had a personal history of breast cancer, 67 (8%) a prior biopsy proven high-risk lesion, and 592 (67%) a family history of breast cancer. 769/875 (88%) patients had a mammogram within 6 months of the ultrasound. Breast density was predominantly fatty in 31 (3%), scattered fibro glandular densities in 171 (20%), heterogeneously dense in 521 (60%), and extremely dense in 152 (17%). 837 (94%) studies were assessed as BI-RADS 1 or 2, 20 (2%) as BI-RADS 3, and 43 (5%) as either BI-RADS 4 or 5. Biopsy was performed for 39/43 suspicious lesions, yielding malignancy in 3/39 (PPV 8%). The cancers were all solid masses between 1.0-1.3 cm in size in heterogeneously dense breasts. Of the 3 women with cancers, 2 had a personal history of breast cancer and the other had no additional risk factor. 2 had a negative mammogram within 5 weeks of the ultrasound and the third within 7 months. The overall cancer detection rate was 3.4 cancers per 1000 women.

CONCLUSION
Technologist performed handheld screening breast ultrasound demonstrates a cancer detection rate (3.4/1000) and PPV (8%) of biopsy similar to that reported for physician performed ultrasound screening.

CLINICAL RELEVANCE/APPLICATION
Screening breast ultrasound performed by technologists is a feasible alternative to physician performed ultrasound screening, reducing radiologists time and cost.

SSQ01-02 • Comparison of an Automated Breast Volume Scanner and a Hand-held Ultrasound in the Detection of Breast Cancer: An Analysis of 5576 Patient Evaluations

Woo Jung Choi MD (Presenter) ; Seonah Jang ; Joo Hee Cha ; Hak Hee Kim MD ; Hee Jung Shin MD ; Hyunj Kim MD ; Eun Young Chae ; Sun Hye Jeong MD

PURPOSE
To retrospectively compare the accuracy and effectiveness of automated breast volume scanning (ABVS) and hand-held ultrasound (HHUS) in the detection of breast cancer in a large population group with a long-term follow-up, and to investigate whether different ultrasound systems may influence the estimation of cancer detection.

METHOD AND MATERIALS
A total of 1870 ABVS and 3706 HHUS participants, who underwent these procedures at our institute between September 2010 and August 2011, were included in this study. Cancers occurring during the study and subsequent follow-up were evaluated. The reference standard was a combination of histology and follow-up imaging (=12 months). The diagnostic accuracy, sensitivity, specificity, and positive (PPV) and negative (NPV) predictive values were calculated with exact 95% confidence intervals.

RESULTS
CONCLUSION
ABVS shows a comparable diagnostic performance to HHUS. We thus find that ABVS as an effective supplemental tool for mammography in breast cancer detection in a large population.

CLINICAL RELEVANCE/APPLICATION
In this study, ABVS shows comparable diagnostic performance when compared with HHUS in the detection of breast cancer in a large population group with a long-term follow-up.

SSQ01-03 • Impact of Radiologists' Professional and Practice Characteristics on Breast Cancer Detection in Women with Dense Breasts; A Reader Study Combining Mammography and Automated Breast Ultrasound

Karen Drukker PhD (Presenter) * ; Maryellen L Giger PhD *

PURPOSE
Evaluate variability in the clinical assessment of breast images, and its dependence on radiologists' professional and practice characteristics, in a retrospective reader study combining X-ray mammography (XRM) and 3D automated breast ultrasound (ABUS) for breast cancer detection in women with dense breasts.

METHOD AND MATERIALS
The study involved 17 breast radiologists of which 7 came from academic radiology practices, 6 from private practice, and 4 from community clinics. A sequential study design was employed with readers first interpreting XRM alone, followed by an interpretation of the combined XRM+ABUS, with each interpretation including a forced BI-RADS scale and a likelihood that the woman had breast malignancy. The analysis included 164 asymptomatic patients, including 31 breast cancer patients, with dense breasts and a negative screening XRM. Of interest were inter-reader variability in scoring for XRM alone, XRM+ABUS, and the dependence on reader experience, fellowship training, and type of practice. Performance analysis included Receiver Operating Characteristic (ROC), percentile, kappa statistics, correlative, and Bland-Altman analyses. The statistical significance of the impact of consecutive reads was assessed for the kappa statistics using bootstrapping.

RESULTS
The median change in area under the ROC curve after ABUS interpretation was 0.12 (range 0.04-0.19). Reader agreement was fair with the median inter-reader kappa being 0.26 (0.05-0.48) for XRM alone and 0.34 (0.11-0.55) for XRM+ABUS (95% confidence interval for the difference in kappa [0.06:0.11]). The only factor that appeared to have a substantial effect on reader performance was the type of clinical radiology practice, with the increase in area under the ROC curve for the largest 3 radiologists from academic practices, with changes of 0.18, 0.19, and 0.19 respectively.

CONCLUSION
A modest, but statistically significant, increase in inter-reader agreement was observed after interpretation of ABUS, while radiologists from academic practice seemed to benefit the most from ABUS interpretation.

CLINICAL RELEVANCE/APPLICATION
Understanding reader variability and factors such as training and clinical practice will yield informed decisions on the use of multimodality imaging in breast cancer screening.

SSQ01-04 • Whole Breast Ultrasound: Comparison of the Visibility of Suspicious Lesions with Automated Breast Volumetric Scanning versus Hand-held Breast Ultrasound

Cherie M Kuzmiak DO (Presenter) * ; Eun Young Ko MD, PhD ; Laura Tuttle ; Doreen Steed ARRT * ; Donglin Zeng PhD
To assess how well radiologists visualize relevant features of lesions seen with automated breast volumetric scanning in comparison to hand-held breast ultrasound in population of women going to biopsy.

**RESULTS**

There were thirty biopsied lesions in this study. All were masses. Seven (23.3%) masses were malignant and 23 (76.4%) were benign. Across all lesions regardless of size or final pathology, there was no significant difference between the two modalities in the readers’ BIRADS classification, probability of malignancy, sensitivity or specificity (P > 0.15). For malignant lesions, the reader visualization confidence scores between the two ultrasound modalities were not significantly different (P > 0.1). However, analysis for non-malignant cases showed a statistically significant increase in reader visualization confidence in lesion shape and margins with ABVS (P < 0.001).

**CONCLUSION**

Radiologists showed equal confidence in visualization of suspicious masses with automated breast volumetric scanning in comparison to hand-held breast ultrasound mammography and increased confidence in visualization of non-malignant lesions with automated breast volumetric scanning.

**CLINICAL RELEVANCE/APPLICATION**

Dedicated automated whole breast ultrasound is a novel imaging technology that has the potential application for decreasing hand-held breast imaging use in a busy diagnostic clinic.
RESULTS
A total of 138 patients who had mammography, US, or MR available for review and were included in the study. Mean patient age was 53 years (range 18-83). All 138 patients underwent a mean of 3.0 years of screening with M, 115 (83%) a mean of 2.7 years of screening with US, and 30 (20%) patients a mean of 1.9 rounds of screening with MRI. Eleven (8.0%) patients were diagnosed with cancer. Of 115 patients who received both M and US, 10 (8.7%) were diagnosed with cancer. Mammographic cancer detection rate 2.6%. US cancer detection rate was 2.6%, and all these cancers were mammographically occult. A subgroup of 30 patients with LN and lifetime risk >20% received supplemental MRI screening; 5 (16.7%) of whom were diagnosed with cancer. US did not detect any of these 5 cancers, M detected 1 (3%) and MRI detected 2 (6.7%) while remaining 2 were detected clinically. The sensitivity (95% CI) of screening M was 30% (7%-65%), specificity (95% CI), PPV (95% CI), and NPV (95% CI) were 100% (97%-100%), 100% (99%-100%), and 94% (88%-97%), respectively. The sensitivity (95% CI) of screening M was 27% (6%-67%), specificity (95% CI), PPV (95% CI), and NPV (95% CI) were 100% (97%-100%), 100% (99%-100%), and 94% (89%-97%), respectively. The sensitivity of screening MRI was 50% (95% CI: 12%-88%), while NPV was 89% [95% CI: 71%-98%].

CONCLUSION
Annual screening US as a supplement to screening M resulted in an incremental cancer detection rate of 2.6% in patients with a history of LN

CLINICAL RELEVANCE/APPLICATION
Supplemental US screening in patients with LN who do not fulfill the American Cancer Society criteria for high risk MRI screening may help detect mammographically occult malignancy

SSQ01-08 • Reassessment and Follow-up Results of BI-RADS Category 3 Lesions Detected on Screening Breast US

Jung Lim Yoo MD (Presenter); Joo Hee Cha; Eun Young Chae; Hak Hee Kim MD; Hee Jung Shin MD; Hyunji Kim MD

PURPOSE
To determine the frequency and the malignancy rate of BI-RADS category 3 lesions detected on screening breast ultrasound and reassess whether they satisfied the ACRIN 6666 protocol.

METHOD AND MATERIALS
During two years, 28,796 asymptomatic women underwent screening mammography. Among them, 8359 women underwent additional breast ultrasound as part of a screening examination. Radiologists analyzed US lesion features and provided a final BI-RADS assessment. We retrospectively reviewed the initial US images with BI-RADS category 3 lesions and their mammography as well. We also investigated the outcome of these lesions. The reference standard was a combination of pathology and clinical follow-up for at least 24 months.

RESULTS
The frequency of category 3 lesions detected on breast US was 16.8% (1403/8359). Of 941 patients with follow up for at least 24 months or biopsy, six eventually proved to be malignant (0.6%). The malignancy rate was 1.5% (4/805) for patients with abnormal mammogram and 0.5% (2/136) for those with negative mammogram. When the ACRIN (American College of Radiology Imaging Network) 6666 protocol were strictly applied, 147 (15.6%) were retrospectively recategorized as BI-RADS 4 (n=7) or BI-RADS 2 (n=140).

CONCLUSION
The malignancy rate of BI-RADS category 3 lesions is very low, especially with negative mammogram.

CLINICAL RELEVANCE/APPLICATION
With BI-RADS category 3, careful assessment is needed to avoid unnecessary biopsy or short-interval follow-up.

SSQ01-09 • Review of Interval Cancers in a Mammographic Screening Programme: What Can We Learn? Are We Being Too Hard on Ourselves?

Katerina Lekanidi MRCP, MBCh (Presenter); Phillip Dilks; Tamara Suaris MBBS; Hema N Purushothaman

PURPOSE
To determine the features of interval breast cancers considered to be detectable on previous screening.

METHOD AND MATERIALS
This study was approved by the clinical governance committee. As a requirement of the national breast screening programme, the previous screening mammograms for all interval breast cancers are reviewed and classified as: no signs, minimal signs or suspicious appearances. Patients with interval breast cancer over a period of 21 years were included in this study if minimal or suspicious signs were seen on most recent screening mammogram. 3 radiologists, individually and blinded to the site of interval cancer, reviewed the mammograms and documented the presence, site, characteristics and BIRADS classification of any abnormality. Findings were compared with the appearances of the subsequent symptomatic mammogram.

RESULTS
111/590 interval cancers documented in the study period fulfilled the study inclusion criteria. The mean age at the time of screening mammogram was 59.04 (range 51-75). The mean interval to the diagnosis of breast cancer was 17.30 months (range 1-36). 61.3% of cases were considered as "minimal signs" and 38.7% as suspicious. In 17.1% of the cases none of the readers identified a relevant abnormality on the screening mammogram. In 21.6% of the cases 1/3 readers identified the abnormality, 27.6 % of cases 2/3 readers and 33.3% all 3 readers identified the abnormality. In 50% of one-reader recalls, the mammographic abnormality was an asymmetric density, followed by ill-defined mass (20.8%) and architectural distortion (20.8%). In three-reader recalls, microcalcification was the most common finding (35.1%), followed by asymmetric density (27%) and an ill-defined mass (24.3%). Overall, the most common abnormality was asymmetric density (36%), followed by ill-defined mass (15.3%) and microcalcification with or without a mass (15.3%).

CONCLUSION
The most common retrospectively and unanimously identified sign of breast cancer is microcalcification and the most common subtle sign is asymmetric density. Interval cancer mammographic review not blinded to the position of subsequent cancer overestimates the percentage of "minimal signs" cases.

CLINICAL RELEVANCE/APPLICATION
Review of interval breast cancers is a valuable learning tool in breast screening programmes and is more valid if done initially blinded to the position of the subsequent breast cancer.

Emergency Radiology (Imaging Abdominal Emergencies)

Thursday, 10:30 AM - 12:00 PM • N226

Back to Top
SSQ05-01 • Sonography of the Borderline Appendix: A Closer Look

Jason D Oppenheimer MD (Presenter); Rupesh Kalthia MD; Eric W Olcott MD; R. Brooke Jeffrey MD *

PURPOSE
Some authorities diagnose appendicitis on ultrasound with an outer diameter criterion of >6 mm while others use a criterion of >7 mm. We evaluated the potential utility of secondary findings including hyperemia and hyperechoic fat in the diagnosis of patients whose appendices measured between 6 and 7 mm and thus were considered borderline by size criteria.

METHOD AND MATERIALS
We retrospectively reviewed 3,506 consecutive ultrasound examinations for suspected appendicitis in patients who presented to the emergency department at a tertiary care center over a 5-year period, with HIPAA and IRB compliance. Three radiologists blinded to final diagnoses identified 98 sonograms with non-compressible 6 to 7 mm diameter appendices and evaluated them for secondary findings of appendicitis including hyperemia, hyperechoic fat, loss of the submucosal layer echo, periappendiceal fluid and appendicoliths. Hyperechoic fat was defined as increased periappendiceal echogenicity greater than 1 cm in diameter. Fisher's exact test and linear regression were used to compare secondary findings with final diagnoses made by surgical pathologic examination.

RESULTS
From 2007 to 2012, 98 ultrasounds demonstrated appendices with diameters between 6 and 7 mm of which only 51 (52%) had appendicitis by surgical pathologic examination. Of the secondary signs in the 98 patients, hyperechoic fat had the highest individual positive predictive value and specificity for appendicitis (78% and 83%, respectively), which increased with the addition of hyperemia to 80% and 89%, respectively. Statistically modeling showed a linear direct correlation between the number of secondary signs present and both positive predictive value and specificity (R²=0.963 and R²=0.949, respectively), values that increased to 100% in the presence of four secondary signs.

CONCLUSION
Hyperemia and hyperechoic fat increase the positive predictive value and specificity of sonography for appendicitis in patients with noncompressible appendices of diameters between 6 and 7 mm. Without secondary signs, a conservative approach should be followed as approximately half of such patients with borderline diameter appendices do not have appendicitis.

CLINICAL RELEVANCE/APPLICATION
Ultrasound reliably predicts appendicitis in borderline 6 to 7 mm diameter appendices when secondary characteristics are assessed.

SSQ05-02 • Does Inclusion of Imaging in the Work Up of Patients with Clinically Suspected Appendicitis Reduce the Rate of Unnecessary Surgical Procedures?

Max Lahaye MD, PhD (Presenter); Doenja M Lambregts MD, PhD; Eveline Mutsaers; Alfons Kessels; Stephanie Breukink; Regina G Beets-Tan MD, PhD

PURPOSE
Since February 2010 new Dutch guidelines have been implemented recommending the use of US or CT to confirm or refute clinically suspected appendicitis before (laparoscopic) surgery. For equivocal cases with US additional imaging (CT/MRI) is recommended. This study aimed to see whether these new guidelines lowered the percentage appendix sana.

METHOD AND MATERIALS
This retrospective study included all consecutive patients operated for clinically suspected appendicitis at our hospital from 2006 until 2013. The use of imaging (none versus US, CT and/or MRI) and its findings were recorded. Surgical and histopathological findings - where available - were notified. The primary study endpoint was the number of appendix sana before and after the guideline implementation.

RESULTS
745 patients were included, of which 475 were collected before the implementation of the guidelines and 270 after. Pre-implementation, 22.3% (106/475) of the patients received imaging focussed on the appendix. Post-implementation, 98.9% (267/270) of the patients received imaging before surgery. The average percentage of an appendix sana before the guidelines was 25% (119/475). After implementation, this average percentage dropped significantly to 5.9% (16/270, p < 0.001). Use of preoperative imaging in all patients with suspected clinically appendicitis resulted in a significant reduction in the percentage of appendix sana. This suggests that the implementation of imaging in the work up of these patients could be an effective strategy to reduce the number of unnecessary surgeries.

CLINICAL RELEVANCE/APPLICATION
Preoperative imaging results in a significant reduction of unnecessary surgery and should thus be recommended for all patients clinically suspected for appendicitis.

SSQ05-03 • The Alvarado Score as a Method for Potentially Reducing the Number of Unnecessary CT Scans for Appendicitis When Appendicultrasound Fails to Visualize the Appendix

Robert Jones MD (Presenter); R. Brooke Jeffrey MD *; Terry S Desser MD *; Eric W Olcott MD

PURPOSE
To evaluate the Alvarado score as a means to reduce referrals to CT when ultrasound fails to visualize the appendix but is otherwise normal.

METHOD AND MATERIALS
With IRB and HIPAA compliance, 1241 consecutive appendicultrasound exams for suspected appendicitis were reviewed to yield 247 patients whose studies did not visualize the appendix but were otherwise normal and had CT within 48 hours. Of the 247 patients, 86 had Alvarado scores of 3 or less.

RESULTS
The incidence of appendicitis was 15.4% (38/247) for all 247 patients but less among the 86 with Alvarado scores of 3 or less, whether considering all 86 (2/86, 2.3%; p=0.001), females (0/59, 0%); P

CONCLUSION
Patients with non-visualization of the appendix and an Alvarado score of 3 or less are at particularly low risk for acute appendicitis and low risk for disorders requiring emergent surgery. Active clinical observation should be considered for them rather than direct referral to CT.

CLINICAL RELEVANCE/APPLICATION
Patients with non-visualization of the appendix but an otherwise normal ultrasound and an Alvarado score of 3 or less should be considered for active clinical observation rather than direct CT.

SSQ05-04 • Diagnosing Acute Appendicitis Using a Non-oral Contrast CT Protocol in Patients with a BMI of Less than 25

Vijay Ramalingam MD (Presenter); Jennifer W Uyeda MD; David D Bates MD; Kathy Zhao; Marisa Roberts; Lindsey
SSQ05-06 • Improving the Role of CT in Diagnosing Complicated Appendicitis: Are there Occult Signs?

Mustafa Al Sultan MD (Presenter) ; Tarek Hegazi MBBS ; Caroline Reinhold MD, MSc ; Lawrence A Stein MD

PURPOSE
Retrospectively evaluate the accuracy of focal appendiceal wall enhancing defect and intra-luminal gas in predicting gangrenous and/or perforated appendicitis when not apparent on imaging in relation to surgical and pathological results.

METHOD AND MATERIALS
Patients with surgical/pathology-proven appendicitis who underwent preoperative IV contrast CT within 24 hours of surgical intervention over a 4-year period (n=187) were retrospectively reviewed. Variable clinical data and length of admission for each patient were also assessed. Two radiologists who were blinded from the clinical data and final surgical/pathology results assessed each scan for: diameter of appendix, intra- and extra-luminal appendicolith, intra- and extra-luminal gas, phlegmon, abscess, and focal enhancing wall defect. The results were compared against surgical and pathology findings and divided into 3 groups (perforated, gangrenous and simple). The perforated group was subsequently divided into 2 subgroups whether there was presence or absence of classic CT findings of perforated hollow viscus (i.e. either/or abscess, extra-luminal gas, or extra-luminal appendicolith). Statistical significance, sensitivity and specificity for each finding were calculated. Interobserver agreement using kappa index was used for focal enhancing wall defect.

RESULTS
Simple, gangrenous and perforated appendicitis were present in 65.8%, 16% and 18.2% of the study cohort respectively. There was a good interobserver agreement (kappa = 0.78) for focal wall enhancing defect. Sensitivity and specificity of focal wall defect for diagnosing perforated appendicitis was 81.8% and 92.8% respectively, PPV = 71.0%, NPV = 95.9%. Sensitivity and specificity for Intraluminal gas was 45.3 % and 91.1% respectively, PPV = 72.5%, NPV = 76.2%.

CONCLUSION
Classic CT signs have been well-documented for diagnosis of perforated appendicitis, however, recognition of occult signs, as focal enhancing wall defect or intra-luminal gas in otherwise uncomplicated appendicitis at imaging increases suspicion of suggesting a perforated or gangrenous acute appendicitis.

CLINICAL RELEVANCE/APPLICATION
Focal wall defect and intra-luminal gas add more sensitive interpretation value in the diagnosis of image-occult complicated appendicitis and is recommended in routine evaluation of these cases.

SSQ05-07 • Simple or Solid? Prospective Clinical Evaluation of Iterative Reconstruction Using Dual-source Single-detector Reconstruction to Compare Renal Cyst Density on 50% Dose Images

Kristy Lee MD (Presenter) ; Patrick McLaughlin FFRRCSI ; Rekha Raju ; Shamir Rai BSC ; Sarah A Barrett MBBCh ; Charlotte J Yong-Hing MD, FRCP ; Alison C Harris MBBCh ; John R Mayo MD * ; Savvas Nicolaou MD

PURPOSE
Many studies now demonstrate the utility of iterative reconstruction (IR) algorithms to generate acceptable abdominal CT images at lower
Diagnosing Acute Pancreatitis Using Attenuation Values in Patients with Unexplained Abdominal Pain, Apparently Normal CT Scans and Normal Serum Levels of Pancreatic Enzymes

Mahmood A Al Bahhar MD (Presenter) ; Soumia Senouci ; Puskar Pattanayak MBBS, FRCR ; Caroline Reinhold MD, MSc

PURPOSE
To evaluate the ability of pancreas CT attenuation values to diagnose acute pancreatitis in patients presenting with abdominal pain, apparently normal CT scans and normal serum levels of pancreatic enzymes.

METHOD AND MATERIALS
Out of 124 patients reviewed, 31 patients satisfied the inclusion criteria, including documented clinical suspicion of pancreatitis, three folds elevation of pancreatic enzymes and grade A or B pancreatitis by CT scan. Another 31 normal CT scans for trauma were included in the control group. The attenuation values, measured in Hounsfield Units (HU), of the spleen, aorta, portal vein and head, body and tail of the pancreas were measured using a validated technique. All images were reconstructed using FBP and a raw data based IR algorithm (SAFIRE). The size and mean Hounsfield unit (HU) of renal hypodensities measuring greater than 1 cm was recorded on AP100-FBP, AP100-IR, AP50FBP and AP100-IR datasets. Hypodensities >20 HU were classified as solid and those between -20 HU and 20 HU were considered simple. AP100-IR images were chosen as the reference standard for the purposes of sensitivity and specificity analysis.

RESULTS

CONCLUSION
Our study demonstrates that when a patient presents with abdominal pain, normal pancreatic enzymes and no CT findings to explain the patient's pain, a pancreatic-splenic attenuation ratio in the portalovenous phase of 0.77 has a 76% PPV with an 85% specificity for diagnosis acute pancreatitis. These findings may allow a diagnosis of acute pancreatitis to be made in cases where early clinical and morphological imaging findings are non-diagnostic. This will help explain the cause of abdominal pain in some of patients and reduce the number of negative emergency CT scans.

CLINICAL RELEVANCE/APPLICATION
This finding may allow a diagnosis of acute pancreatitis to be made where early clinical, laboratory and morphological imaging findings are non-diagnostic, which could explain patient's symptoms.

Ultrasound of Superficial Structures (An Interactive Session)
Thursday, 04:30 PM - 06:00 PM • E353B
LEARNING OBJECTIVES

1) To recognize the various intra- and extra-testicular lesions seen on a sonographic examination. 2) To understand the variety of predominantly benign extra-testicular lesions seen in adult men. 3) To recognize the variety of intra-testicular lesions and to understand the malignant composition of the majority of these lesions. 4) To understand the role of sonography in acute scrotal pain. 5) To understand the role of application of color Doppler to the examination. 6) To appreciate the possible role of the new imaging techniques of contrast-enhanced sonography and tissue elastography.

ABSTRACT

Ultrasonography remains the ideal imaging method for examining the scrotal contents, with high inherent resolution of the technique and the superficial position of the scrotal contents helping. Any abnormalities present may be divided into extra-and intra-testicular lesions; the majority of lesions outside the testis in the adult likely to be benign and the majority within the testes likely to be malignant; in the pediatric population, intra-testicular lesion may be malignant; a rhabdomyosarcoma likely. The assessment of the extra-testicular space will identify cysts (spermatoceles) hydroceles, varicoceles and the solid tumors of adenomatoid or lipoma origin. Within the testes the focal lesion is likely a primary germ cell tumor; seminoma or a mixed germ cell tumor of different cell lines. Rarely a benign entity may be encountered; epidermoid cyst, segmental infarction or a Leydig cell tumor. The differentiation of malignant from benign may be dependent on the presence of vascularity on color Doppler sonography. Rare intra-testicular lesions such as sarcoïdosis or adrenal rest cells may cause difficulty. The presentation with acute testicular pain may be problematic but age is important; a pubescent boy may have spermatic cord torsion, the older man inflammatory disease. Color Doppler sonography may help in the differentiation but beware the sonographic diagnosis of torsion; this is essentially a clinical diagnosis. The presence of testicular microthlasis has associated risk factors, and sonographic surveillance is controversial. Macrocalcification may also have implications for the patient. The issue of testicular sparing surgery for benign disease may be realized with the advent of the newer techniques. Contrast-enhanced sonography confirming the absence of vascularity indicating the lesion is benign and tissue elastography confirms the lesion is hard indicating malignancy.

LEARNING OBJECTIVES

1) Recognize the sonographic features of thyroid nodules that are most predictive of malignant nodules. 2) Recognize the sonographic features of thyroid nodules that are most predictive of benign nodules. 3) Discuss different recommendations and indications for performing FNA of thyroid nodules.

ABSTRACT

Thyroid nodules are commonly noted in the thyroid gland of adults when examined by sonography. The sonographic features of thyroid nodules have been recognized to be the most important feature of thyroid nodule assessment with respect to the risk of malignancy. The optimal management of an incidentally-detected thyroid nodule depends on a working knowledge of which sonographic features raise suspicion for malignancy as contrasted which those features present in the much more common, benign nodule. This talk will review those sonographic features as well as discuss the rationale for the recommendations from both the Endocrinology and the Radiology literature concerning which nodules should undergo fine-needle aspiration (FNA).

LEARNING OBJECTIVES

1) To recognize the various intra- and extra-testicular lesions seen on a sonographic examination. 2) To understand the variety of predominantly benign extra-testicular lesions seen in adult men. 3) To recognize the variety of intra-testicular lesions and to understand the malignant composition of the majority of these lesions. 4) To understand the role of sonography in acute scrotal pain. 5) To understand the role of application of color Doppler to the examination. 6) To appreciate the possible role of the new imaging techniques of contrast-enhanced sonography and tissue elastography.

ABSTRACT

Ultrasound/opto-acoustic molecular imaging

The fundamental principles of the ultrasound and optoacoustic imaging. In the first part, principles and applications of ultrasound molecular imaging will be reviewed. In the second part, principles and applications of molecular imaging using photoacoustic imaging techniques will be presented. In the third part, ultrasound guided drug delivery approaches will be reviewed. At the end of this course, the attendees will understand the principles and potential clinical applications of ultrasound and optoacoustic imaging as well as of ultrasound guided drug delivery.

LEARNING OBJECTIVES

1) Understand the fundamental principles of photoacoustic imaging and major components of photoacoustic imaging system. 2) Knowing how photoacoustic images are formed and how to interpret photoacoustic images. 3) Understand how imaging contrast agents or imaging probes affect contrast, penetration depth and specificity in photoacoustic imaging. 4) Understand the ability of photoacoustic imaging system to visualize anatomical, functional and molecular properties of imaged tissue. 5) Identify the role of photoacoustic imaging in pre-clinical and clinical applications.

ABSTRACT

Photoacoustic imaging or tomography is a non-ionizing, non-invasive, real-time imaging technique capable of visualizing optical

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absorption properties of tissue at reasonable depth and high spatial resolution, is a rapidly emerging biomedical and clinical imaging modality. Photonoacoustic imaging is regarded for its ability to provide in-vivo morphological and functional information about the tissue. With the recent advent of targeted contrast agents, photoacoustics is capable of in-vivo molecular imaging, thus facilitating further molecular and cellular characterization of tissue.

This presentation is designed to provide both a broad overview and a comprehensive understanding of photoacoustic imaging. With a brief historical introduction, we will examine the foundations of photoacoustics, including relevant governing equations, optical/ acoustic properties of the tissues, laser-tissue interaction, system hardware and signal/image processing algorithms. Specifically, penetration depth and spatial/temporal resolution of photoacoustic imaging will be analyzed. Integration of photonoacoustic and ultrasound imaging systems will be discussed. Techniques to increase contrast and to differentiate various tissues in photoacoustic imaging will be presented. Furthermore, design, synthesis and optimization of imaging probes (typically, nanoconstructs or dyes) to enable molecular/cellular photoacoustic imaging will be presented. Special emphasis will be placed on contrast agents capable of multiplexed imaging, multi-modal imaging and image-guided therapy including drug delivery and release. The presentation will continue with an overview of several commercially available and clinically-relevant systems capable of photoacoustic imaging. Regulatory aspects of photoacoustic imaging systems and imaging contrast agents will be presented. Finally, current and potential biomedical and clinical applications of photoacoustics will be discussed.

**RC717B • Ultrasound Molecular Imaging**

Juergen K Willmann MD (Presenter) *

LEARNING OBJECTIVES
1) To understand the acquisition and quantification principles of ultrasound molecular imaging. 2) To understand the characteristics and biodistribution of molecularly targeted ultrasound contrast agents. 3) To understand the role of ultrasound molecular imaging in preclinical and clinical applications.

**ABSTRACT**

Ultrasound imaging is a widely available, relatively inexpensive, and real-time imaging modality that does not expose patients to radiation and which is the first-line imaging modality for assessment of many organs. Through the introduction of ultrasound contrast agents, combining specificity of ultrasound for detection and characterization of focal lesions has been substantially improved. Recently, targeted contrast-enhanced ultrasound imaging (ultrasound molecular imaging) has gained great momentum in preclinical research by the introduction of ultrasound contrast agents that are targeted at molecular markers over-expressed on the vasculature of certain diseases. By combining the advantages of ultrasound with the ability to image molecular signatures of diseases, ultrasound molecular imaging has great potential as a highly sensitive and quantitative method that could be used for various clinical applications, including screening for early stage disease (such as cancer); characterization of focal lesions; quantitative monitoring of disease processes at the molecular level; assisting in image-guided procedures; and, confirming target expression for treatment planning and monitoring.

In this refresher course the concepts of ultrasound molecular imaging are reviewed along with a discussion on current applications in preclinical and clinical research.

**RC717C • Sonographically-guided Drug Therapy**

Alexander L Klibanov PhD (Presenter) *

LEARNING OBJECTIVES
1) To identify the basic principles of ultrasound energy deposition as applied to molecular imaging and image-guided therapeutic interventions. 2) To combine the general physical principles of ultrasound-microbubble interaction, drug-carrier systems pharmacokinetics and ultrasound contrast imaging, apply this knowledge for the development of triggered delivery approaches in the setting of personalized medicine. 3) To understand advantages and disadvantages of ultrasound application in the potential image-guided intervention designs. 4) To identify and compare potential clinical applications of ultrasound-guided drug delivery.

**ABSTRACT**

The reason of ultrasound use in drug delivery is to enhance drug action specifically in the area of disease. The design of such therapeutic intervention should assure that drug deposition or action enhancement take place only in the disease site, with the general goal to improve the therapeutic index. There are several approaches to ultrasound-assisted drug delivery. The first approach, closest to clinical practice, takes advantage of existing ultrasound contrast agents (intravenous gas microbubbles approved in US for cardiac imaging). When these bubbles are co-injected intravenously with the drugs, and ultrasound energy applied to the areas of disease, localized energy deposition leads to endothelium activation or transient ‘softening’ of blood brain barrier (BBB). Drugs (including antibodies or liposomes) can thus transit BBB and achieve therapeutic action. Ultrasound imaging can be used for targeted focusing of ultrasound energy in the areas of disease. Second approach suggests attaching microbubbles to the drug or a drug carrier (including nucleic acid drugs). Microbubbles can be complexed with drug or gene carrier nanoparticles, so that local action of ultrasound would result in triggered drug release/desit or transfection in the ultrasound-treated area. Third approach involves targeted microbubble design, as in ultrasound molecular imaging. Combination of targeted microbubbles with drug carrier makes possible unfocused ultrasound use, to act only in the areas of the target receptor expression, where microbubbles adhere and ultrasound energy is then deposited. Lately, formulation moved from microbubbles to smaller nanodroplet drug carriers, to reach interstitium, where drug release could take place upon ultrasound treatment. Overall, combination of ultrasound imaging, including contrast (molecular) imaging, focused ultrasound, and drug carrier systems will lead to novel image-guided therapies, especially applicable in the era of personalized medicine.
cyst aspiration, soft tissue foreign body removal, and radiofrequency tumor ablation. 4) Incorporate these component skills sets into further life-long learning for expansion of competency and preparation for more advanced interventional sonographic learning opportunities.

**ABSTRACT**

**Right Upper Quadrant Ultrasound**

**Friday, 08:30 AM - 10:00 AM  •  E351**

**RC825B • RC825A • RC825**

**Friday, 08:30 AM - 10:00 AM**

**Quantitative Imaging: Quantitative Imaging in Ultrasound**

1) Understand the pitfalls of ultrasound based blood flow acquisition, analysis, and interpretation. 2) Become familiar with current approaches of quantitative estimation of blood flow and learn how to minimize associated errors. 3) Obtain an overview of current commercial ultrasound contrast agents as well as their availability in the US. 4) Learn about contrast agent enhanced measurements in a state of the art in elasticity imaging and quantitative ultrasound from backscattered echoes.

**LEARNING OBJECTIVES**

1) Describe the various approaches and history of Quantitative Ultrasound. 2) Understand the difference in system-dependent and system-independent backscatter parameters. 3) Understand the benefits of system-independent backscatter parameters. 4) Describe the state of the art in elasticity imaging and quantitative ultrasound from backscattered echoes.

**ABSTRACT**

There is a long history of attempts to use the backscattered echo signals from medical ultrasound to describe disease conditions of various tissue types. For example, from the initial application of ultrasound in breasts, the investigators attempted to differentiate benign from malignant disease based on characteristics of the echo signals. Along the way, there have been substantial successes. For example, it was only 30yrs ago that we debated how to estimate blood flow based on ultrasound echo signals and how to interpret that data. Just over 20yrs ago we began to display flow dynamics with color flow imaging. More recently, elasticity imaging methods, which also began in the tissue characterization of quantitative ultrasound community, have become commercially viable products with clear diagnostic potential. These were tissue characterization methods in their early days. Now they are recognized as specific procedures with quantifiable diagnostic merit. Numerous other quantitative ultrasound (QUS) methods have been proposed, developed, tested and have demonstrated varying degrees of success. Many of these methods are still under development. This presentation will discuss quantitative ultrasound methods based on backscattered echo signals focusing on the most recent techniques that are either commercially available or that show the greatest potential as diagnostic tools.

**RC825B • Volume Flow and Measures From Contrast Agents**

**Friday, 08:30 AM - 10:00 AM  •  E263**

**RC825A • Sonography of Focal Liver Lesions**

**Mitchell E Tublin MD (Presenter)**

**LEARNING OBJECTIVES**

1) Describe a practical approach for the characterization of liver lesions at ultrasound. 2) Illustrate useful imaging features of typical and atypical hemangiomas. 3) Demonstrate the potential use of ultrasound contrast agents for liver mass characterization.

**ABSTRACT**

Despite improvements in ultrasound technology, the approach to characterization of liver lesions at ultrasound has changed little over the past thirty years. A recommendation for further evaluation by either MRI or CECT is typically given, though in many cases, the ultrasound features (in combination with clinical history) are sufficient for diagnosis. Microbubble contrast agents may improve ultrasound diagnostic specificity in the near future.

**RC810C • Gallbladder and Biliary Disease**

**Anthony E Hanbidge MBBCh (Presenter)**

**LEARNING OBJECTIVES**

1) Discuss the value of ultrasound when evaluating the gallbladder and bile ducts. 2) Identify the imaging features of acute conditions of these structures and complications. 3) Recognize common pitfalls to avoid misinterpretation. 4) Describe other conditions of the gallbladder and bile ducts including adenomyomatosis, sclerosing cholangitis, gallbladder cancer and cholangiocarcinoma.

**LEARNING OBJECTIVES**

1) What are these techniques. 2) When should they be used. 3) How effective are they. 4) Future innovations.

**ABSTRACT**

Noninvasive assessment of liver fibrosis is challenging given that chronic liver disease affects hundreds of million patients worldwide. Fibrosis is reversible with effective intervention. Therefore an effective, relatively fast method to detect fibrosis is essential.

**RC810B • Liver Elastography**

**Thomas H Grant DO (Presenter)**

**LEARNING OBJECTIVES**

1) What are these techniques. 2) When should they be used. 3) How effective are they. 4) Future innovations.

**ABSTRACT**

Noninvasive assessment of liver fibrosis is challenging given that chronic liver disease affects hundreds of million patients worldwide. Fibrosis is reversible with effective intervention. Therefore an effective, relatively fast method to detect fibrosis is essential.

**Quantitative Imaging: Quantitative Imaging in Ultrasound**

**Friday, 08:30 AM - 10:00 AM  •  E263**

**RC825B • AMA PRA Category 1 Credit ™:1.5  • ARRT Category A+ Credit:1.5**

**Director**

**Michael F McNitt-Gray , PhD * **

**RC825A • Elasticity and Backscatter Related Measures**

**Timothy J Hall PhD (Presenter) * **

**LEARNING OBJECTIVES**

1) Understand the difference in system-dependent and system-independent backscatter parameters. 3) Understand the benefits of system-independent backscatter parameters. 4) Describe the state of the art in elasticity imaging and quantitative ultrasound from backscattered echoes.

**ABSTRACT**

There is a long history of attempts to use the backscattered echo signals from medical ultrasound to describe disease conditions of various tissue types. For example, from the initial application of ultrasound in breasts, the investigators attempted to differentiate benign from malignant disease based on characteristics of the echo signals. Along the way, there have been substantial successes. For example, it was only 30yrs ago that we debated how to estimate blood flow based on ultrasound echo signals and how to interpret that data. Just over 20yrs ago we began to display flow dynamics with color flow imaging. More recently, elasticity imaging methods, which also began in the tissue characterization of quantitative ultrasound community, have become commercially viable products with clear diagnostic potential. These were tissue characterization methods in their early days. Now they are recognized as specific procedures with quantifiable diagnostic merit. Numerous other quantitative ultrasound (QUS) methods have been proposed, developed, tested and have demonstrated varying degrees of success. Many of these methods are still under development. This presentation will discuss quantitative ultrasound methods based on backscattered echo signals focusing on the most recent techniques that are either commercially available or that show the greatest potential as diagnostic tools.

**RC825B • Volume Flow and Measures From Contrast Agents**

**Oliver D Kripfgans (Presenter) * **

**LEARNING OBJECTIVES**

1) Understand the pitfalls of ultrasound based blood flow acquisition, analysis, and interpretation. 2) Become familiar with current approaches of quantitative estimation of blood flow and learn how to minimize associated errors. 3) Obtain an overview of current commercial ultrasound contrast agents as well as their availability in the US. 4) Learn about contrast agent enhanced measurements in a clinical setting.

**ABSTRACT**

Clinical ultrasound scanners typically offer three methods of blood flow acquisition, namely pulse wave, color flow and power Doppler. While real-time blood flow visualization is one of the perks of ultrasound, standardized quantitative methods are still unavailable to the radiologist. Pulse wave offers volumetric flow computation based on assumptions that are often violated. Color flow has never been directly quantitative as no angle correction can be dialed-in. The advent of 2D ultrasound arrays (electronic or mechanically swept) has enabled color flow and power Doppler acquisition in the coronal plane thus yielding Doppler angle as well as geometry independent flow...
information for direct quantification of in situ real-time volumetric flow. Ultrasound contrast agents have been approved for many clinical applications in Europe, Asia and Canada. The FDA has limited the use of ultrasound contrast agents in the US and essentially only cleared ultrasound contrast agents for cardiac applications. However, off-label application is practiced in the US. Its extend and benefits will be discussed in this course along with current approaches for ultrasound contrast agents based clinical measurements.

URL's
www.ultrasound.med.umich.edu/ODK/RSNA2012

RC825C  ●  Ultrasound Measurements and FDA Criteria for Display of New Quantitative Measures

Brian S Garra  MD (Presenter)

LEARNING OBJECTIVES
1) Review the main types of quantification of Ultrasound images. 2) Review some recent examples exploring sources of error in ultrasound morphometric quantification. 3) Summarize new ultrasound based parameters that might be displayed. 4) Discuss the formation of the Ultrasound QIBA Technical Committee and its objectives. 5) Review recent changes in FDA policy regarding display of quantitative features on ultrasound images.

ABSTRACT
Ultrasound images are probably the most frequently measured images and extensive literature on a wide variety of ultrasound image measurements exists going back to the 1960’s. Most morphometric and Doppler measurements are well documented and are at a mature stage. Automated measurements of volume and structures such as arterial intimal medial thickness are also finding increasing clinical application but each method of image segmentation and quantification has its own characteristic problems and sources of error. Some newer measurements including measurement of tissue strain (elastography) and strain rate and one of the newest, shear wave speed, are the subject of considerable research activity and the sources of error and bias are just now being identified and quantified. The RSNA Quantitative Imaging Biomarker Alliance (QIBA) has recently undertaken the task of developing standardized protocols for measurement of ultrasound related parameters. The first project of the US QIBA technical committee is to develop a profile for measurement of shear wave speed in tissue using ultrasound. The FDA has long allowed many types of measurements to be displayed as part of the ultrasound image. A demonstration of reasonable accuracy and precision important for obtaining clearance to display a new measurement. Display of measurement accuracy may also be required and users should be informed of situations where the measurement may be inaccurate. The efforts of the QIBA may provide data that in the future will help to speed up FDA clearance for display of new types of measurements.

US for Thyroid Cancer: Diagnosis, Surveillance, and Treatment (How-to Workshop)

Friday, 08:30 AM - 10:00 AM  ●  E450B

RC831  ●  AMA PRA Category 1 Credit ™:1.5  ●  ARRT Category A+ Credit:1.5
Jill E Langer, MD *
Kathryn A Robinson, MD
Sheila Sheth, MD *

LEARNING OBJECTIVES
1) Describe the sonographic characteristics of thyroid nodules that are suspicious for malignancy. 2) a. Discuss the Bethesda Cytology Classification of Thyroid FNA results and the risk of malignancy associated with each category. b. Describe the indications for two new genetic tests that may be performed on FNA's obtained from thyroid nodules with indeterminate cytology. 3) a. Describe the technique of US-guided biopsy of thyroid nodules and cervical lymph nodes in patients who have undergone thyroidectomy for thyroid cancer. b. Discuss the rationale and method of performance of US-guided ethanol ablation of malignant cervical adenopathy in post thyroidectomy patients.

ABSTRACT
This presentation will consist of a three individual presentations. The first will review the sonographic characteristics of thyroid nodules that are suggestive of malignancy. Recommendations for selecting which thyroid nodules require ultrasound-guided biopsies which have been provided by both Radiology consensus conferences and published Endocrinology guidelines will be discussed. The second presentation will review with the Bethesda Cytology Classification of Thyroid FNA results and the risk of malignancy associated with each category. Additionally this presentation describes the indications for two new genetic tests that may be performed on FNA’s obtained from thyroid nodules with indeterminate cytology. The last presentation will provide a detailed description of the technique for performing ultrasound guided biopsy of thyroid nodules and cervical lymph nodes. Various methods will be discussed and required equipment outlined. Possible complications, though rare, will be described. A comparison of the typical sonographic features of normal versus abnormal lymph nodes will be presented in an effort to identify those patients in whom sonographic follow up can be used instead of biopsy. A discussion of the possible advantages of adding thyroglobulin assay to cytologic evaluation will be provided. The rationale for and technique of performing ultrasound guided ethanol ablation of malignant cervical lymph nodes in patients with thyroid cancer will be undertaken.

Pediatric Neurosonography Update: Head, Spine, and Transcranial Doppler Ultrasound (How-to Workshop)

Friday, 08:30 AM - 10:00 AM  ●  E261

RC851  ●  AMA PRA Category 1 Credit ™:1.5  ●  ARRT Category A+ Credit:1.5
M. Beth McCarville, MD *
Geetika Khanna, MD,MS
Kristin A Fickenscher, MD

LEARNING OBJECTIVES
1) Describe advances in neurosonography that can be applied on a local level to improve daily practice of neonatal neurosonography. 2) Review indications for neonatal spine sonography, identify normal variants/pitfalls that can simulate disease, and recognize the sonographic features of spinal anomalies. 3) Review the role of transcranial Doppler ultrasound with imaging (duplex) and without imaging (non-duplex), in assigning stroke risk to children with sickle cell disease.

ABSTRACT
URL’s
http://www.umckradres.org/education/peds/neuro/index.htm

US-guided Intervventional Breast Procedures (Hands-on Workshop)

Friday, 08:30 AM - 10:00 AM  ●  E264

RC852  ●  AMA PRA Category 1 Credit ™:1.5  ●  ARRT Category A+ Credit:1.5
Jocelyn A Rapelyea, MD
Sriscilla J Slanetz, MD, MPH *
Shambhavi Venkataraman, MD
LEARNING OBJECTIVES
1) Describe the equipment needed for ultrasound guided interventional breast procedures. 2) Review the basic principles of ultrasound guidance and performance of minimally invasive breast procedures. 3) Practice hands-on technique for ultrasound guided breast interventional procedures.

ABSTRACT
This course is intended to familiarize the participant with equipment and techniques in the application of US guided breast biopsy and needle localization. Participants will have both basic didactic instruction and hands-on opportunity to practice biopsy techniques on tissue models with sonographic guidance. The course will focus on the understanding and identification of: 1) optimal positioning for biopsy 2) imaging of adequate sampling confirmation 3) various biopsy technologies and techniques 4) potential problems and pitfalls.
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<th>Name</th>
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