

2013 RSNA (Filtered Schedule)

**Sunday, December 01, 2013**

- 10:45-12:15 PM • **SSA01** • Arie Crown Theater • Breast Imaging (Diagnostic Ultrasound)  
12:30-01:00 PM • **LL-BRS-SUA** • Room: Lakeside Learning Center • Breast - Sunday Posters and Exhibits (12:30pm - 1:00pm)  
01:00-01:30 PM • **LL-BRS-SUB** • Room: Lakeside Learning Center • Breast - Sunday Posters and Exhibits (1:00pm - 1:30pm)  
02:00-03:30 PM • **RC115** • Room: S406A • Current Issues in Breast Cancer Screening  
02:00-03:30 PM • **RC150** • Room: E260 • MR Imaging-guided Breast Biopsy (Hands-on Workshop)

**Monday, December 02, 2013**

- 08:30-10:00 AM • **RC221** • Room: S404AB • Medical Physics 2.0: Mammography  
08:30-10:00 AM • **RC252** • Room: E264 • US-guided Interventional Breast Procedures (Hands-on Workshop)  
08:30-12:00 PM • **VSB21** • Arie Crown Theater • Breast Series: Breast MR Imaging  
12:15-12:45 PM • **LL-BRS-MOA** • Room: Lakeside Learning Center • Breast - Monday Posters and Exhibits (12:15pm - 12:45pm)  
12:45-01:15 PM • **LL-BRS-MOB** • Room: Lakeside Learning Center • Breast - Monday Posters and Exhibits (12:45pm - 1:15pm)  
01:30-03:00 PM • **MSCM23** • Room: S100AB • Case-based Review of Magnetic Resonance: Woman's Imaging (An Interactive Session)  
03:00-04:00 PM • **SSE01** • Arie Crown Theater • Breast Imaging (MRI Interpretation)  
03:00-04:00 PM • **SSE02** • Room: E450A • Breast Imaging (Digital Breast Tomosynthesis Lesions)  
04:30-06:00 PM • **SPSI24** • Room: E451A • Special Interest Session: Breast Density: Risk Assessment, Communication, and Approaches to Supplemental Imagi...

**Tuesday, December 03, 2013**

- 08:30-10:00 AM • **MSRO34** • Room: S103CD • BOOST: Breast-Anatomy and Contouring (An Interactive Session)  
08:30-12:00 PM • **VSB31** • Arie Crown Theater • Breast Series: Emerging Technologies in Breast Imaging  
10:30-12:00 PM • **MSRO35** • Room: S103CD • BOOST: Breast-Integrated Science and Practice (ISP) Session  
10:30-12:00 PM • **SSG01** • Room: E451A • ISP: Breast Imaging (Nuclear/Molecular Imaging)  
12:15-12:45 PM • **LL-BRS-TUA** • Room: Lakeside Learning Center • Breast - Tuesday Posters and Exhibits (12:15pm - 12:45pm)  
12:45-01:15 PM • **LL-BRS-TUB** • Room: Lakeside Learning Center • Breast - Tuesday Posters and Exhibits (12:45pm - 1:15pm)  
03:00-04:15 PM • **MSRO36** • Room: S103CD • BOOST: Breast-Case-based Review (An Interactive Session)  
03:00-04:00 PM • **SSJ01** • Arie Crown Theater • Breast Imaging (Screening and Density)  
03:00-04:00 PM • **SSJ02** • Room: E450A • ISP: Breast Imaging (Computed Tomography)  
04:30-06:00 PM • **RC415** • Room: S406B • Breast Interventional Procedures

**Wednesday, December 04, 2013**

- 08:30-10:00 AM • **RC511** • Room: S505AB • High-Resolution Radionuclide Breast Imaging (An Interactive Session)  
08:30-10:00 AM • **RC515** • Room: E450A • BI-RADS® Update and Challenge (An Interactive Session)  
10:30-12:00 PM • **SSK01** • Arie Crown Theater • Breast Imaging (Digital Breast Tomosynthesis Screening Outcomes)  
10:30-12:00 PM • **SSK02** • Room: E450A • Breast Imaging: (Interventional Techniques and Radiology/Pathology Correlation)  
12:15-12:45 PM • **LL-BRS-WEA** • Room: Lakeside Learning Center • Breast - Wednesday Posters and Exhibits (12:15pm - 12:45pm)  
12:45-01:15 PM • **LL-BRS-WEB** • Room: Lakeside Learning Center • Breast - Wednesday Posters and Exhibits (12:45PM - 1:15PM)  
03:00-04:00 PM • **SSM01** • Arie Crown Theater • Breast Imaging (MRI Lesion Characterization)  
03:00-04:00 PM • **SSM02** • Room: E451A • Breast Imaging (Multimodality Breast Imaging)  
03:00-04:00 PM • **SSM21** • Room: S406B • Physics (X-ray Imaging Techniques)  
03:00-04:00 PM • **SSM22** • Room: S104A • Radiation Oncology and Radiobiology (Breast)  
03:30-05:00 PM • **MSES44** • Room: S100AB • Essentials of Breast Imaging

**Thursday, December 05, 2013**

- 08:30-10:00 AM • **RC615** • Room: N227 • Breast US  
08:30-10:00 AM • **RC617** • Room: S504CD • Emerging Breast Imaging Strategies  
10:30-12:00 PM • **ICI151** • Room: S501ABC • Breast Imaging: Interoperability Challenges and Solutions  
10:30-12:00 PM • **SSQ01** • Arie Crown Theater • Breast Imaging (Ultrasound Screening)  
10:30-12:00 PM • **SSQ02** • Room: E450A • Breast Imaging (CAD/Quantitative Imaging)  
12:15-12:45 PM • **LL-BRS-THA** • Room: Lakeside Learning Center • Breast - Thursday Posters and Exhibits (12:15pm - 12:45pm)  
12:45-01:15 PM • **LL-BRS-THB** • Room: Lakeside Learning Center • Breast - Thursday Posters and Exhibits (12:45pm - 1:15pm)  
04:30-06:00 PM • **RC715** • Room: E451B • Digital Breast Tomosynthesis  
04:30-06:00 PM • **RC750** • Room: E260 • MR Imaging-guided Breast Biopsy (Hands-on Workshop)

**Friday, December 06, 2013**

- 08:30-10:00 AM • **RC815** • Room: E450A • Clinical Breast MR Imaging (An Interactive Session)  
08:30-10:00 AM • **RC852** • Room: E264 • US-guided Interventional Breast Procedures (Hands-on Workshop)  
10:30-12:00 PM • **SST01** • Room: E450B • Breast Imaging (Issues in Screening)

**Unusual Breast Masses: Histopathological and Multimodality Radiological Approach**

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**LL-BRE1141**

**Emine Dagistan**  
**Betul Kizildag**  
**Safiye Gurel, MD**  
**Yuksel Barut**  
**Esra Pasaoglu**

**PURPOSE/AIM**

The aim of this education exhibit is; 1. To increase awareness of radiologists for unusual and challenging breast lesions  
2. To illustrate sonographic, mammographic, contrast-enhanced dynamic MRI findings in combination with histopathological features

**CONTENT ORGANIZATION**

- Incidence of unusual breast lesions
- Histopathological classification of lesions according to World Health Organization (WHO)
- Multimodality imaging and histopathological findings of various demonstrative cases

**SUMMARY**

Major teaching points of this exhibit are 1. A wide range of neoplastic and nonneoplastic breast lesion spectrum has been on stage due to the remarkable increase in both diagnostic and screening breast examinations. 2. Imaging findings of unusual breast lesions almost always overlap with frequent benign and malignant ones. Therefore radiologic diagnosis stays behind pathological diagnosis. 3. Increasing awareness for unusual breast masses such as desmoid, focal fibrosis, idiopathic granulomatous mastitis, tubular adenoma in the benign category, and osteoclastic giant cell carcinoma, phyllodes, microinvasive papillary carcinoma, squamous cell carcinoma, metaplastic carcinoma in the malignant category would help radiologists to improve their differential diagnosis.

**LL-BRE1142**

**Maryellen L Giger** , PhD \*  
**Hui Li** , PhD  
**Karen Drukker** , PhD \*  
**Li Lan**  
**Hiroyuki Abe** , MD  
**Gillian M Newstead** , MD \*  
**Charlene A Sennett** , MD

**PURPOSE/AIM**

To inform attendees on computerized quantitative methods for both extracting data from multi-modality breast images (computer vision) and mining the data to yield image-based phenotypes that relate to breast cancer risk, diagnosis, prognosis, and response to therapy.

**CONTENT ORGANIZATION**

This educational exhibit will first describe methods for the HIPAA-compliant retrospective collection of (300) breast cancer cases and for the subsequent computerized quantitative analyses of tumors and parenchymal surround to yield image-based phenotypes of tumor size, morphology (e.g., margin sharpness), texture (e.g., heterogeneity), and kinetics (e.g., curve shape). Next an overview of data mining techniques will be presented, which can take as input either just the imaging phenotypes or multiple phenotypes from histopathology, molecular classification, and imaging. In data mining, a computer algorithm categorizes cases in an unsupervised manner after which researchers can color code the output based on cancer subtype, molecular classification (e.g., ER receptor) and/or genetic markers (e.g., BRCA1) in order to systematically and statistically discover relationships.

**SUMMARY**

Exhibit will teach high-throughput quantitative image analyses of clinical cases showing image-based biomarkers/phenotypes for assessing gene expression and enhancing precision medicine.

**Cone-beam Breast Computed Tomography: A Promising Modality for Assessing Tumor Response Following Neoadjuvant Treatment of Breast Cancer**[Back to Top](#)**LL-BRE1143**

**Adam Fang** , MD  
**Shirley Chan** , MD  
**Avic M O'Connell** , MD

**PURPOSE/AIM**

Accurate imaging is important for patients diagnosed with locally advanced breast cancer for monitoring tumor size and guiding treatment decisions. Currently utilized standard imaging and clinical breast examinations are not always accurate. The purpose of this exhibit is to highlight non-contrast cone-beam breast computed tomography (CBBCT) as a promising modality for evaluating tumor response during and following neoadjuvant treatment of breast cancer.

**CONTENT ORGANIZATION**

1) Briefly describe the current clinical and standard imaging modalities that are used to assess tumor response in patients undergoing neoadjuvant treatment of breast cancer. 2) Review CBBCT and compare it with other imaging modalities such as mammography, ultrasound, and magnetic resonance imaging. 3) Illustrate the advantages of using CBBCT to assess changes in tumor response prior to, during and following neoadjuvant treatment of breast cancer through a variety of image rich cases.

**SUMMARY**

CBBCT imaging before, during and after neoadjuvant treatment of breast cancer can provide more accurate imaging than clinical evaluation, better imaging for follow up and for tumor localization and potentially improve surgical and radiation therapy outcomes.

**Imaging Features of Incidental Breast Abnormalities Detected on Body CT with Mammographic and Ultrasound Correlation**[Back to Top](#)**LL-BRE1144**

**Nicola J Cook** , MBChB  
**Abedi Farhad Syed Abbas Hasan** , MBBS, MRCS  
**Zatinahhayu Mohd Isa** , MBBS

**PURPOSE/AIM**

To review the imaging features of incidental breast pathologies demonstrated on body Computerised Tomography (CT) with mammographic and ultrasound correlation.

**CONTENT ORGANIZATION**

With the increasing role of imaging in clinical practice and ever-expanding workload of body CT, an increasing number of incidental breast abnormalities are being detected. In a retrospective study at a tertiary teaching hospital, a wide range of benign and malignant incidental breast pathologies were identified on body CT. The CT features of a variety of incidental breast pathologies are described and illustrated with representative images. These CT findings are correlated to the mammographic and ultrasound features with reference to the relevant literature. Various pathologies including cyst, fibroadenoma, gynaecomastia, duct ectasia, intraductal papilloma, lymphoma, metastases and carcinoma are illustrated.

**SUMMARY**

A wide spectrum of breast pathologies can be identified on body CT as demonstrated at our institution. Previous studies have reported a detection rate of breast carcinoma on body CT of 1-2% and emphasized the importance of reviewing breast while examining body CT. We highlight the range of breast pathologies demonstrated on body CT along with their corresponding imaging characteristics, which would be of use to the general radiologist in day to day reporting.

**Retrospective Comparison of Contrast-enhanced Spectral Mammography (CESM) and Contrast Enhanced Breast MRI (BMRI) in the Detection of Breast Cancer**[Back to Top](#)**LL-BRE1145**

**Walson Metzger** , MD, PhD  
**Karen Hendershott** , MD  
**Kristin Brill** , MD  
**Raymond L Baraldi** , MD  
**Elizabeth Tinney** , RT  
**Michael Lee** , MD  
**Pauline Germaine** , DO

**PURPOSE/AIM**

Our purpose is to define the role of CESM in workflow management.

**CONTENT ORGANIZATION**

CESM is a new diagnostic tool for early breast cancer detection utilizing dual energy digital mammography to detect contrast enhanced cancer that can not be seen by mammogram. Studies have shown that CESM does increase sensitivity to detect breast cancer. A prospective study comparing CESM to BMRI shows that CESM has a higher specificity but lower sensitivity. The role of CESM is still

uncertain. Our study analyzed the sensitivity and specificity of CESM compared to BMRI in 18 breast cancer patients. The number of malignant lesions, the size, the enhancement intensity, and intensity of breast background enhancement on both studies of each patient have been quantified using a scale of 0-3. The total score for number of lesions is 106 on CESM and 124 on BMRI. CESM failed to detect cancer smaller than 5 mm. The score for cancer enhancement intensity is 48 for CESM and 58 for BMRI. The score of the breast background enhancement is 12 for CESM and 24 for BMRI.

#### SUMMARY

Our conclusion is that CESM sensitivity is slightly lower than BMRI for small cancer (< 5mm) with higher specificity, and equal sensitivity to BMRI for large lesion (> 5 mm). With its low cost and feasibility for easy application, CESM can be used as a triage tool before BMRI is applied.

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### Quality Control of Ultrasonography System for Breast Screening

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#### LL-BRE1146

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

#### 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 for ultrasonography system were produced in 2009. Three targets are in the phantom. The Mass target evaluates LUT, and the Dot target evaluates resolution, and the Cyst target evaluates circle degree.

#### CONTENT ORGANIZATION

In this paper, we introduce an objective evaluation method using a computer automated analysis for the ultrasonography system. We imaged the phantom images by the movie of 15frames/sec. 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 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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### Beyond Conventional Diagnostics: The Emerging Role of Quantitative Magnetic Resonance in Breast Cancer Prognostication and Treatment Response Prediction

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#### LL-BRE1148

**Dania Daye** , BS  
**Jennifer Rowland** , MD  
**Ahmed B Ashraf** , PhD  
**Majid Mahrooghy**  
**Michael D Feldman** , MD, PhD  
**Mark A Rosen** , MD, PhD  
**Emily F Conant** , MD \*  
**Despina Kontos** , PhD

#### PURPOSE/AIM

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

#### CONTENT ORGANIZATION

1.Case-based examples will be used to illustrate how quantitative MR techniques can contribute to prognostication and treatment response prediction.

- a)DCE-MRI (volume,kinetics and texture)
  - b)DWI-MRI (ADC measures)
  - c)1H-MRS (water:fat ratio and choline SNR)
- 2.Histopathologic correlates will be used to illustrate:

- a)Tumor characteristics associated with prognosis
  - b)Partial and complete pathologic treatment response
- 3.Predictive models that integrate pathology and imaging will be shown to illustrate clinical implications of emerging MR biomarkers.

#### SUMMARY

MRI of the breast is widely used clinically for breast cancer diagnosis. Yet, its role in disease prognostication and assessment of treatment response remains an area of active investigation. Here, we review the emerging role of different quantitative MR biomarkers in breast cancer prognostication and prediction of treatment response. As demand for tailored treatment options grows, quantitative imaging biomarkers may become essential to aid in this process.

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### Magnetic Resonance Imaging of Late Periprosthetic Fluid Collections in Patients with Silicone Breast Implants: An Illustrative Case Series

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#### LL-BRE1149

**Mary F Wood** , MD

**Catalina Vial** , MD  
**John K Plemmons** , MD  
**Dravna V Razmilic** , MD  
**Maria E Navarro** , MD

**PURPOSE/AIM**

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

**CONTENT ORGANIZATION**

Review appearance of silicone breast implants on MR Review late complications of silicone breast augmentation Illustrative case series of periprosthetic fluid collections Summary and future directions

**SUMMARY**

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

**Magnetic Resonance Imaging of Late Periprosthetic Fluid Collections in Patients with Silicone Breast Implants: An Illustrative Case Series**

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

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**LL-BRE1150**

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

**PURPOSE/AIM**

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

**CONTENT ORGANIZATION**

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

**SUMMARY**

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

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

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### LL-BRE1150

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

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## Contrast Enhanced Digital Mammography. Spectrum of Imaging Findings

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### LL-BRE1151

**Athanasios N Chalazonitis** , MD, MPH  
**Eleni Feida**  
**Spiros Liopiris**  
**George Tsimitselis** , MD  
**Dionisis Goutzamanis**  
**Zoi Antoniou** , BMedSc  
**Olga Giouvri**  
**Efi Christopolou**

#### PURPOSE/AIM

1. To review current Contrast Enhanced Digital Mammography (CEDM) indications.
2. To suggest an appropriate CEDM examination protocol.
3. To demonstrate the spectrum of CEDM imaging findings.
4. To review the potential CEDM pitfalls.

#### CONTENT ORGANIZATION

More than eighty (80) CEDM cases will be presented in detail as a pictorial review. All cases will be followed by a list of radiological signs paired with appropriate histological confirmation.

#### SUMMARY

Two separate and almost simultaneous x-ray exposures, after intravenous iodinated contrast media administration, are used to create two mammographic images with a dual-energy acquisition technique, in both CC and MLO projections. The low energy image looks like a standard mammogram and the high energy (a temporal subtracted) image shows highlighted, enhanced areas of blood flow pointing to areas of potentially cancerous lesions.

CEDM is a useful adjunctive tool and a problem-solving method to diagnostic mammography with many clinical applications in every-day practice. Our exhibit can be used as a basis for further education on breast imaging modalities and in order to understand the added value of this relatively new method to detect early and accurately breast cancer.

## Finding Cancers in Dense Breast- Review and Comparison of Studies for Additional Imaging Options-Tomosynthesis and Automated Breast Ultrasound

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### LL-BRE1152

**Megha Garg** , MBBS \*  
**Lilian K Lwin** \*

**PURPOSE/AIM**

The purpose of this exhibit is: 1) To review the published screening population based studies on tomosynthesis and automated breast ultrasound. 2) Compare the studies for increase in sensitivity with addition of these tests to mammography. Also compare the call back rates, specificity, positive and negative predictive value. 3) Increase awareness and provider reader for a comprehensive overview for these 2 promising modalities

**CONTENT ORGANIZATION**

1. Increased awareness for dense breasts - why? 2. Breast cancer in relation to dense breast 3. Review of mammogram alone 4. mammogram with screening breast ultrasound - compile data from published studies in screening population 5. mammogram with tomosynthesis - compile data from published studies in screening population 6. Comparison of the above data for - increased cancer detection, call back rates, specificity, negative and positive predictive values 7. Sample cases from the studies 8. Future directions and summary

**SUMMARY**

The major teaching points of this exhibit are: 1. Screening population - women with dense breast - additional tools available 2. How does these 2 modalities help in addition to mammogram 3. How do these compare to each other 4. Apart from just increased cancer detection rate, make the readers aware of the additional factors

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

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**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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## Youâ€™ll See It When You Know It â€” World Health Organization-classified (2012) Rare Breast Carcinomas

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### LL-BRE1154

**Sheryl G Jordan**, MD  
**Nisha Mehta**, MD  
**Fernando J Boschini**, MD  
**Samuel H Jordan**  
**Zane S Jordan**  
**Siobhan O'Connor**, MD

#### PURPOSE/AIM

The purpose of this exhibit is:

- To describe the newly published 2012 classification of World Health Organization (WHO) rare breast carcinomas
- To present pathology, immunohistochemistry (IHC), and prognosis of rare breast carcinomas
- To emphasize these patients' imaging findings
- To illustrate utility of oncologic literature subclassification of these patients into subgroups by IHC and prognosis: ER Positive Good Prognosis; ER Negative Good Prognosis; ER Positive Poor Prognosis; ER Negative Poor Prognosis

#### CONTENT ORGANIZATION

- Newly published 2012 WHO classification of breast epithelial tumors
- Case presentations of WHO rare carcinoma types
- Oncology literature subclassification of rare breast carcinomas via IHC and prognosis
- Good Prognosis Triple Negative Breast Cancer – no longer an oxymoron

#### SUMMARY

1. This concise educational activity bridges radiologists' current knowledge gap about WHO rare breast carcinomas; these cases are not as rare as one may think given the sheer annual number of newly diagnosed breast cancers
2. Differences in the molecular definition of rare breast carcinomas account for the heterogeneity of breast cancer presentation and clinical course.
3. Knowledge of the differing tendencies of each type of rare breast carcinoma assists in understanding disease prognosis and directing care recommendations.

## Manifestations of Post Transplant Lymphoproliferative Disorder in the Breast: A Case Series

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### LL-BRE1155

**Nicole Roy**, MD  
**Mark D Kettler**, MD  
**Kathryn B Snyder**, MD  
**Cynthia W Hanemann**, MD

#### PURPOSE/AIM

The purpose of this exhibit is: 1. To learn that PTLD may affect the breast and become familiar with imaging manifestations of breast PTLD 2. To include PTLD in the differential diagnosis for breast masses in the appropriate patient population 3. To utilize appropriate specimen handling when performing core biopsy on a breast mass that may represent PTLD, and to communicate the suspected diagnosis to the pathologist

#### CONTENT ORGANIZATION

This presentation will display multimodality imaging features of 3 cases of PTLD in the breast. A brief clinical history and imaging findings will accompany the images for each patient. The discussion section will emphasize the importance of incorporating patient history into the differential diagnosis of breast lesions and offer guidelines for specimen processing when PTLD is suspected. Section headings will be Case 1, Case 2, Case 3 and Discussion.

#### SUMMARY

After reviewing the cases in this presentation, the radiologist will be aware that PTLD may present as a variety of new breast findings in transplant patients. Proper handling of potential breast PTLD biopsy specimens will enable timely pathologic diagnosis. A newly diagnosed case of PTLD on breast biopsy will facilitate prompt treatment for this serious systemic disease.

## Breast Imaging Radiologists' Opinions on Management of Breast Pain as a Sole Presenting Symptom

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### LL-BRE1156

**Neil A Shah**, MD  
**Kathleen R Gundry**, MD

#### PURPOSE/AIM

The purpose of this exhibit is to:

1. Review recent literature on classification and workup of breast pain
2. Present data on how breast imaging radiologists classify and workup breast pain
3. Gain an understanding of the current standard of care for breast pain

#### CONTENT ORGANIZATION

Content will be organized as follows:

1. Review of current breast pain literature
2. Survey results
3. Results analysis
4. Current breast pain standard of care based on results and analysis
5. Future directions

#### SUMMARY

Major teaching points of this exhibit are to:

1. Present breast imaging radiologists' opinions on the management of breast pain, and in doing so...
2. Understand current and future direction of standard of care for breast pain

Preliminary data are as follows:

1. Pain is the ONLY indication in
2. >90% of respondents consider focal pain significant. 50% consider single quadrant pain significant.
3. General trend for workup is to ultrasound younger patients and begin with mammogram on older patients.

## An Automatic Multi-scale Contrast Homogenization of Mammograms to Facilitate Current-prior Comparison and Mammogram Reading

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### LL-BRE1157

**Fabian Zoehrer**  
**Horst K Hahn**, PhD \*

#### PURPOSE/AIM

Due to unique post processing by manufacturers, digital mammograms acquired with different systems can show large variations in their multi-scale contrast appearance. We show how automatic wavelet-based contrast filtering can be used to transform the multi-scale contrast appearance of mammograms, supporting current-prior comparison or different reader viewing customs.

#### CONTENT ORGANIZATION

Our workstation consists of two settings. 1 features a one mammogram whose contrast can be switched by the user to predefined multi-scale adjustment templates. The templates mimic the specific post processing of acquisition systems by different manufacturers, thus supporting individual viewing custom of readers. 2 presents pairs of current-prior mammograms, which have been previously post-processed by different systems. The user can switch between the original and the homogenized setup. The original setup illustrates the difference in appearance of the mammograms. The homogenized setup shows how these differences can be minimized by adjusting the multi-scale contrast of the prior to that of the current mammogram.

#### SUMMARY

Our workstation shows how multi-scale contrast filtering of mammograms can be used to easily adjust the appearance of mammograms in order to facilitate the comparison of current prior mammogram reading or to adapt to individual viewing customs.

## The Role of Virtual Clinical Trials in Preclinical Testing of Breast Imaging Systems

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### LL-BRE1158

**Andrew D Maidment**, PhD \*  
**Predrag R Bakic**, PhD \*  
**Joseph H Chui**, MSc \*  
**Ali N Avanaki**, PhD \*  
**Cedric Marchessoux** \*  
**David D Pokrajac**, PhD  
**Kathryn S Espig**, MSc \*  
**Tom Kimpe**, PhD \*  
**Albert Xthona** \*  
**Miguel A Lago**  
**Varsha Shankla**

#### PURPOSE/AIM

To introduce the concept of Virtual Clinical Trials (VCTs) and to illustrate the use of VCTs in preclinical testing of novel imaging systems for breast imaging.

#### CONTENT ORGANIZATION

1) The computational pipeline for VCTs will be detailed, including software anthropomorphic phantom design, simulation of the image acquisition and display, and task-based model observers. 2) The principles of VCT design will be illustrated with applications to digital breast tomosynthesis screening. 3) The benefits, challenges and limitations of VCTs will be discussed.

#### SUMMARY

The preferred approach to validation and optimization of novel imaging devices, including medical-grade monitors, is clinical trials; however, these are limited by cost, duration, and the need for repeated irradiation of patients. We have developed a preclinical alternative in the form of VCTs, which include simulations of breast anatomy with lesions, image acquisition and display. Based upon observer studies using a large number of phantom images and model observers, VCTs can be used to estimate sensitivity, specificity, and other clinically relevant measures over a broad range of breasts and lesions. Those measures help to identify the most promising imaging device designs, which can then be further optimized and validated in focused, cost-effective clinical trials.

## Breast Cancer: Role of Molecular Imaging

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### LL-BRE1159

**Mario Patino-Zarco**, MD  
**Violeta Ofelia Cortes-Hernandez**, MD  
**Carlos Martin Galindo-Sarco**, MD  
**Rafael Delgado Espin**, MD  
**Carla Moctezuma Velasco**, MD  
**Enrique Estrada-Lobato**, MD  
**Irma Soldevilla-Gallardo**

#### PURPOSE/AIM

The purpose of this exhibit is: Overview of clinical and biologic considerations in breast cancer. To review current applications of molecular imaging for breast cancer screening, staging, restaging, response evaluation and guiding therapies

#### CONTENT ORGANIZATION

-Incidence, risk factors, pathology, and classification -Breast cancer detection and diagnosis: PEM -Locoregional Staging: PEM, SPECT/CT lymphoscintigraphy, FDG PET/CT -Systemic Staging: FDG PET/CT, Bone scan -Response to therapy assessment: PEM and PET/CT -Potential role of other PEM and PET/CT radiotracers: Fluorothymidine - FES

#### SUMMARY

The major teaching points of this exhibit are: **Indications for PEM** - Detection in high-risk groups, and for cases in which mammography is less effective. - Defining disease extent for surgical Planning. - Therapy Selection and Monitoring. **Indications for lymphoscintigraphy** - Lymphoscintigraphy + SLN sampling is the standard of care for axillary nodal staging. - Best results with SPECT/CT **Indications for PET/CT** - Emergent role for locoregional staging in advanced disease. - Assessment of extent of disease in selected patients before therapy. - Therapy Selection and Monitoring (Emerging role for FES PET/CT).

## 9G Vacuum-assisted Breast Biopsy and 14G Automated Large-core Biopsy of Ductal Carcinoma in Situ: Determination of Underestimation Rates

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### LL-BRE1161

**Viera Lehotska**, PhD  
**Katarina Rauova**, MD, PhD

#### PURPOSE/AIM

To measure the accuracy and effect of VAB compared with LNCB on the DCIS underestimation rate.

#### CONTENT ORGANIZATION

Nonpalpable breast lesions received a histologic diagnosis of DCIS after LNCB in 271 lesions and after VAB in 263 lesions, respectively.

There were 103 high-grade DCIS, 86 intermediate and 52 low-grade DCIS in the group of LNCB, and 105 high-grade, 81 intermediate and 77 low-grade DCIS in the group of VAB. The presence of histopathologic invasive carcinoma was noted at subsequent breast conserving surgery.

Independent significant DCIS underestimation rates diagnosed at LNCB were 25,5% (69 of 271) of lesions and 8,0% (21 of 263) of lesions diagnosed at VAB (P SUMMARY

DCIS overall underestimations were 3,2 times more frequent with LNCB than with VAB, 8,5 times more frequent in high-grade lesions in the group of LNCB. In the diagnosis of DCIS VAB is more accurate than LNCB (92% vs 75,5%).

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## Automatic Real-time Position Correlation for Multi-view Tomosynthesis Images to Facilitate the Breast Reading Workflow

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### LL-BRE1162

**Fabian Zoehrer**  
**Joachim Georgii**  
**Horst K Hahn**, PhD \*

#### PURPOSE/AIM

Due to the 3D nature of tomosynthesis, manual position correlation between different acquisitions is time expensive and requires complex thinking. We show how our automatic real-time position correlation method can facilitate comparison between different tomosynthesis images as well as mammograms.

#### CONTENT ORGANIZATION

Our workstation features sets of two tomosynthesis images of the same patient acquired at different angles. The user can view both 3D images without our method being active to illustrate the difficulties of manually correlating finding positions between views. If our method is active, the users selected position in one view will automatically and in real-time be correlated to a position in the other view. Additionally, the correlation from one tomosynthesis image to the same patients mammograms (acquired with different compressions or at different angles) is also supported and shown.

#### SUMMARY

The presented workstation will show the difficulties of manual correlation tasks as well as the advantages of our automatic real-time position correlation for multi-view tomosynthesis images.

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

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### LL-BRE1163

**Joachim Georgii**  
**Fabian Zoehrer**  
**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.

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

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**Horst K Hahn**, PhD \*

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### Axillary Lymph Nodes: Spectrum of Imaging Findings at Multi-imaging Modalities

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#### LL-BRE2412

**Ahmed Abdel Razek**, MD  
**Dalia Mahfouz**, MD  
**Hanan S Gewefel**, MD

#### PURPOSE/AIM

- 1) To illustrate basic background and causes of enlarged axillary lymph nodes (LN).
- 2) To review the spectrum of typical and atypical imaging appearance and biomarkers of enlarged metastatic axillary LN at different imaging modalities.
- 3) To evaluate role of imaging of axillary LN in cancer breast

#### CONTENT ORGANIZATION

- 1-Anatomical level, drainage and staging of axillary LN
- 2-Causes of enlarged axillary LN
- 3-Mammography appearance of axillary LN
- 4-Ultrasound, power Duplex and elastography of metastatic axillary LN
- 5-Biopsy of sentinel LN
- 6-Dynamic contrast MR, diffusion MR and MR spectroscopy biomarkers of metastatic axillary LN
- 7-CT perfusion, PET CT of metastatic axillary LN
- 8-Role of imaging of axillary LN in preoperative staging and treatment planning of patient cancer breast
- 9-Imaging appearance of lymphomatous and benign axillary LN

#### SUMMARY

The major teaching points of this exhibit are:

- 1-To be familiar of radiologist with the broad spectrum of imaging appearance and biomarkers of metastatic axillary LN at different imaging modalities
- 2-Imaging helpful for differentiating metastatic axillary LN from other benign causes of enlarged nodes, preoperative staging and treatment planning of patients with cancer breast

### 3D Automated Breast Ultrasound (ABUS): Pictorial Review of Applications and Clinical Utility

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#### LL-BRE2413

**Angels Domingo**, MD  
**Francisca Virginia C Gras**, MD  
**Carmen V Cusido**, MD  
**Xavier Salvador**, MD \*

#### PURPOSE/AIM

To review the potential applications of ABUS such as detection and characterization of benign and malignant lesions, evaluation of breast implants and its complications (i.e. rupture), screening of asymptomatic dense-breasted women, amongst others.

#### CONTENT ORGANIZATION

1. Review of ABUS applications. 2. Illustrative case reviews: \*Malign lesions: intraductal, multifocal, tubular and in situ carcinomas. Mammographic correlation. \*Benign lesions: fibroadenomas, cysts, post-operative scars, mastopathy, calcifications, lymph nodes. \*Breast implants evaluation and its complications (i.e. rupture). 3.ABUS screening in asymptomatic dense-breasted women. Examples of asymptomatic dense-breasted women with normal mammography and pathologic findings in ABUS.

#### SUMMARY

ABUS represents a potential diagnostic tool, especially in dense-breasted women. It doubles overall cancer detection when combined with screening mammography. It provides additional information in the evaluation of focal lesions with multiplanar reconstructions, increasing diagnostic accuracy and offering visualization of the whole breast. The coronal plane offers an easily understandable representation of the breast's anatomy, specially useful in breast surgery. It guarantees high patient safety as there is no exposure to ionizing radiation and no injection of contrast medium.

### 3D Automated Breast Ultrasound (ABUS): Pictorial Review of Applications and Clinical Utility

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#### LL-BRE2413

**Angels Domingo**, MD  
**Francisca Virginia C Gras**, MD  
**Carmen V Cusido**, MD  
**Xavier Salvador**, MD \*

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**Francisca Virginia C Gras**, MD  
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**Xavier Salvador**, MD \*

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### Breast and Body Imaging: What Can We Learn from Each Other?

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#### LL-BRE2414

**Debra S Copit**, MD \*  
**Kelli B Pokorny**, MD  
**Shilpa N Reddy**, MD  
**Mindy M Horrow**, MD \*

#### PURPOSE/AIM

The purpose of this exhibit is: 1. Review common breast diseases that may be visualized on CT scans 2. Encourage body imagers and general radiologists to look at the breast tissue on CT scans 3. Help radiologists decide which studies would be most helpful when an abnormality is seen in the breast on CT 4. Remind breast imagers to utilize available body imaging studies to solve diagnostic problems on mammograms

#### CONTENT ORGANIZATION

Masses: carcinoma(primary vs recurrent), metastases, benign Vascular abnormalities Iatrogenic: silicone, fat necrosis, breast reconstruction Male breast lesions

#### SUMMARY

The major teaching points of this exhibit are: 1. Both benign and malignant breast masses can be seen on CT as non-enhancing or enhancing masses and can/should be correlated with mammography and ultrasound. 2. Gynecomastia seen on CT often has a typical appearance and may not need further work up. 3. Etiologies of vascular abnormalities seen on mammography often require review of the patient's other imaging studies. 4. Being familiar with the appearance of the normal reconstructed breast as well as normal implants will help body imagers understand associated problems or complications.

### The Tricky Breast. A Case-based Review of Misleading Mammographic Images

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#### LL-BRE2415

**Rosa M Lorente-Ramos**, MD, PhD  
**Javier Azpeitia Arman**, MD  
**Teresa Rivera Garcia**  
**Isabel Casado Farinas**  
**Josefa Galobardes Monge**, MD  
**Esther Dominguez-Franjo**, MD, PhD

#### PURPOSE/AIM

The purpose of this exhibit is: 1. To review and illustrate different challenging mammographic findings, subtle appearances of malignant breast lesions, as well as pitfalls. 2. To discuss the appropriate management and associated diagnostic workup of these breast conditions.

#### CONTENT ORGANIZATION

Screening mammography may be challenging: early invasive breast cancer presents sometimes with subtle mammographic findings but pitfalls may also be found. We provide a case-based presentation consisting of tricky screening mammograms that will help us to review different difficulties in diagnosis. We add a description of findings, complementary studies (MR, US) and illustrative pathologic images when available. We present: - focal asymmetries in breast parenchyma, posterior contour, retroglandular fat, the axillary area - increased breast density - lesions depicted only in one mammographic view - subtle architectural distortion - microcalcifications - nipple/superficial lesions - associated findings with occult breast cancer: axillary lymph nodes, skin

#### SUMMARY

The major teaching point of this exhibit is to increase familiarity with subtle and unusual imaging findings in breast lesions, highlighting distinguishing features that may aid in detection of lesions and diagnosis of breast cancer .

### Missed Breast Cancers at Mammography and/or Sonography: Lessons to Be Learned

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#### LL-BRE2416

**Renato M Ribeiro**, MD  
**Mariane U Sato**, MD  
**Erica E Francolin**, MD  
**Paula C Moraes**, MD  
**Ana C Racy**, MD  
**Marcelo B Funari**, MD

#### PURPOSE/AIM

The purpose of this exhibit is:

1. To review and understand the causes of missed breast cancer;
2. To present and discuss the steps that have to be taken to avoid these events;
3. To discuss the importance of a comprehensive mammographic quality assessment program.

#### CONTENT ORGANIZATION

Causes of missed breast cancers; Review of imaging findings:

- Mammography;
- Sonography;

Pathologic results of missed cancers; Importance of a mammographic quality assessment program.

#### SUMMARY

Patients with biopsy proven breast cancer were selected from our database. All of them had previous normal exams also made in our facility. Among these exams, we selected those with missed breast cancer. This selection was made after a retrospective analysis of the previous normal exams and concluding that the cancer was already visible. We discuss the following questions: Was the lesion visible? If so, why the lesions was not depicted? Is it a case of misdetection, misinterpretation or technical error? What factors contributed for the

error to occur? What issues must be discussed among the team members (radiologists and technologists) trying to avoid these events to repeat? A comprehensive Breast Imaging Quality Program must include discussions among the team members targeting the causes of missed breast cancer.

## Imaging and Management of Poor Surgical Candidates with Screen Detected Breast Cancer: Current Practice and Future Directions

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### LL-BRE2417

**David V Schacht** , MD  
**Hiroyuki Abe** , MD  
**Kirti M Kulkarni** , MD  
**Kirsten Gaarder** , MD  
**Charlene A Sennett** , MD

#### PURPOSE/AIM

When early stage breast cancer is found in patients who have poor general health, radiologists need to be familiar with non-standard treatment and imaging paradigms. This exhibit will present examples of such patients including clinical details, imaging and pathology. Additionally, a general discussion of screening older patients and those in poor health will be presented.

#### CONTENT ORGANIZATION

1. Clinical presentations of patients with poor health who are screened for breast cancer will be provided. 2. Imaging workup and biopsy histopathology (ER staining) will be shown. 3. Treatment, including anti-estrogen therapy alone, will be discussed. 4. Mammography and ultrasound, before and after anti-estrogen therapy, will be shown. 5. A review of recommendations regarding screening older women will be presented. 6. Screening those in poor health and emerging therapies such as MRI guided ablation will be discussed.

#### SUMMARY

Imaging paradigms that meet the needs of poor surgical candidates with breast cancer should be understood after viewing this exhibit. Radiologists will also be able to better educate referring clinicians about the detection of early stage cancer in patients with poor general health, and help guide decision making about whether to screen these patients. Emerging treatments which may eventually prove to be beneficial in this population will be introduced.

## Multimodality Imaging of Breast Cancer Recurrence

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### LL-BRE2418

**Laura Billadello** , MD  
**Lilian Wang** , MD

#### PURPOSE/AIM

The purpose of this exhibit is:

1. Review predictors for breast cancer recurrence
2. Illustrate common and uncommon imaging features of breast cancer recurrence on mammography, ultrasound, and MRI
3. Discuss current surveillance strategies in patients with a history of breast cancer

#### CONTENT ORGANIZATION

Predictors of breast cancer recurrence Review imaging features of breast cancer recurrence on:

- mammography
- ultrasound
- MRI

Sample cases and mimics Brief review of surveillance strategies Future directions and summary

#### SUMMARY

The major teaching points of this exhibit are:

1. Predictors of breast cancer recurrence include positive surgical margins, marked intraductal tumoral component, higher tumor grade, node positive disease, and poorly differentiated tumor, among others.
2. The appearance of breast cancer recurrence on mammography, ultrasound, and MRI is varied. Changes including increasing asymmetry, an enlarging mass, increasing skin thickening and the development of pleomorphic calcifications in or near the operative bed can indicate possible tumor recurrence.
3. The imaging surveillance protocol for patients with a history of breast cancer is variable. Ultrasound and MRI may be helpful adjuncts to mammography and clinical breast exam in this subset of patients.

## Male Breast Lesions: Are You Up to the Challenge?

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### LL-BRE2419

**Cherie M Kuzmiak** , DO \*  
**Kenneth L Crosby** , MD

#### PURPOSE/AIM

Although male breast cancer is uncommon, many men present to their doctor for a mass or pain in their breast. The purpose of this exhibit is to learn about benign and malignant male breast disorders through a pictorial review in quiz format. In addition to breast imaging and pathology correlation, this exhibit will also focus on the diagnostic work-up and management of the different findings.

#### CONTENT ORGANIZATION

The key anatomic and radiology-pathology findings with differentials will be highlighted in the discussion of each case. The list of cases includes: •Mammography vs. ultrasound imaging in male patients with a mass. •Gynecomastia vs. Pseudogynecomastia. •Gynecomastia vs. Breast Cancer. •Skin lesions vs. other benign breast lesions. •Image-guided breast biopsy vs. open surgical excision in the male patient.

#### SUMMARY

After completion of the exhibit, the viewer should understand the imaging and correlate the pathology findings of different male breast diseases and develop an imaging management plan to evaluate male patients.

## Dedicated 3D Breast CT: Pearls and Pitfalls

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### LL-BRE2420

**Cherie M Kuzmiak** , DO \*  
**Randolph L McKinley** , PhD \*  
**Martin P Tornai** , PhD \*  
**Laura Tuttle**  
**Doreen Steed** , ARRT \*

#### PURPOSE/AIM

Dedicated Breast CT is an alternative technology that is not limited by breast density. It is a new imaging modality for the breast that provides low radiation dose, 3D data and is performed without breast compression. The purpose of this exhibit is to provide a demonstration through a series of cases of dedicated breast CT from optimal scanning techniques to recognizing normal findings, unique characteristics and artifacts, as well as, benign and malignant breast lesions.

#### CONTENT ORGANIZATION

The information will be presented in a quiz format. The key diagnostic teaching points will be highlighted in the discussion of each section.

1. Image Acquisition: Appropriate patient positioning and technical aspects, including acquisition artifacts.
2. Image Interpretation: How to evaluate 3-dimensional breast CT data sets.
3. Sample Cases: Appearance of normal breast anatomy, artifacts, benign and malignant lesions and other findings associated with disease.

#### SUMMARY

Due to the limitations of mammography, radiologists should become familiar with the unique characteristics, imaging findings and artifacts associated with this new emerging breast imaging tool.

### Common and Uncommon Breast Masses and Imaging Findings in Pregnant and Lactating Women

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#### LL-BRE2421

**Kenneth L Crosby**, MD  
**Cherie M Kuzmiak**, DO \*

#### PURPOSE/AIM

There are a variety of breast masses that present during pregnancy and lactation. The purpose/aim of this exhibit is to provide a review of common and uncommon breast masses and imaging findings in both pregnant and lactating women. While the majority of breast disorders diagnosed during pregnancy are benign, pregnancy associated breast cancer (PABC) is defined as breast cancer found either during pregnancy or during the first year after pregnancy. There has been an increase in the incidence of PABC. Understanding the effect of pregnancy and lactation on various breast disorders may be useful in the management, treatment and early detection of PABC. This will be accomplished through a pictorial review and quiz.

#### CONTENT ORGANIZATION

- I. Common and uncommon breast masses in pregnant and lactating women. A. Pathophysiology  
B. Imaging (Mammography, Ultrasound and MRI)  
C. Sample cases
- II. Quiz

#### SUMMARY

The major teaching point of this exhibit is: To recognize both common and uncommon breast masses seen in pregnant and lactating women. The majority of breast disorders that occur in non-pregnant patients also occur in pregnant and lactating patients, including breast cancer. Pregnancy-associated breast cancer is rare, but extremely important to recognize as early as possible in order to improve survival.

### Pictorial Review and Work-up of Breast 'Peau d'orange' Sign

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#### LL-BRE2422

**Rosa M Lorente-Ramos**, MD, PhD  
**Javier Azpeitia Arman**, MD  
**Eva Balbin**  
**Isabel Casado Farinas**  
**Teresa Rivera Garcia**  
**Rosa Casariego Pola**

#### PURPOSE/AIM

To describe clinical, mammographic, ultrasound, and magnetic resonance (MR) imaging findings of "peau d'orange" sign of the breast, providing clinical images and pathologic correlation. To review the wide spectrum of entities presenting with "peau d'orange" sign. To emphasize pitfalls, diagnostic difficulties and differential diagnosis. To provide a specific work-up for those patients.

#### CONTENT ORGANIZATION

"Peau d'orange" sign of the breast is usually clinically striking and requires a specific management. Clinical, mammographic, ultrasound, MR and pathological findings will be described providing a pictorial review of imaging and pathology and highlighting distinguishing features that may aid in diagnosis and differentiating among different etiologies of the sign. We analyse the specific work-up for those patients. We present: - non-mammary origin: heart failure, surgery, radiation, dermatosis, angioedema - mammary origin: breast infection, inflammatory breast cancer, primary pure signet cell carcinoma of the breast, lymphoma

#### SUMMARY

"Peau d'orange" sign of the breast is the common appearance of a broad spectrum of diseases ranging from breast to systemic entities and from benign to malignant lesions. Recognizing imaging and clinical findings and the specific work-up for these patients is essential in diagnosis.

### Multimodality Imaging of Benign and Malignant Adult Male Breast Disease

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#### LL-BRE2423

**Megha Madhukar**, MD  
**Alison L Chetlen**, DO

#### PURPOSE/AIM

Advanced imaging modalities such as CT, PET, and MRI can detect incidental male breast disease. The purpose of this exhibit is to expose radiologists to a series of challenging cases in order to review imaging features of benign and malignant adult male breast disease on both conventional imaging including mammography and sonography and advanced imaging including CT, MR, PET exams. This exhibit will also reinforce the appropriate diagnostic work-up and management of male breast disease.

#### CONTENT ORGANIZATION

Cases will be shown in a 'quiz' format illustrating the classic conventional imaging appearance of benign and malignant breast disease as well as their corresponding appearances on advanced imaging modalities. Malignant Male Breast Disease - IDC - Invasive Papillary Carcinoma - Metastatic Melanoma Benign Male Breast Disease - Gynecomastia - PASH (Pseudoangiomatous Stromal Hyperplasia) - Cavernous Hemangioma

#### SUMMARY

With the increasing use of advanced imaging modalities, male breast lesions are more frequently being visualized on modalities other than standard mammography and ultrasound. It is important for the radiologist to understand the various appearances of both benign and malignant male breast lesions on conventional and advanced imaging in order to provide proper clinical management.

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

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## LL-BRE2424

Su-Ju Lee , MD \*

Mary C Mahoney , MD \*

### PURPOSE/AIM

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

### CONTENT ORGANIZATION

Literature supporting preoperative breast MRI 1. Staging and extent of disease:

- a) Tumor size
- b) Additional sites of disease
- c) Pectoralis muscle and chest wall
- d) Nipple and skin
- e) Lymph Nodes 2. Subsets of patients likely to benefit:
  - a) Dense breast tissue
  - b) Invasive lobular carcinoma
  - c) Posterior breast cancer
  - d) Planned partial breast irradiation
  - e) High risk patients Literature against preoperative breast MRI:
    1. Delay in definitive therapy
    2. Re-excision rate
    3. Mastectomy rate
    4. Survival impact

### SUMMARY

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

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**SUMMARY**

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4. Many studies show preoperative breast MRI reduces re-excision rate.
5. No increased survival with preoperative breast MRI has been demonstrated.

**Integrating Digital Breast Tomosynthesis into Clinical Practice: Practical Considerations**

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**LL-BRE2425**

**Ashley A Roark** , MD  
**Lilian O Ebuoma** , MD  
**Emily L Sedgwick** , MD

**PURPOSE/AIM**

The purpose of this exhibit is to: 1. Discuss advantages of integrating digital breast tomosynthesis (DBT) into clinical practice, specifically, its effects on diagnostic accuracy, recall rates, and cancer detection rates 2. Describe approaches to incorporating DBT into screening and diagnostic examinations 3. Discuss the educational and financial implications of DBT

**CONTENT ORGANIZATION**

A review of clinical advantages of DBT will be presented based on literature review. Using our institution's experience with integrating DBT in addition to published data, we will demonstrate various approaches to integration into screening and diagnostic examinations. We will discuss practical considerations when implementing DBT into practice such as unit cost and longevity, IT requirements, healthcare personnel training and reimbursement.

**SUMMARY**

DBT has recently been shown to improve diagnostic accuracy, decrease recall rates and increase cancer detection rates. The decision to incorporate DBT into practice will confront radiologists as we strive to improve sensitivity and specificity of mammography, attract and retain patients and address recent legislation regarding breast density. A thorough understanding of the clinical benefits, as well as the financial and educational implications of DBT, is paramount to successful implementation of this technology.

**Skinterest: A Case Based Review of Mammographic Skin Findings**

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**LL-BRE2426**

**Kandarp Bhatt** , MD  
**Cheryl Williams** , MD

**PURPOSE/AIM**

Skin findings on mammography are commonly encountered in the reading room on a daily basis. Some of these lesions may mimic parenchymal abnormalities; others portray a systemic disease process or represent a more serious process. The purpose of this exhibit is to review a series of common and uncommon skin findings found on mammography, sometimes supplemented by MRI and US. We will discuss imaging characteristics and some differential diagnoses.

**CONTENT ORGANIZATION**

Cases will be presented in a quiz format with case discussions reviewing differential diagnosis as well as key imaging characteristics and diagnostic problem solving methods. The categories that will be reviewed include:

1. Skin thickening: unilateral and bilateral
2. Epidermal inclusions cysts and sebaceous cysts
3. Deodorant
4. Scars: keloids, burns, etc.
5. Tattoos
6. Neurofibromatosis
7. Skin Calcifications
8. Melanoma
9. Dermatomyositis
10. Benign skin lesions
11. Pores

**SUMMARY**

Major teaching points include:

1. Awareness of classic skin findings on initial mammography can help reduce misdiagnosis of underlying parenchymal disease.
2. Skin abnormalities on mammography may provide a glimpse into systemic disease processes.

**Architectural Distortion: A Review of the Imaging Findings and Pathological Correlation on Digital Breast Tomosynthesis (DBT)**

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**LL-BRE2427**

**Takayoshi Uematsu** , MD, PhD

**PURPOSE/AIM**

1. To understand the value of digital breast tomosynthesis (DBT) for the detection of subtle architectural distortions eliminating interference from overlapping breast tissue. 2. To outline the discrimination between true and pseudo architectural distortions in digital mammography with and without the use of DBT. 3. To describe the spectrum of architectural distortions in various breast lesions providing pathologic findings.

**CONTENT ORGANIZATION**

1. Introduction
2. Review of the definition of architectural distortion on mammography
3. Understanding of usefulness of DBT for the detection of subtle architectural distortions and the discrimination between true and pseudo architectural distortions
4. Illustrative cases: Review of the spectrum of architectural distortions in various breast lesions providing pathologic findings
5. Discussion
6. Summary

**SUMMARY**

Architectural distortion is the most commonly missed abnormality in false-negative findings of screening mammography. DBT is adequate for enhancing the detection of subtle architectural distortions and can efficiently judge digital mammography. DBT has the potential to

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

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### LL-BRE2428

**Takayoshi Uematsu**, MD, PhD

#### PURPOSE/AIM

1. To review breast MR findings of edemas on T2-weighted imaging (T2WI). 2. To learn three different types (peritumoral, prepectoral, subcutaneous) of edema on T2WI. 3. To describe the spectrum of edemas on T2WI in various breast lesions providing pathologic findings. 4. To identify three different edemas as clinical clues for differential diagnosis.

#### CONTENT ORGANIZATION

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

#### SUMMARY

Peritumoral edema is defined as high signal intensity on T2WI in the breast tissue around the tumor. The increased vascular permeability is one of the factors contributing to the presence of peritumoral edema. Prepectoral edema is indicative of extensive lymphovascular invasion and high axillary lymph node positivity. Subcutaneous edema usually follows prepectoral edema when lymphovascular invasion progresses. Three different edemas on T2WI can show a close relationship with the clinical-pathological conditions of breast cancers.

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## From Fibroadenoma to Phyllodes and Everything in-between: A Rad-Path Correlate

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### LL-BRE2429

**Irene S Tsai**, MD

**David Y Lu**, MD

**Lawrence W Bassett**, MD

#### PURPOSE/AIM

The purpose of this exhibit is: 1. To review the different fibroepithelial lesions in the spectrum of fibroadenoma to phyllodes tumor, including conventional fibroadenoma, cellular fibroadenoma, benign phyllodes, borderline phyllodes, and malignant phyllodes. 2. To highlight the imaging characteristics of each subtype, and how they correlate with pathology findings. 3. To review the appropriate workup and management of these lesions.

#### CONTENT ORGANIZATION

Overview of lesions in the continuum from fibroadenoma to phyllodes tumor, and their histological differences. Review of imaging findings for each lesion type with mammography, ultrasound, and MRI. Correlation of imaging findings with pathology findings. Workup and management of each lesion type.

#### SUMMARY

Fibroadenomas, a type of fibroepithelial lesion, are the most common solid mass in women of all ages. Imaging, as well as tissue sampling,

are vital aspects of management when fibroepithelial lesions begin to demonstrate concerning features. After viewing this exhibit, viewers should: 1. Become familiar with the different subtypes of fibroepithelial lesions within the breast. 2. Be able to recognize salient imaging findings for these lesions, and how they correlate with pathology findings. 3. Understand the management and treatment for each of these subtypes.

## Evaluation of Breast Disorders during Pregnancy and Lactation

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### LL-BRE2430

**Morgan R Goldberg** , MD  
**Dipti Gupta** , MD  
**Ellen B Mendelson** , MD \*

#### PURPOSE/AIM

Palpable masses and thickening are common symptoms of pregnant and lactating women referred for imaging. 3% of breast cancers are associated with pregnancy. Increased levels of hormones cause physiologic changes that can limit physical exam and imaging sensitivity. This exhibit will familiarize the radiologist with the spectrum of breast disorders that occur during pregnancy and lactation, exemplify mimickers of malignancy and suggest the optimal imaging work up.

#### CONTENT ORGANIZATION

1. Explain the hormonal and histologic changes that cause increased breast size, density and nodularity;
2. Discuss an algorithmic approach to imaging modalities for evaluation of palpable masses and other symptoms during pregnancy and lactation;
3. Using the BIRADS lexicon, review imaging features of disorders during this time period including fibroadenoma, lactating adenoma, galactocele, mastitis, abscess, and cancer.

#### SUMMARY

Understanding the spectrum of breast findings during pregnancy and lactation and their imaging appearances is important for radiologists, not only to detect cancers in a timely fashion, but also to recognize benign disorders and avoid unnecessary biopsies. While ultrasound is the recommended initial modality and concern with radiation exposure challenges radiologists, mammography is indicated in some patients and plays a complementary role.

## Making Sense of Mammograms - A Quiz for Residents

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### LL-BRE2431

**Samira Rostampour** , MBBS, BSc  
**Nicholas F Bassett** , MBBS  
**Simon Allen** , MD  
**Asha Radhamma** , MBBS, FRCR  
**Janet Bietzk**  
**Sheena G McLaggan** , MBBS

#### PURPOSE/AIM

To facilitate detection and characterisation of mammographic abnormalities in a self assessment quiz format aimed at those with limited knowledge of breast radiology.

#### CONTENT ORGANIZATION

A series of cases will be presented in quiz format - this will consist of: 1/ Set of mammograms for reporting- these cover the common pathologies encountered in breast imaging. The viewer should make the following judgements a) Normal or Abnormal b) If abnormal, benign or malignant c) if abnormal - is further assessment required? 2/ On the following slide - a 'correct' report ,agreed by 2 experienced mammographic film readers will accompany the films with the abnormality highlighted. Included will be any relevant ultrasound images and histopathology reports. All of the cases included will have a histological confirmation or a normal screening mammogram 3 years later.

#### SUMMARY

Breast radiology can seem to be a daunting subject for inexperienced radiologists. In a low pressure setting, we aim to teach trainees the fundamentals of mammographic reading in a creative way. The best way to learn radiology is through 'doing'.

## Triple-negative Breast Cancer: Multimodality Imaging Findings with Pathologic Correlation

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### LL-BRE2432

**Ji Eun Jo**  
**Jin You Kim** , MD  
**Suk Hong Lee**  
**Ji Won Lee** , MD  
**Suk Kim** , MD

#### PURPOSE/AIM

The purpose of this exhibit is: 1. To review the radiologic findings of triple-negative breast cancer on mammography, sonography and MRI with pathologic correlation 2. Discuss the strengths and limitations of each modality in the diagnosis of triple-negative breast cancer.

#### CONTENT ORGANIZATION

1. Molecular classification of breast cancer
2. Review of clinical and pathologic features of triple-negative breast cancer
3. Review of radiologic findings of triple-negative breast cancer a. mammography b. ultrasound c. MRI
4. Sample cases

#### SUMMARY

Triple-negative breast cancer is a subtype of breast cancer with aggressive clinical course and poor prognosis which currently lacks effective targeted therapies. We outline the benefit of imaging of triple-negative breast cancer with MRI and highlight some of the practical difficulties in diagnosis by mammography and ultrasonography.

## Architectural Distortion of the Breast: Radiologic and Histopathological Correlations

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### LL-BRE2433

**Mari Aida**  
**Akihiko Shiraishi** , MD  
**Ryohei Kuwatsuru** , MD  
**Rie Dosho** , MD  
**Tatsuro Inoue**  
**Akihiro Hotta** , MD  
**Yuki Yamashiro**  
**Kazuhiro Suzuki**  
**Atsushi Arakawa**

#### PURPOSE/AIM

The purpose of this exhibit is to identify architectural distortion and its cause, and to review the imaging findings of breast diseases showing

architectural distortion and understand their pathologic correlation.

#### CONTENT ORGANIZATION

1. Introduction
2. What is architectural distortion? – Describes the pathology focusing on stromal fibrosis including radial sclerosing lesions (RSLs)-
3. Diseases with architectural distortion
4. Imaging findings (mammography, US, MRI)
5. Patterns of architectural distortion
6. Point of the interpretation of architectural distortion on mammography
7. Illustrative cases correlation with histopathological findings: (1) invasive carcinoma (invasive ductal carcinoma, invasive lobular carcinoma), (2) ductal carcinoma in situ (DCIS), (3) DCIS with microinvasion, (4) special type (apocrine carcinoma, etc.), and (4) DCIS in RSLs.
8. Summary

#### SUMMARY

Architectural distortion is the important finding, suggestive of malignancy. Architectural distortion is caused by a variety of pathological conditions associated with increased fibrous component, and it is important to understand radiologic findings of architectural distortion with reference to the histopathological findings.

## Abnormalities of Nipple and Areola: A Radiologic-Pathologic Correlation Study

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### LL-BRE2434

**Debbie L Bennett**, MD  
**Mansi A Saksena**, MD  
**Elena Brachtel**, MD  
**Michelle C Specht**, MD  
**Elizabeth A Rafferty**, MD \*

#### PURPOSE/AIM

1. To provide an overview of the pathophysiology and epidemiology of various pathologies seen in the nipple-areolar complex. 2. To provide a review of various radiologic presentations of nipple-areolar complex abnormalities (utilizing mammography, ultrasound, and MR) and their pathologic correlation. 3. To discuss various clinical presentations and management options of pathologies affecting the nipple-areolar complex.

#### CONTENT ORGANIZATION

- Description of various clinical presentations of pathologies of the nipple-areolar complex.
- Discussion of the most appropriate imaging strategy to optimize evaluation of the nipple-areolar complex in each clinical scenario.
- Case-based review of radiologic features of various nipple-areolar complex abnormalities and their pathologic correlation.
- Review of various management algorithms for pathologies affecting the nipple-areolar complex.

#### SUMMARY

The nipple-areolar complex has unique features which present specific imaging challenges for the imager and the treating physician. Additionally, certain pathologies are more commonly seen in the nipple-areolar complex. This exhibit will review the various pathologies affecting the nipple-areolar complex, discuss their radiologic manifestations with pathologic correlation, and describe the clinical implications of these conditions.

## Get Up on Stage: The Role of Imaging in TNM Staging of Breast Cancer

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### LL-BRE2435

**Geraldine H Chang**, MD  
**Julie Bykowski**, MD  
**Jade Quijano De Guzman**, MD  
**Hyung W Choi**, BA  
**Sarah L Blair**, MD  
**Haydee Ojeda-Fournier**, MD

#### PURPOSE/AIM

1. Discuss the radiologist role in breast cancer staging 2. Review the updated 7th ed. TNM system 3. Illustrate with multiple imaging modalities the clinical staging system 4. Self assessment using sample cases

#### CONTENT ORGANIZATION

Introduction; 7th Ed of Cancer Staging Manual; Principles and rules of staging; Clinical v. pathologic staging; Imaging modalities used to stage breast cancer; Tumor size; Multifocal and multi centric disease; Regional lymph node evaluation; Distant metastasis; Putting it all together; Sample cases in quiz format; Conclusion

#### SUMMARY

The staging of breast cancer has been developed and is maintained by the American Joint Committee on Cancer (AJCC). Patients are grouped according to extent of disease based on the tumor size, lymph nodes involved and metastasis using the TNM system. Staging is used to guide treatment, assign patients into clinical trials, and provide prognosis. The radiologist plays an important role in the clinical staging of breast cancer and is able to provide accurate primary tumor size, assessment of lymph nodes and presence or absence of distant metastasis.

## Nipple Discharge: What It Could Mean

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### LL-BRE2436

**Ajay A Rao**, MD  
**Jade Quijano De Guzman**, MD  
**Julie Bykowski**, MD  
**Sarah L Blair**, MD  
**Haydee Ojeda-Fournier**, MD

#### PURPOSE/AIM

After reviewing this educational exhibit the radiologist will be able to recommend the appropriate imaging workup and will be able to appropriately refer patients with suspicious discharge to clinical management. Both clinical images of nipple discharge and multi modality imaging will be used to review this common complaint.

#### CONTENT ORGANIZATION

Discuss the causes of benign, high risk and malignant nipple discharge: Ductal ectasia, lactation, papilloma, mastitis, and breast cancer. Illustrate the clinical finds of nipple discharge. Review appropriate imaging modalities used to evaluate nipple discharge. Recommend appropriate interventional techniques for the work-up of nipple discharge. Provide appropriate follow up recommendations and succinct recommendations to primary care physicians and patients.

#### SUMMARY

Nipple discharge is a common clinical complaint in the breast-imaging center. Most causes of nipple discharge are benign. It is important for the radiologist to be familiar with the etiologies, correct imaging work up and interventional techniques in the evaluation and management of nipple discharge. The appropriate referral to surgical clinic versus primary care follow up of patients presenting with different types of nipple discharge is one of the important responsibilities of the radiologist.

**LL-BRE2437**

**Nicole S Winkler** , MD  
**Sughra Raza** , MD  
**Meaghan Mackesy**  
**Robyn L Birdwell** , MD

**PURPOSE/AIM**

1. Explore importance of breast density assessment including implications of 'dense' breasts and discussion of current and potential government legislation.
2. Illustrate historical and current methods of both qualitative and quantitative density assessment utilizing graphics.
3. Suggest a method of visual assessment followed by case examples for self-assessment.

**CONTENT ORGANIZATION**

- Define 'dense' breasts
- Discuss implications of 'dense' breasts
- Discuss current issues regarding disclosure of density in the lay summary including current and pending legislation in some states
- Discuss and illustrate various published methods of density assessment including qualitative, quantitative, and automated methods.
- Provide a subjective method of density assessment corresponding to BI-RADS categories utilizing custom graphics
- Practice module - case examples allowing self-assessment of density compared to our assessment using our subjective method of assessment

**SUMMARY**

1. Breast density assessment is important with significant clinical implications
2. Patients will be informed of their breast density in several states as the result of recent legislation
3. Understanding subjective and automated methods of density assessment and incorporating a suggested method of visual assessment may improve radiologist's accuracy

**Radiographic Findings Following Treatment with Balloon Brachytherapy Accelerated Partial Breast Irradiation****LL-BRE2438**

**Srividya Anandan** , MD  
**Cathleen M Kim** , MD

**PURPOSE/AIM**

Accelerated Partial Breast Imaging (APBI) is gaining popularity as an alternative to whole breast radiation in a select group of patients. The post APBI mammogram can appear different from the whole breast irradiation mammogram. Understanding the basics of APBI and recognizing how the post APBI mammogram differs from the conventional whole breast irradiation mammogram is key for the radiologist, who will inevitably encounter women who have been treated with this modality.

**CONTENT ORGANIZATION**

Our institution currently performs balloon brachytherapy, which is the most commonly performed APBI. We will present cases from our institution to illustrate the mammographic changes following balloon brachytherapy APBI.

**SUMMARY**

APBI is a promising mode of radiotherapy in the appropriate patient population. With the evolution of breast cancer treatment, understanding the radiographic findings following APBI and recognizing how it differs from the conventional whole breast irradiation mammogram are key tools to have in the radiologist's armamentarium.

**Assessing Response to Neoadjuvant Chemotherapy: How Well Can Breast MRI Perform the Task?****LL-BRE2439**

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

**PURPOSE/AIM**

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

**CONTENT ORGANIZATION**

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

**SUMMARY**

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

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### To Achieve Oncologic and Aesthetic Success What Can We Do in Patients with Breast Cancer?

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#### LL-BRE2440

**Youichi Machida** , MD, PhD  
**Kazunori Kubota** , MD, PhD  
**Kaori Okazawa** , MD  
**Tomoyuki Fujioka** , MD, PhD  
**Naoya Gomi**  
**Isamu Ohashi** , MD, PhD

#### PURPOSE/AIM

The aim of this exhibit is to provide knowledge regarding:

1. Surgical strategies for breast cancer from both oncologic and aesthetic points of view.
2. Acquiring vascular and nonvascular information of use to surgeons through preoperative imaging.

#### CONTENT ORGANIZATION

1. Essential information regarding conservative breast surgery and oncoplastic breast surgery.
2. Interpretation of breast MRI : what types of surgery are recommended?
3. Anatomy essential for oncoplastic breast surgery, compared with the images radiologists are required to prepare.
4. Preoperative US mapping using ordinary and 4D probes

#### SUMMARY

Nowadays, radiologists performing breast imaging must be familiar with not only oncologic features, but also various aesthetic aspects related to conservative breast surgery or oncoplastic breast surgery that are indispensable for optimizing the shape after surgery. This review should help many viewers to learn points that they must be aware of to obtain oncologic and aesthetic success after breast surgery.

### Breast Tomosynthesis as an Additional View for BIRADS Category 0 Lesions: An Educational Case Review Series

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#### LL-BRE2441

**R. J Weinfurter** , MD  
**Holly N Marshall** , MD  
**Blaise P Mooney** , MD  
**Jennifer S Drukteinis** , MD

#### PURPOSE/AIM

The purpose of this exhibit is to demonstrate the utility of 3D breast tomosynthesis in the evaluation of BIRADS category 0 lesions through case review.

#### CONTENT ORGANIZATION

Overview of 3D Breast Tomosynthesis Case Review of BIRADS Category 0 lesions further evaluated by 3D breast tomosynthesis Summary and future directions

#### SUMMARY

Breast Tomosynthesis is a relatively new imaging modality with increasing utility in practice. This exhibit will educate the reader on the modality and its utility as a second look imaging tool.

### Breast Papillary Neoplasia: Expanding Your Imaging Expertise

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#### LL-BRE2442

**Mark D Kettler** , MD  
**Zach Kramer** , MD

**PURPOSE/AIM**

Papillomas are the most common type of breast papillary neoplasia (BPN) and usually present as characteristic intraductal masses on ultrasound or galactography. Other less common types of papillary neoplasia such as papillary DCIS and invasive papillary carcinoma may present as solid or complex masses and simulate non-papillary breast neoplasia. Breast imagers must understand the variability in imaging features among papillary neoplasia to plan interventions, assess for concordance of biopsy results and know when to recommend surgical excisions.

**CONTENT ORGANIZATION**

This educational review will present the imaging and histologic features of BPN including papilloma, papilloma with atypia, papilloma with DCIS, papillary DCIS and invasive papillary cancer.

**SUMMARY**

Through an understanding of the histologic features of BPN, breast imagers will better recognize both characteristic and atypical imaging features of this class of breast diseases. Moreover, this knowledge will broaden differential diagnoses of atypical breast masses which will translate into higher rates of concordance between pre-biopsy predictions and post-biopsy results.

**ILC on Tomosynthesis: Now You Can See It!**

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**LL-BRE2443**

**Pragya A Dang** , MD  
**Kathryn L Humphrey** , MD  
**Phoebe E Freer** , MD  
**Elizabeth A Rafferty** , MD \*

**PURPOSE/AIM**

Due to insidious growth pattern of Invasive lobular carcinoma (ILC), early diagnosis is often difficult on mammography. Conventional mammography is also known to underestimate the size and extent of disease. By reducing the diagnostic challenges associated with superimposed breast tissues, tomosynthesis has been shown to improve lesion conspicuity and more accurately characterize lesion margins. In this exhibit we will outline a variety of appearances of ILCs on digital breast tomosynthesis images to familiarize radiologists with its spectrum of appearance on this modality.

**CONTENT ORGANIZATION**

1. Background of Tomosynthesis 2. Illustrative Cases demonstrating the range of appearances of ILC on Tomosynthesis 3. Comparison of visibility, shape, margins, and size of ILCs on Tomosynthesis versus conventional mammography 4. Intermodality correlation of tomosynthesis imaging of ILCs with Ultrasound and MRI with select pathologic correlation.

**SUMMARY**

Breast Tomosynthesis often provides better morphologic detail of masses and architectural distortion than conventional mammography alone. Through this series of illustrative cases, the radiologist will develop a better understanding of the spectrum of appearance of ILC on tomosynthesis, potentially allowing early detection of these often difficult to diagnose cancers.

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

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**LL-BRE2444**

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

**PURPOSE/AIM**

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

**CONTENT ORGANIZATION**

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

**SUMMARY**

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

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### Review of SAVI (Strut Adjusted Volume Implant) Partial Breast Irradiation Device Related Changes on Surveillance Breast Imaging in Breast Cancer Patients

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**Ruby Lukse** , MD  
**Carolyn L Raia** , MD  
**Phillip M Vigneri** , DO  
**Parameshwari Baladandapani** , MD

**PURPOSE/AIM**

Accelerated partial breast irradiation (APBI) is used for selected breast cancer patients instead of the conventional paradigm of lumpectomy with whole breast irradiation. A strut adjusted volume implant (SAVI) breast brachytherapy device, approved by the FDA, is a novel approach to APBI. Changes on breast surveillance imaging, to evaluate for residual or recurrent disease, may be a challenge in study interpretation. Breast imaging changes after the use of a SAVI device have not previously been described. We describe mammographic, MRI and US changes in 73 patients who had breast conservation treatment with a SAVI device from Jan 2010-Dec 2012 at Staten Island University Hospital. This review will help the radiologist to distinguish benign treatment-related changes from findings suspicious for malignancy.

**CONTENT ORGANIZATION**

Compare APBI vs conventional whole breast irradiation.

Criteria for APBI patient selection and preoperative imaging recommendations.

Types of APBI devices.

Changes post breast surgery with SAVI device for APBI on mammogram, MRI and US. Interpretation pitfalls.

Discuss when imaging findings stabilized and institutional incidence of breast cancer recurrence following SAVI APBI.

**SUMMARY**

Radiologists must be familiar with post-APBI changes on imaging to better differentiate post treatment changes from residual or recurrent disease.

### False Positive FDG Uptake in the Breast on PET/CT: How the Radiologist Can Avoid Common Pitfalls

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**Ruby Lukse** , MD  
**Carolyn L Raia** , MD  
**Shrita Smith** , MD  
**Parameshwari Baladandapani** , MD

**PURPOSE/AIM**

FDG-PET/CT is used increasingly in staging patients with known malignancies and knowledge of various etiologies of false positive FDG uptake in the breast is crucial to accurate interpretation. Through sample cases, we will discuss various benign etiologies for uptake in the breast on PET/CT that could simulate malignancy. We also suggest steps radiologists should take to confirm benign etiology.

**CONTENT ORGANIZATION**

Brief review of FDG PET principles.

Show FDG uptake in normal breasts and cases of biopsy proven breast cancer with associated uptake on PET-CT.

Describe etiologies of false-positive FDG uptake in the breast.

Show representative cases and in each case provide additional test results to confirm benign etiology. False positive cases include physiologic uptake in dense breasts, fat necrosis, inflammation, benign masses, lactation, foreign material, post-surgical and uptake in breast implants.

Discuss features of benign uptake including orientation, degree of uptake and distribution.

Describe steps to confirm benign etiology (history and prior imaging; additional imaging or biopsy).

**SUMMARY**

Radiologists must be aware of etiologies for false positive breast uptake on PET/CT, features that help differentiate benign and malignant uptake and how to manage these patients with incidental breast uptake in order to arrive at a definitive diagnosis.

### Super Size Me: Imaging Features of Injection Mammoplasty

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**Marwa M Almeslemani** , MBBS  
**Sze Yiun Teo**

**PURPOSE/AIM**

The purpose of this exhibit is: 1. To describe the various types of materials commonly used in injection mammoplasty including silicone, polyacrylamide gel, hyaluronic acid and autologous fat 2. To illustrate the normal and abnormal imaging findings in the various types of injection mammoplasty

**CONTENT ORGANIZATION**

1. Description of the properties of the various materials used in injection mammoplasty 2. Illustration of the normal imaging appearances of these materials on mammogram, ultrasound and MRI 3. Illustration of the complications associated with injection mammoplasty 4.

Discussion on implications on breast cancer screening

**SUMMARY**

The main teaching points of this exhibit are: 1. Knowledge of the various types of injection mammoplasty 2. Knowledge of the different imaging appearances of the various types of injection mammoplasty and their complications 3. Application of the appropriate imaging modality for diagnostic and screening purposes in patients with injection mammoplasty

## Diagnostic Usefulness of Digital Breast Tomosynthesis (DBT) for Invasive Lobular Carcinoma (ILC)

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### LL-BRE2448

**Nachiko Uchiyama**, MD  
**Takayuki Kinoshita**  
**Takashi Hojyo**  
**Sota Asaga**  
**Hitomi Tani**  
**Kyoichi Otsuka**  
**Minoru Machida**, MD, PhD  
**Hirokazu Watanabe**, MD

#### PURPOSE/AIM

ILC is difficult to detect and to evaluate the extent of the lesion in comparison with IDC among breast cancer subtypes because of its diffuse growth. According to recent reports, DBT is a useful diagnostic procedure compared to 2D MMG because overlap of breast tissue is reduced by DBT. In this paper, the authors will demonstrate the radiological findings and diagnostic usefulness of DBT for ILC in comparison with the other diagnostic modalities; 2D MMG, US, and contrast-enhanced MRI.

#### CONTENT ORGANIZATION

- Demonstrate the differences of radiological findings between 2D MMG only and DBT for ILC
- Demonstrate which radiological findings will assist to improve the detection rate and the diagnostic accuracy utilizing DBT in comparison with 2D MMG only for ILC
- Indicate which diagnostic modality (2D MMG, DBT, US, or contrast-enhanced MRI) will be recommended regarding the evaluation of extent of the lesion especially for ILC

#### SUMMARY

DBT is useful for detecting and clarifying the extent of the lesion for ILC in comparison with other diagnostic modalities; US or 2D MMG only. In addition, to evaluate extent of the lesion, the combination of the adjunction of 2D MMG to DBT and contrast-enhanced MRI is the best option.

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

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### LL-BRE2449

**Richa Bansal**, MD

#### PURPOSE/AIM

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

#### CONTENT ORGANIZATION

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

#### SUMMARY

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

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

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#### LL-BRE2450

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

#### PURPOSE/AIM

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

#### CONTENT ORGANIZATION

1. Review of the surrogate subtypes of breast cancer based on the St. Gallen International Expert Consensus. Review of the purpose of neoadjuvant systemic therapy for each subtype of early breast cancer.

2. Description of the methods for evaluating the histological therapeutic response.

Discussion of the problems with each method.

3. Outline of the MRI evaluation for each subtype.

Does MRI evaluate pCR or non-pCR accurately in any subtype? Do MRI measurements indicate the histological tumor size in each subtype?

#### SUMMARY

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

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#### SUMMARY

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## How to Use Multiple Modalities for Diagnosis of Axillary Lymph Node and Other Axillary Diseases?

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### LL-BRE2451

**Kazunori Kubota** , MD, PhD  
**Youichi Machida** , MD, PhD  
**Takashi Katayama**  
**Kaori Okazawa** , MD  
**Tomoyuki Fujioka** , MD, PhD  
**Akira Toriihara**  
**Isamu Ohashi** , MD, PhD

#### PURPOSE/AIM

The purpose of this exhibit is: To review the axillary anatomy  
To review the axillary lymph node metastasis and other axillary diseases  
To explain the utility of Ultrasound, MRI, FDG-PET/CT in the diagnosis

#### CONTENT ORGANIZATION

Anatomy of axilla  
- Lymph node levels  
- Vessels Diagnosis of axilla with  
- Ultrasound  
- MRI  
- FDG-PET/CT Regional lymph nodes  
- Supraclavicular LN  
- Parasternal LN Other axillary diseases

#### SUMMARY

The major teaching points of this exhibit are: 1. Pectoralis minor muscle to very important for the level anatomy. 2. Sensitivity of each modality for small metastasis is low, and PET only has high specificity 3. combination of US-guided needle aspiration cytology may play a role in the detection of lymph node metastasis when the primary tumor size is large and the FDG uptake in the primary tumor is low. 4. Anyway, combined diagnostic imaging is helpful in some cases.

## Unilateral Breast Enlargement

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### 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

I. Illustration of cases 1. Lymphangioma and lymphangiectasia 2. Chronic inflammation with lymphangiectasia 3. Giant fibroadenoma 4. Interstitial breast edema with right pleural effusion 5. Asymmetric breast enlargement due to unilateral lactation 6. Inflammatory breast cancer II. Review of pathophysiology III. Review of imaging findings in each case IV. Summarize characteristic imaging findings and differential diagnostic points

#### 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

## Unilateral Breast Enlargement

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### Ductal Carcinoma in Situ: Pathophysiology, Imaging Characteristics, and Potential Biomarkers for Risk Stratification and Individualized Treatment

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#### LL-BRE2453

**Diana L Lam**, MD  
**Habib Rahbar**, MD  
**Savannah C Partridge**, PhD \*  
**Mara Rendi**, MD, PhD  
**Constance D Lehman**, MD, PhD \*

#### PURPOSE/AIM

To discuss and review the:

- Incidence, clinical significance, and pathophysiology of ductal carcinoma in situ (DCIS)
- Multi-modality imaging characteristics and updated terminology
- Clinical, pathological, and radiologic biomarkers to predict aggressiveness of DCIS
- Potential role of imaging for DCIS diagnosis and management

#### CONTENT ORGANIZATION

DCIS Background

- Incidence
- Clinical significance
- Pathophysiology Imaging Characteristics
- Mammography
- Ultrasound
- MRI Predictors and Biomarkers of Aggressiveness
- Clinical features
- Pathological features
- Architectural patterns
- Nuclear grade, comedonecrosis, Van Nuys
- Hormonal, enzyme, multigene assays
- Imaging features
- Mammography
- Ultrasound
- MRI Evolving role of imaging in detection and management

#### SUMMARY

The diagnosis rate of DCIS has been steadily rising over the past decade due in part to improved imaging techniques. While treated DCIS has survival rates that approach 100%, it is believed that some woman may be over-treated for this variably aggressive disease. This exhibit provides a better understanding of current role of imaging in diagnosis of DCIS, current risk stratification systems, and the potential role of imaging biomarkers for improved DCIS risk characterization that could allow for more individualized therapies.

### Circumscribed Lobulated Masses on Tomosynthesis: Beware the Pitfall!

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#### LL-BRE2454

**Pragya A Dang**, MD  
**Kathryn L Humphrey**, MD  
**Phoebe E Freer**, MD  
**Elizabeth A Rafferty**, MD \*

#### PURPOSE/AIM

Breast tomosynthesis has been shown to improve lesion conspicuity and margin analysis by overcoming the effect of tissue overlap. Many masses found to have indistinct margins or called focal asymmetries on mammography can be better characterized by tomosynthesis. A proportion of these masses characterized as circumscribed lobulated masses seen on tomosynthesis, however, do not always represent a benign process. By reviewing this case-based outline of lobulated circumscribed lesions seen on tomosynthesis, the radiologist will develop a better understanding of these lesions and avoid the pitfall of classifying all lobulated circumscribed lesions on tomosynthesis as benign or probably benign masses.

#### CONTENT ORGANIZATION

1. Lobulated circumscribed masses on mammography-historical perspective, mostly benign or probably benign lesions 2. Tomosynthesis-Background and ability to better characterize morphology of lesions 3. Illustrative tomosynthesis cases of lobulated circumscribed masses with pathologic correlation 4. Description and examples of neoplasms presenting as lobulated circumscribed masses on tomosynthesis.

#### SUMMARY

These series of cases will help radiologists understand the common pathologies associated with lobulated circumscribed masses on tomosynthesis as well as recognize that not all lobulated circumscribed masses on tomosynthesis are benign.

### Apocrine Lesions of the Breast: What Are They and What Should Radiologists Know?

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#### LL-BRE2455

**Lauren Q Chang Sen**, MD  
**Wendie A Berg**, MD, PhD \*

#### PURPOSE/AIM

- 1-To review different types of apocrine lesions of the breast, including apocrine metaplasia, papillary apocrine metaplasia, atypical apocrine adenosis, apocrine carcinoma
- 2-To discuss the malignant potential of various apocrine lesions
- 3-To illustrate the imaging findings of apocrine lesions of the breast
- 4-To explain the treatment of apocrine lesions

#### CONTENT ORGANIZATION

Define different apocrine lesions Malignant potential of apocrine lesions Review imaging findings Molecular phenotype of apocrine carcinomas and treatment implications

#### SUMMARY

- 1-Recognizing imaging findings of benign, atypical and malignant apocrine lesions can help radiologists avoid unnecessary biopsies and detect early cancers
- 2-Understanding management recommendations for various apocrine lesions is important in daily practice of radiologic-pathologic concordance and patient management after breast core biopsy.

**LL-BRE2456**

**Tatiane M Oliveira** , MD  
**Francesca M Faria** , MD  
**Larissa R Mouro** , MD  
**Sara R Teixeira** , MD  
**Salomao F Chodraui-Filho** , MD  
**Jamilly G Maciel**  
**Maria C Zotin** , MD  
**Andrea F Melo** , MD  
**Daniel G Tiezzi** , MD, PhD  
**Jorge Elias** , MD, PhD  
**Valdair F Muglia** , MD, PhD

**PURPOSE/AIM**

The aim of this exhibition is to review the most frequent underestimated breast diseases in core biopsies, correlating key imaging findings with main histopathological features.

**CONTENT ORGANIZATION**

- To discuss the technical aspects of breast core needle biopsies (CNB), focusing on practical tips that may reduce diagnostic underestimation. - To review the main concepts required to achieve a confident 'triple test', emphasizing the importance of concordance among clinical, histopathological and imaging features, essential to make a decision for surgical biopsy or for a safe follow-up. - To review the main breast conditions and their imaging findings that may impose diagnostic difficulties for the pathologist, inducing false negative biopsies, papillary lesions, lobular neoplasia, phyllodes tumor, radial scar, atypical ductal hyperplasia, columnar cells change with atypia, micropapillary adenosis, sclerosing adenosis and ductal carcinoma in situ (DCIS).

**SUMMARY**

Diagnostic underestimation has become a serious clinical problem in mastology. Breast radiologists should be aware of the most frequent conditions associated with diagnostic underestimation and be able to correlate histopathologic features with clinical and imaging findings in order to provide the most confident and adequate approach, avoiding delays in diagnosis and patient's management.

**Assessing Axillary Lymph Nodes: Benign or Malignant?**

**LL-BRE2457**

**William Loverme** , MD  
**Ana P Lourenco** , MD  
**Martha B Mainiero** , MD

**PURPOSE/AIM**

To illustrate multimodality imaging appearance of normal and abnormal axillary lymph nodes detected on breast imaging, including benign and malignant causes of nodal abnormalities.

**CONTENT ORGANIZATION**

Lymph node status is an important prognostic indicator and abnormal nodes are frequently encountered on breast imaging, but distinguishing benign from malignant remains challenging. US, CT and MRI images will demonstrate features of metastatic disease to the axilla, including focal cortical thickening, effacement of the normal fatty hilum, and non-hilar blood flow detected on Color Doppler US. Benign etiologies for adenopathy, including autoimmune diseases and dermatopathic nodes will be shown. Axillary anatomy will be reviewed, including involvement of Level I, II, and III nodes.

Etiologies for unilateral (e.g. breast cancer, lymphoma, mastitis) and bilateral (e.g. chronic lymphocytic leukemia) axillary adenopathy will be reviewed.

US guided FNA technique, indications for core biopsy, and core biopsy technique will be illustrated.

**SUMMARY**

Abnormal axillary lymph nodes are commonly encountered on breast imaging. Utilizing multimodality imaging characteristics, radiologists must characterize these nodes to help guide appropriate intervention. Findings on mammography, US, CT and MRI will be presented.

**Pattern of Disease Spread in Metastatic Invasive Lobular Carcinoma of the Breast**

**LL-BRE2458**

**Hongying He** , MD, PhD  
**Anneliese Gonzalez**  
**Emily Roberson**  
**Wei T Yang** , MD

**PURPOSE/AIM**

To demonstrate unusual patterns of metastatic invasive lobular carcinoma (ILC) as compared to invasive ductal carcinoma (IDC) of the breast.

**CONTENT ORGANIZATION**

Metastatic ILC mirrors the diffuse infiltrative process of ILC in the breast, with a tendency to spread to the gastrointestinal (GI) and genitourinary (GU) tracts, peritoneum/retroperitoneum and leptomeninges. ILC can infiltrate the stomach wall leading to the "linitis plastica" appearance, and metastasize to the ovaries (Krukenburg tumor). Tumor cells form tiny nodules which may become confluent in the peritoneum/retroperitoneum and may cause omental caking. ILC has a predilection for the bone with diffuse infiltration of bone marrow. In the central nervous system, ILC usually causes leptomeningeal carcinomatosis. In the orbit, the extraocular muscles and orbital fat/connective tissue are often involved with sparing of the optical nerves and the globes. The imaging characteristics of metastatic ILC to the lung, liver and soft tissue are indistinguishable from metastatic IDC.

**SUMMARY**

ILC of the breast tends to spread to uncommon sites such as the GI and GU tracts, peritoneum/retroperitoneum and leptomeninges. Knowledge of this unusual pattern of disease spread aids in differentiating metastatic breast carcinoma from site specific primary malignancies and initiating appropriate treatment.

**My My My My My Seroma: The Role of the Radiologist in the Evaluation and Management of Postoperative Seromas of the Breast**

**LL-BRE2459**

**Rebecca L Seidel** , MD

**PURPOSE/AIM**

The majority of postoperative seromas are managed solely by the surgeon. In certain circumstances, the radiologist may be consulted. The purpose of this exhibit is to illustrate the role of the radiologist in the management of postoperative seromas of the breast and review proper technique for percutaneous ultrasound guided seroma drainage.

**CONTENT ORGANIZATION**

1. What is a seroma and how does it form 2. Seromas typically managed by the breast surgeon 3. Seromas in patients with tissue

expanders and implants 4. Seromas in patients undergoing radiation therapy planning 5. Evaluation of fluid collections for possible infection 6. Proper technique for percutaneous ultrasound guided aspiration of a fluid collection in the breast, with an emphasis on minimizing risk of damage to implant or expander.

#### SUMMARY

The radiologist may play an important role in the evaluation and management of postoperative seromas of the breast. This exhibit will improve the radiologist's ability to collaborate with the referring surgeon to appropriately characterize and manage postoperative fluid collections of the breast.

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### **My My My My My Seroma: The Role of the Radiologist in the Evaluation and Management of Postoperative Seromas of the Breast**

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**Rebecca L Seidel** , MD

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### **Contrast Enhanced Spectral Mammography: Initial Experience with Benign and Malignant Lesions. A Pictorial Review with Mammographic, MRI, Ultrasound and Pathologic Correlation**

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#### **LL-BRE2460**

**Eva Rodriguez** , MD  
**Kristin C Byrne** , MD  
**Neal F Epstein** , MD

#### PURPOSE/AIM

1. To review the imaging findings of benign and malignant lesions on contrast enhanced spectral mammography. 2. To correlate findings on contrast enhanced spectral mammography with other imaging modalities including mammography, MRI and ultrasound. 3. To exhibit our initial experience with contrast enhanced spectral mammography and which lesions are best detected with this modality.

#### CONTENT ORGANIZATION

Background and overview of contrast enhanced spectral mammography. Pictorial review of benign and malignant lesions detected by contrast enhanced spectral mammography. Correlation of these lesions with mammography, MRI and US as well as with pathologic correlation if applicable. Discussion of future potential of contrast enhanced spectral mammography.

#### SUMMARY

Understanding of the utility and clinical application of contrast enhanced spectral mammography. Understanding of the appearance of known benign and malignant lesions on contrast enhanced spectral mammography.

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### **3D Ultrasound Imaging of Axillary Lymph Nodes in Breast Cancer Patients: A Pictorial Atlas**

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#### **LL-BRE2461**

**Beatriu Reig** , MD, MPH  
**Tova C Koenigsberg** , MD  
**Susan J Frank** , MD

#### PURPOSE/AIM

1. Present the spectrum of 3D ultrasound findings in metastatic axillary lymph nodes utilizing both gray scale and color Doppler imaging. 2. Review published literature on 3D ultrasound of lymph nodes, which until now has not included axillary lymph nodes.

#### CONTENT ORGANIZATION

- Review importance of axillary lymph node status in breast cancer staging.
- Summarize the current literature on 3D ultrasound of lymph nodes.
- 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.

**LL-BRE2461**

**Beatriu Reig**, MD, MPH  
**Tova C Koenigsberg**, MD  
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**LL-BRE2462**

**Jacquelyn Copeland**, MD  
**Nimisha Doshi**  
**Ingy Hanna**, MD  
**Christina Giuliano**

## PURPOSE/AIM

1. Review the use of tomosynthesis in breast imaging as it applies to the clinical setting.
2. Pictorial review of malignancies and benign lesions as they appear on tomosynthesis.
3. Discussion of the appropriateness of tomosynthesis as a beneficial tool for the diagnosis of breast cancer.

## CONTENT ORGANIZATION

1. Background of Tomosynthesis
2. Technical Aspects: How tomosynthesis differs from computed tomography and mammography.
3. Clinical Use: How tomosynthesis fits into the widely used imaging modalities and clinical practice.
4. Review of imaging findings
  - Discussion of the expected images and an approach to their review.
  - Review of malignant and benign features as they specifically manifest on tomosynthesis.

## 5. Compendium

## SUMMARY

1. Tomosynthesis can be performed on existing mammography technology.
2. Tomosynthesis is a useful tool that can supplement diagnostic mammograms when used effectively.
3. Tomosynthesis may be used for patients with known malignancy and dense breasts as part of their routine mammogram in addition to ultrasound when MRI is not appropriate.

**LL-BRE2463**

**Gabriela Martins**, MD  
**Marcele F Cortes**, MD  
**Juliana M Felix**  
**Joana Cezar K Macena**  
**Cynthia Maria C Lins**  
**Fernanda P Pereira**, MD

## PURPOSE/AIM

To discuss the utility of breast MR on the assessment of patients with ductal system abnormalities such as nipple discharge or duct ectasia with intraluminal component on ultrasound. Many patients with unilateral nipple discharge have normal ultrasound, mammography, and

negative cytology. In some cases the ultrasound shows duct ectasia filled with echogenic material that can obscure or simulate some vegetating lesion. Considering percutaneous biopsy of duct lesion is controversial, most patients proceed to excisional biopsy. Thus, MR can be helpful to distinguish an intraluminal vegetant lesion from secretory component.

#### CONTENT ORGANIZATION

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

#### SUMMARY

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

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

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#### LL-BRE2463

**Gabriela Martins** , MD  
**Marcele F Cortes** , MD  
**Juliana M Felix**  
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### The Role of Breast MR on the Assessment of Ductal System Abnormalities

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### Growing Pains - How to Approach Breast Lesions in Children and Adolescents

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#### LL-BRE2464

**Yiming Gao** , MD  
**Mansi A Saksena** , MD  
**Deborah C Termeulen** , MD  
**Elena Brachtel** , MD  
**Elizabeth A Rafferty** , MD \*

#### PURPOSE/AIM

1. Review stages of normal breast development and expected imaging appearance of normal pediatric breast. 2. Recognize critical differences in imaging approach to, and clinical management of pediatric breast versus adult breast. 3. Case based presentation of clinical features, imaging appearance, histologic correlation, and appropriate management of breast lesions in children and adolescents.

#### CONTENT ORGANIZATION

1. Review of embryology and anatomy of the developing breast. 2. Discuss expected radiologic features of the pediatric breast at various stages of development. 3. Case based review of developmental variants and developmentally related breast lesions, including clinical presentation, imaging algorithm, imaging appearance, and management. 4. Case based review of breast pathology in adolescent boys and girls, including clinical presentation, imaging findings, pathologic correlation and management algorithms.

#### SUMMARY

The developing pediatric breast presents unique challenges for both radiologists and treating physicians. Patient's can present with a range of breast abnormalities including developmental variants, benign and malignant lesions. This exhibit aims to provide a comprehensive overview of normal anatomy, spectrum of disease in the developing breast, and to highlight key differences between pediatric and adult breast diseases.

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### Fusion of Prone F-18 Fluoro-deoxy-glucose (FDG) Positron Emission Tomography (PET) and Contrast-enhanced Magnetic Resonance (CE-MR) Breast Scans: An Optimized Tool for the Local Staging of Breast Cancer

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**LL-BRE2465**

**Jon Etxano** , MD  
**Pedro Slon** , MD  
**Maria J Garcia-Velloso** , MD, PhD  
**Arlette Elizalde**  
**Luis Pina** , MD, PhD  
**Maria J Ribelles** , MD  
**Paula B Garcia** , MD  
**Macarena Rodriguez-Fraile** , MD, PhD

**PURPOSE/AIM**

To present our experience with the use of FDG-PET scans and 1.5T CE-MR fusion images for the local staging of patients with breast cancer.

**CONTENT ORGANIZATION**

A) Description of the acquisition of both CE-MRI and computer tomography (CT) attenuation-corrected FDG-PET scans in prone position using the same breast coil array to facilitate the comparison between them. B) Description of the procedure of fusion between both techniques with a specific software (True-D). This is a semiautomatic, landmark-based program used to perform nonrigid fusion of both techniques. C) Evaluation of the first 16 cases studied in our center. D) To present the limitations and benefits of fusion images in the local staging of breast cancer.

**SUMMARY**

Local staging of breast cancer is a continuous evolving topic. With the development of the new functional-based-image-techniques (CE-MR and FDG-PET/CT), It has been possible to optimize presurgical staging, reaching a significantly lower number of false negative/positive lesions. However, both CE-MR and FDG-PET/CT have several limitations. As they are complementary techniques based on different principles, the combination of both techniques in fusion images improves the detection and characterization of nonconclusive and previously nondetected breast lesions. This fact can lead to a change of the planned surgical treatment.

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**Radiologic-pathologic Correlation of Uncommon Breast Lesions: Thinking beyond Routine Pathologies**


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**Gopal R Vijayaraghavan** , MD, MPH  
**Rebecca Hultman** , DO  
**Sue A MacMaster** , MD  
**Martin H Luu** , MD  
**Carolynn M Debenedectis** , MD  
**Vighnesh Walavalkar** , MD  
**Ashraf Khan** , MD

**PURPOSE/AIM**

To create awareness among practicing radiologists of the more uncommon breast lesions that may be encountered in every day practice.

**CONTENT ORGANIZATION**

Uncommon breast lesions encountered in our practice supported by histological findings at biopsy or following surgical excision will be reviewed. Each case will be presented as an unknown with relevant patient history and imaging findings, followed by histopathological features and a brief discussion. These cases have been categorized under benign tumors (hamartoma, nodular fasciitis, granulomatous mastitis and lactating adenoma malignant tumors (spindle cell carcinoma, malignant phyllodes, inflammatory carcinoma metastatic lesions (melanoma, neuroendocrine carcinoma, lymphoma) and systemic disease (calciophylaxis).

**SUMMARY**

It is important for residents and fellows in training along with practicing radiologists to be aware of the spectrum of unusual breast lesions that one may occasionally encounter in practice. The radiological and pathologic characteristics of the uncommon cases described above are discussed.

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


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**Luciana P Silveira** , MD  
**Barbara H Bresciani** , MD  
**Luciano F Chala** , MD  
**Bruna M Thompson** , MD  
**Marco A Costenaro** , MD  
**Nestor De Barros** , MD

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


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[Back to Top](#)**LL-BRE2467**

**Luciana P Silveira** , MD  
**Barbara H Bresciani** , MD  
**Luciano F Chala** , MD  
**Bruna M Thompson** , MD  
**Marco A Costenaro** , MD  
**Nestor De Barros** , MD

**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:

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## Management of Fat Necrosis of the Breast According to Imaging Features

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### LL-BRE2468

**Beatriz E Adrada** , MD  
**Gaiane M Rauch** , MD, PhD  
**Modupe M Adeyefa** , MD  
**Lei Huo** , MD  
**Tanya W Stephens** , MD  
**Wei T Yang** , MD

#### PURPOSE/AIM

1. To present the chronological imaging changes of fat necrosis on mammography, ultrasound and MRI  
2. To correlate the imaging features of fat necrosis with histopathology  
3. To discuss distinctive imaging features of fat necrosis associated with the appropriate BI-RADS categories and indications for biopsy

#### CONTENT ORGANIZATION

Accurate classification and description of fat necrosis imaging findings according to BI-RADS will help radiologists understand the benign spectrum (BI-RADS 2) and suspicious (BI-RADS 4) imaging findings that warrant biopsy.

#### Mammography:

BI-RADS 2: Circumscribed fat containing mass with peripheral curvilinear calcifications.

BI-RADS 3: Amorphous clustered calcifications at the surgical scar site.

BI-RADS 4: Pleomorphic clustered calcifications, irregular spiculated masses.

#### Ultrasound:

BI-RADS 2: Hyperechoic masses; cysts.

BI-RADS 3: Fluid-filled masses with echogenic bands.

BI-RADS 4: Complex masses with internal mural nodules; irregular spiculated masses

#### MRI:

BI-RADS 2: Masses with high signal on unenhanced non-fat saturated T1W imaging.

BI-RADS 4: Irregular enhancing masses with variable kinetics, or nonmass enhancement.

#### SUMMARY

Knowledge of the imaging features of fat necrosis will help guide appropriate management that includes annual mammography (benign) or biopsy (suspicious) to exclude malignancy.

## PET CT Atlas of Usual and Unusual Metastatic Spread Patterns in Carcinoma Breast

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### LL-BRE2469

**Hemant T Patel** , MD  
**Ankur Shah** , MD  
**Manas Mayank** , MD  
**Megha Sanghvi** , MD  
**Mrunali I Shah** , MBBS  
**Jay V Shah** , MBBS

#### PURPOSE/AIM

The purpose of this exhibit is

1. Functional PET with FDG and combined anatomical-functional PET CT have been rapidly adapted as method of diagnosis, staging and therapeutic monitoring in a variety of breast cancers  
2. This exhibit shows the frequency and appearances of breast cancer metastatic disease process using PET CT

#### CONTENT ORGANIZATION

- Pathophysiology of breast cancers
- Review of imaging findings: Most common and uncommon locations
- Post treatment recurrence and use of PET CT
- Sample cases and images

#### SUMMARY

The major teaching points of this exhibit are: 1. Functional anatomic imaging with PET CT is a powerful tool in staging, prognosis and therapy decision making for breast cancer  
2. This exhibit will help radiologists to get acquainted with common and uncommon locations and appearances of metastatic disease process in breast cancer

**LL-BRE2470**

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

**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.

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## Breast Reconstruction Complications: MRI Diagnostic Features

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### LL-BRE2471

**Ines Casazza**

**Mara A Guglietta**

**Marco Di Girolamo** , MD

**Mauro Mattei**

**Giuseppe Argento**

**Vincenzo David** , MD

PURPOSE/AIM

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

CONTENT ORGANIZATION

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

SUMMARY

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

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## Breast Reconstruction Complications: MRI Diagnostic Features

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**LL-BRE2472**

**Laura Martincich** , MD \*  
**Rita Giada Spinelli** , MD  
**Silvia Carabalona** , MD  
**Eleonora Rachetta** , MD  
**Valentina Piccione** , MD  
**Daniele Regge** , MD

**PURPOSE/AIM**

1) To review causes of nipple discharge 2) To showcase the appearance on mammography, sonography and MRI (Dynamic Contrast-Enhanced and DWI) of both benign and malignant conditions associated with nipple discharge. 3) To discuss optimal imaging modality in evaluating nipple discharge.

**CONTENT ORGANIZATION**

Review of major causes of nipple discharge. Presentation of several clinical cases regarding major benign and malignant conditions associated with nipple discharge (Papilloma, DCIS, Invasive Cancer, Paget's disease, Lymphoma), including a discussion on multimodality imaging features and radiological/pathological correlation. Discussion of optimal imaging modality and diagnostic work-up in subjects with nipple discharge.

**SUMMARY**

The exhibit will familiarize radiologists with: multimodality imaging features of benign and malignant conditions associated with nipple discharge; optimal imaging modality and diagnostic work-up in subjects with nipple discharge.

**Usefulness of Roll Technique Guided by Breast Magnetic Resonance Imaging****LL-BRE2473**

**Vicente Martinez De Vega** , MD \*  
**Silvia Fuertes Cabero** , PhD  
**Susana Linares Gonzalez** , MD  
**Carolina K Otani**  
**Antonio Maldonado** , MD  
**Manuel Recio Rodriguez**

**PURPOSE/AIM**

Show the utility of breast MRI to perform radioguided breast surgery for those malignant lesions displayed only with breast MR (ROLL) and sentinel node detection (SNOLL). Description of ROLL technique guided by MRI

**CONTENT ORGANIZATION**

General description of ROLL-SNOLL technique. MRI-guide localization of breast cancer, displayed only by breast MRI, using a titanium needle. Injection of the 99mTc-nanocolloid radiotracer. Advantages.

**SUMMARY**

Breast MRI is more sensitive for detecting breast cancer than mammography and ultrasound. There are breast cancers that are only detected by MRI. Histological diagnosis is made by MRI-guided vacuum assisted biopsy. Typically, to perform conservative surgery, is necessary to mark the lesion with a hook wire guided by mammography (over a titanium marker placed after the biopsy with MRI) or guided with MRI directly. Mammography and ultrasound-guided ROLL technique are widely accepted to locate non-palpable lesions and perform breast conserving surgery. We describe the technique of marking breast occult lesions by injection a 99mTc-nanocolloid radiotracer guided with MRI.

**Can You Find the Cancer? A Pictorial Review of Breast Cancers Initially Detected on Ultrasound Following a Negative Mammogram****LL-BRE2474**

**Laura S Sheiman** , MD  
**Paul H Levesque** , MD

**PURPOSE/AIM**

As the use of screening breast ultrasound rises, more 'mammographically occult' breast cancers are being detected. Some of these patients have truly mammographically occult findings while others may have subtle mammographic findings which were passed on initial screening mammogram. A review of post biopsy imaging in women with sonographically detected cancers will help mammographers review the pitfalls of mammography and may help improve diagnostic accuracy for subtle findings.

**CONTENT ORGANIZATION**

The cases will be presented in an interactive review format. The initial 'negative' mammogram will be shown with prior mammogram for comparison. Next, ultrasound images of the sonographically suspicious finding, (interpreted as BIRADS 4 or BIRADS 5), will be displayed. Pathology from the ultrasound guided core biopsy will be revealed. Finally, the post clip mammogram will be shown with the corresponding initial 'negative' mammographic images.

**SUMMARY**

With the increasing use of screening breast ultrasound as an adjunct to screening mammography, breast imagers need to be aware of the mammographically occult breast cancer and its imaging appearances. Although some breast cancers are truly mammographically occult, reviewing post biopsy imaging and correlating multimodality findings may help a mammographer detect subtle findings of carcinoma on mammography.

**Mammography, Ultrasound and MR Imaging in Breast Disorders Related to Pregnancy and Lactation: Literature Review and Personal Experience****LL-BRE2475**

**Sandra Bednarova** , MD  
**Orazio Pennisi**  
**Micaela De Lorenzo Poz** , MChir  
**Viviana Londero** , MD  
**Chiara Zuiani** , 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
3. Imaging findings

- Mammography
- Ultrasonography
- MR Imaging
- 4. 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.

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

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**LL-BRE2475**

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**Imaging of Triple Negative Breast Cancers (TNBC)**

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**LL-BRE2476**

- Anna Morresi** , MD, PhD
- Alberto Martegani** , MD \*
- Sara Mombelloni** , MD
- Loredana Tufarulo** , MD
- Franca Mascheroni** , MD
- Camilla Fachinetti**
- Claudio Ballarati** , MD
- Claudia Borghi** , MD

**PURPOSE/AIM**

To show morphological and functional features of TNBC (MX, US, MRI). To correlate imaging features to aggressive behavior.

**CONTENT ORGANIZATION**

TNBC (ER negative, Pr negative, Her2 negative) represent 10 – 18% of all breast cancers. They are more frequent in younger women and characterized by poor prognosis, rapid growing, high histological grade. TNBC include most basal like breast cancers and cancers correlated to BRCA1 mutation . Only few reports on TNBC imaging are available and there is evidence that some features are quite typical of TNBR (they can mimic benign mass). The typical aspect is a unique mass, oval or lobulated shape, with circumscribed margins, without calcifications, large in size. On US the mass is hypoechoic, without posterior attenuating echoes, some vascularity inside, high score on elasticity imaging, anechoic areas representing necrotic changes. On MRI it usually shows very high signal in T2-weighted images and rim enhancement due to necrotic areas, plateau or persisting curves, often high ADC values close to benign lesions. Careful work up of masses showing benign features with adequate tissue sampling is necessary especially in young women and in BRCA1 mutation carriers. Cases from our experience are shown.

#### SUMMARY

Imaging can predict TNBC subtype and can be helpful in tailored therapy planning.

### Beyond the 90%: A Review of Rare Pathology in Male and Female Breasts along with Detailed Anatomical Diagrams and Histology Correlation

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#### LL-BRE2477

**Angelica Robinson** , MD  
**Claudia Cotes** , MD  
**Maria R Torrone** , MD  
**Ashley Moehring** , BS  
**Tomas E Uribe** , MD

#### PURPOSE/AIM

Review male and female rare breast pathology using mammographic, ultrasound and MRI imaging.

Provide detailed diagrams showing disease progression.

Provide explanation and histology correlation.

#### CONTENT ORGANIZATION

**Females** • Angiomyoepithelioma •Desmoid Tumor •Granular Cell tumor •Synchronous Breast Cancer •Granulomatous Mastitis **Males**  
•Breast Abscess •Hamartoma •Intrapectoral Lipoma •Myofibroblastoma •Invasive Papillary Cancer

#### SUMMARY

Familiarity with rare breast pathology can aid in diagnosing uncommon lesions. Review of pertinent imaging characteristics, detailed diagram representation and histology can educate radiologists on rare presentations in a typical practice setting.

### Vascular Abnormalities of the Breast: A Multimodality Imaging Approach to Diagnosis

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#### LL-BRE2478

**Maria Del Pilar Sanchez-Camacho Gonzalez-Carrato** , MD  
**Asuncion Almenar**  
**Cristina Romero** , MD  
**Paul M Aguilar Angulo** , MD  
**Virginia Segur**  
**Olga Martin**  
**Maria T Fernandez Taranilla**

#### PURPOSE/AIM

Describe the normal vascular anatomy of the breast and the normal imaging findings.

Identify the key imaging features of arterial and venous disorders, benign and malignant vascular masses and mimic lesions.

#### CONTENT ORGANIZATION

Describe the normal imaging appearance of breast vasculature and imaging findings of vascular disorders.

Vascular abnormalities of the breast include arterial disorders (atherosclerosis, aneurysms and pseudoaneurysms), venous disorders (congestive heart failure, collateral venous flow and superficial thrombophlebitis), benign vascular tumors (hemangioma, lymphangioma and angioliipoma) and malignant vascular tumors (angiosarcoma and hemangiopericytoma).

Multimodality imaging is often necessary to accurately diagnose several of these uncommon conditions. Mammograms, gray-scale and color Doppler ultrasounds and magnetic resonance imaging play an important role in the diagnosis.

#### SUMMARY

Vascular disorders of the breast may be seen with a variety of breast imaging modalities. Knowledge of radiologic anatomy and imaging appearances of pathologic conditions affecting breast vasculature enables more accurate diagnosis and treatment planning and allow radiologists to have a more active role in breast care.

### Benign and Malignant Breast Masses Using Digital Breast Tomosynthesis: An Interactive Review and Quiz

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#### LL-BRE2479

**Katharine D Maglione** , MD  
**Stuart L Cohen** , MD  
**Janet R Szabo** , MD  
**Neesha S Patel** , MD  
**Anita Mehta** , MD, MSc  
**Emily B Sonnenblick** , MD  
**Laurie R Margolies** , MD

#### PURPOSE/AIM

This exhibit will review the appearance of breast masses on digital breast tomosynthesis (DBT). It will also include a concise review of the key literature supporting the ability of DBT to visualize and characterize benign and malignant masses.

#### CONTENT ORGANIZATION

This interactive exhibit will allow the participant to review and test themselves as they view selected tomosynthesis images. Each example/case will include an image with a multiple choice question, followed by an answer slide with visual descriptions, arrows highlighting the key findings in each case, and corresponding videos or conventional mammographic images. A spectrum of benign and malignant masses will be reviewed. Additionally, there will be a concise review of the literature on the ability of DBT to identify and characterize masses.

#### SUMMARY

The goal of the educational exhibit is to illustrate a spectrum of masses using DBT. After reviewing this exhibit, the radiologist should have a greater ability to identify and characterize masses using DBT.

### To Excise or Not to Excise, That Is the Question – World Health Organization-classified (2012) Mesenchymal Breast Tumours

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#### LL-BRE2480

**Lee D Bell** , MD  
**Samuel H Jordan**  
**Siobhan O'Connor** , MD

PURPOSE/AIM

The purpose of this exhibit is:

1. To describe 2012 World Health Organization (WHO) classification of mesenchymal tumours of the breast
2. To present each type of mesenchymal tumour with attention to pathology, patient presentation and prognosis through actual cases recorded at the University of North Carolina – Chapel Hill
3. To emphasize the key image findings of each tumour and how the radiologist plays a role in the patient's continual care through follow up examinations or referral to surgery
4. To educate radiologists on the importance of radiologic-pathologic correlation, ie which core needle biopsy results must proceed to excisional biopsy

CONTENT ORGANIZATION  
SUMMARY

1. We would like to provide an educational module that will address the key points of the 2012 classification of WHO mesenchymal breast tumours.
2. Knowledge of the differing tendencies of each type of breast mesenchymal tumour assists in understanding disease prognosis and directing care recommendations.
3. Radiologic-pathologic correlation of core needle biopsy results is crucial in this group of tumours. Many require surgical referral for intervention.

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### Utility of Digital Breast Tomosynthesis in the Diagnostic Setting: How It has Changed Our Practice

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**LL-BRE2481**

**Heather R Peppard** , MD  
**Brandi T Nicholson** , MD \*  
**Carrie M Rochman** , MD  
**Clinton S Pease** , MD  
**Nicholas A Demartini** , MD  
**Jennifer A Harvey** , MD \*

PURPOSE/AIM

Digital breast tomosynthesis (DBT) is an emerging technology in the diagnostic setting designed to evaluate and localize suspicious imaging findings.

The purpose of this exhibit is: To review potential uses of tomosynthesis in the diagnostic setting To discuss how to utilize tomosynthesis for localization of an abnormal finding To demonstrate the impact of tomosynthesis in the determining the extent of disease

CONTENT ORGANIZATION

Review current clinical uses for DBT in diagnostic evaluation

Discuss implementation of two view DBT for mammographic work-up of masses and asymmetries

Discuss utility of DBT for localization of finding and potential pitfalls

Sample cases with mammographic and DBT images in which:

- (1) DBT demonstrates extent of disease in newly diagnosis cancer
- (2) Problem solving two views DBT for localizing a single view finding
- (3) False positive recall with no persistent abnormality on DBT (superimposition)
- (4) False negative recall with mass not detected on DBT

SUMMARY

The major teaching points of this exhibit are:

Tomosynthesis is a useful diagnostic tool for evaluation of women for determining extent of disease.

Tomosynthesis can be implemented effectively in problem solving suspicious findings and localizing single view abnormalities.

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### Translation of Preoperative Breast MRI Findings into the Surgical Field Using Real-time Virtual Sonography

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**LL-BRE2482**

**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
  - Three dimensional mapping of tumor extent based on preoperative MRI
3. Case presentations with illustrated images and short videos
  - Patients with negative resection margins
  - Patients with positive resection margins
4. 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.

**LL-BRE2482**

**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
  - Three dimensional mapping of tumor extent based on preoperative MRI
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**Translation of Preoperative Breast MRI Findings into the Surgical Field Using Real-time Virtual Sonography****LL-BRE2482**

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

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**To Mark or Not to Mark: Indications for and Utility of Marker Placement after Percutaneous Image-guided Breast Biopsy****LL-BRE2483**

**Taghreed I Alshafey** , MSc  
**Brandi T Nicholson** , MD \*  
**Carrie M Rochman** , MD  
**Heather R Peppard** , MD  
**Jennifer A Harvey** , MD \*

**PURPOSE/AIM**

The purpose of this exhibit is:

- to review indications and contraindications for marker placement after image-guided breast biopsy
- to demonstrate the utility of marker placement for confirmation of lesion location between modalities, localization for excision, and follow-up
- to discuss adjustments when the marker is not located in the lesion

**CONTENT ORGANIZATION**

Types of markers Indications and contraindications for marker placement Marker placement to confirm lesion concordance between modalities - mammographic finding sampled with US guidance - MRI finding sampled using US - low density mammography finding sampled with stereo guidance Use of marker placement to aid in surgical lesion excision - when no longer visible or obscured following biopsy - confirm excision of intraductal/intracystic mass or lesion identified on galactography - following neoadjuvant chemotherapy - recognize and adjust for marker migration Localization of malignancy at gross pathology examination Use of marker in follow up of benign image-guided biopsy, particularly with multiple lesions and at other institutions

**SUMMARY**

Marker placement - confirms adequate lesion targeting when sampled using a different modality - Aids in lesion excision and follow-up - recognize and adjust for marker migration

**Breast Cancer Receptors: What Is the Implication for the Radiologist?****LL-BRE2484**

**Maria C Carrillo** , MD  
**Andrea X Gallo** , MD  
**Mark Goldstein** , MBChB

PURPOSE/AIM

Determination of receptor status of a breast invasive cancer is standard practice as a prognostic and predictive factor as well as guidance for therapy. Estrogen positive (ER+) cancers respond to hormonal therapy whilst human epidermal growth factor receptor 2 (HER2) responds to targeted monoclonal antibodies. Currently there are 5 subtypes of breast cancer identified using DNA microarrays. The aim of this educational exhibit is to familiarize the radiologist with this classification

CONTENT ORGANIZATION

The exhibit would be divided in the 5 subtypes of breast cancer: luminal A, luminal B, normal breast-like HER2+/ER- and basal-like. Triple-negative cancer is used as a surrogate marker for basal like cancers. The clinical features, population distribution, clinical associations and prognosis for each subtype are explained and illustrated using mammography, ultrasound and breast MRI with pathological correlation. The triple negative cancers have MRI specific features that have high predictive value for their diagnosis making a likely diagnosis prior to biopsy possible. This features are illustrated.

SUMMARY

Breast cancer receptor identification is essential for disease management and prognosis and it is therefore important for the radiologist to be familiar with this classification and its clinical and radiological implications.

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**Ultrasonographic Features with Pathologic Correlation of Ductal Diseases**

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**LL-BRE2485**

**Lise P Berner**  
**Christophe Tourasse**  
**Jean Francois Denier**  
**Agnes Coulon**

PURPOSE/AIM

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

CONTENT ORGANIZATION

Describe the imaging appearance of normal ductal anatomy.  
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, infiltrates, 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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**Pseudoangiomatous Stromal Hyperplasia of the Breast (PASH): Multimodality Review with Pathologic Correlation**

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**LL-BRE2486**

**Sean D Raj , MD**  
**Beatriz E Adrada , MD**  
**Marion E Scoggins , MD**  
**Constance Albarracin**  
**Flavia Posleman Monetto**  
**Gary J Whitman , MD \***

PURPOSE/AIM

- 1) To review the imaging features of PASH on mammography, sonography, CT, MRI, and nuclear medicine studies.
- 2) To review atypical imaging presentations of PASH.
- 3) To describe pathologic features of PASH.
- 4) To review the clinical management of PASH.

#### CONTENT ORGANIZATION

We will present a pictorial essay of our experience diagnosing PASH over the last 10 years, including clinical and imaging findings, along with pathologic correlation.

- 1) Patient demographics and clinical presentation of PASH.
- 2) Tissue sampling: gross and microscopic features of PASH on histopathology.
- 3) Pathologic features of PASH and differentiation from angiosarcoma.
- 4) Mammographic, sonographic, CT, MRI, and nuclear medicine appearances of PASH.
- 5) Atypical imaging findings of PASH.
- 6) Characteristic imaging findings that can help the radiologist differentiate PASH from similar appearing lesions.
- 7) Clinical management of PASH.

#### SUMMARY

Major teaching points of this exhibit, include:

- 1) Reviewing the appearance of PASH on different imaging modalities.
- 2) Integrating clinical history with imaging findings to assist the radiologist in assessing lesions that resemble PASH.
- 3) Knowledge of the characteristic imaging features of PASH may help the radiologist to distinguish PASH from other similar appearing lesions.

### Opto-Acoustic Breast Imaging - A Novel Functional Modality with Histopathologic Correlation

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#### LL-BRE2487

**Reni S Butler**, MD  
**A. Thomas Stavros**, MD \*  
**F. L Tucker**, MD  
**Michael J Ullissey**, MD \*

#### PURPOSE/AIM

1. To explain opto-acoustic (OA) imaging and its potential role in the assessment of breast masses
2. To illustrate the functional findings within tumor zones and their histopathologic basis

#### CONTENT ORGANIZATION

1. Fundamental Principles of OA Imaging
2. Types and Interpretation of Functional OA Maps
  - a. Tumor Zones and Their Histopathologic Relevance
  - b. Differential Diagnosis of Functional Map Patterns
3. Correlation of Functional Imaging Features and Histopathology

#### SUMMARY

Opto-acoustics is a new fusion breast imaging and functional modality that combines gray scale ultrasound with color-coded opto-acoustic maps that reflect the degree of oxygenation of hemoglobin. Because cancers are more metabolically active and, therefore, deoxygenate blood to a greater degree, this added information may help distinguish between benign and malignant lesions with greater specificity than morphologic features alone. We correlated histopathologic features, including mitotic rate, tumor cell density, vessel density, vessel size, and degree of lymphocytic reaction, with OA findings within three zones: the hypoechoic tumor nidus zone, the hyperechoic boundary zone, and the peripheral tissue zone. Within each zone, color map findings strongly correlated with histopathologic features of malignancy, which will be illustrated through quantitative graphs and case examples.

### Diagnostic Evaluation of the Augmented Breast

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#### LL-BRE2488

**Jane An**, MD  
**Jennifer A Hadro**, MD  
**David E March**, MD  
**Giovanna M Crisi**, MD, PhD  
**Holly Mason**  
**Jennifer A Harvey**, MD \*

#### PURPOSE/AIM

Women who have undergone breast augmentation may present for diagnostic imaging with clinical signs and symptoms that could be caused by either the implant/augmentation procedure or to underlying breast pathology. The purpose of this exhibit is to review common presenting complaints in this population and to describe how diagnostic mammography, US, and MRI can be used to differentiate benign findings related to the augmentation from those suspicious for malignancy.

#### CONTENT ORGANIZATION

The common signs and symptoms in women with breast augmentation that may be suspicious for malignancy will be reviewed. These include a palpable breast abnormality, a palpable axillary mass, breast swelling/enlargement, or breast pain. The differential diagnosis of each of the presenting complaints will be reviewed. The indications and diagnostic effectiveness of mammography, US, and MRI will be discussed and demonstrated in case examples.

#### SUMMARY

Breast augmentation can provide challenges for both clinical and diagnostic evaluation. Familiarity with the differential diagnosis of symptomatic patients and the use of mammography, US, and MRI to distinguish implant-related findings from those suspicious for malignancy will facilitate appropriate diagnosis.

### Looking Behind the Scenes: Tomosynthesis Appearance of Benign and Malignant Breast Disease

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#### LL-BRE2489

**Luke M Partyka**, MD  
**Ana P Lourenco**, MD  
**Martha B Mainiero**, MD

#### PURPOSE/AIM

To illustrate the imaging findings of common benign and malignant breast diseases on tomosynthesis.

#### CONTENT ORGANIZATION

Tomosynthesis is relatively new technology in breast imaging, with studies showing decreases in false positive callbacks and possible increases in cancer detection. The technology is new to many centers, and has yet to be widely adopted. It is thus important to illustrate the findings of both benign and malignant processes on tomosynthesis to increase radiologist familiarity with this emerging technology. Tomosynthesis and digital mammography images will be shown, with corresponding US, MRI, and pathology when available. Examples will include abnormalities seen only on tomosynthesis, or characterized better on tomosynthesis than on digital mammography alone. Cases will include architectural distortion due to cancer as well as radial scar, malignant spiculated masses occult on digital mammography, and benign and malignant masses with obscured margins. Benign skin lesions and skin calcifications will also be demonstrated on tomosynthesis.

#### SUMMARY

Tomosynthesis offers a new approach to breast imaging. It is important to familiarize radiologists with the appearance of common benign and malignant breast diseases by this modality. Examples will demonstrate the utility of tomosynthesis in detection of otherwise occult lesions.

## The Potential and Integration of Digital Breast Tomosynthesis (DBT) in the Diagnostic Pathway of Breast Disease: Five Years of Experience at Kings College Hospital, London. A Multi Modality Correlation of 2D FFDM, DBT, US, MR and Histopathology

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### LL-BRE2490

**Oshaani Abeyakoon** , MBBS, FRCR  
**Rumana Rahim** , MBBS  
**Asif Iqbal** , MBBS  
**David Evans** , MBBS  
**Priya Bhagawat** , MBBS, MRCP  
**Michael J Michell** , MBBCh  
**Juliet C Morel** , MChB, MRCP  
**Rema Wasan** , MBBCh

#### PURPOSE/AIM

To date there is much interest in digital breast tomosynthesis (DBT). It shows promise in overcoming the challenges caused by overlapping structures in 2D FFDM. There is however a learning curve with any new modality. We share our experience, expertise and lessons learnt in integrating DBT into our screening assessment and diagnostic practice since 2009.

#### CONTENT ORGANIZATION

Our educational exhibit includes

- The diagnostic pathway at Kings College Hospital Breast Unit
  - A pictorial review of scenarios where tomosynthesis adds value
1. Further characterisation of indeterminate breast lesions on 2D FFDM.
  2. Detection of multifocality occult on 2D FFDM.
  3. Detection of soft tissue abnormalities in patients with micro calcification.
  4. Determining the exact position of calcification that eliminates the need for biopsy (eg in the skin, vascular ).
- Correlation of tomosynthesis images with ultrasound, MR and histopathology
  - A review of the current literature.
  - Important considerations in setting up a service.

#### SUMMARY

In our practice DBT has enhanced the care in both symptomatic and screening assessment. It is particularly useful for the assessment of soft tissue abnormalities. Sharing our experience and knowledge of the potential pitfalls will assist others integrate tomosynthesis into clinical practice.

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

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### LL-BRE2491

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

#### PURPOSE/AIM

#### CONTENT ORGANIZATION

#### SUMMARY

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#### PURPOSE/AIM

#### CONTENT ORGANIZATION

#### SUMMARY

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**Bonnie N Joe** , MD, PhD

#### PURPOSE/AIM

#### CONTENT ORGANIZATION

#### SUMMARY

## A Dozen Tech-Savvy Ways to Enhance an Academic Breast Imaging Practice

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### LL-BRE2492

**Ramin Javan** , MD

#### PURPOSE/AIM

The aim of this exhibit is to demonstrate some examples of how information technology (IT) may be used to potentially improve an academic breast imaging practice.

#### CONTENT ORGANIZATION

1. Use of optical character recognition (OCR) to obtain number of views per mammographic study (screening or diagnostic) for quality improvement and dose reduction initiatives. 2. Web-based video screen capture to create tutorials on use of dedicated breast imaging software such as for standardized reporting (e.g. PenRad or MagView) or breast MRI software (e.g. Aegis 4D by Hologic). 3. Interactive web-based Flash teaching modules and quizzes. 4. Video recording of breast interventional procedures. 5. Voice recording during read-outs. 6. Development of breast interventional phantoms utilizing 3D printing technologies. 7. Shared Google calendar with routine schedule updates including conferences. 8. Improving patient counseling and consenting with use of pamphlets and RadiologyInfo.org. 9. Online collection of interesting cases. 10. Audience response tools on mobile devices. 11. An electronic queue for technologists entering the diagnostic reading room. 12. A secure intra-departmental instant messaging system.

#### SUMMARY

Methods where IT could potentially enhance the experience of all parties involved in a breast imaging practice in the academic setting are discussed.

### Incidental Uptake in the Breast on FDG PET/CT: Multimodality Imaging Features and Pathologic Correlation

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#### LL-BRE2493

**Sang Soo Shin**, MD  
**Hyo Soon Lim**, MD  
**Seo In Jeong**  
**So Yeon Ki**  
**You Ri Choi**

#### PURPOSE/AIM

The purpose of this exhibit is

1. To illustrate unexpected focal hypermetabolic activity in the breast in patients undergoing PET/CT for reasons other than for breast cancer.
2. To discuss and illustrate the normal physiological pattern of FDG uptake in the breast and the pathological patterns of FDG uptake in various breast diseases.
3. To understand how to manage the incidental breast uptake on FDG PET/CT.

#### CONTENT ORGANIZATION

Mechanism of 18F-FDG PET/CT

Physiologic uptake

Imaging work-up for incidental detected breast lesion on PET/CT

Benign breast disorder

Recent surgery.

Radiation therapy

Inflammatory and infectious disease

Post-operative healing scars / fat necrosis

Fibroadenoma

Fibrocystic change

Atypical ductal hyperplasia

Phyllodes tumor

Malignant conditions

Invasive ductal carcinoma

Invasive lobular carcinoma

Lymphoma

#### SUMMARY

1. Although high SUV may be useful to differentiate benign and malignant lesions, increased FDG accumulation may be observed in a variety of benign entities and in some physiological conditions.
2. Incidental focal hot uptake lesion in the breast on FDG PET/CT should be assessed via mammography and sonography.
3. Some benign lesions can be differentiated from malignancy by correlative imaging finding and biopsy should be done if a lesion is of BI-RADS category 4 or 5.

### Breast Disorders Encountered during Pregnancy and Lactation: Imaging and Pathologic Correlation

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#### LL-BRE2494

**So Yeon Ki**  
**Seo In Jeong**  
**Hyo Soon Lim**, MD  
**You Ri Choi**

#### PURPOSE/AIM

The purpose of this exhibit is

1. To understand the physiologic changes of breast and diseases affecting the breast during pregnancy and lactation.
2. To review the clinical, pathologic, and imaging features of various breast disorders related to pregnancy and lactation

#### CONTENT ORGANIZATION

Physiologic changes

Evaluation of the breast during pregnancy and lactation

Benign condition

Galactocele

Inflammatory and infectious disease

Lactating adenoma

Growing fibroadenoma

Fibroadenoma with infarction

Malignant conditions

Pregnancy associated breast carcinoma

Burkitt lymphoma

#### SUMMARY

The major teaching points of this exhibit are:

1. During pregnancy and lactation, the breast shows physiologic changes and the breast can be affected by various specific and unique disorders including benign and malignant disorders.
2. Imaging findings are very helpful in the selection of patients for diagnostic interventions and knowledge of the clinical, pathologic, and imaging features allows the radiologist to guide appropriate management of these patients.

### Imaging Findings after Breast Conservation Therapy: Mammographic, US, and MR Findings with Pathologic Correlation

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#### LL-BRE2495

**Hyo Soon Lim**, MD

**PURPOSE/AIM**

The purpose of this exhibit is

1. To demonstrate the imaging findings of common post treatment changes after breast conservation therapy and locoregional recurrence.
2. To assess the role of mammography, ultrasound, and MR imaging in the patients after breast conservation therapy.

**CONTENT ORGANIZATION**

Breast conservation therapy  
Post therapy imaging follow-up  
Common post-therapy findings: mammography, ultrasound, and MR imaging

Edema

Fluid collection: Hematoma, seroma

Post surgical scarring

Fat necrosis with or without dystrophic calcifications

Mastitis, abscess formation

Calcifications: dystrophic vs. recurrent malignancy

Recurrent cancer

Usefulness of each imaging modality

**SUMMARY**

The major teaching points of this exhibit are:

1. The expected changes after breast conservation therapy are skin thickening, edema, fluid collection, architectural distortion, fat necrosis, and dystrophic calcifications.
2. It is important to be familiar with the post therapeutic changes and to differentiate the post treatment changes from tumor recurrence because unnecessary biopsy can be minimized and early detection of local tumor recurrence may improve survival.

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**Idiopathic Granulomatous Mastitis: Imaging Update with Clinical and Histopathology Correlation**

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**LL-BRE2496**

**Robert T Fazio** , MD, PhD  
**Katrina N Glazebrook** , MBChB  
**Nichole Sandhu** , MD, PhD  
**Sejal Shah** , MD

**PURPOSE/AIM**

Idiopathic Granulomatous Mastitis (IGM) is an aggressive inflammatory condition of the breast found predominantly in women of childbearing age. IGM is a relatively rare entity and few cases have been reported from the North American patient population. Imaging findings of IGM often mimic classic features of malignancy. Distinguishing IGM from breast carcinoma is important as conservative therapy is often sufficient for treatment and surgery may be avoided. The purposes of this educational exhibit are to review the imaging features of IGM in order to help facilitate expeditious diagnosis.

**CONTENT ORGANIZATION**

1. Review the current understanding of IGM pathophysiology.
2. Report cases of IGM with clinical and histopathology correlation, including outcomes data.
3. Demonstrate imaging features of IGM with readily available breast imaging techniques (mammography and ultrasound).
4. Demonstrate the usefulness of MRI in evaluation of IGM.
5. Compare/contrast features of IGM with typical features of breast carcinoma.

**SUMMARY**

Major teaching points of this exhibit: IGM is an aggressive inflammatory condition of the breast with imaging features similar to breast carcinoma. Accurate characterization and diagnosis during breast imaging evaluation is essential for treatment planning purposes and favorable prognosis.

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**Papillary Carcinoma of the Breast**

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**LL-BRE2497**

**Anubha Wadhwa** , MD  
**Mary Beth Gonyo** , MD  
**Carla J Shah** , MD  
**Zainab Basir** , MD

**PURPOSE/AIM**

Papillary carcinoma is a rare breast malignancy for which the prognosis is better than many other breast tumors. The aim of this presentation is to understand the mammographic and sonographic presentations of papillary carcinoma and their correlation with histopathology.

**CONTENT ORGANIZATION**

1. Histologic classification of papillary carcinoma: Invasive and in situ (intraductal and intracystic) forms.
2. Mammographic appearances of intraductal and intracystic papillary carcinoma.
3. Understand its sonographic presentations with histologic correlation.
4. Diagnosis and management.

**SUMMARY**

There is a spectrum of papillary lesions of the breast extending from benign papillomas to invasive papillary carcinoma. Papillary carcinoma of the breast is classified into intraductal and intracystic forms, each having characteristic imaging appearances on mammography and ultrasound. The absence of myoepithelial layer on histology distinguishes it from a benign papilloma. Invasion is infrequent and often occurs at the periphery of the tumor, therefore is difficult to diagnose on core needle biopsy. This presentation focuses on the imaging appearances of different forms of papillary carcinoma with histopathologic correlation.

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

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**LL-BRE2498**

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

**PURPOSE/AIM**

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

**CONTENT ORGANIZATION**

1. Review various expected imaging changes after radiation therapy for breast cancer.
2. Compare radiation induced imaging changes with imaging findings in proven breast cancer recurrence. Include case examples with

- pathology.
3. Discuss emerging data regarding alternative MRI sequences and their potential future role in helping to distinguish radiation induced changes and tumor recurrence.
    - a. Diffusion
    - b. Perfusion
    - c. Spectroscopy
  4. Quiz: Three cases will be presented. The corresponding images will be displayed and discussed in regards to appropriate next steps in management.

#### SUMMARY

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

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

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#### LL-BRE2498

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

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#### LL-BRE2498

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

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#### LL-BRE2499

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

#### PURPOSE/AIM

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

#### CONTENT ORGANIZATION

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

#### SUMMARY

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

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

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### LL-BRE2499

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

#### PURPOSE/AIM

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

#### CONTENT ORGANIZATION

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

#### SUMMARY

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

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

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### LL-BRE2499

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#### SUMMARY

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

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

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### LL-BRE2500

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

#### PURPOSE/AIM

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

#### CONTENT ORGANIZATION

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

#### SUMMARY

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

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

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### LL-BRE2500

**Francisco Carrillo Paredes** , MD  
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### Characterization of Malignant Lymph Nodes in the Axillary Region: Basis and Application of Diffusion-weighted (DWI) and Mean Diffusivity (ADC) Magnetic Resonance (MR) Imaging

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#### LL-BRE2500

**Francisco Carrillo Paredes**, MD  
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- 3) MR imaging contributes beneficial advantages as a diagnostic tool in the characterization of malignant lymph nodes in the axillary region.

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### Common Benign Breast Masses as Depicted on Contrast-enhanced Digital Mammography with Ultrasound, MRI and Biopsy Correlation

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#### LL-BRE2501

**Danielle Senge**, DO  
**Pauline Germaine**, DO  
**Michael Lee**, MD  
**Raymond L Baraldi**, MD  
**Elizabeth Tinney**, RT  
**Kristin Brill**, MD  
**Karen Hendershott**, MD

#### PURPOSE/AIM

Intravenous contrast material makes use of tissue vascularity, imparting a physiologic capability, which in mammography has otherwise been limited to contrast enhanced MRI. Contrast-Enhanced Digital Mammography (CEDM) was recently introduced into the diagnostic imaging community. Many benign lesions will enhance after contrast administration. This pictorial essay illustrates such lesions.

#### CONTENT ORGANIZATION

CEDM is performed with standard mammography equipment that has undergone software modifications, such as the GE Senographe System. This exhibit will introduce the technique, which utilizes full-field low energy and software-derived subtraction views of standard CC and MLO projections. Additionally, routinely encountered benign lesions are correlated with biopsy results and findings on ultrasound and MRI. Simple and inflamed cysts, fibrocystic change and fibroadenoma had characteristic appearance on CEDM and diagnosis was made with certainty, especially when correlated with ultrasound. Papilloma, fat necrosis, usual ductal hyperplasia, PASH and phylloides demonstrated nonspecific enhancement requiring biopsy for definitive diagnosis.

#### SUMMARY

CEDM can potentially offer valuable information in the screening and workup for breast cancer. As CEDM becomes more widely available, it is important to recognize characteristic enhancement patterns of benign lesions.

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### The Use of the Geographical Information Systems (GIS) for Establishing Mammography Facilities

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#### LL-BRE2502

**Faezeh Sodagari**, MD  
**Pedram Golnari**, MD  
**Fatemeh Sodagari**, BS, MBA  
**Hamid R Baradaran**, MD, PhD

#### PURPOSE/AIM

The availability and ease of access to mammography facilities is one of the most important factors in the degree of the compliance of the target population with the current guidelines and standards. It has been shown that the distance to the mammography facility is correlated with the stage of the cancer at the diagnosis.

With the use of the Geographical Information Systems (GIS), we can integrate the data on geographical attributes, access routes, and

available facilities with the demographic characterization of the local population and determine the best available location for establishment of a mammography center with the best access for the current or future number of women in the screening age. It can also be integrated with the available data on the prevalence of breast cancer in different neighborhoods.

#### CONTENT ORGANIZATION

- Introduction of the GIS and their use in healthcare especially in the field of radiology
- Basic introduction to the available software and developing maps
- Simple analyses using GIS
- Demonstrating an analysis based on a hypothetical data for determining the best place for establishment of a mammography screening facility (both permanent and portable facilities)

#### SUMMARY

The use of GIS-based approaches can improve the efficacy and cost-effectiveness of establishment of future mammography screening centers.

### 3T MR Guided High Intensity Focused Ultrasound (HIFU) for Non-invasive Breast Cancer Treatment: A Reliable Therapeutic Strategy

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#### LL-BRE2503

**Alessandro Napoli** , MD  
**Luisa Di Mare** , MD  
**Fabrizio Boni**  
**Vincenzo Noce** , MD  
**Maurizio Del Monte**  
**Carlo Catalano** , MD

#### PURPOSE/AIM

The application of HIFU presently covers a broad spectrum of fields, ranging from pain bone palliation, treatment of uterine fibroid, osteoid osteoma, to complex interventions on prostate, pancreatic and breast cancer. Our experience will review the experience and current applications of MRgFUS, with particular emphasis on treatment of 2 cm unifocal biopsy-proven breast cancer detected at MRI, in a treatable location.

#### CONTENT ORGANIZATION

We present:

1. MRgFUS functioning and current application vs state of art in breast cancer treatment.
2. MRI planning to evaluate size, accessibility and viability of breast.
3. MRgFUS therapy details and imaging follow-up.
4. MRI role in detection of the post-ablation residual disease.
5. Surgical specimen to validate treatment efficacy.

#### SUMMARY

The MRgFUS may offer an alternative treatment option to conventional surgical lumpectomy with the advantage of being a safe and noninvasive procedure and potentially achieving a better cosmetic outcome. FUS device can target and ablate tissue without incision. Better soft tissue contrast resolution, absence of ionizing radiation, real time (thermal) monitoring with improved safety and efficacy are the main topics in favor of MR guide. Comparison with pathology enables to test MRgFUS treatment efficacy; we present our results and show agreement with post-treatment MRI.

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

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#### LL-BRE2504

**Riham H El Khouli** , MD, PhD  
**Katarzyna J Macura** , MD, PhD \*  
**Ihab R Kamel** , MD, PhD \*  
**David A Bluemke** , MD, PhD \*  
**Michael A Jacobs** , PhD

#### PURPOSE/AIM

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

#### CONTENT ORGANIZATION

1. Conventional and advanced MRI techniques of the breast: Principles, applications, and limitations.
2. Case examples demonstrating the multiparametric approach to diagnosing breast lesions

#### SUMMARY

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

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## Ultrasound Elastography in Detecting Breast Neoplasms

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### LL-BRE2505

**Faezeh 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.

## Ultrasound Elastography in Detecting Breast Neoplasms

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### LL-BRE2505

**Faezeh Sodagari** , MD  
**Pedram Golnari** , MD  
**Hamid R Baradaran** , MD, PhD

#### PURPOSE/AIM

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**Faezeh Sodagari** , MD  
**Pedram Golnari** , MD

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- 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.

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**How to Start a Successful I-125 Pre-operative Breast Localization Program in Your Institution**

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**LL-BRE2506**

**Basak E Dogan , MD**  
**Mark J Dryden , MD**  
**Jay Poston , PhD**  
**Benjamin D Smith , MD**  
**Richard E Wendt , PhD**  
**William D Erwin , PhD**  
**Jamie Wagner , DO**

**PURPOSE/AIM**

- To review the NRC guidelines for setting up a RSL program.
- To discuss the concept and technique of pre-operative RSL of breast lesions
- To review logistic and patient safety requirements

**CONTENT ORGANIZATION**

**Content Organization**

- Concept and current role of RSL in pre-operative localization will be discussed.
- Available equipment and vendors with advantages and disadvantages of each equipment will be reviewed.
- Potential pitfalls and complications will be illustrated.
- Radiation safety guidelines will be discussed and a suggested algorithm for each institution will be illustrated

**SUMMARY**

RSL of breast lesions is globally increasing in application. Radiologists should be aware of state licensing requirements, dose implications related to this procedure as well as patient safety and logistic considerations . Successful RSL implementation increases patient comfort, decreases surgery time and excised tissue volume and can be easily applied by breast imaging radiologists familiar with interventional procedures.

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

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**LL-BRE2507**

**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

- 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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**Min Jung Kim , MD**

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- A. Pathologic diagnosis with H-E and immunohistochemistry staining
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    - 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.
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**Breast Case of the Day**

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**LL-EDE3001**

**Moderator**  
**Colleen H Neal , MD \***  
**Deborah O Jeffries , MD**

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**Breast Case of the Day**

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**LL-EDE3001**

**Moderator**  
**Colleen H Neal , MD \***  
**Deborah O Jeffries , MD**

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**Breast Case of the Day**

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**LL-EDE3001**

**Moderator**  
**Colleen H Neal , MD \***  
**Deborah O Jeffries , MD**

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**Breast Case of the Day**

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**LL-EDE3001**

**Moderator**  
**Colleen H Neal , MD \***  
**Deborah O Jeffries , MD**

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**Breast Imaging (Diagnostic Ultrasound)**

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

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**US** **BR**

**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 ; Jiyeon 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 papillomas 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 59 (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 18-78). 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

**Sunitha 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

Combined VEGFR2- and CD276- targeted molecular imaging information can further improve accuracy of US for in vivo assessment of breast tissue progression from normal to breast cancer in this transgenic mouse model

## CLINICAL RELEVANCE/APPLICATION

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 is 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 more 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 hand held 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, 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 calcifications 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 ( $\leq 2$ cm) Breast Lesions**

**Kyung Hee Ko** (Presenter) ; **Hae Kyoung Jung MD** ; **Jung Hyun Yoon MD** ; **Hye Rin Kim**

## PURPOSE

To evaluate the usefulness of SWE for the differential Diagnosis of small ( $\leq 2$ cm) 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 $\pm$ 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 $\pm$ 98.03kPa) was significantly higher than that of benign (49.14 $\pm$ 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  $\leq 2$ cm 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; all in 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;  $\geq$  3mm 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 diagnosis, were eligible. Data were retrospectively analysed from 396 consecutive patients meeting these criteria. The mean stiffness values were obtained using the Aixplorer ultrasound machine from SuperSonic Imagine Ltd. Measurements were taken from a region of interest positioned over the area identified via the colour map as the stiffest part of the abnormality. The average of the mean values obtained in each of four projections was used for analysis. Associations between lymph node involvement and mean lesion stiffness in kilopascals, invasive cancer size, histological grade, tumour type, ER and HER-2 receptor status and vascular invasion were assessed using univariate and multivariate logistic regression.

#### Results

#### 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: 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 underwent 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 galatography only in 13 cases (11.1%) and US only in 11 cases (9.4%), of which galactograms were negative (n=1), only ductal 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.

### **Breast - Sunday Posters and Exhibits (12:30pm -1:00pm)**

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



**LL-BRS-SUA • AMA PRA Category 1 Credit™:0.5**

**Host**

**Donna M Plecha**, MD \*

**LL-BRS-SU1A • Measurement of Invasive Breast Cancer Using Digital Breast Tomosynthesis, Full Field Digital Mammography and Ultrasonography**

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**Asif Iqbal** MBBS (Presenter) ; **Michael J Michell** MBBCh ; **Rema Wasan** MBBCh ; **Abdel Douiri** PhD ; **David Evans** MBBS ; **Clare Peacock** MBBS ; **Juliet C Morel** MBChB, MRCP

#### PURPOSE

In preoperative assessment of local extent of breast cancers, full field digital mammography (FFDM) and ultrasonography (US) imaging are routinely used. Digital breast tomosynthesis (DBT), an application of FFDM which displays the breast structures as a series of thin slices, overcomes the problem of overlying tissues and displays more clearly the tumour outline. We compare DBT with FFDM and US in the size measurement of invasive cancers.

#### METHOD AND MATERIALS

A retrospective analysis was carried out on 139 invasive breast cancers examined by DBT, FFDM and US. Only soft tissue lesions were included. Separate tumour size measurements on three imaging modalities and histological tumour size confirmed following surgical resection, were recorded. Statistical analysis was done by following Bland-Altman method and concordance correlation coefficient (CCC); the size differences in millimetres between imaging modality measurements and histology measurements were plotted.

#### RESULTS

Histologically, 108 lesions (77.7%) were diagnosed as invasive ductal carcinoma, 22 (15.8%) as invasive lobular carcinoma and 9 (6.5%) as other invasive types. For the whole dataset, on Bland-Altman analysis, the DBT showed the lowest bias  $1.216 \pm 7.99$ ; 95% CI [-14.44 to 16.87], whereas the FFDM was  $1.88 \pm 9.387$ ; [-16.51 to 20.28] and US was  $5.647 \pm 9.424$ ; [-12.82 to 24.11]. In the subanalysis by mammographic features, the CCC values demonstrated significantly high ( $p$  rho=0.925, FFDM rho=0.704, US rho=0.422); asymmetric density [DBT rho=0.892, FFDM rho=0.685, US rho=0.534]; spiculate masses [DBT rho = 0.652, FFDM rho=0.556, US rho=0.523] and circumscribed masses [DBT rho =0.519, FFDM rho=0.519, US rho=0.452].

#### CONCLUSION

This study has shown that DBT has a higher accuracy for determining invasive cancer size than FFDM and US. The most significant effect is seen with parenchymal distortion and asymmetric density, where measurement using FFDM and US is difficult and unreliable.

#### CLINICAL RELEVANCE/APPLICATION

Use of digital breast tomosynthesis in the diagnostic workup of breast cancers for accurate pre-surgical assessment of tumour size could help in choosing appropriate treatment.

### LL-BRS-SU2A • The Added Value of Dual Energy Contrast Enhanced Digital Mammography in Breast Cancer Diagnosis

**Athanasios N Chalazonitis** MD, MPH ; **Zoi Antoniou** BMedSc (Presenter) ; **Eleni Feida** ; **Spiros Liopiris** ; **Dionisis Goutzamanis** ; **Olga Giouvri** ; **Efi Christopoulou**

#### PURPOSE

The purpose of our study is to evaluate the diagnostic accuracy of dual energy contrast enhanced digital mammography (CEDM), as an adjunctive technique to digital mammography, using the histological results of all lesions and to study the added value of this method in the evaluation of early breast cancer.

#### METHOD AND MATERIALS

Fifty (50) consenting women, with suspicious findings on digital mammography and/or on U/S, enrolled in this study. A pair of low and high energy images was acquired using a modified full field digital mammography system with a CsI absorber. MLO and CC projections of the breast with the suspicious findings were performed 2 minutes after 1.5 ml/kg iodinated contrast agent intravenous injection and then both projections of the normal breast were also performed. Two subtracted images with contrast agent uptake were reviewed by two experienced breast radiologists and compared with the histological results.

#### RESULTS

A) One or more enhancing breast lesions were depicted in 34 women. 26 of the enhancing mammograms were histologically proven to be malignancies. In this group 5 women had multicentric enhancing malignant lesions. From the 8 rest of the 34 patients with enhancing lesions, 4 proved to be sclerosing adenosis, 2 fibroadenomas and 2 fibrosis-adenosis of the breast.

B) In the remaining 16 women, without enhancing lesions, histological results were benign in 15 of them. The one missed lesion was a 7mm invasive ductal carcinoma with associated DCIS.

#### CONCLUSION

Dual energy CEDM as an adjunctive tool to mammography can improve the diagnostic accuracy and the sensitivity to malignant breast lesions.

#### CLINICAL RELEVANCE/APPLICATION

Dual energy CEDM is a new and advanced clinical application, easily implemented, fast and reproducible, with radiation comparable to that of standard digital mammography.

### LL-BRS-SU3A • Breast Density Bill: Is This a Good Idea?

**Hannah Nien** MD (Presenter) ; **Yasmeen K Shariff** MD ; **Cynthia A Barone** DO

#### PURPOSE

Breast density is an emerging topic that has received significant media attention recently. Currently, there is a push to pass a bill requiring that a letter be sent to patients post mammography, detailing the patient's breast density. The purpose of our study was to survey the Breast Imagers across the country to find out whether or not they support the breast density bill and their reasoning behind their stance.

#### METHOD AND MATERIALS

Permission was obtained from the Society of Breast Imagers to use the SBI email list. An anonymous survey was emailed to the members of SBI across the United States regarding the recent State and Federal effort to pass the breast density bill. Questions included whether or not they support the breast density bill, and what would be their argument for or against the bill. There were questions specifically asking those who practice in the state that have already passed the bill whether or not they thought it has had a positive impact on patient care and their practice.

#### RESULTS

A total of 351 responses were obtained. 68.6% did not support the bill and 31.4% supported the bill. Patient confusion was the most frequently stated argument against the bill, followed by unnecessary patient anxiety and fear. Patient education was the most frequently stated argument for the bill, followed by improved/early cancer detection. Of those who practice in states that have already passed the bill, 36% reported positive effect on patient care while 28% reported negative effect and 20% were unsure.

#### CONCLUSION

Breast density influences the sensitivity of mammography and the breast density bill addresses the issue of alerting patients of this limitation of annual mammograms. The result of our study suggests that a majority of Breast Imagers across the nation does not support the bill because the sending density information to the patients would cause patient confusion, unnecessary anxiety and fear. Furthermore, there are complex issues involving the adjunct screening modalities including the limited availability of equipment and adequately trained personnel as well as the high false positive rates and higher radiation doses.

#### CLINICAL RELEVANCE/APPLICATION

Our study addresses the recent State and Federal push to pass the bill that makes density reporting to patients mandatory which would

have a large clinical impact on how Breast Imagers practice daily.

### **LL-BRS-SU4A • Diagnostic Usefulness of Breast Ultrasonography in the Evaluation of the Patients with Pathologic Nipple Discharge: Comparison with Galactography**

**Jun Ho Park** (Presenter) ; **Young Mi Park** MD, PhD ; **Suk Jung Kim** ; **Hyun Kyung Jung** ; **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 underwent 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 ductal 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.

### **LL-BRE-SU5A • 'Physics and Tips' Behind the Scenes for Successful Stereotactic Breast Biopsy Results in Technically Limited Cases**

**Luis F Serrano** MD (Presenter) ; **John Sfondouris** MD

#### **PURPOSE/AIM**

To teach Radiologists, fellows and residents technical aspects and applications involving Physics and tips , for stereotactic breast biopsy in difficult patients with considerable reduction rate of stereotactic breast biopsy cancellations after the patient has been involved in the procedure.

#### **CONTENT ORGANIZATION**

A. Most typical technical issues B. How to avoid failures C. Understanding the physics and how it helps D. How to improve lesion visualization E. Negative stroke margin principle and technical aspects to avoid it.

#### **SUMMARY**

Applying the 'unused parameters', improve technical aspects, and helps the radiologist to perform those difficult stereotactic breast procedures, with better confidence and satisfactory results. The implementation of these variations will also reduce significantly the rate of cancellations during the biopsy, after the patient has been involved, causing unnecessary anxiety for the patient, and waste of time for both Health personnel and patient. Likewise, improving the utilization of our stereotactic resources in such challenging cases, will benefit the patients by keeping them as ambulatory minimally invasive procedures, instead of go through unnecessary open surgeries in the operating room under general anesthesia.

### **LL-BRE-SU6A • Sources of Error in MR Directed Breast Biopsies**

**Phillip B Shaffer** MD (Presenter)

#### **PURPOSE/AIM**

MR directed breast biopsy is an essential component of any breast program which includes breast MR. However, it can be very difficult at times to position patients for biopsy. Further, unlike ultrasound or stereo biopsy, verifying that the targeted lesion has been biopsied is complicated by the fact that 1) the lesion has faded by the time that a post biopsy image is obtained and 2) anesthetic and bleeding obscure the lesions. The wide variety of breast pathology (and even normal tissue) that can demonstrate enhancement complicates the determination of concordant vs discordant pathology even further. This exhibit will review proven "misses" and analyze how the miss occurred and how it may have been recognized.

#### **CONTENT ORGANIZATION**

1)Review of method of MR directed biopsy. 2) Review of cases in which there was a definitive miss of the targeted tissue. 3) Review the common causes of misses and their avoidance 4) Suggest methods to recognize when misses may have occurred.

#### **SUMMARY**

MR directed biopsy is a necessary component of a comprehensive breast imaging program. Yet, they are much more difficult to perform than stereotactic or ultrasound directed breast biopsies. Given this difficulty, misses are inevitable. This work should aid radiologists in avoiding misses and then recognizing them when they occur

### **LL-BRE-SU7A • Images a Radiologist Should Never See: Common Mammography Artifacts and Their Root Causes**

**Thomas Oshiro** PhD (Presenter) ; **Karen Neiberg** BS, RT ; **Tami Samuel** BS, RT ; **Lawrence W Bassett** MD

#### **PURPOSE/AIM**

Artifacts from positioning and technical errors are frequent causes of substandard image quality during mammography examinations. While many of these images are repeated by the technologist prior to interpretation, some can slip through the review process. It is important for the radiologist to understand the root causes of these artifacts and possible methods of correction.

#### **CONTENT ORGANIZATION**

The presentation will be given as a slideshow in quiz format. A problem image will be shown with no annotations for the reviewer to develop an unbiased impression. Subsequent slides will highlight problem areas, root causes and post correction images. Five classifications of artifacts will be presented:

- Obstruction due to patient anatomy
- Underexposure (noise)
- Overexposure (detector saturation)
- Equipment failure
- Patient motion

The content will also convey the importance of the repeat analysis and will review other feedback mechanisms radiologists can implement in the clinic.

#### SUMMARY

When artifacts in mammography are not caught during the review process, it is important to understand how to identify and correct for these problems. Monitoring of quality control procedures can help reduce the amount of these images being sent to the radiologist.

### **LL-BRE-SU8A • It's Not All in the CAD or BI-RADS: Optimizing Your Interpretation of Breast MRI by Avoiding the Perils of CAD and Including Diagnostic Imaging Data Not Yet Included in BI-RADS**

**Frederick Kelcz MD, PhD (Presenter)**

#### PURPOSE/AIM

Computer aided evaluation (CAE/CAD) has helped most radiologists to interpret the hundreds of images associated with breast MRI. Our purpose is to advance your MRI reading skills by discussing and illustrating: (1) The pitfalls of using CAE/CAD - don't just 'hit the button' and believe all those colors (2) Imaging techniques, anatomic and contrast enhancement patterns that contribute to diagnosis, but are not currently included in the BI-RADS lexicon.

#### CONTENT ORGANIZATION

A. Proper use of CAD/CAE - illustrating: 1. Incorrect setup can result in missing peak enhancement 2. Check for patient motion first, before trusting the color assignment! 3. Motion compensation can lead you astray - use cine mode to visually check for software induced artifacts 3. Threshold properly to achieve balance of sensitivity and specificity B. Review of MRI findings not yet in BI-RADS 1. T2 signal intensity 2. Blooming sign (not just a sign of Spring) 3. Hook sign 4. Edema sign 5. Diffusion properties

#### SUMMARY

After viewing this exhibit the viewer will: 1. Approach CAE/CAD software with healthy skepticism, knowing how to set it up, use it properly and what to do when things seem wrong. 2. Go beyond the BI-RADS descriptors and be able to incorporate additional subtle information to improve accuracy of diagnosis.

### **Breast - Sunday Posters and Exhibits (1:00pm - 1:30pm)**

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



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**LL-BRS-SUB • AMA PRA Category 1 Credit™:0.5**

### **LL-BRS-SU1B • The Radiation Dose of Breast Tomosynthesis Comparison with Conventional Digital Mammography**

**So Young Jung RT (Presenter) ; Meoung Mi Jang ; Kyung Sun Lee ; Sung Suk Bae ; Dong Sung Kim ; Jung Min Chang MD ; Ka Hee Jung**

#### PURPOSE

Early clinical results with DBT are very promising. However, it has been reported that the radiation dose of DBT is higher than MG. To investigate how breast density characteristics and the presence of cancer can affect the dose of digital breast tomosynthesis (DBT) compared with conventional digital mammography(MG).

#### METHOD AND MATERIALS

Between January 2012 and April 2012, DBT and MG were performed in 211 women (mean age 50.3;range 25~77 years), including 148 patients with breast cancer. For Phantom experiments, the radiation dose of both DBT and MG were compared using ACR phantom (CIRS model15). For clinical data evaluation, the radiation dose of DBT and MG were compared between breast density (BI-RADS grade 1,2 [N=50], Grade3 [N=94] and Grade4 [N=67]). In addition, the radiation dose of DBT and MG were compared in breasts with cancers and contralateral normal breasts in patient with breast cancer [N=148].

#### RESULTS

The radiation dose of DBT was 1.32 mGy, which was 20% higher than MG(1.1mGy)in phantom study. According to the composition of the breast density in 211 women, DBT dose increased 44% in breast density grade1,2 (p=0.00), 11% in grade 3 (p=0.01), and 1% in grade 4 (p=0.585) when compared to MG. The dose differences between DBT and MG were significant in all breast density except for grade 4. The dose increase in DBT compared to MG was 9% in the breast with cancer, and 15% in normal contralateral breasts.

#### CONCLUSION

The radiation dose of DBT was generally higher compared to MG. However, the difference of radiation dose between DBT and MG grew smaller with higher breast density, and breast with cancers.

#### CLINICAL RELEVANCE/APPLICATION

In evaluation of dense breast, and breast with malignancy, concerns on increased dose could be minimized. Because in that case, the minimal dose differences were noted between DBT and MG is.

### **LL-BRS-SU2B • Microcalcifications in 1,658 Patients with Pure Ductal Carcinoma in Situ of the Breast: Imaging Findings with Clinical, Histopathologic and Biologic Correlation**

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

#### PURPOSE

Analyze microcalcifications (MC) on mammography (M) in patients with pure ductal carcinoma in situ (DCIS) by nuclear grade (G), comedonecrosis (CN), estrogen receptor (ER) status, patient age and surgical outcome.

#### METHOD AND MATERIALS

An institutional review board approved retrospective single institution database search was performed from January 1, 1996 to July 31, 2009 of patients with pure DCIS who underwent preoperative M. All M and, when available, ultrasound (US) images were reviewed according to the ACR BIRADS lexicon. Imaging findings were analyzed in respect to clinical, histopathologic, and biologic characteristics. Statistical analyses used multiple logistic regression with model selection via AIC or Pearson's chi-squared test for marginal homogeneity or linear dependence.

#### RESULTS

There were 1911 patients with pure DCIS. Patients with negative M (n=98) and noncalcified lesions (n=155) were excluded, 1658 patients were included in final analysis. M was performed in all patients; US in 506 (31%) patients. Mean age at diagnosis was 55 years (SD, 11.0). G3 lesions were associated with fine linear morphology and segmental distribution of MC (p

#### CONCLUSION

G3 DCIS and CN are associated with fine linear MC, segmental distribution, large size, ER (-) lesions, and visibility on US. Dense breasts are associated with multicentricity and close surgical margins.

#### CLINICAL RELEVANCE/APPLICATION

Patients with dense breasts should be carefully evaluated for multicentricity and the possibility of close surgical margins, and might benefit from supplemental imaging.

## **LL-BRS-SU3B • Correlation between Cancer Detection and Image Quality in an Organized Provincial Screening Mammography Program**

**Rasika Rajapakshe** PhD (Presenter) ; **Brent A Parker** BSc ; **Cynthia Araujo** PhD ; **Teresa Wight** ; **Nancy Aldoff** ; **Janette Sam RT** ; **Christine M Wilson** MD

### **PURPOSE**

Studies from the Screening Mammography Program of British Columbia (SMPBC) and the U.S. FDA National Mammography Quality Standard's Act have shown that improvements in mammographic technologies improved image quality over the 1990s and early 2000s. These studies also show that increases in image quality came at the expense of roughly doubling the mean glandular dose per mammogram. There is little understanding whether these changes improved mammography screening outcomes at a populational level. This study investigates the extent that improvements in film based mammographic image quality influenced the detection of breast cancer within the SMPBC between the years 1994-2005.

### **METHOD AND MATERIALS**

The SMPBC performs annual image quality tests on all of their units at each of their centers and these are reported by the BC Cancer Agency. From this data an annual average Image Quality (IQ) Score using the ACR accreditation phantom was calculated. An IQ clinic average was calculated by averaging the score of each mammographic unit within a clinic, and a provincial average was calculated from each of the clinic's average scores. The SMPBC also publishes annual reports that describe participation and screening outcomes. This data was used to calculate the annual cancer detection rates for women between the ages of 40-79 who had cancer detected from the SMPBC between the years 1994-2005. The calculation of this data enabled longitudinal comparison of cancer detection rates against the provincial average IQ score.

### **RESULTS**

The screening program grew from 123,881 screens with 19 sites in 1994 to 256,961 screens with 37 fixed and 3 mobile sites in 2005. Both IQ and detection (CDR) of invasive tumours  $\geq 5$  mm increased over this time period. (IQ increased 20%, CDR  $\geq 5$  mm increased 107%). In contrast, the detection of tumours  $>5$ mm was reduced by 30%. The  $R^2$  values, based on linear fitting, for these trends is 0.65 (CDR  $\geq 5$  mm) and 0.64 (CDR  $>5$ mm). The detection rate of DCIS varied from 4-8 detections per 10,000 screens. The program's sensitivity and specificity remained constant ( $\pm 2\%$ ) over this period of time.

### **CONCLUSION**

Between 1994-2005 mammographic image quality, mean glandular dose and the detection of invasive tumours  $\geq 5$ mm increased while detection of tumours  $>5$ mm decreased.

### **CLINICAL RELEVANCE/APPLICATION**

Improvements in image quality over the years are associated with increased detection of small invasive breast tumours. This came at the cost of increased radiation dose.

## **LL-BRS-SU4B • Evaluation of Spiculation and Retraction Patterns in Coronal Reconstructions in 3D Automated Breast Ultrasound (ABUS) Improve Differentiation between Benign and Malignant Breast Lesions**

**Jan Van Zelst** (Presenter) ; **Tao Tan** \* ; **Bram Platel** PhD ; **Nico Karssemeijer** PhD \* ; **Ritse M Mann** MD, PhD \*

### **PURPOSE**

To investigate the value of coronal reconstructions of transversal 3D ABUS data in differentiation of benign from malignant breast lesions.

### **METHOD AND MATERIALS**

This study received a waiver by the local ethics committee. For this reader study we obtained 96 3D ABUS casus with 37 malignant and 59 benign ultrasound guided core biopsied breast lesions. The localization of the lesions was done by a physician with 1 year 3D ABUS experience based on the primary radiology reports and biopsy results. The 3D ABUS view in which the lesion was best visible, was presented to 3 experienced breast radiologists with 2 years experience with 3D ABUS.

They were first asked to detect and classify the most suspicious lesion in the view using the BIRADS lexicon and scoring system. A likelihood-of-malignancy (LOM) score between 0 and 100 was also requested. Thereafter the coronal reconstruction was shown and readers were asked to re-assess the lesion. Spiculation and retraction in the coronal plane were scored on a five point scale (Spiculation and Retraction Severity Index (SRSI)). Subsequently LOM and BI-RADS scores could be adjusted.

Az-values for differentiation of benign from malignant lesions based on LOM scores were computed with DBM-MRMC method. Pearson's correlation coefficient between the re-assessed LOM on the coronal reconstructions and SRSI was calculated for all readers.

### **RESULTS**

Three readers respectively pointed out 92%, 97% and 92% of 37 cancers as the most suspicious lesion in the 3D ABUS acquisition. After evaluation of the coronal reconstructions, detected malignant lesions were not downgraded to BI-RADS 2, however, 7 benign lesions were downgraded from BI-RADS 3 to BI-RADS 2. After re-evaluation the discrimination between benign and malignant lesions significantly improved from 0.84 (95% CI 0.76-0.92) to 0.87 (95% CI 0.80-0.94) ( $p=0.02$ ). SRSI scores correlated significantly with the re-assessed LOM scores for all readers,  $r = 0.85, 0.75$  and  $0.75$ , respectively ( $p$

### **CONCLUSION**

Coronal reconstructions in 3D ABUS significantly improve the differentiation between benign and malignant breast lesions, by providing new visual information on breast cancer spiculation and retraction.

### **CLINICAL RELEVANCE/APPLICATION**

Better differentiation between malignant and benign breast lesions may reduce false positive biopsies in evaluation of automated breast ultrasound.

## **LL-BRE-SU5B • Do We Describe the Response of Breast Cancer to Neoadjuvant Chemotherapy Accurately? A Systematic Approach to Reporting**

**Rosa M Lorente-Ramos** MD, PhD (Presenter) ; **Javier Azpeitia Arman** MD ; **Eva Cueva Perez** ; **Isabel Casado Farinas** ; **Teresa Rivera Garcia** ; **Miguel Angel Lara Alvarez**

### **PURPOSE/AIM**

To review imaging findings in advanced breast cancer after neoadjuvant chemotherapy with correlation with pathological changes occurring during treatment. To analyse and illustrate the appropriate description and reporting of the different types of radiological response to neoadjuvant therapy, including residual tumor features and complete remission.

### **CONTENT ORGANIZATION**

The imaging findings in 62 patients with advanced breast cancer undergoing neoadjuvant chemotherapy (NAC) were reviewed and compared with responses after treatment and pathological findings at surgery. Mammograms, US and MR, dynamic contrast-enhanced and diffusion weighted imaging (DWI), were performed in all the patients before and after NAC. We describe and illustrate a schematic reporting system including a description of the residual lesion with comparison with the pretreatment tumor: - morphologic type of response: absence of lesion (complete response), mass shrinkage, fragmentation (scattered foci) - tumour size (longest diameter and volume) - tumour signal intensity on MR T2-weighted images - peak signal enhancement ratio on dynamic contrast-enhanced MR - ADC ratio - response in lymph nodes

### **SUMMARY**

Imaging features correlate with pathologic findings after surgery. Accurate description and reporting of the different types of radiological

response helps in tumor evaluation.

## LL-BRE-SU6B • Histopathologic Components of Breast Cancer: Radiologic Findings and Pathologic Correlation

**Ken Yamaguchi MD (Presenter) ; Takahiko Nakazono MD, PhD ; Ryoko Egashira MD ; Shuji Toda ; Hiroyuki Irie MD, PhD**

### PURPOSE/AIM

To identify the histopathologic components of breast cancer including calcification, hemorrhage, necrosis, edema, mucin, fibrosis  
To review the radiologic findings of each histopathologic components of breast cancer  
To correlate the radiologic findings with histopathology

### CONTENT ORGANIZATION

1. Pathophysiology of histopathologic components
2. Radiologic findings, including mammography, US, and MRI of each histopathologic components of breast cancer with pathologic correlation
3. Discussion about radiological differential diagnosis using histopathologic components

### SUMMARY

Breast cancer is heterogeneous disease. Besides the cancer nest, breast cancer contains many histopathologic components including calcification, hemorrhage, necrosis, edema, mucin and fibrosis. In this exhibit, we have shown the radiologic findings of these histopathologic components of breast cancer with pathologic correlation. Identifying the radiologic findings of histopathologic components with understanding its pathophysiology is useful for differential diagnosis for breast cancer, including DCIS and some special types.

## LL-BRE-SU7B • Breast Biopsies under MRI Guidance: What Have We Learned in the Past Decade? Challenges of an Essential but Imperfect Technique

**Isabelle Trop MD, MPH ; Marie-Claude Chevrier MD (Presenter) ; Isabelle Thomassin-Naggara MD ; Mona M El Khoury MD ; Lucie Lalonde MD ; Maude Labelle MD ; Julie David MD**

### PURPOSE/AIM

The goals of this exhibit are 1. to present and discuss the technical challenges related to MRI-guided breast biopsy, and propose management tips for challenging situations, 2. to discuss radio-pathologic correlation and management recommendations for benign and high-risk breast lesions diagnosed after biopsy, and 3. to present algorithms to minimize the risk of false negatives.

### CONTENT ORGANIZATION

1. Technical challenges of MRI-guided breast biopsy: due to lesion position, to lesion size, to enhancement characteristics; 2. Management tips for challenging situations: vanishing lesion, missed lesions; 3. Radio-pathologic correlation examples, with management recommendations for benign and high-risk breast lesions diagnosed after biopsy; 4. False negatives: how to identify them, how to prevent them.

### SUMMARY

MRI-guided breast biopsy is an essential tool of the breast imager, yet, a decade after its introduction, this technique remains challenging and imperfect. Challenges include technical considerations related to adequate lesion sampling, and difficulties in confirming radiologic-pathologic correlation for enhancing lesions. Through various clinical examples, this exhibit will offer practical tips for the radiologist, as well as propose evidence-based algorithms for the management of benign and high-risk lesions diagnosed after MRI-guided biopsy.

## LL-BRE-SU8B • Breast Anatomy and Characteristics of Breast Lesions in Digital Breast Tomosynthesis

**Paola Clauser MD (Presenter) ; Arianna De Nicolo' MD ; Viviana Londero MD ; Rossano Girometti MD ; Chiara Zuiani MD ; Massimo Bazzocchi MD**

### PURPOSE/AIM

To define breast anatomy and characteristics of the more frequently encountered breast lesions in Digital Breast Tomosynthesis (DBT).

### CONTENT ORGANIZATION

1. Normal breast anatomy in DBT: a. glandular tissue; b. ligaments and vessels; c. lymph nodes. 2. Benign breast lesions: a. fibroadenomas; b. cysts; c. fibrocystic changes. 3. Malignant breast lesions: a. invasive ductal carcinoma; b. invasive lobular carcinoma; c. ductal carcinoma in situ. 4. Pitfalls in DBT: macrocalcifications and metallic markers.

### SUMMARY

DBT is able to show more details on breast anatomy and lesions, compared to Digital Mammography; several specific tips and tricks should be taken into account in assessing normal or pathologic findings.

## Current Issues in Breast Cancer Screening

**Sunday, 02:00 PM - 03:30 PM • S406A**

BR

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**RC115 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5**

### RC115A • Current Controversies

**Daniel B Kopans MD (Presenter) \***

#### LEARNING OBJECTIVES

- 1) The recent US Preventive Services Task Force guidelines will be reviewed.
- 2) Learn why the Task Force guidelines are not supported by the scientific evidence.
- 3) The age of 50 has no biological or screening importance.
- 4) The decrease in deaths associated with screening is 30% or higher, and not the 15% used by the Task Force.
- 5) Screening cannot yet be tailored to risk for breast cancer beyond those who are genetically predisposed.
- 6) The majority of breast cancers occur in women who are at average and not at elevated risk.
- 7) Biennial screening will lead to deaths that could be averted by annual screening.
- 8) Annual screening should begin at the age of 40 for all women.

### RC115B • Future Directions

**D. David Dershaw MD (Presenter)**

#### LEARNING OBJECTIVES

- 1)To understand the new breast imaging technologies that are under clinical trial.
- 2)To learn the advantages and disadvantages of new digital technologies, including tomosynthesis and contrast mammography.
- 3)To understand the appropriateness and problems of isotope based breast imaging.
- 4)To learn how these technologies may be used for screening.

#### ABSTRACT

New technologies entering the breast imaging armamentarium include advanced digital applications of tomosynthesis, contrast enhanced mammography and contrast enhanced tomosynthesis. Breast imaging with isotopes is also possible with positron emission tomography.

Other technologies are less developed. The advantages, disadvantages and the data supporting or arguing against the use of these techniques will be discussed.

## RC115C • Breast Density Based Screening

**Stephen A Feig MD (Presenter) \***

### LEARNING OBJECTIVES

1) To review the criteria and methods for assessment of breast density. 2) To analyze the effect of breast density on breast cancer risk as well as on sensitivity and specificity of mammography. 3) To discuss strategies for use of supplementary screening modalities such as MRI and ultrasound according to patient age, breast density, and risk status.

### ABSTRACT

Randomized trials and service screening studies have found that screening mammography can reduce breast cancer death rates by as much as 30% - 50%. Supplementary screening with breast MRI or ultrasound has been shown to substantially increase detection rates beyond those from mammography alone. This suggests that women with dense breasts, where mammography is less sensitive, may benefit from such multimodality screening. Objective measurement of breast density and estimation of risk status may help to provide screening recommendations for an individual woman. Benefits such as higher survival rates, risks such as false positive biopsy rates, costs, reimbursement status for and practicality of supplementary screening will be discussed. Current status of breast density notification legislation and results from states having such legislation will be reviewed. Based on experience in Connecticut and California, practical advice to help the radiologist respond to such legislation will be given.

## MR Imaging-guided Breast Biopsy (Hands-on Workshop)

**Sunday, 02:00 PM - 03:30 PM • E260**

**MR** **BR**

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**RC150 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5**

**Peter R Eby**, MD  
**Alice S Rim**, MD  
**Annamaria Wilhelm**, MD \*  
**Janice S Sung**, MD  
**Mary C Mahoney**, MD \*  
**Michelle D McDonough**, MD  
**Simone Schradig**, MD  
**Laura B Shepardson**, MD  
**Christiane K Kuhl**, MD \*  
**Gary J Whitman**, MD \*  
**Michael P McNamara**, MD \*  
**Elizabeth R Deperi**, MD  
**W. Phil Evans**, MD \*  
**Roberta A Jong**, MD \*  
**Francesca D Beaman**, MD  
**Elsie Levin**, MD \*  
**Carol H Lee**, MD  
**Wendy B Demartini**, MD \*  
**Hiroyuki Abe**, MD  
**Margarita L Zuley**, MD  
**Stamatia V Destounis**, MD  
**Jennifer R Cranny**, MD  
**Michael N Linver**, MD \*  
**Robert L Gutierrez**, MD

### LEARNING OBJECTIVES

1) Establish criteria for MR-guided breast biopsy patient selection. 2) Cultivate a working understanding of MR-guided biopsy and needle localization instrumentation and implementation. 3) Understand basic MR-guided biopsy and needle localization parameters and requirements for appropriate coil, needle and approach selection. 4) Consider patient management before, during and after MR-guided breast biopsy. 5) Explore benefits and limitations of availability of MR-guided biopsy/needle localization in your practice. 6) Practice the MR-guided biopsy procedure on phantoms with multiple needle and coil combinations.

### ABSTRACT

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

## Medical Physics 2.0: Mammography

**Monday, 08:30 AM - 10:00 AM • S404AB**

**PH** **DM** **BR**

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**RC221 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5**

**Co-Director**  
**Ehsan Samei**, PhD \*  
**Co-Director**  
**Douglas E Pfeiffer**, MS \*

## RC221A • Mammography Perspective

**Douglas E Pfeiffer MS (Presenter) \***

### LEARNING OBJECTIVES

1) Understand the history and development of mammographic imaging equipment. 2) Understand the impact of equipment development on testing protocols. 3) Understand the impact of equipment development on regulation.

### ABSTRACT

Mammographic imaging has undergone tremendous change since its inception. Rapid development from screen-film imaging to nearly universal acceptance of digital imaging has required a shift in testing methodology. This talk will briefly introduce the developments that have taken place and discuss the impact that this development has had on testing and regulation.

## RC221B • Mammography 1.0

**Melissa C Martin** MS (Presenter)

### LEARNING OBJECTIVES

1) Current requirements for Quality Control for Hologic Digital Mammography Units. 2) Current requirements for Quality Control for General Electric Digital Mammography Units. 3) Current requirements for Quality Control for Fuji Computed Radiography for Mammography Units. 4) Current requirements for Quality Control for Printers used with Digital Mammography Units. 5) Current requirements for Quality Control for Monitors used with Digital Mammography Units.

## RC221C • Mammography 2.0

**Eric A Berns** PhD (Presenter)

### LEARNING OBJECTIVES

1) To provide an overview of how the Medical Physicist can prepare for the future of clinical mammography physics. 2) To provide a landscape of mammography imaging technologies. 3) To describe methods of image quality metrics, dose reduction, and quality control in relation to mammography technologies. 4) To describe the future roles of the Medical Physicist in clinical mammography physics.

## US-guided Interventional Breast Procedures (Hands-on Workshop)

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

**US** **BR**

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**RC252 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5**

**Gary J Whitman**, 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 F Cossi**, MD  
**Eren D Yeh**, MD  
**Gary W Swenson**, MD  
**Catherine W Piccoli**, MD \*  
**Michael P McNamara**, MD \*  
**Selin Carkaci**, MD  
**Jean M Seely**, MD  
**Phan T Huynh**, MD \*  
**H. Carisa Le-Petross**, MD  
**Basak E Dogan**, MD  
**Jay A Baker**, MD \*  
**Tanya W Stephens**, MD  
**Jiyon Lee**, 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

## Breast Series: Breast MR Imaging

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

**MR** **BR**

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**VsBR21 • AMA PRA Category 1 Credit™:3.25 • ARRT Category A+ Credit:4**

**Moderator**  
**Christopher E Comstock**, MD  
**Moderator**  
**Linda Moy**, MD

## VsBR21-01 • MR Image Acquisition

**Mitchell D Schnall** MD, PhD (Presenter)

### LEARNING OBJECTIVES

1) To describe the technical elements needed to perform high-quality breast MRI. 2) To describe and illustrate the pulse sequences needed for high-quality breast MRI. 3) To describe and illustrate the importance of simultaneously achieving high in-plane spatial resolution, thin slices, adequate temporal resolution, adequate signal-to-noise ratios, and full coverage of both breasts in breast MRI. 4) To show examples of high-quality and sub-standard breast MRI exams.

## VsBR21-02 • Breast MRI at 7 Tesla: Image Evaluation and Comparison to 3 Tesla

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

### PURPOSE

To evaluate the image quality of T1-weighted fat suppressed breast MRI at 7T, with 3T images in the same subjects serving as a baseline reference.

### METHOD AND MATERIALS

3D T1w images were acquired in 17 subjects using a bilateral transmit-receive coil and adiabatic inversion-based fat suppression (FS) at 7T, and a seven channel receive array and saturation-based FS at 3T. Images were qualitatively graded on a five-point scale by two radiologists and quantitatively assessed through fibroglandular/fat contrast, and signal uniformity measurements. Acquisition time and voxel size for the four unilateral sequences were: 1. 7T standard resolution, 119s, 1.1x1.1x1.6mm<sup>3</sup>; 2. 7T high resolution, 390s, 0.6mm

isotropic; 3. 3T standard resolution, 71s, 1.1x1.1x1.6mm<sup>2</sup>; 4. 3T high resolution, 324s, 0.6mm isotropic.

## RESULTS

Image quality scores at 7T and 3T were similar (4.3 at 7T vs 4.1 at 3T,  $p=0.27$ ) in standard-resolution images, indicating that breast imaging with clinical protocol parameters can be performed with high image quality at 7T. The 7T SNR advantage was underscored in high-resolution images, where image quality was significantly greater than at 3T (4.2 at 7T vs 3.1 at 3T,  $p$ )

## CONCLUSION

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

## CLINICAL RELEVANCE/APPLICATION

High breast image quality and uniformity was achieved with clinical parameters at 7T. 7T SNR improves delineation of small structures that may be beneficial for lesion classification.

### **VBSR21-03 • Determining Breast Cancer Grade with 3T-TWIST MRI**

**Roel D Mus MD** (Presenter) ; **Ritse M Mann MD, PhD \*** ; **Jelle O Barentsz MD, PhD** ; **Peter Bult MD, PhD** ; **Nico Karssemeijer PhD \*** ; **Bram Platel PhD**

## PURPOSE

To assess the correlation between time to enhancement (TTE) and tumor grade using an ultrafast DCE MR Mammography protocol.

## METHOD AND MATERIALS

1031 patients underwent contrast enhanced breast MRI at 3.0T (Siemens, Magnetom Trio and Skyra) using a 16 channel bilateral breast coil. A bi-temporal protocol was employed, interleaving a TWIST (Time-resolved angiography With Stochastic Trajectories) sequence during and immediately after IV administration of 0.1mmol/kg Gd-DOTA (20 time points, spatial resolution 1\*0.9\*2.5 mm, temporal resolution 4.32 seconds). 102 consecutive patients with invasive ductal (IDC) or lobular (ILC) carcinoma were included in this analysis. The TTE was determined on maximum intensity projections from the TWIST acquisitions as displayed on a dedicated DynaCAD breast MRI workstation (InVivo). TTE was defined as "the timepoint where the lesion started to enhance" minus "the time point where the aorta started to enhance". For different tumor histology and grade categories the mode TTE was calculated and TTE distribution was compared using one way anova.

## RESULTS

Mode TTE was 4.3 sec for 32 grade III IDC, 8.6 sec for 40 grade II IDC and 18 ILC and 12.9 sec for 12 grade I IDC. There was no significant difference in TTE between IDC and ILC ( $p=0.465$ ). In IDC TTE distribution was significantly different between tumor grade categories ( $p$ )

## CONCLUSION

TTE provides a non-invasive method to predict histological grade. Lesions that enhance very rapidly are more likely high grade than lesions that enhance relatively slow.

## CLINICAL RELEVANCE/APPLICATION

Breast cancer therapy is dictated by pathological features of the tumor with the poorest prognosis. Because pathology is subject to sampling errors, TTE can be used to ascertain sampling of the most relevant part of the tumor.

### **VBSR21-04 • Dynamic Contrast-enhanced (DCE) Breast MR of DCIS: A Comparison of Same-patient Quantitative Features at 3T and 1.5T**

**Amie Y Lee MD** (Presenter) ; **Habib Rahbar MD** ; **Wendy B Demartini MD \*** ; **Savannah C Partridge PhD \*** ; **Matthew L Olson** ; **Sue Peacock MSC** ; **Constance D Lehman MD, PhD \***

## PURPOSE

Breast MR is increasingly performed at 3T, which is hypothesized to improve lesion characterization over 1.5T due to higher spatial and contrast resolution. More accurate depiction of extent with 3T may be especially important for DCIS as surgical re-excision is often required due to imaging-occult components. Our purpose was to assess same patient MR features of DCIS at 3T and 1.5T.

## METHOD AND MATERIALS

This IRB-approved prospective study included 20 patients (6/2010 to 5/2012) with newly diagnosed pure DCIS who underwent preoperative MR at both 3T and 1.5T. Both examinations had 3D T1-weighted fast gradient echo protocols with one pre- and three post-contrast series of approximately 180 seconds each. 3T (Philips Achieva TX) spatial resolution was 0.5 x 0.5 x 0.65 mm and 1.5T (GE LX) was 0.85 x 0.85 x 1.6 mm. 3T and 1.5T MR examinations were interpreted by different radiologists blinded to results of the second MR. Radiologist-assessed maximum lesion sizes were recorded, and whole-lesion kinetic synopses were computed using in-house automated software for 90 seconds initial and 450 seconds delayed phase enhancement. Sizes at 3T and 1.5T were correlated to final surgical pathology and differences in MR kinetics at 3T and 1.5T were evaluated (Spearman correlation, Wilcoxon signed-rank test).

## RESULTS

DCIS mean sizes were 18.2 mm (0-67) on 3T, 18.2 mm (0-60) on 1.5T, and 14.1 mm (0-55) on pathology. Size correlation between imaging and pathology was higher for 3T (0.66,  $p=0.002$ ), mean difference 7.5 (0-35) mm, compared to 1.5T (0.36,  $p=0.13$ ), mean difference 11.5 (0-50) mm. Initial phase mean peak and % rapid enhancement were higher at 3T, but overall there were no statistically significant differences in initial or delayed phase kinetics at 3T compared to 1.5T, with mean peak enhancement 173.8 vs. 118.2 ( $p = 0.08$ ), % medium 66.7 vs. 80.2 ( $p = 0.12$ ), % rapid 33.3 vs. 19.8 ( $p = 0.12$ ), % persistent 54.6 vs. 62.8 ( $p = 0.29$ ), % plateau 23.2 vs. 21.0 ( $p = 0.05$ ) and % washout 22.2 vs. 16.1 ( $p = 0.22$ ).

## CONCLUSION

In patients with newly diagnosed DCIS, lesion size at 3T MR had higher correlation than 1.5T with final pathology. Initial and delayed phase kinetics did not differ significantly between field strengths.

## CLINICAL RELEVANCE/APPLICATION

3T may be more accurate than 1.5T in preoperative assessment of DCIS extent. Despite a hypothesized improved contrast resolution at 3T, DCIS kinetics did not differ significantly between 3T and 1.5T.

### **VBSR21-05 • Time-resolved Gadolinium-enhanced MR Imaging of the Breast**

**Hanan Sherif MD** (Presenter) ; **Ahmed-Emad Mahfouz MD** ; **Amal Alobadly MD** ; **Issam Albozom MD**

## PURPOSE

To evaluate the very early onset of lesion enhancement on time-resolved ultrafast gadolinium-enhanced MR imaging as a differentiating sign between benign and malignant breast lesions.

## METHOD AND MATERIALS

100 women with breast lesions were examined at 1.5 T (Siemens, Erlangen, Germany), by ultrafast T1-weighted GRE images every 5 s for 30 s after injection of Gd-DOTA (Dotarem, Guerbet, France), followed by 5 spacially-resolved MR image series every 30 s. Images were subtracted; maximum-intensity-projection images were obtained, and images were randomized and reviewed by two blinded readers, who reviewed only the spacially-resolved MR images and gave BIRADS diagnosis. After one month, they evaluated only the time-resolved MR images and noted the time of first appearance of enhancement.

## RESULTS

The patients had 249 enhancing lesions: 66 malignant on histopathology and 183 benign on basis of histopathology or 1-year imaging

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

#### CONCLUSION

Time-resolved ultrafast gadolinium-enhanced MR imaging of the breast demonstrates earlier enhancement of malignant lesions compared to benign lesions. Lesion enhancement within the first 20 s is an accurate sign of breast carcinoma.

#### CLINICAL RELEVANCE/APPLICATION

Time-resolved imaging after injection of contrast agent increases accuracy of diagnosis of breast carcinoma. It is a useful addition to the protocol of gadolinium-enhanced MR imaging of the breast.

### **VBSR21-06 • Sensitivity of an Abridged Breast MRI Protocol to Detect a Known Breast Cancer**

**Laura Heacock** MS, MD (Presenter) ; **Amy N Melsaether** MD ; **Kristine M Pysarenko** MD ; **James S Babb** PhD ; **Hildegard B Toth** MD ; **Linda Moy** MD

#### PURPOSE

A shorter MRI may be cheaper, better tolerated by patients and faster for the radiologist to interpret. These changes may lead to wider access to Breast MRI. We evaluated the ability of an abridged MRI protocol to detect a known breast cancer.

#### METHOD AND MATERIALS

An IRB approved retrospective review of 100 breast MRI exams at 3T; with a unifocal biopsy-proven carcinoma was performed by two radiologists. Initially they evaluated the precontrast T1, first post-contrast T1 and first subtraction T1 post-contrast images blinded to the clinical history and prior films. Then they assessed the images given the above information and once more with the addition of the pre-contrast T2 images. The scan time for the 3 T1-sequences was 4 mins; the scan time for the T2-sequence was 4 mins. The time to interpret the study and the confidence score was assessed for each study. Comparison was made to the original diagnostic interpretation.

#### RESULTS

Of 100 cancers, 58 were masses, 25 were nonmass enhancement (NME) and 17 were categorized in the original report as both masses and NME. Sixty-two were invasive carcinomas, 29 were ductal carcinoma in situ (DCIS), and 9 were invasive carcinomas and DCIS. The mean size was 1.8 cm (range 0.6 - 10 cm). The sensitivity for both readers was 98% (CI 93.4% - 99.6%). Mean time for interpretation for reader 1 (R1) was 24secs (range 1 - 55 secs) for reader 2 (R2) was 14secs (range 3-77secs). R1 took an additional 10 secs to read and correlate the T2 image and R2 took 4.2 secs. R1 showed a significant increase in confidence (p 0.1) with the addition of either priors or T2 images. There was no significant correlation (r) between lesion size and either evaluation time (r|0.5) or reader confidence (r|0.35). Also, there was no significant difference (p>0.25) between lesion types in terms of evaluation time or reader confidence. Two cases of DCIS were missed; both were seen on the 2nd post-contrast scan.

#### CONCLUSION

An abridged protocol has a high sensitivity for detecting known DCIS and invasive carcinoma and significantly reduced the interpretation time.

#### CLINICAL RELEVANCE/APPLICATION

Almost all cancers are detected with an abridged MRI protocol. The specificity and recall rates of a shorter exam should be examined to determine if this change may lead to wider access to breast MRI.

### **VBSR21-07 • DCE MRI of the Breast: The Effect of Breast Compression on the Diagnosis and Staging of Breast Cancer**

**Riham H El Khouli** MD, PhD (Presenter) ; **Katarzyna J Macura** MD, PhD \* ; **Ihab R Kamel** MD, PhD \* ; **David A Bluemke** MD, PhD \* ; **Michael A Jacobs** PhD

#### PURPOSE

Breast compression stabilizes the breast to reduce motion and is used in conjunction with MRI guided breast biopsy. Our study aim was to evaluate the effect of breast compression on A) enhancement of both breast cancer and glandular tissue (GT) B) DCE MRI performance

#### METHOD AND MATERIALS

For this IRB approved retrospective study, we reviewed 425/210 studies/cases. Each patient had 2 or more MRI studies, 1 with and at least 1 without breast compression. We included 302 studies in total divided in 3 groups:1) Biopsy proven breast cancer (102/59 studies/lesions), 2) Breast lesion detected on one MRI study and not the other (18/9 studies/lesions), 3) Cases with 1 study with unilateral compression (for GT enhancement difference, 90), and a noncompressed study (control, 92). %Enhancement difference between noncompressed and compressed studies for early and delayed post-contrast phases was calculated. Breast density, type of lesion (mass versus NMLE), lesion size, %Compression and kinetic curve type were evaluated

#### RESULTS

%Compression varied between 0 and 61%. Among 59 cancer cases, 39% were DCIS and 61% invasive. %Enhancement was higher in noncompressed versus compressed studies in both early and delayed phases (p-value 0.1)

#### CONCLUSION

Breast compression affected cancer detection, lesion size, and DCE MRI interpretation and performance. We recommend limiting the application of breast compression except when clinically necessary

#### CLINICAL RELEVANCE/APPLICATION

Many breast coils are capable of applying compression with a patient dependent degree. Compression significantly affected enhancement characteristics of breast cancer and DCE MRI diagnostic accuracy

### **VBSR21-08 • Diffusion-weighted Imaging and Advanced Techniques**

**Savannah C Partridge** PhD (Presenter) \*

#### LEARNING OBJECTIVES

1) Understand the physical basis of diffusion imaging and methods used to acquire diffusion-weighted data. 2) Understand the clinical applications of diffusion-weighted imaging for cancer diagnosis and assessment of response to therapy. 3) Be familiar with the challenges of breast diffusion imaging and technical considerations for protocol optimization. 4) Future directions.

#### ABSTRACT

### **VBSR21-09 • Diffusion Weighted Imaging and Dynamic Contrast Enhanced Imaging in Breast Cancer at 7 Tesla**

**Stephan Gruber** MD (Presenter) ; **Olgica Zaric** ; **Katja Pinker-Domenig** MD ; **Lenka Minarikova** ; **Thomas H Helbich** MD \* ; **Siegfried Trattnig** MD ; **Pascal A Baltzer** MD ; **Wolfgang Bogner** MSC

#### PURPOSE

To assess the feasibility and diagnostic value of diffusion weighted imaging (DWI) in addition to contrast-enhanced imaging (DCE-MRI) with high spatial and/or temporal resolution in breast cancer at 7 Tesla. DWI has been shown to add important diagnostic value at lower

field strengths (METHOD AND MATERIALS

## RESULTS

Both DWI and DCE-MRI provided excellent data quality with sub-milimeter spatial resolution approving great feasibility of these techniques in morphological evaluations. Based on the ADC threshold of  $1.35 \times 10^{-3} \text{mm}^2/\text{s}$ , DWI showed a 100% sensitivity and 100% specificity to distinguish between malignant and benign lesions. DCE-MRI, based on contrast enhancement kinetics and morphologic features, had a sensitivity and a specificity of 100%, 96%, respectively in breast lesions diagnostics.

## CONCLUSION

This study shows that DWI and DCE-MRI at 7T are feasible in patients with breast cancer. In our pilot data we could demonstrate high sensitivity and specificity at 7T for both methods. At 7T, DWI automatically provides high-quality T2-weighted reference images ( $b=0 \text{ s/mm}^2$ ) that can replace additional T2-weighted MRI and, thereby, save valuable measurement time.

## CLINICAL RELEVANCE/APPLICATION

Ultra high-field MR at 7T has the potential to improve sensitivity and specificity of DWI and DCE-MRI in the differential diagnosis between benign and malignant breast tumors.

### **VSB21-10 • Apparent Diffusion Coefficient in Invasive Ductal Breast Carcinoma: Correlation with the Tumor-stroma Ratio of Breast Cancer and Detailed Histologic Features**

**Eun Sook Ko MD (Presenter) ; Boo-Kyung Han MD, PhD ; Eun Young Ko MD, PhD ; Jung Hee Shin MD ; Soo Yeon Hahn MD**

## PURPOSE

The purpose of this study was to determine whether ADC values vary according to tumor-stroma ratio, dominant stroma type or presence of central fibrosis.

## METHOD AND MATERIALS

61 patients with invasive ductal carcinoma not otherwise specified (IDC NOS) who underwent breast MRI with diffusion-weighted imaging (DWI) were included in this study. Apparent diffusion coefficient (ADC) values of lesions were measured. Two pathologists evaluated the tumor-stroma ratio, dominant stroma type (collagen, fibroblast, lymphocyte), and central fibrosis. Detectability on DWI was compared according to tumor-stroma ratio. Mean ADC values were compared with tumor-stroma ratio, dominant stroma type, presence of central scar. Multiple linear regression analysis was also performed to determine variables independently associated with ADC values.

## RESULTS

On DWI, detectability was not significantly different between two groups ( $P = 0.244$ ). ADC values were significantly lower in stroma-poor group ( $P < 0.001$ ). There was statistically significant difference of mean ADC values according to dominant stroma type ( $P = 0.021$ ). Mean ADC values in collagen dominant type were lower than fibroblast dominant or lymphocyte dominant type. At multiple linear regression analysis, tumor-stroma ratio ( $P = 0.007$ ), tumor size ( $P = 0.007$ ) and dominant stroma type (fibroblast dominant,  $P = 0.029$ ) were independently correlated with ADC values.

## CONCLUSION

ADC values showed significant difference according to tumor-stroma ratio and dominant stroma type.

## CLINICAL RELEVANCE/APPLICATION

Tumor-stroma ratio is known as independent prognostic factor of breast carcinoma. We hypothesized that these histopathologic features affect ADC values.

### **VSB21-11 • Dynamic Contrast Enhanced (DCE) and Diffusion Weighted Imaging (DWI) Breast MRI at 3T: A Road Map of MRI Characteristics for Breast Cancer Histological Subtypes Characterization**

**Riham H El Khouli MD, PhD (Presenter) ; Katarzyna J Macura MD, PhD \* ; Ihab R Kamel MD, PhD \* ; David A Bluemke MD, PhD \* ; Michael A Jacobs PhD**

## PURPOSE

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

## METHOD AND MATERIALS

Our institutional review board approved the study. Out of 1405 consecutive patients who underwent bilateral breast MRI at 3T, 219 patients with 234 lesions were included in the study (mean age  $53 \pm 11.5$  year). Both high temporal (15 sec) DCE and high spatial resolution ( $0.5 \text{ mm}^2$  voxel size) MRI were acquired along with DWI. Regions of interest were drawn on the ADC maps of breast lesions and normal appearing glandular tissue (GT). Morphologic features, DCE-MRI results (kinetic curve type), GT and lesion absolute and normalized ADC values were included in multivariate models for prediction of breast cancer histological subtypes. Area under ROC curve analysis was performed

## RESULTS

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

## CONCLUSION

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

## CLINICAL RELEVANCE/APPLICATION

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

### **VSB21-12 • Is Unenhanced Breast MRI Using Diffusion Weighted Imaging at 3 Tesla an Alternative to Dynamic Contrast Enhanced Breast MRI?**

**Pascal A Baltzer MD (Presenter) ; Hubert Bickel MD ; Wolfgang Bogner MSC ; Thomas H Helbich MD \* ; Stephan Gruber MD ; Katja Pinker-Domenig MD**

## PURPOSE

Contrast enhanced breast MRI (ceMRI) is the most sensitive method for detection of breast cancer. Limiting factors for a broader availability of this method are costs caused by magnet time and the contrast agent. Diffusion Weighted Imaging (DWI) is increasingly used in clinical practice. It has shown its value for lesion detection and differentiation and has been used together with T2w TSE images as an unenhanced alternative (ueMRI) to ceMRI in mass lesions. The purpose of this study was to apply DWI only to a non-selected group of MRI patients referred during routine clinical practice and to compare the results to ceMRI in a multi-reader study.

#### METHOD AND MATERIALS

Patients from routine breast MRI at 3 Tesla referred due to conventional BI-RADS 3-5 ratings were eligible for this retrospective study and retrieved from our prospectively populated database. No dropouts due to incomplete examinations occurred. Two radiologists with >5 years experience in breast MRI (O1, O2) independently read ueMRI and ceMRI examinations and gave them a BI-RADS rating (1=no lesion, 2=benign lesion, 3=probably benign lesion, 4=suspected malignancy, 5= definite malignancy). Furthermore, lesion size, ADC values and BI-RADS criteria were assessed. Reference standard for radiological ratings was histopathology or imaging follow up. Statistical analysis included Receiver Operating Characteristics (ROC) analysis and kappa statistics.

#### RESULTS

67 malignant and 56 benign findings were identified in 119 patients (mean age 54+/-14y). Area under the ROC curve was 0.901 (O1) and 0.905 (O2) for ceMRI and 0.882 (O1) and 0.854 (O2) for ueMRI. The differences between observers and techniques were not statistically significant ( $P>0.05$ ). However, specificity was 75% (O1) and 71% (O2) in ueMRI and 80% (O1) and 77% (O2) in ceMRI. Kappa agreement was high with 0.968 (ceMRI) and 0.893 (ueMRI).

#### CONCLUSION

Unenhanced MRI of the breast is feasible in clinical practice. While invasive cancers can be detected with equal sensitivity compared to ceMRI, ueMRI showed lower specificity and reproducibility.

#### CLINICAL RELEVANCE/APPLICATION

Due to equal sensitivity, ueMRI has potential to be applied as a screening sequence before ceMRI. Further studies are needed in order to clarify whether it could be a cost effective alternative.

### **VSBR21-13 • MR Spectroscopy**

**Michael S Middleton** MD, PhD (Presenter) \*

#### LEARNING OBJECTIVES

1) Understand spectroscopy techniques. 2) Learn the biochemical basis for breast spectroscopy. 3) Interpret spectroscopy. 4) Understand potential applications of breast spectroscopy.

#### ABSTRACT

### **VSBR21-14 • Role of 1H MRS Metabolic Profiling in Assessing Breast Cancer Recurrence**

**Dania Daye** BS (Presenter) ; **Suzanne L Wehrli** PhD ; **Dhruv Pant** ; **Christopher Sterner** ; **Mitchell D Schnall** MD, PhD ; **Lewis Chodosh** MD, PhD

#### PURPOSE

While dysregulated metabolism has long been recognized as a key feature of cancer development, the metabolic changes accompanying cancer recurrence are largely unexplored. The goal of this study was to identify key metabolic differences between primary and recurrent mammary tumors using 1H MRS in combination with expression analysis of key metabolic enzymes and to assess the role of those findings in predicting human breast cancer recurrence.

#### METHOD AND MATERIALS

Our lab has developed an inducible bitransgenic mouse model which accurately reproduces key features of the natural history of human breast cancer progression: primary tumor development, tumor dormancy and recurrence. 9 primary and 9 recurrent mammary gland tumors were dissected from a cohort of 18 MMTV-rtTa;TetO-NeuNT mice in which Her2/neu is overexpressed specifically in the mammary glands. 1H MRS was performed at 400 MHz on a Bruker Avance DMX 400 wide-bore spectrometer. Gene expression levels of associated metabolic enzymes were obtained using qRT-PCR. A tumor metabolism gene expression signature was generated based on these results and used for human association analysis in five microarray datasets from patients with HER2-positive breast cancer.

#### RESULTS

Recurrent mammary tumors displayed higher levels of lactate ( $p=0.009$ ) and glycine ( $p=0.001$ ), lower levels of succinate ( $p=0.009$ ) and phosphocholine (PC) ( $p=0.013$ ), and a higher glutamate:glutamine ratio (glu/gln) ( $p$

#### CONCLUSION

Our results suggest that tumor metabolism evolves during breast cancer progression and raise the possibility that tumor metabolic changes may be useful for predicting clinical outcomes in breast cancer patients.

#### CLINICAL RELEVANCE/APPLICATION

1H MRS could potentially aid in predicting risk of relapse in patients diagnosed with HER2-positive breast cancer. More studies are needed to assess the role of MRS in breast cancer prognostication.

### **VSBR21-15 • Three Dimensional MR Spectroscopic Imaging Using DIXON Imaging for Water Content Correction and Improved Cho Quantification in Breast Cancer**

**Stephan Gruber** MD (Presenter) ; **Lenka Minarikova** ; **Katja Pinker-Domenig** MD ; **Thomas H Helbich** MD \* ; **Wolfgang Bogner** MSC ; **Siegfried Trattng** MD ; **Marek Chmelik** MS

#### PURPOSE

Fat contamination in breast tissue alters measured Cho SNR and consequently, the estimated Cho concentration measured by three dimensional MR spectroscopy (3D-MRSI). We propose a semi-quantitative Cho signal estimation with additional correction to tissue water content for each voxel, using information extracted from Dixon imaging.

#### METHOD AND MATERIALS

#### RESULTS

Average variance of initial Cho signal amplitude from selected voxels was 16.1 and 5.72 before and after correction. In vivo results showed a variance for Cho SNR of 2.05 and 0.256 before and after correction.

#### CONCLUSION

Variations of Cho concentrations in the phantom and in vivo were reduced after correction for fat/water content by a factor of ~3 and ~8, respectively. Furthermore, the influence of the CSI matrix position on Cho SNR in patient's data is minimized. Our method is able to compensate for deviations in matrix positioning (i.e. partial volume effects), which improves quantification of Cho. In this study we have shown that information deriving from Dixon images can be used as a partial water reference for Cho SNR in 3D-MRSI.

#### CLINICAL RELEVANCE/APPLICATION

Semi-quantitative 3D-MRSI based on fat/water-Dixon imaging reduces the variance of Cho signal. This is important for therapy monitoring and to distinguish between malignant and benign lesions.

### **VSBR21-16 • Quantitative Imaging of Breast Cancer: Association between Receptor Status, 18FDG-PET and 3 Tesla MRI Using DWI and 3D-MR-spectroscopy**

**Katja Pinker-Domenig** MD (Presenter) ; **Pascal A Baltzer** MD ; **Heinrich Magometschnigg** ; **Michael Weber** ; **Wolfgang Bogner** MSC ; **Stephan Gruber** MD ; **Georgios Karanikas** MD ; **Zsuzsanna Bago-Horvath** ; **Thomas H Helbich** MD \*

#### PURPOSE

Expression of specific molecular markers such as estrogen receptor (ER), progesterone receptor (PR), and HER2 status assessed by

invasive tissue sampling, has direct prognostic and therapeutic implications in breast cancer (BC) patient management. The aim of this study was to determine whether correlations exist between imaging biomarkers such maximum standardized up-take value (SUVmax) with 18FDG breast PET-CT or apparent diffusion coefficient (ADC) with diffusion weighted imaging and signal-to-noise ratio with 1H MR spectroscopy (MRSI) of the primary breast cancer lesions and IHC derived receptor status.

#### METHOD AND MATERIALS

In this IRB approved prospective study 249 patients with primary BC were included. Before surgery all patients underwent 3T MRI including DWI with ADC measurements in all patients. Cho-SNR obtained by 3D-1H-MRSI was available in 62 cancers. 134 patients underwent 18FDG breast PET-CT and SUVmax of tumors was calculated. Standard immunohistochemistry was performed on a surgical specimen. Appropriate statistical tests were used to test for possible associations among ER, PR, HER2 and imaging biomarkers.

#### RESULTS

#### CONCLUSION

#### CLINICAL RELEVANCE/APPLICATION

Assessment of the non-invasive imaging biomarker SUVmax with 18FDG breast PET-CT can provide valuable information about the state of ER, PR, and HER2 receptors of BC.

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

**Stefania Montemezzi MD (Presenter) ; Francesca Caumo MD ; Iliaria Baglio ; Lucia Camera ; Gabriele Meliado ; Carlo Cavedon DPhil**

#### PURPOSE

The study was aimed at improving the feasibility of total choline (tCho) detection in breast lesions and at estimating sensitivity and specificity of breast 3T-MR spectroscopy (MRS) to aid MR-based diagnosis of malignancy.

#### METHOD AND MATERIALS

141 patients (157 lesions, range 0.05-108.86 cm<sup>3</sup>, mean 6.62 cm<sup>3</sup>) were enrolled (21-84 yrs, mean 58.5 yrs). All patients had breast abnormalities on mammography or sonography, confirmed by cytology and/or micro-biopsy. Single-voxel MRS was performed by means of a Philips Achieva STx 3.0T scanner. First-order pencil-beam shimming was used on a 15.6 cm<sup>3</sup> volume centred on the region of interest (ROI), which ranged 0.34-8.0 cm<sup>3</sup> (mean 1.33 cm<sup>3</sup>). MRS used TE=135ms, TR=3000ms, 128 samples, water (window 140Hz) and fat (SPAIR, offset 80Hz) suppression. When possible, MRS was performed before contrast agent injection and repeated thereafter. Pre-saturation was used to suppress signal from nearby regions. Local field homogeneity was evaluated by means of the FWHM of the unsuppressed water peak. A threshold was placed at 45Hz, above which MRS was not performed due to insufficient field homogeneity. tCho was estimated by means of the signal-to-noise ratio (SNR) of the peak at 3.2 ppm.

#### RESULTS

MRS was feasible in 89.5% of the lesions using pencil-beam shimming (mean FWHM of water peak 34Hz), compared to 54.2% (29Hz) when standard iterative shimming was used (first 80 patients). 59 lesions (52.2% of reliable spectra) showed detectable tCho (SNR 1.4-53.7, mean 8.5). Comparison with available histopathological examination of surgical specimens (or micro-biopsy for benign lesions) showed 87.5% sensitivity and 86.0% specificity. No correlation between lesion volume and SNR of the tCho peak was observed. Malignant lesions that showed no tCho had a volume of 0.7cc or less.

#### CONCLUSION

High-field MR spectroscopy is expected to improve SNR of the investigated metabolites, however field homogeneity is more difficult to achieve compared to 1.5T. The adjustment of the shimming process improved the fraction of cases for which high-field MRS resulted feasible. Further research is warranted to improve choline detectability and to confirm the observed sensitivity and specificity of the method.

#### CLINICAL RELEVANCE/APPLICATION

MRS at 3T could improve the specificity of breast MR. Improving its feasibility is a key factor, however the possible correlation between tCho concentration and malignancy needs further investigation.

### Breast - Monday Posters and Exhibits (12:15pm - 12:45pm)

#### Monday, 12:15 PM - 12:45 PM • Lakeside Learning Center

BR

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#### LL-BRS-MOA • AMA PRA Category 1 Credit™:0.5

Host

Susan P Weinstein, MD

#### LL-BRS-MO1A • Round and Oval Circumscribed Masses Found on Digital Mammography and Ultrasound: Is Biopsy Necessary in Patients without Previous Cancer History or Bloody Nipple Discharge?

**Wei-Shin Wang MD (Presenter) ; Shadie S Majidi MD**

#### PURPOSE

To assess the positive cancer rate of round and oval circumscribed masses found on digital mammography and ultrasound in patients without a current or previous history of cancer or breast atypia and presenting without bloody nipple discharge.

#### METHOD AND MATERIALS

This retrospective study was approved by the institutional review board. Diagnostic mammograms and ultrasounds performed at Indiana University Health hospitals were reviewed from 2004 to 2013. All round and oval circumscribed masses described on diagnostic mammogram and ultrasound were identified. Patient age, breast mass size and palpability, and clinical history data were collected. Pathology results from those that underwent biopsy were reviewed. Patients with a current or previous history of cancer or breast atypia and those presenting with bloody nipple discharge were excluded from analysis.

#### RESULTS

A total of 402 circumscribed masses were biopsied in 393 patients. Seven patients presented with bloody nipple discharge, while eight presented with a current or prior history of cancer or breast atypia. These patients were excluded from analysis. Pathology results from the remaining 387 circumscribed masses demonstrated carcinoma in five patients (3 ductal carcinoma in situ, 1 invasive ductal, 1 adenoid cystic). A single case of phyllodes tumor was also identified. This corresponds to a positive biopsy rate of 1.6%.

#### CONCLUSION

In patients without a current or prior history of cancer and presenting without bloody nipple discharge, short term imaging followup can be considered for patients demonstrating a round or oval circumscribed mass on digital mammography and ultrasound.

#### CLINICAL RELEVANCE/APPLICATION

Potentially expands the criteria for what is considered a BIRADS 3 lesion. May decrease the number of inappropriate breast biopsies.

### LL-BRS-MO2A • Preoperative I-125 Radioactive Seed Localization (I-125 RSL) of Breast Lesions: Impact of Lesion Selection on

## Surgical Margins

**Mark J Dryden MD (Presenter) ; Jamie Wagner DO ; Wei T Yang MD ; Kelly K Hunt MD ; Eric M Rohren MD, PhD \* ; Basak E Dogan MD**

### PURPOSE

To evaluate the impact of lesion selection for RSL procedure on final surgical margins.

### METHOD AND MATERIALS

Our institutional review board approved this HIPAA compliant study. A retrospective review of mammographic (M), ultrasound (US) and ductogram (D)-guided I-125 RSLs performed between 05/16/2012 and 03/06/2013 was performed in a single institution. 73 consecutive RSLs were performed in 70 women prior to segmental mastectomy or excisional biopsy. Procedure time and clinicopathologic data were recorded from the electronic medical records. Seed-to-target distance was measured on pre-operative mammograms, and specimen radiographs reviewed for the presence of the seed and targeted lesion.

### RESULTS

Mean patient age was 59 years (range 40-83). Of the 73 RSLs, 39% were done using M, 60% US, and 1% D guidance. RSL was performed with a single seed in 60 (82%), and 2 or more seeds in 13 (18%) lesions. Median lesion size was 1.7 cm (range 0-5); mean seed-to-target distance 6 mm (range 0-13); and median procedure time was 10 minutes (range:5-60). All seeds and targeted lesions were retrieved. Final pathology revealed negative margins (NM) in 60 (82.1%) and close or positive margins (PM, < 2mm) requiring re-excision in 13 (17.8%). NM were observed in 32/36 (89%) masses, 2/5 (40%) calcifications, 8/11 (73%) masses with calcifications, 3/4 (75%) architectural distortions, and 11/13 (85%) single clips. All 3 focal asymmetries and 1 filling defect were excised with NM. Mean lesion size excised with PM was 2.3 cm, compared to 1.8 cm in NM group. NM was achieved in 48/60 (80%) of lesions localized with a single seed and 12/13 (92%) with multiple seeds. Final surgery type was segmental mastectomy in 69 (98.6%) patients and mastectomy in 1 (1.5%). Complications included seed migration (

### CONCLUSION

RSL is an efficient, effective procedure for localization of non-palpable breast lesions that allows uncoupling of radiology-surgery schedules, with a low incidence of complications and surgical outcomes similar to wire localization. Using multiple seeds for lesions >2cm and calcifications may decrease the risk of PM.

### CLINICAL RELEVANCE/APPLICATION

Radiologists should triage lesions to assess lesion type, lesion size, and number of seeds needed prior to RSL for optimal surgical outcomes.

## LL-BRS-MO3A • Imaging Lymphatic System in Breast Cancer Patients with Magnetic Resonance Lymphangiography

**Qing Lu MD (Presenter) ; Jia Hua ; Jiani Hu**

### PURPOSE

To investigate the feasibility of magnetic resonance lymphangiography (MRL) protocol using a gadolinium (Gd)-based contrast agent (Gd-MRL) for breast patients in a typical clinical setting, and to establish a Gd-MRL protocol and identify potential MRL biomarkers for differentiating metastatic from non-metastatic lymph nodes.

### METHOD AND MATERIALS

Thirty two patients with unilateral breast cancer were enrolled and divided into 4 groups of 8 patients. Groups I, II, and III received 1.0, 0.5, and 0.3 ml of intradermal contrast; group IV received two 0.5 ml doses of intradermal contrast. For Gd-MRL, 3D fast spoiled gradient-recalled echo T1-weighted coronal images with a fat saturation were acquired before and after the administration of Gd-DTPA at different time points. All MRL images were evaluated independently by two radiologists for the number and size of enhanced lymph nodes, lymph node contrast uptake kinetics, lymph vessel size, and contrast enhancement patterns within lymph nodes.

### RESULTS

Group III patients had a statistically significant decrease in the total number of enhanced axillary lymph nodes and lymphatic vessels compared to all other groups. While group IV patients had a statistically significant faster time to reach the maximum peak enhancement than group I and II (about 3 minutes), there was no other statistically significant difference between imaging results between groups I, II, and IV. Using the pattern of enhancement defect as the sole criterion for metastatic lymph nodes in terms of Gd-MRL interpretation and histopathologic results as the gold standard, sensitivity and specificity were estimated to be 86% and 95%, respectively.

### CONCLUSION

Gd-MRL can adequately depict the lymphatic system, and has the potential to differentiate metastatic from non-metastatic lymph nodes in breast cancer patients.

### CLINICAL RELEVANCE/APPLICATION

this study may help establish an effective MRL protocol to differentiate metastatic from non-metastatic lymph nodes in breast cancer patients.

## LL-BRS-MO4A • The Role of MR-Mammography in 'BIRADS-4 Cases'-Can Biopsies Be Avoided?

**Clemens G Kaiser MD, BA (Presenter) ; Julia Krammer MD ; Klaus Wasser MD ; Stefan O Schoenberg MD, PhD \* ; Werner A Kaiser MD, PhD**

### PURPOSE

To evaluate the role of MR-Mammography (MRM) in patients with 'BIRADS 4 cases', i.e. in patients in which conventional assessment (X-Ray or Ultrasound) would otherwise require biopsy.

### METHOD AND MATERIALS

Breast specialists from all over the country were invited to send patients with 'BIRADS- 4' findings in either X-Ray-Mammography or Ultrasound (US) for MRM in our institution. Between 04/2006 and 12/2011 a consecutive total of 1492 women were examined resulting in a study population of 1488 patients after dropout. MRM exams were performed using all morphological and kinetic signs.

### RESULTS

124 patients were diagnosed with malignant diagnoses (cancer or DCIS) by MRM, resulting in 76 true positive and 48 false positive findings after histology. 971 true negative cases and 0 false negative cases were recorded in follow-ups of between 2-5 years. True negative cases were either confirmed by histology upon recommendation of external physicians (18 patients), follow-up by MRM or patient questionnaires over the next 5 years by mail (1737 cases). 393 patients were lost to follow-up. This resulted in a sensitivity of 100%, specificity of 95,2%, positive predictive value of 61,3%, a negative predictive value of 100% and an accuracy of 95,5%. For the calculation of invasive cancers only (without DCIS cases), the results were 63 true positives, 27 false positives for malignant findings, 971 true positives and 0 false positives for benign findings (Sensitivity 100%, Specificity 97,2%, PPV 70 %, NPV 100%, Accuracy 97,5%).

### CONCLUSION

'BIRADS-4' cases in conventional assessment seem to be an adequate indication for high-quality MRM, using all morphological and kinetic signs. At least 88,7% (971/1095) of biopsies could be prevented. However, these results are strongly dependent on reader experience and adequate technical standards as prerequisites for optimal diagnoses.

### CLINICAL RELEVANCE/APPLICATION

'BIRADS-4 cases' in conventional assessment as a new standard indication for MR-Mammography under high quality circumstances reduced the number of biopsies by 88%.

## LL-BRS-MO5A • Accuracy of Tumor Sizing on Breast Tomosynthesis

**Kathryn L Humphrey MD** (Presenter) ; **Pragya A Dang MD** ; **Phoebe E Freer MD** ; **Mansi A Saksena MD** ; **Elkan F Halpern PhD** \* ; **Elizabeth A Rafferty MD** \*

### PURPOSE

Using tomosynthesis discrete spiculations extending from a tumor mass often appear far more prominent than on conventional mammography. Whether these spiculations should be included in the preoperative tumor size remains unclear. This investigation compares the size of newly diagnosed invasive breast cancers on tomosynthesis (with and without inclusion of the tumor spicules) to the size on surgical pathology.

### METHOD AND MATERIALS

This IRB approved study retrospectively reviewed tomosynthesis imaging for 172 invasive breast cancers diagnosed between 3/2011 and 10/2012. The largest tumor dimension was documented with and without inclusion of any associated spicules. These imaging sizes were compared to the true tumor size on surgical pathology. Statistical analysis evaluated whether inclusion or exclusion of the spicules seen on tomosynthesis better predicted the actual tumor size.

### RESULTS

A total of 172 invasive cancers were evaluated (142 invasive ductal carcinomas; 25 invasive lobular carcinomas; and 5 invasive mammary carcinomas). 135 of the tumors presented as a mass on tomosynthesis with 115 having spiculated margins. Average size on tomosynthesis for the 115 spiculated masses was 14.8 mm +/- 10.4 mm when excluding the spicules and 44.4 mm +/- 18.8 mm when including the spicules. The average surgical pathology size for these 115 tumors was 16.9 mm +/- 12.4 mm. There was no significant difference in the imaging and pathologic size when excluding associated spicules (p-value = 0.18); however, when the spicules were included in the imaging measurement, the tumor sizes were significantly different from those found at surgical pathology (p-value = 1.41243 x 10<sup>-29</sup>). The absolute average difference in the measured to true size without inclusion of the spicules was 5.0 +/- 6.4 mm with 65 cases over-measured and 38 cases under-measured. When the spicules were included, the absolute average difference was 27.7 +/- 16 mm with 113 cases over-measured and 2 under-measured.

### CONCLUSION

Measuring the central tumor mass and excluding any associated spicules on tomosynthesis imaging provides a more accurate preoperative estimate of the true tumor size.

### CLINICAL RELEVANCE/APPLICATION

The size of a newly diagnosed breast cancer, as measured on preoperative imaging, plays a significant role in prognosis and treatment planning, driving the need for accuracy.

## LL-BRS-MO6A • Diffusion Weighted Imaging in Mantle Radiated Women: Comparison of Apparent Diffusion Coefficient Values with a Control Group

**Punam Bajaj MD, MBBS** (Presenter) ; **Chiara Iacconi MD** ; **D. David Dershaw MD** ; **Elizabeth A Morris MD**

### PURPOSE

To compare the value of the Apparent Diffusion Coefficient (ADC) of normal breast tissue in high risk women who underwent mantle radiation before ages 30 years and a screening control group, matched for breast tissue density.

### METHOD AND MATERIALS

This was a retrospective analysis of breast MRI examinations performed between 2008 and 2013 of 21 women who were treated with mantle radiation. Based on breast tissue density evaluated on pre contrast T1W fat suppressed sequence, cases were divided into two groups: fatty breasts (n=10) and dense breasts(n=11). A total of 41 breasts were evaluated. One breast with a benign mass lesion in the retroareolar region was excluded. Breast MRI exams in 21 controls, matched for breast tissue density, were compared. Diffusion Weighted Imaging(DWI) with b=0, 1000 was performed for all cases and controls and the ADC maps were evaluated on advantage workstation (GE). ADC value of normal breast tissue were calculated by placement of the region of interest (ROI) in bilateral retroareolar regions. Normal breast tissue was defined as absence of any finding on dynamic MRI (BIRADS-1). Statistical analysis was performed using Mann-Whitney unpaired t test.

### RESULTS

Quantitative DWI study showed that median ADC value of irradiated breasts was lower ( 1.32 x 10<sup>-3</sup>mm<sup>2</sup>/sec) compared to the non-irradiated control group ( 1.63 x 10<sup>-3</sup>mm<sup>2</sup>/sec) ( p value= 0.0004). When matched for breast tissue density, irradiated fatty breasts had lower median ADC value (1.23 x 10<sup>-3</sup>mm<sup>2</sup>/sec) compared to control group (1.54 x 10<sup>-3</sup>mm<sup>2</sup>/sec) (p=0.0018). The irradiated dense breasts also showed a similar, statistically significant, lower median ADC value (1.59 x 10<sup>-3</sup>mm<sup>2</sup>/sec) compared to the controls with dense breasts (1.77 x 10<sup>-3</sup>mm<sup>2</sup>/sec) (p value=0.0435).

### CONCLUSION

Mantle radiated breasts have lower ADC values compared to non-irradiated breasts. This difference in ADC value is independent of the breast tissue density.

### CLINICAL RELEVANCE/APPLICATION

Women who have received mantle radiation have lower ADC values, probably due to post-radiation fibrosis which affects the tissue diffusion.

## LL-BRE-MO7A • Fat Necrosis: The Great Mimicker in Breast Imaging

**Anubha Wadhwa MD** (Presenter) ; **Mary Beth Gonyo MD** ; **Carla J Shah MD** ; **Zainab Basir MD** ; **Kelly M England MD**

### PURPOSE/AIM

Fat necrosis of the breast is a benign inflammatory process which can often mimic breast cancer clinically and radiologically. The aim of this presentation is to discuss and understand the pathogenesis of fat necrosis and its variable presentations on mammography, ultrasound and MRI.

### CONTENT ORGANIZATION

1. Understanding the etiology and pathogenesis of fat necrosis and its correlation with imaging.
2. Clinical presentations of fat necrosis.
3. The varied mammographic presentations of fat necrosis and their evolution.
4. Discuss its sonographic and MR imaging appearances.
5. The postoperative breast: fat necrosis or recurrent tumor? Discuss the evolution of fat necrosis post lumpectomy, accelerated partial breast radiation therapy and flap reconstruction.
6. Management of fat necrosis .

### SUMMARY

Fat necrosis can occur due to any kind of trauma, biopsy, radiation, surgery, breast infection etc. It often poses a dilemma to both radiologists and clinicians. Understanding the pathogenesis and imaging appearances of this condition will help solve some of this dilemma and avoid unnecessary biopsies. Mammography is more specific than ultrasound in its diagnosis. In some cases, MR may be useful in distinguishing fat necrosis from malignancy. An evolution of imaging findings is seen which correlates well with the histology.

## LL-BRE-MO8A • Revisiting Probably Benign Lesions on Mammography, Sonography, and MRI

**Barbara H Bresciani MD (Presenter) ; Luciana P Silveira MD ; Luciano F Chala MD ; Bruna M Thompson MD ; Nestor De Barros MD**

**PURPOSE/AIM**

- Define the concept and the rationale of probably benign assessment - Review probably benign lesions on mammography - Address potential probably benign lesions on sonography and MRI - Discuss the conditions necessary for its correct and safe use

**CONTENT ORGANIZATION**

- Concept of probably benign assessment - Rationale for its use: past, present and new modalities - Probably benign lesions on mammography: case-based review - Potential probably benign lesions on sonography and MRI: case-based review - Address complete lesions workup and correct follow-up: key factors for correct and safe use - Examples of inappropriate use of probably benign assessment.

**SUMMARY**

- Probably benign assessment remains important to reduce the number of biopsies with benign results, especially on sonography and MRI breast cancer screening. - Probably benign assessment applies to a limited number of lesions and its correct use requires a complete workup and appropriate follow-up to prevent that malignant or typically benign lesions are allocated in this assessment. - Use of this assessment on MRI implies additional challenges. On the one hand, it can reduce biopsies with benign results. On the other hand, indiscriminate use can lead to excessive MRI examinations. Therefore, correct selection of the lesions is critical to balance these two opposing demands

**LL-BRE-MO9A • How to Correlate Breast Symptoms with Imaging Findings to Increase Yield of Breast Cancer Detection**

**Shilpa V Lad MD ; Lily Cao MD, PhD (Presenter) ; Jean M Seely MD**

**PURPOSE/AIM**

Review the most common presenting breast symptoms and the appropriate sonographic management for 1. Breast pain or tenderness 2. Palpable lump 3. Nipple discharge 4. Others: enlarging/shrinking breast; nipple/skin changes.

**CONTENT ORGANIZATION**

- ◆ Mastalgia is categorized as cyclic and non cyclic. Less than 1% of women with mastalgia have malignancy. For mastalgia with no other symptoms, role of US is more for patient reassurance than for cancer detection.
- ◆ In patients presenting with a palpable lump, risk of breast cancer varies with age. Fibroadenoma is the most common cause of breast masses in women < 35 year old. Breast mass in > 70 year old woman has >85% incidence of malignancy.
- ◆ Most nipple discharge is physiologic. Spontaneous, unilateral, bloody or clear nipple discharge has a higher association with malignancy.
- ◆ Enlarging breast is most commonly due to mastitis and breast cancer. Shrinking breast is most commonly due to invasive lobular cancer.

**SUMMARY**

Breast pain, palpable mass and nipple discharge are the most common presenting symptoms to breast clinics. We discussed effective ways to triage patients based on symptoms, age group and imaging features to help differentiate benign from malignant lesions, as well as, ways to problem solve in cases of negative findings of ultrasound and persistent breast symptoms.

**LL-BRE1160-MOA • Can Functional Imaging Methods Improve Assessment of Breast Lesions?**

**Almir Bitencourt MD (Presenter) ; Eduardo N Lima ; Elvira F Marques ; Rubens Chojniak MD, PhD ; Juliana A Souza ; Marcos D Guimaraes MD ; Luciana Graziano MD**

**PURPOSE/AIM**

To illustrate and discuss the use of functional imaging methods to improve the assessment of breast lesions.

**CONTENT ORGANIZATION**

Functional Imaging Methods - Definition - Comparison with Conventional Imaging Methods Magnetic Resonance Imaging (MRI) - Dynamic Contrast-Enhancement (DCE) - Diffusion-Weighted Imaging (DWI) - MR spectroscopy - Indications - Limitations 18F-fluorodeoxyglucose (FDG) PET/CT - Dedicated protocol for breast evaluation - Indications - Limitations - PET/MRI fusion Positron Emission Mammography (PEM) - Technique - Advantages - Indications - Limitations - Guided Biopsy - New radiopharmaceuticals

**SUMMARY**

The major teaching points of this exhibit are: - Functional imaging methods show metabolic / biologic alterations in normal breast tissue that may precede anatomic / morphologic alterations that is shown on conventional imaging methods. - MRI can provide functional information through DCE, DWI and MR spectroscopy. - 18F-FDG PET/CT dedicated to breast evaluation can supply important information and allows PET/MRI fusion. - PEM is a promising tool to evaluate small breast lesions and guide biopsy.

**Breast - Monday Posters and Exhibits (12:45pm -1:15pm)**

**Monday, 12:45 PM - 01:15 PM • Lakeside Learning Center**



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**LL-BRS-MOB • AMA PRA Category 1 Credit™:0.5**

**LL-BRS-MO2B • Ultrasound-guided Wire Localization of Mammary Duct Contour Change in the Workup and Treatment of Pathologic Nipple Discharge**

**Benjamin Nulsen (Presenter) ; Christina Wertz MD ; Shabnam Jaffer MD ; Jolinda Mester MD**

**PURPOSE**

To evaluate the role of ultrasound-guided needle localization of a mammary duct in patients who present with pathologic nipple discharge (PND) and otherwise negative clinical and radiologic workup.

**METHOD AND MATERIALS**

A search of our radiology database of ultrasound-guided needle localizations from 2003-2013 was performed using the keywords ◆nipple discharge◆ and ◆duct◆ in either the clinical history and/or radiology report. Any patient with a new positive mammogram or ultrasound finding was excluded. All patients with PND underwent breast sonography with attention to the subareolar region of the symptomatic breast. Those patients in whom a nondilated (< 3 mm) or dilated (> 3 mm) duct was identified in the region of PND subsequently underwent ultrasound guided preoperative needle localization using a 12-5 MHz linear array transducer and a 3 or 5 cm Kopans needle-wire system. The mammographic and sonographic images were reviewed and correlated with the histopathologic findings.

**RESULTS**

Twenty-six cases in 25 patients referred for breast sonography for evaluation of PND met the inclusion criteria. The median age of the patients was 56 (range 31-80). All patients had mammograms with findings that were either negative (BI-RADS 1) or stable benign findings (BI-RADS 2). A single nondilated or dilated duct was identified at the site of PND in 22/26 cases. No intraductal mass was appreciated in any of these cases. Needle localization of the nondilated/dilated duct was successfully performed in the 22 cases in which a single target for localization was identified. The histopathologic results included papilloma (14), cancer (5), ADH (2) and no lesion (1).

## CONCLUSION

The results of our series suggest that ultrasound-guided needle localization of either a nondilated or dilated duct identified in the region of PND can help guide the breast surgeon to the location of an intraductal lesion that is otherwise occult on both mammography and sonography. This approach may serve as an alternative to galactography and conventional blind ductal excision. In our study, imaging occult papilloma was found in 14/22 (63 %) and cancer in 5/22 (23%) of the patients.

## CLINICAL RELEVANCE/APPLICATION

Ultrasound-guided localization of ductal changes provides a reliable alternative to techniques such as galactography and blind ductal excision in the workup and treatment of imaging occult PND.

### **LL-BRS-MO3B • 2D and 3D Contrast Ultrasonography of Breast Lesions: Quantitative and Morphological Vascular Analysis**

**Tomoyuki Ohta** (Presenter) ; **Norio Nakata** MD ; **Yukio Miyamoto** MD ; **Kunihiko Fukuda** MD

## PURPOSE

The purpose of this study was to evaluate the diagnostic value of quantitative analysis and vascular morphology of benign and malignant breast mass lesions using 2D and 3D contrast-enhanced ultrasonography (CEUS).

## METHOD AND MATERIALS

CEUS using perflubutane-based contrast agent (Sonazoid) were performed in 65 pathologically proved palpable breast mass lesions of 63 patients, which were able to depict with B-mode ultrasonography (US). The ultrasound equipments were GE LOGIQ7 and LOGIQ E9 with the linear transducer. CEUS movies in the vascular phase from 0 sec to 50 sec were recorded. The microvascular morphologic and distribution features of breast mass lesions were evaluated with micro flow imaging (MFI). Retrospective quantitative analyses using the time-signal intensity curve (TIC) of CEUS breast lesions were performed in all lesions. Kinetic curves acquired in the first 50 s after the appearance of contrast, were used for statistical analysis. In addition, the wash-in and wash-out patterns of the contrast agent were evaluated by quantitative assessment. In 18 breast lesions, sequential multiphase sweep scans (10-15 sec per sweep) of contrast 2D US images were obtained and 3D images were reconstructed by those manual sensorless parallel CEUS images.

## RESULTS

Surgical pathologic analysis showed 19 benign and 46 malignant lesions. A significant difference was found between the benign and malignant lesions in time-to-peak (P

## CONCLUSION

CEUS is useful in the evaluation of breast mass lesions including benign and malignant tumors.

## CLINICAL RELEVANCE/APPLICATION

CEUS has a great potential to play role of a bridge between conventional B-mode US and MRI in diagnostic breast imaging.

### **LL-BRS-MO4B • Evaluation of Tumor Response to Neoadjuvant Chemotherapy by Diffusion Weighted Imaging (DWI): Do the Biological Characteristics of Breast Cancer Influence Its Assessment?**

**Laura Martincich** MD (Presenter) \* ; **Silvia Carabalona** MD ; **Rita Giada Spinelli** MD ; **Valentina Rossi** ; **Filippo Montemurro** MD ; **Daniele Regge** MD

## PURPOSE

To evaluate if biological characteristics of breast cancer influence the response to neoadjuvant chemotherapy (NCT) assessed by DWI.

## METHOD AND MATERIALS

64 patients with locally advanced breast cancer (stage II with T>3 cm or IIIA/B/C) were treated by taxane-based NCT. DWI was performed before, during (after 2 cycles) and after NCT using 1.5T magnet and 8-channel coil (EPI sequence; b-value 0/900 s/mm<sup>2</sup>; slice thickness 4mm; acquisition time 80s). Apparent Diffusion Coefficient (ADC) value was calculated by tracing a region of interest within the lesion. Responders were defined as subjects achieving pathological complete response (absence of invasive cancer cells) after NCT. ADC value before, during and after NCT was correlated with pathological response, also considering the tumor biological characteristics (steroid receptor and HER2 status).

## RESULTS

## CONCLUSION

DWI is a promising tool to assess the tumor response to NCT. However, tumor biological characteristics influence the ADC value in both Responders and Non-Responders. These differences should be taken into account for a reliable clinical application of DWI (e.g. definition of ADC threshold value) in monitoring the response to primary medical treatments.

## CLINICAL RELEVANCE/APPLICATION

ADC of breast cancer differs on the basis of tumor biological characteristics. This aspect should be considered for a reliable clinical application of DWI (e.g. definition of ADC threshold value) in monitoring the response to NCT.

### **LL-BRS-MO5B • Predicting Tumor Aggressiveness with Breast MRI: Role of Quantitative Diffusion-weighted Imaging (DWI)**

**Giulia Cristel** MD (Presenter) ; **Elena Schiani** MD ; **Claudio Losio** MD ; **Mariagrazia Rodighiero** MD ; **Francesco A De Cobelli** MD ; **Alessandro Del Maschio** MD

## PURPOSE

The aim of our study was to assess whether or not apparent diffusion coefficient (ADC) can be used as a prognostic factor in the pre-operative setting by evaluating the relationship between the ADC values provided by diffusion-weighted imaging (DWI) and the histopathological features of MRI-detected malignant lesions.

## METHOD AND MATERIALS

One-hundred-and-twenty-two patients with breast cancer underwent pre-operative breast MRI at 1.5 T. The protocol included T2-TSE sequences, DWI (b-values: 0 and 900 s/mm<sup>2</sup>) and dynamic study. For each malignant lesion, the ADC value was quantified and compared with histological type, grade and receptor expression (oestrogen receptor [ER], progesterin receptor [PgR], Ki-67, HER-2). Based on these features, the lesions were classified as Luminal-A (LumA), Luminal-B (LumB), HER2-enriched (HER2) and triple-negative (TN). Correlations were analyzed using the Mann-Whitney U and Kruskal-Wallis H tests.

## RESULTS

MRI detected 178 malignant lesions, confirmed by histological analysis (18 in situ, 160 invasive carcinomas). The mean ADC value was significantly lower for invasive than in situ (IS) carcinomas (0.94x10<sup>-3</sup>mm<sup>2</sup>/s vs 1.15x10<sup>-3</sup>mm<sup>2</sup>/s, p

## CONCLUSION

Our study demonstrated that, despite some overlap of ADC values among different cancer subtypes, ADC could be a promising prognostic quantitative parameter inversely associated with histopathological factors.

## CLINICAL RELEVANCE/APPLICATION

Quantitative Diffusion Weighted Imaging is concordant with biological aggressiveness of breast cancer and could be an additional prognostic predictor.

### **LL-BRS-MO6B • Value of Additional Digital Breast Tomosynthesis Combined with Digital Mammography in a Diagnostic Setting**

**Mirinae Seo** MD (Presenter) ; **Jung Min Chang** MD ; **Sun Ah Kim** MD ; **Jihe Lim** MD ; **Won Hwa Kim** MD, MS ; **Su Hyun Lee** MD

#### PURPOSE

To assess the value of adding digital breast tomosynthesis (DBT) to digital mammography (DM) in a diagnostic workup and to compare abilities to detect breast cancer.

#### METHOD AND MATERIALS

#### RESULTS

In the pooled receiver operating characteristic (ROC) analysis, the average AUC for combined DBT and DM was 0.812, significantly higher than that of DBT alone (0.788), and DM alone (0.748), (P<0.05). Among 129 cancers detected, 50 cancers were detected on the combined studies by at least one reader that was missed on DM alone (39 invasive cancers and 11 ductal carcinomas in situ [DCIS]). Multivariate analysis revealed that microcalcifications (odds ratio 17.1) and architectural distortion (odds ratio 12.2) were significantly associated with cancer detection rate, and detection of invasive cancer was more frequent than that of DCIS (odds ratio 6.4).

#### CONCLUSION

Combined interpretation of DBT and DM showed the best diagnostic performance in diagnostic workup, and the addition of DBT to DM increases cancer detection without decreasing the specificity. Cancer detection rate was correlated with image findings and histology in combined studies.

#### CLINICAL RELEVANCE/APPLICATION

Adding DBT to DM improved diagnostic performance in a diagnostic setting. Invasive cancers, lesions with microcalcifications or architectural distortion were more easily detected by the combined study

### **LL-BRE-MO7B • Papillary Lesions of the Breast: Classification, Imaging Aspects and Management**

**Fabiola P Kestelman MD (Presenter)** ; **Clara F Gomes MD** ; **Fernanda B Fontes** ; **Carolina D Conti MD** ; **Marcia Jazbik** ; **Fernanda A Cavallieri MD** ; **Suzana A Cavallieri MD**

#### PURPOSE/AIM

The purpose of this exhibit is: (1) to define histopathologic classification of papillary lesions, (2) to review the spectrum of findings on breast imaging modalities and (3) to discuss the management after percutaneous diagnosis.

#### CONTENT ORGANIZATION

1) Review the pathologic classification of papillary lesions of the breast according to WHO: a) Intraductal papilloma: central, peripheral, atypical papillomas b) Intraductal papillary carcinoma: intracystic papillary carcinoma, papillary intraductal carcinoma c) Invasive papillary carcinoma 2) Pictorial examples of imaging findings in ultrasound, mammography and MRI. 3) Review the literature and discuss the management of nonmalignant papillary lesion diagnosis in percutaneous biopsy.

#### SUMMARY

The appearance of papillary lesions of the breast vary clinically, radiologically, and pathologically. There is a wide spectrum of appearances on imaging, and differentiation of benign from malignant pathologies may be difficult. Tissue sampling is usually necessary. Clinical management on nonmalignant breast papillary lesion diagnosed at percutaneous biopsy is controversial. Literature recommend that atypical papillary lesions undergo surgical excision, although some studies recommend following patients with benign lesions with serial imaging.

### **LL-BRE-MO8B • MRI to the Rescue: Unusual Lesions of the Breast, MRI Features with Mammography, Ultrasonography and Histopathology Correlation**

**Seema Sud MBBS (Presenter)** ; **Tarvinder B Buxi MD** ; **Samarjit S Ghuman MBBS, MD** ; **Ruhani Doda MBBS** ; **Aditi Sud**

#### PURPOSE/AIM

1) To illustrate the technique of performing and analyzing MRI of the breast 2) To depict the imaging findings of rare lesions of the breast on MRI correlated with ultrasonography, mammography and histopathology. 3) Provide clues to arriving at the correct diagnosis on MRI

#### CONTENT ORGANIZATION

1) Breast MRI equipment, sequences and parameters and importance of diffusion weighted imaging 2) Case based reviews of unusual lesions of the breast with mammography, ultrasonography and histopathology correlation -

- Benign Virginal Hyperplasia
- Sarcoidosis
- Tubercular Mastitis
- Focal adenosis
- Paget's disease of the nipple
- Ductal ectasia with periductal mastitis and papillomatosis in male breast
- Intraductal Papillomas with Gynaecomastia and invasive carcinoma in male breast
- Fat necrosis
- Fibroadenolipoma
- Benign and malignant phyllodes tumor
- Inflammatory breast carcinoma
- Colloid carcinoma
- Medullary carcinoma
- Invasive carcinoma with central necrosis
- Lobular carcinoma
- Fibroadenomatoid hyperplasia.

3) Pearls and pitfalls

#### SUMMARY

The major teaching points of this exhibit are:

- A wide variety of unusual pathological conditions may be seen in the breast
- Breast MRI is a powerful tool which can resolve the diagnostic dilemma in many of these cases

### **Case-based Review of Magnetic Resonance: Woman's Imaging (An Interactive Session)**

**Monday, 01:30 PM - 03:00 PM • S100AB**

**MR** **OB** **GU** **BR**

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**MSCM23 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5**

**Director**

**John R Leyendecker, MD**

**MSCM23A • Breast**

**Constance D Lehman MD, PhD (Presenter) \***

**LEARNING OBJECTIVES**

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

**ABSTRACT**

**MSCM23B • Fetal/Placental MRI**

**Keyanoosh Hosseinzadeh MD (Presenter) \***

**LEARNING OBJECTIVES**

1) To describe common indications for referral for fetal MRI of the central nervous system, neck and oral cavity. 2) To describe MRI technique and algorithmic approach for the above indications. 3) To describe the MRI appearance of the placenta, with emphasis on abnormal placentation.

**MSCM23C • Malignancies of the Female Pelvis**

**John A Spencer MD (Presenter)**

**LEARNING OBJECTIVES**

Ovarian cancer continues to present at advanced stage of disease. 1) Typical imaging features of ovarian cancer at presentation. 2) Mimics of disseminated ovarian cancer. 3) The role of image guided biopsy in management. Endometrial cancer, now the most common female genital tract malignancy, usually presents in the post-menopausal woman with vaginal bleeding. 4) How to establish deep myometrial invasion and cervical involvement which may modify the surgical approach Cervical cancer is reducing in incidence in the developed world but still a major killer of young women in the developing world. 5) How to use MR imaging as a staging examination that replaces examination under anaesthetic (EUA). 6) The emerging role of CT-PET in management.

**ABSTRACT**

Ovarian cancer continues to present at advanced stage of disease with peritoneal carcinomatosis (PC). The role of imaging is in determining the cause of PC. If this is felt to result from ovarian cancer the next question is if the extent and sites of disseminated tumour preclude effective cytoreductive surgery. For women beyond this scope or unfit for surgery the management is with primary (neoadjuvant) chemotherapy and the key is to obtain a histological diagnosis. We will first cover: 1. typical imaging features of ovarian cancer at presentation 2. mimics of disseminated ovarian cancer 3. the role of image guided biopsy in management Endometrial cancer, now the most common female genital tract malignancy, usually presents in the post-menopausal woman with vaginal bleeding. Its incidence has increased with obesity in the Western world and to a lesser extent from oestrogenic medications including tamoxifen therapy for breast cancer. Because of the worrying nature of this bleeding most women present early with superficial disease cured by hysterectomy. Deep myometrial invasion increases the risk of lymph node metastases and indicates the need for lymphadenectomy. We will cover: 4. how to establish deep myometrial invasion and cervical involvement which may modify the surgical approach Cervical cancer is reducing in incidence in the developed world but still a major killer of young women in the developing world. Until 2009 the FIGO staging did not include information from MR imaging. Nowadays MR imaging provides the primary staging information with CT-PET considered for all tumours of stage IB2 and above i.e. those confined to the cervix of > 4 cm size and those having breached the cervix. We will cover: 5. how to use MR imaging as a staging examination that replaces examination under anaesthetic (EUA). 6. the emerging role of CT-PET in management. A case-based teaching approach will be used.

**Breast Imaging (MRI Interpretation)**

**Monday, 03:00 PM - 04:00 PM • Arie Crown Theater**



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**SSE01 • AMA PRA Category 1 Credit™:1 • ARRT Category A+ Credit:1**

**Moderator**

**Constance D Lehman, MD, PhD \***

**Moderator**

**Elizabeth A Morris, MD**

**SSE01-01 • Lesion Characteristics, Malignancy Rate, and Follow-up of BI-RADS 3 Lesions Identified on Breast MRI: Implications for MRI Interpretation and Management**

**Sona A Chikarmane MD (Presenter) ; Catherine S Giess MD ; Patricia S Poole MD ; Dorothy A Sippo MD ; Robyn L Birdwell MD**

**PURPOSE**

To 1) evaluate the incidence of BI-RADS 3 assessment in screening and diagnostic breast MRI; 2) review types of findings considered BI-RADS 3; and 3) determine outcomes of BI-RADS 3 studies, including BI-RADS upgrades, downgrades and biopsy results.

**METHOD AND MATERIALS**

IRB approved, retrospective review of breast MRI database (2009-2011) with 5778 studies in 3360 patients, was performed to identify all breast MRIs assigned BI-RADS 3 for one or both breasts. 679/5778 (11.8%) studies had at least one BI-RADS 3 finding. Cases in which initial BI-RADS 3 assessment was given prior to 2009 were excluded. Breast MRI reports and electronic medical record were reviewed to obtain patient demographics and outcome data including tissue diagnosis, imaging and/or clinical stability for at least 24 months, or decrease/resolution during imaging surveillance.

**RESULTS**

570 findings (483 studies) were assigned initial BI-RADS 3 assessment during study period. Indications (n=483) included 257 (53%) high risk screening and 226 (47%) diagnostic studies. BI-RADS 3 lesions (n=570) included mass (171, 30%), focus (141, 24.7%), moderate/marked background parenchymal enhancement [BPE] (131, 23%), NMLE (96, 16.8%), post-treatment changes (18, 3%), and other (13, 2.5%). Outcomes data was available in 508/570 (89%) lesions, including 408 (72%) without imaging evidence of malignancy > 24 months, 29 (5%) prophylactic mastectomy (all benign), and 71 (12%) upgraded to BI-RADS 4, with 11 cancers. Cancer rate for BI-RADS 3 lesions was 2.1% (11/508); all invasive cancers were diagnosed in < 12 months of surveillance and in women with genetic mutation or personal history of breast cancer. Cancer morphology (n=11) included mass (3, 27%), focus (4, 36.5%), and ductal or linear NMLE (4, 36.5%). No cancer was detected in cases of moderate/marked BPE.

**CONCLUSION**

Approximately 12% of breast MRI studies had findings assessed as BI-RADS 3, with a 97.9% negative predictive value for cancer. Although it may interfere with cancer detection, marked diffuse background enhancement does not require a BI-RADS 3 assessment. Strict adherence to the BI-RADS lexicon may reduce inappropriate BI-RADS 3 assessments for lesions with more suspicious imaging findings.

**CLINICAL RELEVANCE/APPLICATION**

In a population with an elevated breast cancer risk, breast MRIs assigned BI-RADS 3 assessment had an acceptably low cancer rate which may be further reduced by careful adherence to BI-RADS lexicon.

### **SSE01-02 • Probably Benign Lesions Detected at Dynamic Contrast Enhanced Breast MRI: Prevalence of BIRADS III Diagnoses and Malignancy Rate**

**Yunus Alparslan** (Presenter) ; **Simone Schradig** MD ; **Christiane K Kuhl** MD \*

#### **PURPOSE**

Aim of this study was to analyze the malignancy rate of MRI-BIRADS III lesions.

#### **METHOD AND MATERIALS**

Between 06-2010 and 12-2011 a total of 3154 breast MRI studies were performed at our institution. Among those 107 MRI studies in 107 patients (3.4%) were rated as MR-BIRADS III and were further analyzed. The time interval between the initial MRI and the follow-up examination, BIRADS category in the follow-up study and histologic results of possible biopsies were recorded to calculate the malignancy rate of BIRADS 3 lesions.

#### **RESULTS**

Follow up MRI was performed in 87% (93/107) of the 107 patients after a mean time interval of 10 month (median 9.6, range [4;25]). At this follow up exams MR-BIRADS 3 lesions were stable or regressive and downgraded to BIRADS 1/2 in 96% (89/93). MR-guided biopsy was performed by patients request in 7 of these stable lesions. All of these yielded benign changes at histology, including 2 papillomas. Four MR-BIRADS III lesions were progressive (4%) and upgraded to MR-BIRADS IV in the follow up exam. All of those underwent MR-guided vacuum biopsy. Histology revealed an invasive lobular carcinoma (pT1b, 0.7 cm, pN0 (0/2sn), G2) in one, borderline lesions in two patients (atypical ductal hyperplasia and papilloma) and benign changes in one patient (adenosis). Accordingly the malignancy rate of MR-BIRADS III lesions was 1.1% (1/93).

#### **CONCLUSION**

In concordance with prior studies the malignancy rate of MRI findings categorized as MR-BIRADS III is low. MR-follow up is a valid approach in the management of these lesions.

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

The malignancy rate of MR-BIRADS III lesions is low. To avoid early invasive tissue sampling, the observation with short-term MR-follow up is a valid approach in the management of these lesions.

### **SSE01-03 • Can Breast Cancer Molecular Subtype Help Select Patients for Preoperative MRI?**

**Lars J Grimm** MD (Presenter) \* ; **Mary Scott Soo** MD ; **Jay A Baker** MD \* ; **Karen S Johnson** MD \*

#### **PURPOSE**

To determine whether breast cancer molecular subtype can help predict which patients will benefit from preoperative breast MRI.

#### **METHOD AND MATERIALS**

305 consecutive preoperative breast MRIs were retrospectively reviewed. Patients with prior breast cancer therapy or surgery were excluded. The presence of multicentric/multifocal disease, contralateral disease, skin/nipple involvement, chest wall/pectoral muscle invasion, and lymph node involvement was correlated with the pathology report. Estrogen receptor (ER), progesterone receptor (PR), and human epidermal growth factor receptor-2 (HER2) status were recorded from the pathology report. Molecular subtypes were defined as luminal A (ER+ and/or PR+, HER2-), luminal B (ER+ and/or PR+, HER2+), HER2 (ER- and PR-, HER2+), and basal (ER-, PR-, and HER2-). MRI findings that could potentially alter clinical management were correlated with molecular subtypes.

#### **RESULTS**

The 305 cases were classified as 202 (66.2%) luminal A, 33 (10.8%) luminal B, 17 (5.6%) HER2, and 53 (17.4%) basal subtype. Multicentric/multifocal disease was significantly more commonly ( $p=0.015$ ) detected by MRI in luminal B (16/33, 48.5%) and HER2 (10/17, 58.8%) subtypes, compared to luminal A (62/202, 30.7%) or basal (13/53, 24.5%) subtypes. Compared to luminal A subtype, preoperative MRI was 2.1 ( $p=0.049$ , 95% confidence interval [95% CI], 1.0-4.5) and 3.2 times ( $p=0.022$ , 95% CI, 1.2-9.3) more likely to detect multicentric/multifocal disease in luminal B and HER2 subtypes respectively. Although there was no significant difference ( $p=0.167$ ) between lymph node involvement among all groups, luminal B (14/33, 42.4%) subtype was 2.4 times ( $p=0.026$ , 95% CI, 1.1-5.2) more likely to have lymph node involvement than luminal A (47/202, 23.3%) subtype. There was no significant difference in contralateral disease, skin/nipple involvement, or chest wall/pectoral muscle invasion between subtypes.

#### **CONCLUSION**

Preoperative breast MRI is significantly more likely to detect multicentric/multifocal disease in luminal B and HER2 molecular subtype breast cancer, while lymph node involvement is more commonly detected in luminal B than luminal A molecular subtype breast cancer.

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

Breast cancer molecular subtypes could help tailor utilization of pre-operative breast MRI.

### **SSE01-04 • Does Breast Biopsy Affect Lesion Enhancement Characteristics or Accuracy of Tumor Measurement on MRI?**

**Nikki Tirada** MD (Presenter) ; **Anjeza Chukus** MD ; **Stuart S Kaplan** MD \*

#### **PURPOSE**

The objective of this study is to determine the effect ultrasound, stereotactic, and MRI-guided biopsy may have on lesion morphology, size measurement, and qualitative and quantitative dynamic kinetic features. It is our hypothesis that inflammatory changes and possible tumor burden reduction related to biopsy will alter tumor appearance on MRI. Discordance in imaging characteristics can lead to inaccuracy of size measurement and tumor extension, which could have significant impact on surgical and treatment planning.

#### **METHOD AND MATERIALS**

A retrospective review of patients who had contrast-enhanced Breast MRI performed either before or after biopsy of a suspicious lesion between January 2010 and January 2013 were included in the study. Patients who had neo-adjuvant chemotherapy prior to MRI were excluded. Imaging characteristics evaluated include time-signal intensity curve and changes in degree of enhancement were evaluated. In patients who also underwent surgical excision, the size of tumors measured on MRI was compared with pathology measurement. Using a paired Student's t test, differences were considered significant where  $P < 0.05$ . Approval for this study was obtained from Mount Sinai Medical Center Institutional Review Board.

#### **RESULTS**

To date, we have identified 36 eligible patients. The mean age was 58.2 years. 8 of 36 lesions (22%) demonstrate changes in enhancement pattern after biopsy: 3 lesions (8.3%) with homogenous washout kinetics became heterogeneous, 3 lesions (8.3%) with homogenous washout became persistent, 1 lesion (2.8%) with progressive curve became plateau, and 1 lesion (2.8%) with plateau became indeterminate (hematoma cavity). There was no significant difference between radiologic and pathologic size of the tumor (2.47 vs 2.31;  $P = 0.69$ ).

#### **CONCLUSION**

Breast biopsy leads to changes in enhancement pattern but does not significantly impact the accuracy of diagnosis or tumor size measurement.

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

Breast MRI is frequently performed after the diagnosis of breast cancer has been established. Therefore, it is important to assess any

potential effect prior biopsy may have on imaging characteristics

## SSE01-05 • Breast MRI Background Parenchymal Enhancement and Tumor Characteristics

**Janice S Sung MD (Presenter) ; Jennifer Brooks PhD ; Valencia King MD ; Jennifer B Kaplan MD ; Eve Burstein ; Mark E Robson MD \* ; Jonine L Bernstein ; Malcolm Pike ; Elizabeth A Morris MD**

### PURPOSE

To examine the relationship between fibroglandular tissue (FGT) and background parenchymal enhancement (BPE) on MRI and histopathological and immunohistochemical features of breast cancers.

### METHOD AND MATERIALS

IRB approved retrospective review identified 712 women diagnosed with unilateral invasive ductal breast carcinoma consecutively between February 2008 to February 2011 who had a pre-treatment MRI of the unaffected breast, were not taking hormonal medications, and did not have a prior history of breast cancer. Women with unknown menopausal status or with tumors with unknown receptor status or tumor grade were excluded (N=51). Clinicopathologic data was obtained from the electronic medical records. Two breast imaging radiologists blinded to clinical data independently assessed BPE and FGT using BI-RADS criteria. Odds ratios (OR) and 95% confidence intervals (CI) were generated using logistic regression models adjusting for age, menopausal status and body mass index.

### RESULTS

Of 661 tumors, 522 (79%) were estrogen receptor positive (ER+), 491 (74%) progesterone receptor positive (PR+) and 117 (18%) human epidermal growth factor receptor positive (HER2+). Women with dense breasts (heterogeneously/extremely dense) were more likely to have ER+ (OR=1.6, 95% CI 1.0, 2.5, p=0.05) or PR+ tumors (OR=1.7, (1.1, 2.7), p=0.01) compared to women with less dense breasts (predominantly fatty/scattered fibroglandular densities). Women with dense breasts were less likely to have triple negative breast cancer compared to luminal A (OR=0.5, (0.3, 0.8), p=0.008). No association between these factors and BPE was observed. Results did not differ when stratified by menopausal status.

### CONCLUSION

FGT on MRI is associated with an increased likelihood of having ER+ and PR+ breast cancer, which is consistent with some studies that have shown a similar association between mammographic density and ER+ disease. No association between BPE and subtype was observed.

### CLINICAL RELEVANCE/APPLICATION

FGT on MRI may be a much greater risk factor specific to ER/PR+ disease. Although BPE has been shown to be a breast cancer risk factor, this appears to be independent of subtype.

## SSE01-06 • Prepectoral Edema as a Morphological Sign in MR-mammography

**Clemens G Kaiser MD, BA (Presenter) ; Michael Herold ; Julia Krammer MD ; Matthias Dietzel MD ; Pascal A Baltzer MD ; Klaus Wasser MD ; Stefan O Schoenberg MD, PhD \* ; Werner A Kaiser MD, PhD**

### PURPOSE

Morphological and kinetic signs of breast lesions contribute to diagnosis and differential diagnosis in MR-Mammography. Prepectoral edema in patients without any history of previous biopsy, operation, radiation or chemotherapy has been detected as a new diagnostic Sign during clinical routine. The purpose of this study was to evaluate the role of this morphological sign in the differential diagnosis of breast lesions.

### METHOD AND MATERIALS

Between 11/2001 and 10/2006 a total of 1109 MRM exams have been performed in our institution. Patients had no previous operation, biopsy, intervention, chemotherapy, hormone replacement therapy or previous mastitis. 162 patients with 180 lesions were included and histologically correlated by operation (124 patients / 136 lesions) or corebiopsy (38 patients / 44 lesions) in our hospital. The evaluations were performed by 4 experienced radiologists in consensus.

### RESULTS

180 evaluated lesions included 104 malignant lesions (93 invasive; 11 non-invasive cancers) and 76 benign lesions. The prepectoral edema Sign was seen in 2.6 % of benign lesions (2/76), none of the DCIS-cases (0/11) and 25.8 % of malignant lesions (24/93). Prepectoral edema were found significantly more frequently in poorly-differentiated cancers [(33.9 %; 19/56 vs. 13.9 % (5/36)] as well as in presence of lymphangiosis [(53.8 %; 14/26) vs. (9.8 %; 4/41)], positive lymphnodes [(44.4 %; 12/27) vs. (19.4 %; 12/62)], size of tumor above 2 cm [(47.1 %; 16/34) vs. (13.8 %; 8/58)], pectoralis infiltration [(80.0 %; 4/5) vs. (22.7 %; 20/88)], presence or absence of prominent vessels [(44.4 %; 20/45) vs. (8.3 %; 4/48)] and the presence of the hook sign [(60.9 %; 14/23) vs. 14.5 %; 10/69]. The prepectoral edema Sign was not statistically associated to tumor-type, presence or absence of additional DCIS, receptor status, number of lesions, margin, form, enhancement pattern and curve-type.

### CONCLUSION

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

### CLINICAL RELEVANCE/APPLICATION

Perifocal edema is a very powerful sign towards malignancy in the differential diagnosis of breast lesions in MR-Mammography.

## Breast Imaging (Digital Breast Tomosynthesis Lesions)

Monday, 03:00 PM - 04:00 PM • E450A

DM BR

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SSE02 • AMA PRA Category 1 Credit™:1 • ARRT Category A+ Credit:1

### Moderator

**Liane E Philpotts, MD \***

### Moderator

**Per Skaane, MD, PhD \***

## SSE02-01 • Digital Breast Tomosynthesis (DBT) and Breast Magnetic Resonance Imaging (MRI): Additional Roles as Compared to Conventional Digital Mammography (DM) in Assessment of Breast Disease

**Dalia S El Mesidy MBBCh, MSc (Presenter) ; Rasha M Kamal MD ; Sahar Mansour MD ; Ahmed H Khalil MSc, MD**

### PURPOSE

To assess the additional role of DBT and MRI in comparison to conventional DM in the characterization of different breast lesions and to evaluate their impact on diagnosis and consequent management.

### METHOD AND MATERIALS

55 patients, having 60 breast lesions were referred from the Surgery clinic to the Radiology Department to be assessed by DM, DBT and MRI. An informed written consent to participate in the study was obtained from all patients. Breast US was performed for all cases. Mammography images were acquired using the 'combo mode', a feature that acquires both a DM and a DBT scan in the same compression. MRI was performed using a 1 T system. Each lesion was assigned a blinded BIRADS score for each modality (DM, DBT and

MRI) individually by different readers blinded to each other benign, and BIRADS scores of 1-3 were considered benign, and BIRADS scores of 4 and 5, were considered malignant. The resultant BIRADS scores for each modality were correlated with reports of pathology specimens.

## RESULTS

The sensitivity for DM was 87% and those of DBT and MRI were equivalent to 93.75%. The specificity for DM was 50%, that for DBT was 84.1% and that of MRI was 86.36%. The PPV of DM was 38.89%, that of DBT was 68.18% and that of MRI was 71.43%, whereas the NPV of DM was 91.7% and that of each of DBT and MRI was 97.4%. The efficacy of DM was 60%, that of DBT was 86.7% and that of MRI was 88.3%. Association between DM, DBT and MRI finding results and the final diagnoses revealed highly significant correlation, having p-values of 0.009 for DM and 0.001 for each of DBT and MRI. Association between the results of DM and those of DBT showed that DBT had a statistically significant higher diagnostic value for diagnosing breast lesions than DM, having a p-value of 0.005. However, the association between the results of DM and those of MRI showed that there is no statistically significant difference between DM and MRI, with a p-value of 0.422. The association between the results of DBT and those of MRI showed that there is a statistically significant difference between DBT and MRI for diagnosing breast lesions, with a p-value of 0.043.

## CONCLUSION

Both MRI and DBT showed better performance than did DM. Both can add a lot to the information gained for better diagnosis and prompt management of breast lesions.

## CLINICAL RELEVANCE/APPLICATION

Both DBT and MRI are better than DM in detecting or excluding breast cancer, specially in cases with dense breasts.

### **SSE02-02 • Comparative Study with Digital Mammography (DM) vs. DM Combined with Digital Breast Tomosynthesis (DBT) for the Detection of Invasive Lobular Carcinoma (ILC)**

**Giovanna Mariscotti ; Manuela Durando (Presenter) ; Laura Martincich MD \* ; Enrica Caramia ; Pier Paolo Campanino ; Andrea Luparia ; Laura Bergamasco ; Paolo Fonio ; Giovanni Gandini MD**

## PURPOSE

To compare the diagnostic performance of DM with that of DM combined with DBT for the detection of ILC.

## METHOD AND MATERIALS

We conducted a retrospective multi-reader blinded study, including 6 radiologists with experience of breast imaging ranging between 15 and 4 years and DBT experience ranging between 4 years and no experience (inexperienced readers underwent a DBT training session prior to the study). The radiologists interpreted 56 examinations of women (mean age 59.4 years, range 40-78) with 68 newly diagnosed ILCs, proved at definitive histology (tumours mean size 30.1 mm; range 5-95). All women, who signed an informed consent, underwent mammographic bilateral two standard views in Combo mode: DM and DBT images were acquired within a single compression for each projection. The readers, blinded to histology, were asked to primarily detect lesions in 2D images alone, reporting in previously predisposed modules breast density, mammographic signs with BI-RADS category, localization and size of lesions; then, they were asked to detect lesions by viewing DBT images in conjunction with 2D images, reporting the same parameters. Two experienced radiologists, non-participants in the study, compared the results of each reader to pathology. A statistical analysis was performed to evaluate performances and inter-observer agreement.

## RESULTS

All 6 readers had a significantly higher sensitivity for detection of ILC by using DM combined with DBT (ranging between 84-91%) than DM alone (77-80%) ( $p=0.0002$ ). There was no significant difference ( $p=0.29$ ) in specificity values (DM alone 56.6-92.3%, DM combined with DBT 69.2-92.3%). The diagnostic accuracy was higher considering DM combined with DBT (ranging between 80.3-91.4%) than DM alone (69.2-85.5%) ( $p=0.0029$ ). Considering breast density, for the readers the relative risk to miss a ILC in dense breasts (30/56) by using DM alone compared to DM with DBT was 2.0 (1.3-3.3) ( $p=0.0007$ ) (i.e. a 100% increase in the probability of missing the cancer). In the no dense breasts (26/56), there were no significant differences ( $p=0.34$ ).

## CONCLUSION

The addition of DBT significantly increased sensitivity and diagnostic accuracy of DM in detecting ILCs, especially in dense breasts.

## CLINICAL RELEVANCE/APPLICATION

The use of Digital Breast Tomosynthesis in addition to Digital Mammography (DM) improve diagnostic performances of DM and could be helpful in detecting Invasive Lobular Carcinomas.

### **SSE02-03 • Comparison of Lesion Detection and Characterization in Invasive Cancers Using Breast Tomosynthesis versus Conventional Mammography**

**Pragya A Dang MD (Presenter) ; Kathryn L Humphrey MD ; Phoebe E Freer MD ; Elkan F Halpern PhD \* ; Mansi A Saksena MD ; Elizabeth A Rafferty MD \***

## PURPOSE

To compare tomosynthesis to conventional mammography for detection and characterization of biopsy proven invasive cancers.

## METHOD AND MATERIALS

In this IRB approved, HIPAA compliant study, 172 biopsy proven invasive breast cancers (142 Invasive ductal carcinoma-IDC, 25 Invasive lobular carcinoma-ILC, and 5 invasive mammary carcinoma; age range: 35-91 years), consecutively accrued prior to biopsy between 3/2011 and 10/2012 and imaged with combined tomosynthesis-mammography were retrospectively reviewed. The visibility (rated on 5-point scale) and morphology (shape and margins) of each cancer on 2 view tomosynthesis and 2 view mammography images were recorded.

## RESULTS

The visibility scores for IDC with tomosynthesis and mammography were 3.4+/-1.1 and 2.6+/-1.2, respectively, and for ILC were 3.2 +/- 0.9 and 2.3 +/- 1.2, respectively; significantly higher for tomosynthesis compared to conventional mammography ( $p < 0.0001$ ) for all cancers. 16% (28/172) cancers (20% ILC and 16% IDC) were occult on mammography, whereas 3% (5/172) cancers were occult on tomosynthesis. Common presentations of cancers on tomosynthesis were irregular spiculated masses (61%, 105/172), architectural distortion (12%, 20/172), and lobulated circumscribed masses (8%, 13/172). Of the cancers presenting as architectural distortion on tomosynthesis, 50% (10/20) were occult on conventional mammography and 20% (4/20) were characterized as asymmetry or focal asymmetry on conventional mammography. Cancers presenting as architectural distortion on tomosynthesis had a disproportionately higher percentage of ILCs (20%). Of the irregular spiculated masses on tomosynthesis, 10% (11/105) were occult, 33% (35/105) characterized as asymmetries or focal asymmetries, and only 32% (34/105) definitively characterized as irregular spiculated masses on conventional mammograms. No invasive cancers were characterized as round or oval circumscribed masses on tomosynthesis. Of the cancers occult on tomosynthesis, 1(20%) was visible as an asymmetry on mammography.

## CONCLUSION

Tomosynthesis was significantly better than conventional mammography on detecting cancers particularly those presenting as architectural distortion as well as characterizing cancer morphology.

## CLINICAL RELEVANCE/APPLICATION

Identification of mammographically occult cancers and more accurate depiction of tumor morphology with tomosynthesis may allow formulation of a better assessment of the lesion on initial imaging.

### **SSE02-04 • Tomosynthesis in Breast Cancer Visualization as a Function of Mammographic Density**

**Reni S Butler MD (Presenter) ; Reynolds Ostrover ; Regina J Hooley MD \* ; Jaime L Geisel MD ; Madhavi Raghu MD \* ; Liane**

## **E Philpotts MD \***

### **PURPOSE**

To evaluate the effectiveness of digital breast tomosynthesis in the visualization of non-calcification breast cancers as a function of breast density

### **METHOD AND MATERIALS**

Upon IRB approval, all cancers diagnosed from 10/3/2011 through 1/16/2013 were reviewed. Of these, 186 cancers in 159 patients were imaged with tomosynthesis in combination with 2D mammography. Cancers presenting with calcifications as the only mammographic finding were excluded, leaving a total of 155 cases. Images were evaluated by 7 breast radiologists and classified into five categories: ♦Only Seen on Tomosynthesis♦, ♦Better Seen on Tomosynthesis♦, ♦Equally Well Seen on Both♦, ♦Better Seen on 2D♦, and ♦Only Seen on 2D♦. The breast density, type of mammographic finding, clinical presentation, and cancer histology were recorded.

### **RESULTS**

Patients with scattered and heterogeneously dense breasts had the highest percentage of cancers seen only with tomosynthesis, with 15.4%(10/65) and 14.0%(6/43), respectively, compared to only 5.9%(1/17) of patients with extremely dense breasts and 0%(0/30) of patients with fatty breasts. The scattered and heterogeneously dense breast categories also had the highest percentage of cancers seen better on tomosynthesis with 52.3%(34/65) and 55.8%(24/43), respectively, while the fatty breast category had the lowest percentage (13.3%,4/30). The extremely dense category had 35.3%(6/17) of cancers seen better with tomosynthesis. Finally, patients with fatty breasts and extremely dense breasts had the highest percentage of cancers seen equally well on tomosynthesis and 2D mammography, with 86.7%(26/30) and 58.8%(10/17), respectively, in contrast to 32.3%(21/65) and 30.2%(13/43), respectively, in the scattered and heterogeneously dense categories.

### **CONCLUSION**

Tomosynthesis imaging is particularly beneficial for visualizing non-calcification breast cancers in patients with scattered and heterogeneously dense breasts, with 67.7%(44/65) and 69.8%(30/43), respectively, of cancers in these categories seen only or better with tomosynthesis. Patients with fatty and extremely dense breasts are more likely to have cancers seen equally well on tomosynthesis and 2D mammography.

### **CLINICAL RELEVANCE/APPLICATION**

As tomosynthesis becomes more widely utilized, it is pertinent to understand its relative benefit in different groups of patients.

## **SSE02-05 • Role of Digital Breast Tomosynthesis (DBT) Combined with Digital Mammography (DM) in Second-look (SL) for the Evaluation of Additional Lesions Detected on Preoperative Breast Magnetic Resonance Imaging (MRI): Preliminary Experience**

**Giovanna Mariscotti ; Manuela Durando (Presenter) ; Mirella Fasciano ; Giulia Schivazappa ; Davide Bosco ; Elisa Regini ; Chiara Ruggieri ; Paolo Fonio ; Giovanni Gandini MD**

### **PURPOSE**

To review our institutional experience in using DBT as SL in the evaluation of additional enhancing lesions identified on preoperative breast MRI.

### **METHOD AND MATERIALS**

From June 2009 to January 2013, 520 patients with breast cancers detected on DM and ultrasound (US) and confirmed by cytology/histology underwent preoperative MRI. In 114 patients, MRI detected 164 additional lesions: all the patients underwent SL US who identified 114/164 (69.5%) MRI additional lesions. 50/164 (30.5%) lesions not seen on US underwent SL DM+DBT (the patients, who signed an informed consent, had mammographic two standard views in Combo mode (DM and DBT acquisition within a single compression) on the interested breast). Subsequently to SL DM+DBT, re-targeted US evaluation was performed. Focusing on SL DM+DBT, we compared morphological features, size and BI-RADS-MRI classification of additional MRI findings and DBT lesions features. Suspicious additional lesions were confirmed by percutaneous biopsy or surgical excision. Imaging follow-up (range 6-12 months) was used for probably benign lesions, not biopsied.

### **RESULTS**

SL DM+DBT identified 32/50 (64%) of MRI additional lesions (mean size 10.2±6.2 mm), of which 28/50 (56%) were classified as BI-RADS-MR4 and 22/50 (44%) as MR3. Considering the MRI morphological features of the 32 lesions depicted by SL DM+DBT, 15/32 (46.9%) were non mass-like, 9/32 (28.1%) mass-like and 8/32 (25%) foci. At SL DM+DBT, lesions were 13/32 (40.6%) small masses, 8/32 (25.0%) asymmetric densities with microcalcifications and 11/32 (34.4%) architectural distortions. Of these lesions, 24/32 were subsequently detected on re-targeted US and biopsied under US guidance if suspicious (8/24, 33.3% were cancer). 8/32 lesions were detected only by SL DM+DBT and biopsied under stereotactic guidance if suspicious (2/8, 25% were cancer). Of the 18/50 additional lesions not identified by SL DM+DBT, 2/18 were MR4 (underwent MRI-guided biopsy, resulting atypical ductal hyperplasia) and 16/18 MR3 (all cases sent to follow-up, resulting disease-free).

### **CONCLUSION**

Second-look DM+DBT was helpful in the clinical work-up of additional lesions detected on preoperative breast MRI, particularly for non mass-like enhancement.

### **CLINICAL RELEVANCE/APPLICATION**

In our preliminary experience, the clinical work-up of the additional enhancing lesions detected on preoperative breast MRI was implemented by second-look with Digital Breast Tomosynthesis.

## **SSE02-06 • Digital Breast Tomosynthesis in Diagnostic Mammography: Can Tomo Affect the Final Assessment Categories?**

**Madhavi Raghu MD (Presenter) \* ; Regina J Hooley MD \* ; Liane E Philpotts MD \* ; Jaime L Geisel MD ; Melissa A Durand MD ; Liva Andrejeva-Wright MD ; Laura J Horvath MD ; Reni S Butler MD**

### **PURPOSE**

To evaluate the rates of BI-RADS final assessment categories, in diagnostic patients undergoing tomosynthesis versus those undergoing 2D mammography with particular attention to BI-RAD3.

### **METHOD AND MATERIALS**

A retrospective review of all diagnostic patients over two six month intervals before (Jan-June 2011) and after (Aug 2012-Jan 2013) the implementation of tomosynthesis was performed. The percentage of mammograms categorized as BI-RADS 1-5 was determined. Particular attention was given to BI-RADS 3 and the reasons including asymmetries, calcifications, masses or architectural distortion were evaluated and compared between the two groups.

### **RESULTS**

In the first interval, 2850 diagnostic mammograms were performed. Of these patients, 914 patients were categorized as BI-RADS 3(32%), 1670 patients as BI-RADS 1 or 2(59%), 179 patients as BI-RADS 4(6.3%) and 24 patients categorized as BI-RADS 5(0.8%). The 914 patients in the BI-RADS 3 category had 977 findings: asymmetries 363(37%), calcifications 398(40%), masses 201(21%) and architectural distortion 15(2%). In the second interval, 2761 diagnostic mammograms were performed, of which 2036 patients underwent tomosynthesis. Of these patients, 563 patients were categorized as BI-RADS 3(27.6%), 1315 patients as BI-RADS 1 or 2(64.6%), 153 patients as BI-RADS 4(5.8%) and 35 patients as BI-RADS 5(1.7%). The 563 BI-RADS 3 patients had 602 findings: asymmetries 186(31%), calcifications 245(41%), masses 158(26%) and architectural distortion 14(2%). The BI-RADS 3 rate decreased from 35% in the pre-tomo group to 27% in the post-tomo group (p

### **CONCLUSION**

The use of tomosynthesis in diagnostic patients resulted in a significant decrease in the rate of BI-RADS 3, particularly for masses and

asymmetries with a concomitant significant increase in the rate of BI-RADS 1/2 and 5.

#### CLINICAL RELEVANCE/APPLICATION

Tomosynthesis use in diagnostic mammography can reduce the number of patients categorized as BI-RADS 3 requiring follow up.

### Special Interest Session: Breast Density: Risk Assessment, Communication, and Approaches to Supplemental Imaging

Monday, 04:30 PM - 06:00 PM • E451A

BR

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**SPSI24** • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

#### Moderator

**Robert A Smith**, PhD  
**Martin J Yaffe**, PhD \*  
**Jennifer A Harvey**, MD \*  
**Wendie A Berg**, MD, PhD \*

#### LEARNING OBJECTIVES

1) Describe the current advocacy movement promoting state and federal requirements to report details about breast density, risks associated with breast density, and supplemental imaging options on mammography reports. 2) Understand the association of breast density and the risk of developing breast and the risk of poorer outcomes on screening mammography. 3) Describe the methods for assessment of mammographic density. 4) Describe the strengths and limitations of the different options for supplemental imaging in women with dense breast tissue. 5) Articulate the potential benefits, limitations, and harms associated with supplemental imaging in women with varying degrees of breast density.

### BOOST: Breast-Anatomy and Contouring (An Interactive Session)

Tuesday, 08:30 AM - 10:00 AM • S103CD

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**MSRO34** • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

#### Co-Director

**Fergus V Coakley**, MD  
**Bruce G Haffty**, MD  
**Reni S Butler**, MD  
**Nina A Mayr**, MD

#### LEARNING OBJECTIVES

1) Gain an understanding of the staging of breast cancer and appropriate imaging and diagnostic studies used in the staging of breast cancer focusing on nodal evaluation. 2) Gain an understanding of the various breast imaging techniques, controversies, emerging technologies and future directions in the imaging of breast cancer, focusing on nodal evaluation. 3) Gain an understanding and appreciation of identifying and contouring nodal target volumes and radiation management of regional nodes. 4) Gain an understanding of the controversies regarding nodal evaluation and management in the current era of neoadjuvant systemic therapy and sentinel nodal evaluation.

#### ABSTRACT

The management of breast cancer has undergone rapid evolution with the increased utilization of neoadjuvant systemic chemotherapy and hormonal therapy, and increased utilization of sentinel nodal evaluation. These issues have impacted on both the imaging and radiotherapeutic management of breast cancer, particularly with respect to the evaluation and management of the regional lymphatics. During this 90-minute session a diagnostic radiologist and radiation oncologist will provide an overview of the principles of staging, radiographic imaging and radiotherapeutic contouring and considerations in the management of breast cancer, focusing on nodal evaluation and management. The speakers will review AJCC staging, controversies regarding imaging and staging studies in the evaluation of patients with breast cancer, and provide an overview of contouring of target and normal tissue structures and radiation field considerations in the management of breast cancer with special attention to imaging, contouring and management of the regional lymphatics in the setting of primary management, evaluation after neoadjuvant therapy, and in the setting of local-regional relapse. In this session, special attention will be given to current and evolving approaches to regional nodal evaluation and management.

### Breast Series: Emerging Technologies in Breast Imaging

Tuesday, 08:30 AM - 12:00 PM • Arie Crown Theater

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**VSB31** • AMA PRA Category 1 Credit™:3.25 • ARRT Category A+ Credit:4

#### Moderator

**Michael A Cohen**, MD  
**John M Lewin**, MD \*

#### LEARNING OBJECTIVES

#### ABSTRACT

#### VSB31-01 • Contrast Mammography

**John M Lewin** MD (Presenter) \*

#### LEARNING OBJECTIVES

1) This course will review the use of contrast enhancement in mammography- prior results with temporal evaluation and current results using dual energy technology. 2) Results of trials comparing contrast enhancement with standard breast imaging such as routine mammography, ultrasound and MRI will be discussed.

#### ABSTRACT

Contrast-enhanced digital mammography, now a clinically available product, continues to be a fruitful area of both basic and clinical research. This session will provide an overview of the physics of CEDM, its history, recent research results, current status and potential clinical applications.

#### VSB31-02 • Contrast-enhanced Spectral Mammography vs. Mammography and MRI - Clinical Performance in a Multi-reader Evaluation

**Eva M Fallenberg** MD (Presenter) \* ; **Felix Diekmann** MD \* ; **Corinne Balleyguier** MD ; **Diane M Renz** MD ; **Ritse M Mann** MD, PhD \* ; **Florian Engelken** MD, MBBCh ; **Alexander Poellinger** MD ; **Heba A Amer** ; **Clarisse Dromain** MD

#### PURPOSE

To compare contrast-enhanced digital mammography (CESM) to mammography (MG) and MRI on diagnostic accuracy of histologically proven breast lesions.

#### METHOD AND MATERIALS

The study was approved by Health Authorities and Ethics Committee. 90 consenting patients diagnosed with breast cancer were imaged with MG, CESM and MRI and underwent surgery. CESM was performed as a bi-lateral mammography starting 2 minutes after injection of 1.5ml/kg of an iodinated contrast agent (300 mg/ml) with a flow of 3ml/s. CESM images alone and MG images were interpreted by two blinded independent radiologists with an interval of minimum 4 weeks for memory wash-out. MRI was analyzed by another set of two independent readers. Per lesion sensitivity and specificity were evaluated across readers. BI-RADS 4 was defined as threshold for true positives. Gold standard was post-surgical histology.

#### RESULTS

105 malignant and 10 benign histologically proven lesions were assessed in this dataset. Average sensitivity were 84.1% (reader1) and 67% (reader 2) for MG, 90.2% and 88.8% for CESM and 91.1% and 90% for MRI, respectively. Specificity was 100% (reader 1) and 80% (reader 2) for MG, 81.8% and 90% for CESM and 71.4% and 50% for MRI.

#### CONCLUSION

CESM and MRI showed similar sensitivity for index cancer and multiple foci, both superior to MG. MG and CESM outperformed MRI in specificity.

#### CLINICAL RELEVANCE/APPLICATION

CESM is a reliable imaging technique, which may replace MRI in cases with contraindications and may replace MG due to superior diagnostic accuracy in symptomatic patients.

### **VBSR31-03 • Contrast-enhanced Spectral Digital Mammogram versus Contrast-enhanced MR Mammography in the Assessment of Breast Carcinoma: Initial Clinical Experience**

**Maha Helal MD (Presenter) ; Rasha M Kamal MD ; Radwa Essam MBBS ; Iman Godda MD ; Sahar Mansour MD ; Nelly Alieldin MD ; El-Shaimaa M Sharaf MBCh**

#### PURPOSE

evaluate the diagnostic performance of contrast-enhanced spectral digital mammography versus dynamic contrast-enhanced magnetic resonance imaging in the detection and staging of breast cancer.

#### METHOD AND MATERIALS

In this institutional ethics approved prospective study, we compared the performance of contrast based digital mammography with magnetic resonance imaging on 70 female patients. Standard digital mammogram was done in the mediolateral oblique and craniocaudal projections followed by low (22♦33 kVp) and high (44♦49 kVp) energy exposures in the same projections. Sequential post contrast magnetic resonance imaging was set in the axial orientation and post processed using maximum intensity projection and multiplanar reconstruction images. Both examinations performed by IV injection of non- ionic contrast agent. Outcomes of the surgical specimen or ultrasound guided core biopsy were the gold standard of reference in all cases.

#### RESULTS

The study included 33 pathologically proved benign (47 %) and 37 (53%) malignant breast lesions. The areas of contrast uptake had been correlated with abnormalities seen on the conventional mammography. Both contrast enhanced digital mammography and magnetic resonance imaging were individually assessed in the same group of cases. Multicentric and multifocal carcinomas were detected by contrast mammograms in 29.7% (n=11) of diagnosed malignant cases, when only unifocal carcinoma was reported on conventional mammograms. In the contest of malignancy both modalities stood on the same land. Enhancement detection of some benign lesions (n=5) was limited in digital mammography. Statistical analysis yielded a sensitivity, specificity and accuracy of 93.7%, 66.6% and 80.6% compared to 93.7 %, 86.6% and 90.3% for contrast enhanced mammograms and magnetic resonance imaging respectively

#### CONCLUSION

Contrast-enhanced digital mammogram is non-inferior to breast MRI in the contest of detection and characterization of breast malignancy.

#### CLINICAL RELEVANCE/APPLICATION

Contrast-enhanced mammography is an advanced application of digital mammography that had to be compared with breast MRI as it is more applicable and cost effective.

### **VBSR31-04 • Contrast-enhanced Breast Tomosynthesis versus Dynamic Contrast-enhanced Breast MRI in the Diagnosis of Suspicious Breast Lesions on Mammogram**

**Chen-Pin Chou MD (Presenter) \* ; Chia-Ling Chiang ; Tsung-Lung Yang MD**

#### PURPOSE

To compare the diagnostic performance of contrast-enhanced breast tomosynthesis (CEBT) and dynamic contrast-enhanced breast MRI (DCE-MRI) for breast lesions detected on digital mammogram.

#### METHOD AND MATERIALS

The study was approved by institutional review board. Written informed consent was obtained from all patients. A total of 102 consecutive women suspected of having breast lesions on digital mammogram between March 2012 and December 2012 underwent both CEBT and DCE-MRI. For the dual-energy CEBT, a modified Selenia Dimensions (Hologic, Inc.) machine was used. Simultaneously 2D mammogram and 3D tomosynthesis were taken after injection with 1.5 mL iodine contrast agent per kilogram of body weight of and imaged between 2 and 6 minutes after injection. Contrast-enhanced images were taken in the suspicious breast (pre-contrast MLO view, post-contrast CC and MLO view) and contralateral breast (post-contrast MLO view). The lesion classifications on CEBT were finally determined based on findings on 2D mammogram, 3D tomosynthesis and post-contrast subtraction 2D and 3D images. Women were also evaluated at 1.5T (GE) or 3T MRI (Siemens) with dedicated breast coil. CEBT and DCE-MRI were interpreted by different radiologists.

#### RESULTS

Total 90 histological findings were available in 76 women (mean age 50.7 years, range 35-66 years). About 89% women did not have clinical symptoms. Ten women had two breast lesions in unilateral breasts. Four women had bilateral breast lesions. Of the 90 lesions, 67% had microcalcification on mammogram. The pathology revealed 46 benign lesions and 44 breast malignancies (21 carcinoma in situ, and 23 invasive breast cancers). The sensitivity/ specificity for CEBT and DCE-MRI were 97%/63% and 91%/63%, respectively.

#### CONCLUSION

Both CEBT and DCE-MRI showed similar diagnostic efficacy for women with suspicious breast lesions on mammogram, but CEBT was faster and easily accomplished diagnostic tool than breast DCE-MRI.

#### CLINICAL RELEVANCE/APPLICATION

CEBT may be an alternative tool for women who have suspicious breast lesions and cannot tolerate breast DCE-MRI.

### **VBSR31-05 • Benign Enhancement on Contrast Enhanced Dual Energy Digital Mammography**

**Maxine S Jochelson MD (Presenter) ; D. David Dershaw MD ; Janice S Sung MD ; Mary Hughes MD ; Elizabeth A Morris MD**

## PURPOSE

To describe the incidence, appearance and etiologies of non-malignant enhancing lesions depicted on contrast enhanced dual energy digital mammography (CEDM).

## METHOD AND MATERIALS

In a retrospective HIPAA compliant IRB approved study, images and clinical histories of 100 consecutive women who underwent CEDM for either breast cancer staging or high risk screening were reviewed. The incidence of benign, focally enhancing lesions or diffuse parenchymal enhancement on CEDM, diagnosed by either biopsy, correlation with the clinical history or recent MRI findings, was determined.

## RESULTS

CEDM was performed for staging of known cancer in 67/100 (67%) and for high risk screening in 33/100 (33%). 95/100 (95%) of patients had a breast MRI within 30 days of CEDM. Focal enhancement, subsequently determined to be the result of a benign process, was detected in 11/100 (11%) of women: 8/67 (12%) of women with cancer and 3/33 (9%) of screening patients. 5 patients demonstrated rim enhancing lesions: 3 corresponded to cysts on MRI (2 simple and 1 inflamed) and 2 to seromas at the site of recent intervention. 1 corresponded to a skin lesion on MRI. 5 other areas of focal enhancement underwent biopsy yielding radial scar, fibroadenoma, adenosis, PASH, and periductal inflammation. Diffuse background parenchymal enhancement was present in 26/100 (26%), all of whom had a similar pattern on MRI.

## CONCLUSION

Focal non-malignant enhancement occurred in 11% of studies. Etiologies included cysts, seromas, a radial scar and a fibroadenoma among others. Half of them required tissue sampling to exclude malignancy. Appreciating the imaging appearance of these benign lesions may potentially prevent unnecessary biopsies in the future.

## CLINICAL RELEVANCE/APPLICATION

Both focal and diffuse non malignant enhancement can be seen on CEDM. Recognition of the appearance of these findings may improve the specificity of this exam and limit unnecessary biopsies.

## **VSBR31-06 • Tomosynthesis**

**Mark A Helvie MD (Presenter) \***

### LEARNING OBJECTIVES

1) To understand the basic principles used in obtaining digital breast tomosynthesis (DBT) images. 2) To understand experimental and clinical trial data which form the basis for DBT clinical application. 3) To understand the potential benefits and areas of weakness of DBT compared to conventional mammography. 4) To understand the potential clinical applications of DBT and current regulatory status of DBT. 5) To understand future issues related to DBT.

### ABSTRACT

DBT clinical trial data is emerging which will form the basis of clinical use. Because DBT has the potential to significantly change the practice of breast imaging, careful review of the results of these trials and implications for clinical practice is essential for informed decision regarding DBT.

## **VSBR31-07 • Implementation of Synthesized 2D Plus Tomosynthesis Images in Breast Cancer Screening: Comparison of Performance Levels with Full Field Digital Mammography Plus Tomosynthesis in a Population-based Screening Program**

**Per Skaane MD, PhD (Presenter) \* ; Randi Gullien RT \* ; Ellen B Eben MD \* ; Ingvild N Jebesen \* ; Unni Haakenaasen MD \* ; Ulrika Ekseth MD \* ; Mona Krager MD \***

### PURPOSE

To compare diagnostic performance of combined FFDM plus digital breast tomosynthesis (DBT) with synthesized 2D (C-view) plus DBT in breast cancer screening.

### METHOD AND MATERIALS

Eight radiologists prospectively interpreted independently 12,271 screening examinations including FFDM plus DBT and C-View plus DBT. Both reading modes included standard CC and MLO views of each breast. A 5-point rating scale for probability of cancer was used in the image interpretation. All cases with a positive score (defined as 2 or higher) were discussed at an arbitration meeting before decision for final recall. The reconstructed images (C-Views) do not require additional radiation exposure. Using analyses for binary data accounting for correlated interpretations and adjusted for reader-specific volume and performance levels and two-sided significance levels of 0.05, we compared performance levels when using C-view plus DBT with respect to positive scores, recall rates, and cancer detection rates with the corresponding FFDM plus DBT interpretations.

### RESULTS

Interpretation of 12,271 independently interpreted examinations under the two modes resulted in 656 (656/12,271=5.3%) and 651 (651/12,271=5.3%) positive scores for the FFDM plus DBT and the C-view plus DBT, respectively. Following arbitration meeting, the recall rates were 297/12,271= 2.4% and 270/12,271=2.2%, respectively. The cancer detection rate was 100/12,271=0.81% and 100/12,271=0.81%, for FFDM plus DBT and C-view plus DBT, respectively. There was no significant difference in the cancer detection between the two modes (McNemar test, p=0.85).

### CONCLUSION

Synthetically reconstructed 2D images applied in combination with DBT showed comparable results regarding positive predictive values and cancer detection rates with FFDM plus DBT.

### CLINICAL RELEVANCE/APPLICATION

The use of synthetically reconstructed 2D images (C-View) in combination with tomosynthesis resulted in comparable performance to actual exposure generated 2D plus tomosynthesis.

## **VSBR31-08 • Diagnostic Accuracy of Combination Synthetic Mammograms with Tomosynthesis vs. Combination FFDM with Tomosynthesis**

**Margarita L Zuley MD (Presenter) ; Andriy I Bandos PhD ; Jules H Sumkin DO \* ; Victor J Catullo MD ; Amy H Lu MD ; Denise Chough MD ; Marie A Ganott MD ; Grace Y Rathfon MD ; Luisa P Wallace MD**

### PURPOSE

To assess the diagnostic performance of combination synthetic mammograms and tomosynthesis (synthetic 2D+Tomo) to combination FFDM and tomosynthesis (FFDM+Tomo)

### METHOD AND MATERIALS

IRB approval was obtained. 123 cases deemed challenging by 2 non-participating independent reviewers were chosen from our research database to create a stress test, including 36 biopsy verified cancers, 35 biopsy proven benign lesions and 52 recalled screening exams proven to be normal on recall and 1 year follow up. 5 academic womens imagers performed a retrospective fully crossed and balanced multi case multi reader study where each study was reviewed twice, once with the synthetic mammogram and then tomosynthesis and once with the standard mammogram and then tomosynthesis. Probability of malignancy (POM) on a 100 point scale and BI-RADS scores were recorded for the 2D study and then again with tomosynthesis for each mode. Data analysis was performed using random-reader analysis (DBM MRMC, v.2.33) based on the nonparametric area under the ROC curve (AUC).

### RESULTS

The reader-averaged AUC for the FFDM+Tomo and synthetic 2D+Tomo modalities were 0.898 and 0.871 correspondingly ( $p=0.15$ ). Four readers performed somewhat poorer albeit not significantly ( $p>0.05$ ) with synthetic 2D+Tomo. The average difference of 0.027 was not statistically significant with 95% confidence interval from -0.013 to 0.067.

#### CONCLUSION

Synthetic 2D mammograms with tomosynthesis allowed similar interpretive performance to standard FFDM in combination with tomosynthesis and, therefore, may be an acceptable alternative for screening.

#### CLINICAL RELEVANCE/APPLICATION

Lowering radiation dose during tomosynthesis based screening is possible with synthesized 2D images.

### **VSBR31-09 • Features of Additional Breast Cancers Detected by Digital Breast Tomosynthesis after Normal Digital Mammography**

**Paula Martinez Miravete ; Jon Etxano MD (Presenter) ; Pedro Slon MD ; Paula B Garcia MD ; Maite Millor MEd ; Luis Pina MD, PhD**

#### PURPOSE

To evaluate the radiological presentation and histology of breast cancers detected by digital mammography (DM) and additional cancers detected by complementary Digital Breast Tomosynthesis (DBT).

#### METHOD AND MATERIALS

From December 2010 to September 2012, we prospectively recruited 9300 consecutive patients with ACR density patterns II, III and IV in an enriched population that underwent both DM and DBT (COMBO mode). 165 patients with cancer were detected using the COMBO mode. Out of these 165 breast tumors, 105 were detected by DM and 71 by additional DBT. We retrospectively evaluated the features of the radiological presentation and histology of breast cancers detected by DM and breast cancers detected by DBT. For the statistical analysis we performed a Pearson's Chi Square test with the SPSS 15.0 software.

#### RESULTS

Significant differences were found regarding the radiological presentation of both groups ( $p<0.05$ ) were found in the rate of Invasive Ductal Cancers (DM= 35/105; 33%, DBT=25/61; 41%) and Invasive Lobular Carcinoma (DM= 14/105; 13.3%, DBT=13/61; 21.3%).

#### CONCLUSION

The additional breast cancers detected by DBT show different radiological presentation and histology than breast cancers detected with DM, being more common architectural distortions and tubular breast cancers.

#### CLINICAL RELEVANCE/APPLICATION

DBT is an emerging imaging technique capable to detect additional cancers not seen in conventional DM. The radiological presentation and histology of these additional cancers are different.

### **VSBR31-10 • Addition of Tomosynthesis to Conventional Digital Mammograms: Effect on Image Interpretation Time of Screening Examinations**

**Pragya A Dang MD (Presenter) ; Phoebe E Freer MD ; Kathryn L Humphrey MD ; Elkan F Halpern PhD \* ; Elizabeth A Rafferty MD \***

#### PURPOSE

To determine the impact of the implementation of a screening tomosynthesis program on real-world clinical performance by quantifying the differences in interpretation times of conventional screening mammography to combined tomosynthesis-mammography screening for multiple participating radiologists with a wide range of experience in a large academic center.

#### METHOD AND MATERIALS

Ten board certified radiologists read digital mammography alone or combined tomosynthesis-mammography screening examinations in batch mode for one hour-long uninterrupted sessions, as a part of routine screening practice. Number of examinations read during each session was recorded for each reader. The experience level for each radiologist was also correlated to the average number of cases read during the hour. The BI-RADS density and BI-RADS assessment category for each examination were collected. Analysis of Variance (ANOVA) test (SAS) was used to determine differences in the number of studies interpreted per hour for different radiologists, different techniques, and different experience levels of radiologists.

#### RESULTS

A total of 3,665 examinations (1,502 combined tomosynthesis-mammography and 2,163 digital mammography) were interpreted by 10 radiologists, with at least 5 sessions per radiologist per modality. An average of  $23.8\pm 0.55$  (14.4-40.4) and  $34.0\pm 0.55$ , (20.4-54.3) examinations per hour, were interpreted by combined tomosynthesis-mammography and digital mammography, respectively. The average interpretation time for a combined tomosynthesis-mammography examination was 2.8 (1.5-4.2) minutes and digital mammography was 1.9 (1.1-3.0) minutes. The time taken to read a combined tomosynthesis-mammography examination was on average 0.9 minutes longer (47% longer) compared to the digital mammography alone examination. With the increase in years of breast imaging experience, there was a decrease in the overall additional time required to read combined tomosynthesis-mammography examinations ( $p= 0.03$ ,  $R^2= 0.52$ ).

#### CONCLUSION

Addition of tomosynthesis to mammography results in increased time to interpret screening examinations when compared to conventional digital mammography alone.

#### CLINICAL RELEVANCE/APPLICATION

Reliable estimation of differential interpretation time with tomosynthesis should prove useful in preparing for its impact on radiologists' workload and resource allocation.

### **VSBR31-11 • Diagnostic Performance of Digital Breast Tomosynthesis: Comparison with Breast Magnetic Resonance Imaging and Conventional Digital Mammography in Women with Known Breast Cancers**

**Won Hwa Kim MD, MS ; Jung Min Chang MD (Presenter) ; Ann Yi MD ; Woo Kyung Moon ; Su Hyun Lee MD ; Nariya Cho MD ; Hye Ryoung Koo MD ; Min Sun Bae MD, PhD ; Seung Ja Kim**

#### PURPOSE

To evaluate the diagnostic performance of digital breast tomosynthesis (DBT) compared with breast magnetic resonance (MR) imaging and conventional digital mammography (DM) in women with known breast cancers.

#### METHOD AND MATERIALS

This study was approved by the institutional review board and informed consent was obtained. Between March and October 2012, 176 consecutive patients with known breast cancer (mean age, 51.3 years; range, 22-78 years) underwent DM, DBT and MR imaging. All 176 index cancers and 12 additional cancer (6 ipsilateral and 6 contralateral) cancers were identified. Two radiologists independently interpreted the images from each examination without clinical information and evaluated probability of cancer (5-point scale) for all findings. Sensitivity, false-positive rates, and area under the alternative free-response receiver operating characteristic curve (AUC) were estimated with histopathology and follow-up data as a reference standard.

#### RESULTS

The mean invasive tumor size was 2.2cm. Sensitivity for index cancers was the highest in MR imaging followed by DBT and DM (all  $P <$

.05; reader 1, 98%, 93%, and 85%; reader 2, 98%, 92%, and 85%). Sensitivity for additional cancer was the highest in MR imaging followed by DBT and DM (all  $P < .05$ ; reader 1, ipsilateral, 67%, 33%, and 0%; reader 2, ipsilateral, 83%, 50%, and 17%; reader 1, contralateral, 100%, 67%, and 50%; reader 2, contralateral, 100%, 83%, and 67%). False-positive rate was the highest in MR imaging followed by DBT and DM (reader 1, 18%, 9%, and 7%; reader 2, 13%, 8%, and 7%), and was significantly frequent in MR imaging than DBT in one reader  $P = .033$ ). The AUC for MR imaging, DBT, and DM were 0.946, 0.920, and 0.832 for reader 1; and 0.945, 0.912, and 0.828 for reader 2. The AUCs for DBT and MR imaging were significantly higher than DM ( $P < .05$ ); AUCs were not significantly different between DBT and MR imaging (Reader 1,  $P = .18$ ; Reader 2,  $P = .12$ ).

#### CONCLUSION

DBT showed lower sensitivity than MR imaging in detection of index and additional breast cancers, but false positives were less frequent with DBT than MR imaging.

#### CLINICAL RELEVANCE/APPLICATION

With DBT, comparable diagnostic performance to MR imaging and higher performance than DM was achieved. For additional cancer detection, DBT had limited diagnostic performance compared to MR imaging.

### **VBSR31-12 • Comparison of Visibility and Diagnostic Accuracy of Cone Beam Computed Tomography, Tomosynthesis, MRI and Digital Mammography for Breast Masses**

**Margarita L Zuley MD (Presenter) ; Ben Guo PhD ; Marie A Ganott MD ; Andriy I Bandos PhD ; Victor J Catullo MD ; Amy H Lu MD ; Amy E Kelly MD ; Maria L Anello DO ; Gordon S Abrams MD ; Denise Chough MD**

#### PURPOSE

To compare lesion visibility and diagnostic accuracy of cone beam computed tomography (CBCT) and tomosynthesis (DBT) to MRI and digital mammography (FFDM)

#### METHOD AND MATERIALS

IRB approval was obtained. From 04/16/2009 to 06/21/2011, 178 mass lesions in 151 consecutively consenting women underwent FFDM, DBT, CBCT and contrast enhanced MRI prior to percutaneous biopsy. 97 CBCTs were unenhanced (NC-CBCT) and 81 had contrast (CE-CBCT). DBT studies were unenhanced. Histopathology established truth. A nonparticipating radiologist marked each lesion location. A retrospective fully crossed, balanced reader study was performed with 7 MQSA qualified academic breast radiologists who recorded lesion visibility in each mode and if visible provided a probability of malignancy (POM) score on a 100 point scale. For each mode, ROC curves were obtained by a vertical average of the reader specific curves. Statistical analyses accounting for correlation and random reader effects were performed using the MRMC analysis (DBM MRMC, v.3.0) for area under the ROC curve (AUC) and using the generalized linear mixed model (proc glimmix, SAS, v.9.3) for visibility.

#### RESULTS

100 benign and 78 malignant masses were included. Average size was 19.7 mm (median 14mm, range 4-100mm). Percentage of visible lesions differed (88% FFDM, 91% DBT, 82% CBCT [81% NC-CBCT sub-set, 84% CE-CBCT sub-set] and 93% MRI). For visualization, MRI was significantly better than CBCT ( $p$

#### CONCLUSION

For masses MRI has the highest accuracy and visibility and was significantly better than CBCT but not DBT. CBCT accuracy and visibility improve with use of contrast but further improvements are necessary for use as an alternative to MRI, FFDM or DBT.

#### CLINICAL RELEVANCE/APPLICATION

Tomosynthesis may possibly be a viable alternative to MRI for breast mass evaluation.

### **VBSR31-13 • Elastography**

**A. Thomas Stavros MD (Presenter) \***

#### LEARNING OBJECTIVES

1) To understand the elastic properties of normal and pathologic breast tissues. 2) To get an overview of the different ultrasound methods and technologies. 3) To learn about the clinical results obtained with the different methods. 4) To understand the role of elastography within the imaging protocol.

#### ABSTRACT

Real-time elastography (RTE) of the breast may easily and quickly integrate conventional breast imaging. Excitation is applied to the tissue and sophisticated algorithms are used to estimate their elasticity. Different technologies use direct mechanical or radiation force excitation. Qualitative scores and/or quantitative values are usually derived from the estimate of the effect on the tissue and help to differentiate soft benign lesions from malignancies. These are usually stiffer due to the secretion of collagen and fibronectin, and the surrounding edema. Fluid lesions almost always show a typical three-layered pattern on strain elastography. They have typical patterns even with radiation force technologies (ARFI and shear wave). These last allow a true quantitative evaluation of the acoustic modulus and promise to be the gold standard for the future applications. Clinical reports show a high diagnostic accuracy: increased specificity for atypical carcinomas and a very high specificity in benign lesions, including BI-RADS category 3 lesions. With the best cutoff point between elasticity scores 3 and 4, the true negative predictive value is over 90%. Most mistakes are linked to the histopathology of the lesions. In invasive carcinomas RTE clearly shows the peripheral infiltration improving the volume measurement; 3D elastography and tomographic imaging may help in this respect. RTE scores and values are well reproducible. Indexes of intra-observer and inter-observer agreement are very good. Elastography scores have been introduced into the new BI-RADS edition. They upgrade BI-RADS 3 lesions and downgrade 4a lesions. In daily practice this results into earlier biopsies for cancers and reduced biopsies and longer follow-up intervals for benign lesions. Elastography is easy and quick; it must become part of the evaluation of all focal lesions. Still RTE score is only a complementary descriptor to BI-RADS and its interpretation requires some training.

### **VBSR31-14 • BIRADS Classification for Real Time Ultrasound Elastography: More Comprehensive, Accurate and Action Oriented Results**

**Mukta D Mahajan MBBS (Presenter) ; Sonal Garg MBBS ; Mukund S Joshi MD ; Chander Lulla MBBS**

#### PURPOSE

1. To devise a BIRADS category of standardized breast reporting for Elastography of focal breast lesions based on the elastography score and distance ratio method of evaluating them. 2. To qualitatively assess the sensitivity, specificity, positive and negative predictive value of preset cutoffs of elastography score and distance ratio in assigning a BIRADS rating to them when compared with BIRADS grey scale ultrasound and histopathology. 3. To evaluate the efficacy of implementing this Elastography BIRADS scheme in the diagnostic pathway of evaluating breast lesions at our institution and thereby generate a protocol based guide to management. 4. To reduce the incidence of biopsies and diagnostic conundrums in assessing indeterminate focal breast lesions.

#### RESULTS

The data was analyzed using 2 cut offs for ES and 4 cut offs for DR to compute the most accurate scheme for BIRADS-EL categorisation. The sensitivity, specificity, PPV and NPV for BIRADS-EL was found to be 71.7%, 90.1%, 68%, 91.5%. This was found to be superior to the existing methods of analysis. The area under the receiver operating characteristic (ROC) curve for BIRADS-US, ES, DR and BIRADS-EL was 0.888, 0.928, 0.938 and 0.956 respectively. After implementing BIRADS-EL as a part of diagnostic workflow and protocol, assessment of the number of biopsies that were successfully averted was analyzed. The data collected after its implementation was evaluated after 3 months, 6 months and 1 year and has shown consistent result as the study group.

#### CONCLUSION

The present study suggests that Elastographic BIRADS classification of focal breast lesions is more accurate than BIRADS grey scale ultrasound in differentiating benign and malignant lesions when both methods i.e. ES and DR are combined. This method of reporting can

standardize elastography results and make them readily comparable with other modalities. Results obtained are action oriented and leave no ambiguity in inconclusive or indeterminate lesions thereby improving the quality of non-invasive diagnosis and reducing the incidence of ultrasound guided biopsies.

#### METHODS

We studied a total of 215 breast lesions in 112 women by B-mode ultrasonography and real time breast elastography. All the lesions were assigned an ultrasound BIRADS category based on their imaging appearance. An Elastography score (ES) of 1 to 5 and distance ratio (DR) of 1 was assigned to each lesion based on elastographic assessment. BIRADS US category 4 and 5 lesions, ES 4,5 and DR = 1 or >1 lesion were biopsied. BIRADS US 3, ES 3 and DR 0.8 to 1 lesions were either followed up every 6 months for a period of 2 years or biopsied. BIRADS US 2, ES 1,2 and DR

### **VBSR31-15 • Added Value of Shear-Wave Elastography in Evaluation of Breast Masses Detected on Screening Ultrasound**

**Su Hyun Lee MD ; Jung Min Chang MD (Presenter) ; Nariya Cho MD ; Hye Ryoung Koo MD ; Min Sun Bae MD, PhD ; Won Hwa Kim MD, MS ; Mirinae Seo MD ; Woo Kyung Moon**

#### PURPOSE

To prospectively validate the added value of shear-wave elastography (SWE) in evaluation of breast masses detected on screening ultrasound (US).

#### METHOD AND MATERIALS

This study was conducted with institutional review board approval, and written informed consent was obtained. From April to October 2012, B-mode US and SWE were performed for 207 breast masses detected on screening US (mean size, 1.0 cm) in 207 consecutive women (mean age, 45 years) prior to US-guided core biopsy. Ten radiologists performed the examinations and assessed the likelihood of malignancy and Breast Imaging Reporting and Data System (BI-RADS) category for breast masses using B-mode US alone and a combination of B-mode US and SWE, respectively. Radiologists were allowed to upgrade BI-RADS category 3 masses to 4a when the maximum elasticity color (Ecol) was red and to downgrade category 4a to 3 when Ecol was dark blue or light blue with a maximum elasticity value (E<sub>max</sub>) = 65 kPa, a cutoff value determined in a prior study, to achieve the best diagnostic accuracy in differentiating benign lesions from malignant ones. The areas under the receiver operating characteristics curve (AUC), sensitivities, and specificities of the two datasets were compared.

#### RESULTS

Twelve of the 207 breast masses (5.8%) were malignant and consisted of nine invasive ductal carcinomas, two ductal carcinomas in situ, and one tubular carcinoma. The AUC of B-mode US increased from 0.700 to 0.879 when SWE was added (P = .002). Considering category 4a or higher as a positive result for malignancy, the sensitivities were not different between B-mode alone and combined B-mode and SWE (91.7% [11 of 12], both). However, the specificity increased from 17.4% (34 of 195) to 73.8% (144 of 195) when SWE was added (P

#### CONCLUSION

Combined use of SWE and B-mode US can increase both the accuracy and specificity in differentiating benign from malignant breast masses detected on screening US.

#### CLINICAL RELEVANCE/APPLICATION

SWE can be valuable in reducing the considerable false-positive rate of screening breast US examinations.

### **VBSR31-16 • Volume of Peri-tumoural Stromal Stiffness (VPSS) Surrounding Invasive Breast Cancer as Measured by 3D Shearwave Elastography (SWE): An Imaging Biomarker for Risk of Systemic Spread?**

**Andrew Evans MRCP, FRCR (Presenter) ; Patsy Whelehan MSc \* ; Sarah J Vinnicombe MRCP, FRCR ; Kim Thomson ; Lee Jordan ; Caroline Mitchie ; Colin Puride ; Alistair M Thompson**

#### PURPOSE

3D SWE allows the VPSS around breast cancers to be measured. Vascular invasion (VI) is most commonly detected at the tumour/stromal interface and is strongly associated with nodal involvement. We hypothesised that the likelihood of VI and nodal involvement may vary with the VPSS and that these relationships may be stronger than those seen between these risk factors for systemic spread and other ultrasound (US) parameters such as mean stiffness on 2D SWE, grey scale diameter and grey scale volume.

#### METHOD AND MATERIALS

2 and 3D grey scale US and SWE were carried out on a series of 62 consecutive breast cancers treated by immediate surgery. The VPSS and other US features were measured prior to surgery and then correlated with the presence of vascular invasion and nodal status at histologic examination. Statistical significance was ascertained using chi square and chi square test for trend.

#### RESULTS

VPSS has a strong relationship to VI status (p=0.003) with none of the 17 patients with 3 of VPSS having VI, 13 of 36(36%) with a VPSS between 0.5 and 3cm<sup>3</sup> having VI and 5 of 9(56%) with a VPSS >3cm<sup>3</sup> having VI. Grey scale diameter and grey scale volume had significant but weaker relationships with VI (p=0.02 and 0.03 respectively). A significant relationship was also found between VPSS and nodal status (p=0.04). Nodal positivity rates using the above VPSS cut offs were 12%, 33% and 44% respectively. None of the other US parameters had statistically significant associations with nodal status

#### CONCLUSION

VPSS has stronger associations with markers of systemic spread than other US parameters and may be helpful in patient selection for neoadjuvant chemotherapy.

#### CLINICAL RELEVANCE/APPLICATION

In women with breast cancer the volume of peritumoral stiffness seen on 3D shearwave elastography may help patient selection for neoadjuvant chemotherapy

### **VBSR31-17 • Shear-wave Elastography in Detection of Residual Breast Cancer after Neoadjuvant Chemotherapy**

**Su Hyun Lee MD ; Jung Min Chang MD (Presenter) ; Nariya Cho MD ; Hye Ryoung Koo MD ; Min Sun Bae MD, PhD ; Won Hwa Kim MD, MS ; Mirinae Seo MD ; Woo Kyung Moon**

#### PURPOSE

To evaluate the accuracy of shear-wave elastography (SWE) in detecting residual cancer after neoadjuvant chemotherapy (NAC).

#### METHOD AND MATERIALS

This retrospective study was approved by our institutional review board and the requirement for written informed consent was waived. From January 2012 to February 2013, 71 women with stage II-III invasive breast cancers who received NAC and were imaged with B-mode ultrasonography (US), SWE, and magnetic resonance imaging (MRI) before surgery were included. Clinical tumor response was assessed using image findings from B-mode US and MRI and classified into two groups (0: no residual tumor, 1: residual tumor). Quantitative elasticity values (maximum kPa) were acquired for primary lesions depicted on US. Pathological complete response (pCR) was defined as no residual invasive cancer cells. The quantitative SWE values were compared between the pCR and non-pCR group using independent samples t-test. The areas under the receiver operating characteristics curve (AUC), sensitivities, and specificities of B-mode US, MRI, and SWE for detecting residual tumor were compared, with histopathologic examination as the reference standard.

#### RESULTS

Of the 71 women, 15 (21.1%) achieved pCR. The mean size of residual invasive cancers was 2.1 cm (range 0.1-6.4 cm). The maximum SWE value was significantly higher in the non-pCR group (mean, 122.9 kPa) than in the pCR group (30.6 kPa) (P

#### CONCLUSION

SWE was accurate in the detection of residual cancer after NAC. When combined with B-mode US, the accuracy improved to a level similar to breast MRI.

#### CLINICAL RELEVANCE/APPLICATION

In predicting pCR after NAC, SWE can offer valuable information. Addition of SWE to conventional imaging can be useful for surgical planning in breast cancer patients.

### **BOOST: Breast-Integrated Science and Practice (ISP) Session**

**Tuesday, 10:30 AM - 12:00 PM • S103CD**

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**RO** **OI** **BR**

**MSRO35 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5**

#### **Co-Director**

**Fergus V Coakley, MD**

#### **Co-Director**

**Bruce G Haffty, MD**

#### **Moderator**

**Katherine L Griem, MD \***

#### **Moderator**

**Anna Shapiro, MD**

#### **MSRO35-01 • Invited Speaker:**

**Steven J Chmura MD, PhD (Presenter)**

#### **MSRO35-02 • Volume-based Parameters of 18F-fluorodeoxyglucose Positron Emission Tomography/Computed Tomography Improve Disease Recurrence Prediction in Postmastectomy Breast Cancer Patients with 1 to 3 Positive Axillary Lymph Nodes without Adjuvant Radiotherapy**

**Naomi Nakajima (Presenter) ; Masaaki Kataoka MD ; Takashi Ochi MD ; Yoshifumi Sugawara MD ; Masao Miyagawa MD, PhD ; Teruhito Mochizuki MD**

#### **PURPOSE**

The indication for postmastectomy radiotherapy (PMRT) in patients with 1 to 3 positive axillary nodes have been controversial. In the current study, we focused our study on volume-based parameters of pretreatment 18F-fluorodeoxyglucose positron emission tomography/computed tomography (FDG-PET/CT), with the aim of investigating a measurement that could help identify high-risk populations for recurrence in breast cancer patients treated with mastectomy without adjuvant radiotherapy.

#### **METHOD AND MATERIALS**

We retrospectively analyzed 88 patients with 1-3 positive axillary nodes after modified mastectomy, who were studied with FDG-PET/CT within 30 days before surgery. We evaluated the relationship between PET parameters including the maximum standardized uptake value (SUVmax), metabolic tumor volume (MTV) and total lesion glycolysis (TLG) and clinical outcomes.

#### **RESULTS**

#### **CONCLUSION**

Volume-based parameters on pretreatment FDG-PET/CT improve recurrence prediction in postmastectomy breast cancer patients with 1-3 positive nodes. The addition of MTV to ER status or TN could identify a subgroup of patients at higher risk for recurrence.

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

Patients with high pretreatment MTV or TLG values should be monitored closely or considered for more aggressive treatments including adjuvant radiotherapy or systemic therapy.

#### **MSRO35-03 • Axillary Lymph Node Dose with Whole Breast Radiation Using 3D Conformal and Intensity-modulated Radiation Therapy**

**Matthew Janko BS (Presenter) ; Shirin Sioshansi MD ; Patrick J Bonavitacola ; Paul S Rava MD, PhD ; Thomas J Fitzgerald MD**

#### **PURPOSE**

Intensity-modulated radiotherapy (IMRT) for whole breast irradiation has been shown to decrease acute radiodermatitis in the axilla. Although beneficial from a toxicity perspective this raises the concern of less incidental radiation to the axilla. As the extent of axillary surgery decreases, the radiation dose and distribution within the axilla become increasingly important. Here, we report a dosimetric comparison of incidental dose delivered to axillary level I-III lymph node volumes using CT-based three-dimensional conformal radiation therapy (3DCRT) and hybrid intensity-modulated radiation therapy (IMRT) techniques.

#### **METHOD AND MATERIALS**

58 women treated with whole breast irradiation (WBI) at our institution in 2011-2012 were identified. Patients with bilateral disease, regional nodal disease, or deliberate targeting of the axilla were excluded. All patients underwent CT-based planning. Breast tissue and tumor bed contouring was performed on all patients at the discretion of the treating radiation oncologist and treatment planning was performed to encompass the entire breast parenchyma. Axillary lymph node (ALN) level I, II and III volumes were retrospectively contoured according to the RTOG contouring atlas. The mean dose as well as the volume of each level receiving 50% (V50%), 90% (V90%) and 95% (V95%) of the prescription dose were calculated from treatment plans. Independent samples t-tests and univariate analyses were used to compare baseline characteristics and observed incidental doses.

#### **RESULTS**

Mean volumes of breasts, tumor beds and axillary levels did not differ significantly between WBI techniques. Mean doses to the ipsilateral breast, tumor beds and ALN levels I, II and III were similar between WBI techniques. No significant difference was seen in V50%, V90% and V95% for the same levels.

#### **CONCLUSION**

We report essentially identical incidental dose to axillary levels I, II and III using IMRT and 3DCRT for standard tangential whole breast irradiation.

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

WBI with IMRT results in less acute desquamation and better quality of life. In the era of less axillary surgery, our results are reassuring that IMRT does not give less incidental dose than 3DCRT.

#### **MSRO35-04 • Patterns of Care in Ductal Carcinoma in Situ of the Breast: An Institutional Practice Quality Improvement Initiative**

**Parima Daroui MD, PhD (Presenter) ; Jeffrey V Kuo MD ; Nilam S Ramsinghani MD**

#### **ABSTRACT**

### **Purpose/Objective(s):**

Mastectomy has historically been the standard treatment for Ductal carcinoma in situ (DCIS) of the breast with excellent local control. However to spare patients from possible overtreatment and the morbidity of radical surgery, the treatment paradigm has shifted to an increased use of breast conserving surgery (BCS). In addition, several large randomized trials have demonstrated that the addition of adjuvant radiation treatment (RT) after BCS reduces breast recurrences by 50% to 60%, comparable to results with mastectomy. Although the role of RT in DCIS is strongly supported by randomized data, there are also data that support the possible omission of adjuvant RT in certain low risk subgroups, in attempts to further optimize the risk-benefit ratio in patients with DCIS. The purpose of our study is to determine the pattern of care and utilization of BCS+RT in patients with DCIS treated at our institution, as a quality of care improvement initiative.

### **Materials/Methods:**

A retrospective analysis of data from patients with a first diagnosis of DCIS of the breast from 2008-2010 was performed. Predictors for the use of RT, in addition to the relative frequencies of mastectomy, BCS, and BCS+RT were evaluated to determine the pattern of care for DCIS at our institution in the specified interval.

### **Results:**

A total of 37 patients with DCIS were treated for their disease. Of these patients 78% (n=29) received BCS, and 22% (n=8) received mastectomy as initial treatment. Of the 29 patients receiving BCS, 8 patients received mastectomy after BCS for persistent positive margins. Of the remaining 21 patients receiving BCS, nearly all patients (n=20) were given adjuvant RT after BCS, with the exception of one patient who refused RT. Among the patients who received mastectomy as an initial treatment (n=8), the choice of mastectomy as primary surgery was based on the presence of extensive or multifocal disease in 50% (n=4), patient choice in 25% (n=2) and was unknown in 25% (n=2). In addition, of the 8 patients undergoing mastectomy, 2 patients had residual close margins and one of the two was offered RT after mastectomy.

### **Conclusions:**

In contrast to published data that report an under-utilization of RT after BCS in patients with DCIS, utilization of BCS+RT in patients treated at our institution was within the expectation of current standard of care. The majority of patients with DCIS had BCS as their initial surgical treatment (75%, n=29), and mastectomy was only used as a primary modality in patients with extensive disease, or based on patient preference. Of patients eligible for RT after BCS (n=21), nearly all (n=20) completed RT as per current standard of care guidelines. The implementation of practice quality improvement initiatives such as this can be helpful to gauge practice patterns and identify areas of variance from evidence-based guidelines.

## **MSR035-05 • Assessment of Lung Dose during Breast-respiratory-Gated Irradiation Using a 4-dimensional Breast Phantom Moving to Simulate Respiratory Motion**

**Shimizu Arisa** (Presenter) ; **Toshie Horibe** ; **Yukihiko Oshima** ; **Toshiki Kawamura** ; **Masaru Nakamura** ; **Tsuneo Ishiguchi** MD

### **ABSTRACT**

#### **Purpose/Objective(s):**

In standard radiotherapy after breast-conserving therapy, a portion of the lung is included in the irradiation field due to shifting of the thorax from respiratory motion, and may be a cause of radiation pneumonitis post-therapy. To reduce the lung dose, using a 4-dimensional breast phantom simulating respiratory motion the lung dose was compared between the presence and absence of irradiation during respiratory gating.

#### **Materials/Methods:**

Phantoms resembling breast and lung tissues were prepared, and a 4-dimensional breast phantom was prepared by placing the breast phantom on the lung phantom and moving it up and down to simulate respiratory motion. The breast and lung phantoms were divided into two from top to bottom, and a film to assess the radiation dose was interposed between them. Then, the irradiation field margin was set on the lung portion 5mm from the breast lower margin, and irradiation administered with 4MV LINAC (Mitsubishi EXL-15DP). Irradiation was administered while the respiratory motion of the phantom was stopped during the expiratory phase (irradiation during expiratory phase breath-holding), while the respiratory motion of the phantom was continuous (irradiation during spontaneous respiration), or only in the expiratory phase while the respiratory motion of the phantom was continuous (irradiation during respiratory gating). After irradiation, the films were scanned, and using analytical software the respective lung doses were determined.

#### **Results:**

Lung dose increased in the order of expiratory phase breath-holding irradiation, irradiation during respiratory gating, and irradiation during spontaneous respiration. In the comparison of expiratory phase breath-holding and spontaneous respiration, lung dose was lower during the former (p=0.001), while in that of irradiation during respiratory gating and spontaneous respiration, it was lower with respiratory-gating (p=0.024). No significant difference was noted in lung dose between expiratory phase breath-holding and respiratory-gating (p=0.38).

#### **Conclusions:**

In standard radiotherapy of breast-conserving therapy, irradiation during respiratory gating as compared to irradiation during spontaneous respiration significantly reduced the lung dose, and so may help to prevent the occurrence of radiation pneumonitis when clinically applied.

## **MSR035-06 • Comparison of the Volume and Localization of Lumpectomy Cavity Delineated by Clips and Seroma Based on 4DCT Scan for External-beam Partial Breast Irradiation after Breast Conserving Surgery**

**Yun Ding** (Presenter)

## **MSR035-07 • Breast Conserving Treatment: External Beam or Intraoperative Boost? A Matched Pair Analysis**

**Elena Sperk** (Presenter) ; **Daniela Astor** ; **Grit Welzel** ; **Axel Gerhardt** MD ; **Marc Sutterlin** MD ; **Frederik Wenz** \*

### **ABSTRACT**

**Purpose/Objective(s):** In the context of breast conserving treatment, radiotherapy leads to a better overall survival and in addition to whole breast radiotherapy (WBRT) a boost to the tumor bed leads to a better local control. The tumor bed boost is usually added after WBRT or can be done intraoperatively (IORT). Positive effects, an antitumoral effect and modulation of microenvironment after IORT with 50kV x-rays were already described by Belletti et al. (Clin Cancer Res., 2008). During the San Antonio Breast Cancer Symposium data from the randomized TARGIT A trial were presented (n = >3400 patients) showing a trend towards a better overall survival in patients treated with IORT immediately after tumor removal. For this report a matched pair analysis was performed to investigate the impact of IORT boost on overall survival compared to standard external beam boost.

**Materials/Methods:** In general 370 patients were treated for breast cancer with WBRT + boost (external beam (EBRT) boost n = 146, IORT boost n = 224) between the year 2002 to 2009. A matched pair analysis (1:1 propensity score matching for age, TNM, grading, hormonal treatment and chemotherapy) for overall survival and local recurrence free survival could be done for 53 pairs. All patients underwent breast conserving surgery and WBRT with 46-50Gy. 53 patients received an EBRT boost with 16Gy (2Gy/fraction, dedicated linear accelerator) and 53 patients received an IORT boost with 20Gy (INTRABEAM system, 50kV x-rays). Median follow-up was 6 months (range, 1-77 months) for the EBRT boost patients and 56 months (range, 2-97 months) for IORT boost patients. Kaplan Meier estimates were performed for overall survival and local recurrence free survival.

**Results:** Due to a special follow-up program for IORT boost patients, the IORT group had a longer follow-up than the EBRT boost patients. Despite the difference in follow-up times, there was a strong trend towards better overall survival after IORT boost (90.2% vs.

62.3%, p = 0.375) in our cohort. One local recurrence was present in each group (EBRT boost after 15 months, local recurrence free survival 95%; IORT boost after 12 months, local recurrence free survival 98.1%).

**Conclusion:** IORT given as a boost seems to have a positive impact on overall survival in breast cancer patients after breast conserving surgery. To identify such an effect a prospective randomized trial should be conducted. Secondly, a good local control can be achieved by applying a boost after breast conserving surgery.

### **MSR035-08 • Clinical Research of 3D-CRT Accelerated Partial-breast Irradiation (APBI) for the Selected Chinese Patients with Early-stage Breast Cancer after Breast-conserving Surgery**

**Min Xu** (Presenter)

#### **ABSTRACT**

**Purpose/Objective(s):** To explore the feasibility, efficacy and cosmetic effect of three-dimensional conformal external(3D-CRT) beam partial breast irradiation after breast-conserving surgery for the selected Chinese patients with early-stage breast cancer.

**Materials/Methods:** From June 2003 to December 2010, Forty four Chinese patients with early-stage breast cancer undertaken three-dimensional conformal external beam partial breast irradiation (EB-PBI) after breast-conserving surgery in Shandong Cancer Hospital. Twenty patients undertaken computed tomography (CT) simulation scan in the state of moderate deep inspiration breathing hold (mDIBH) assisted by active breathing control (ABC) system, and twenty-four patients received CT simulation scan during free breathing (FB). The surgical cavity marked by silver clips was defined and delineated as gross tumor volume (GTV), and planning target volume (PTV) was defined as the area encompassed GTV with extended margin of 15 mm for the patients treated in the state of mDIBH or 20 mm for the patients treated in the state of FB. EB-PBI was planned and carried out by 3D-CRT with four non-coplanar fields powered by 6 MV X-ray, the total prescribed dosage was 34 Gy delivered in 3.4 Gy per fractions in thirty nine patients and 38.5Gy delivered in 3.85 Gy per fractions in five patients, twice per day at intervals of at least six hours, in five consecutive days.

**Results:** All patients was followed up for nine to ninety four months with a median follow-up of fifty four months. Grade 1 of acute radiation-induced dermatitis was observed in 38.6% (17/44) of all the patients. No equal or more than grade 2 of radiation-induced dermatitis was observed, and no any grade of acute radiation-induced pneumonitis was observed. Cosmesis scored basing on Harris criteria was good or excellent in all cases at the time of six months after radiotherapy and in 94.9% cases at the time of two years after radiotherapy. The 2-, 3- and 5-year local control rates were 100% (39/39), 98.8% (30/31) and 93.8% (15/16), respectively. The 2-, 3-, and 5-year survival rates were all 100% and no metastases occurred.

**Conclusions:** EB-PBI delivered by 3DCRT is feasible for the selected Chinese patients with early stage breast cancer after breast-conserving surgery, satisfactory cosmetic effect, local control rate and long-term survival rate are obtained, meanwhile, acute radiation response rate is lower

### **MSR035-09 • Variability in Delineation of the Whole Breast Target Volume by Different Methods after Breast-conserving Surgery**

**Min Xu** (Presenter)

#### **ISP: Breast Imaging (Nuclear/Molecular Imaging)**

**Tuesday, 10:30 AM - 12:00 PM • E451A**



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**SSG01 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5**

#### **Moderator**

**David A Mankoff**, MD, PhD

#### **Moderator**

**D. David Dershaw**, MD

#### **SSG01-01 • Breast Imaging Keynote Speaker: Molecular Imaging of Breast Cancer-Clinical and Biological Considerations**

**David A Mankoff** MD, PhD (Presenter)

#### **SSG01-03 • Comparison of FDG-PET/CT and FDG-PET/MRI for Local Staging of Breast Cancer**

**Johannes Grueneisen** (Presenter) ; **James Nagarajah** ; **Sonja Liebeskind** ; **Kai Nassenstein** ; **Sonja Kinner** MD

#### **PURPOSE**

To compare the diagnostic potential of FDG-PET/MRI mammography and FDG-PET/CT for local staging in breast cancer patients.

#### **METHOD AND MATERIALS**

43 Patients with biopsy-proven invasive breast cancer were included in our study. In addition to a clinically indicated FDG-PET/CT all patients subsequently underwent contrast enhanced FDG-PET/MR mammography (Biograph mMR, Siemens) using a 16-channel breast coil. Two readers evaluated separately both imaging methods concerning lesion detection and size measurement of the primary tumor as well as detection of multifocality / multicentricity and bilateral lesions. All patients underwent surgery; histopathology examination served as a reference of standard.

#### **RESULTS**

A total of 52 lesions, including 49 primary tumor lesions and three contralateral lesions were detected. While PET/CT allowed for identification of 46/52 cases (88,5%), PET/MRI offered correct identification of 50/52 (96,2%) breast cancer lesions. PET/MRI enabled a correct assessment of the T stage in 44/52 cases (84,6%); compared to PET/CT (31/52; 59,6%). In five cases the same lesion at T2 stage was falsely diagnosed as T1 stage by both diagnostic modalities.

#### **CONCLUSION**

The results demonstrate the superiority of PET/MRI in detecting malignant lesions and in its size estimation compared to PET/CT while both diagnostic methods reveal the tendency to underestimate the tumor size.

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

PET/MRI seems to be a powerful tool in detecting and rating primary breast cancer lesions as well as accessory lesions and should be diagnostic modality of choice for staging primary breast cancer.

#### **SSG01-04 • Meta-analysis of Molecular Breast Imaging (MBI) Studies**

**James W Hugg** PhD (Presenter) \*

#### **PURPOSE**

Molecular Breast Imaging (MBI) uses planar imaging of single gamma photon emission from intravenous injection of Tc99m-sestamibi or tetrofosmin to visualize breast cancers that are often occult on mammography in the 40-50% of women with radiographically dense breasts. Clinical results published since 2002 support a meta-analysis of the MBI studies in three clinical applications: diagnostic workup, extent of disease, and high-risk screening.

#### **METHOD AND MATERIALS**

MBI consists of a pair of opposed semiconductor (CZT) gamma photon cameras. Breast-Specific Gamma Imaging (BSGI) consists of a single scintillator (NaI or CsI with PS-PMT or photodiode) gamma camera and a compression paddle. In both MBI and BSGI the breast is mildly compressed in standard planar mammographic views. We culled the literature until we had 19 studies and 4948 patients for diagnostic workup, 8 studies and 1507 patients for extent of disease, and 5 studies and 3013 patients for dense-breast screening. The analysis pools studies performed by BSGI (Dilon) and MBI (Gamma Medica or GE Healthcare).

## RESULTS

Patient injected doses were 8-20 mCi for MBI and 20-44 mCi for BSGI, with a general reduction in dose over time. The diagnostic workup studies, including primarily women with suspicious lesions on screening mammography, had a sensitivity of 94% for the detection of 1652 cancers and a specificity of 85%. The extent of disease studies in women with biopsy-proven cancer yielded additional cancers in 8% of women, changing clinical treatment in many cases. The high dense-breast screening studies detected a prevalence of 12.9 cancers per 1000 asymptomatic women screened by MBI or BSGI, compared to an incidence of 3.0 per 1000 for annual screening mammography.

## CONCLUSION

MBI and BSGI are more sensitive and specific than mammography, especially in dense breasts, and should be considered as an adjunct diagnostic and screening tool in breast cancer. Efforts to improve the technology and reduce the patient dose will further encourage the adoption of this new breast imaging modality.

## CLINICAL RELEVANCE/APPLICATION

MBI and BSGI are more sensitive and specific than mammography, especially in dense breasts, and should be considered as an adjunct diagnostic and screening tool in breast cancer.

### **SSG01-05 • Correlation between Quantitative 18F-FDG Uptake on PET/CT with Prognostic Factors in Triple-negative Breast Cancers**

**Hye Ryoung Koo MD ; Woo Kyung Moon ; Nariya Cho MD ; Jung Min Chang MD ; Mirinae Seo MD ; Hye Mi Gweon MD** (Presenter) ; **Keon Wook Kang**

## PURPOSE

We aimed to investigate whether a correlation exists between quantitative 18F-FDG uptake on PET/CT and prognostic factors in triple-negative breast cancer

## METHOD AND MATERIALS

Between January 2009 and December 2012, 1109 patients with newly diagnosed breast cancer underwent 18F-FDG PET/CT for initial staging followed by surgical treatment. This retrospective study involved 112 triple-negative invasive ductal cancers (mean tumor size 2.64cm, range 1 to 6.5cm) in 112 patients (mean age, 50.04 years; range, 28-77 years). Correlations between quantitative 18F-FDG uptake on PET/CT, expressed as maximum standardized uptake value (SUVmax), and prognostic factors including tumor size, axillary lymph node involvement status, histologic grade, nuclear grade, expression of Ki-67, p53, bcl-2, EGFR, CK5/6 were analyzed. Triple-negative breast cancer was defined as estrogen receptor (ER)-negative, progesterone receptor (PR)-negative, and human epidermal growth factor 2 (HER2)-negative.

## RESULTS

The mean SUVmax value of the 112 tumors was  $10.05 \pm 5.8$  (range: 1.4-32.8). Tumors with high nuclear grade (mean SUVmax  $10.39 \pm 5.75$ , n=106) showed higher FDG uptake than tumors with low nuclear grade (mean SUVmax  $3.96 \pm 2.31$ , n=6). There was a positive correlation between 18F-FDG uptake and tumor size (Spearman's correlation coefficient = 0.38) as well as Ki-67 (Spearman's correlation coefficient = 0.22), whereas this relationship was not observed among the axillary lymph node involvement status, histologic grade, p53, bcl-2, EGFR, and CK5/6. In a multivariate logistic regression analysis, tumor size (P

## CONCLUSION

Increased FDG uptake on PET/CT correlates with tumor size, nuclear grade, and Ki-67 proliferation index in triple-negative breast cancer.

## CLINICAL RELEVANCE/APPLICATION

FDG uptake relates to biologically important prognostic factors in triple-negative breast cancer. FDG uptake on PET/CT might be a useful tool to define the heterogeneity of triple-negative breast cancer.

### **SSG01-06 • Molecular Breast Imaging: The Sensitivity of Breast-specific Gamma Imaging (BSGI) as a Diagnostic Adjunct to Mammography and Ultrasound in a Triple Assessment Protocol**

**Jean M Weigert MD** (Presenter) \* ; **Douglas A Kieper BS** \* ; **Marcela Bohm-Velez MD**

## PURPOSE

BSGI is a diagnostic breast imaging procedure becoming more common in clinical breast practice. The goal of this work is to quantify its performance as an addition to mammography and ultrasound in detection of breast carcinoma when used in the community breast center setting.

## METHOD AND MATERIALS

A multi-center patient registry was maintained for all patients routinely sent to BSGI as part of their diagnostic work up. From the registry data, patients who had a mammogram followed by ultrasound and BSGI were selected for evaluation. The BIRADS rating schematic was used for mammography and sonography and a similar category system was used for the BSGI images. For each modality, the reports were classified as positive (categories 4 - 6) or Negative (categories 0 - 3). Needle and/or surgical biopsy were conducted as deemed clinically necessary and all patients who had a malignant diagnosis by pathology were entered into this analysis.

## RESULTS

731 patients had all three imaging modalities as part of their diagnostic work up resulting in 180 malignancies confirmed by pathology: 29 ductal carcinoma in-situ, 110 infiltrating ductal carcinoma, 11 infiltrating lobular carcinoma, 9 papillary carcinoma and 21 mixed component malignancies. Mammography was positive in 130 (sensitivity = 72%) while ultrasound was positive in 114 (sensitivity = 63%) and BSGI was positive in 147 (sensitivity = 82%). Mammography and ultrasound were positive in 163 cases (sensitivity = 90%). BSGI provided positive findings for 177 malignancies resulting in a sensitivity of 98%. A breast MRI detected one lesion missed by the three modalities while two lesions were found by pathology alone

## CONCLUSION

Of the three imaging modalities, BSGI provided the highest independent sensitivity and when added to the diagnostic workup, BSGI detected an additional 14 malignancies, increasing the sensitivity from 90% to 98%. Although it is beyond the scope of this work, it is interesting to note that the cost of the BSGI procedure is relatively low, about \$320, and that in this population the BSGI specificity was 74%. In summary, when added to the diagnostic work up of patients in the community breast cancer, BSGI can improve the detection of breast malignancy when compared to mammography and ultrasound alone.

## CLINICAL RELEVANCE/APPLICATION

BSGI can improve the detection of breast malignancy when compared to mammography and ultrasound alone.

### **SSG01-07 • False Positive Findings on Adjunct Screening Molecular Breast Imaging with Tc-99m Sestamibi**

**Carrie B Hruska PhD** (Presenter) \* ; **Amy L Conners MD** ; **Katie N Jones MD** ; **Michael K O'Connor PhD** \* ; **Deborah J Rhodes MD**

## PURPOSE

To determine the rates and histopathologic subtypes of false positive imaging findings and benign biopsies generated from adjunct screening with molecular breast imaging (MBI).

## METHOD AND MATERIALS

Screening MBI was performed in asymptomatic women presenting for screening mammography who had dense breasts (>50% fibroglandular) on past prior mammogram. Intravenous injection of 8 mCi Tc-99m sestamibi was administered; bilateral 2-view MBI was performed using a dual-head CZT-based gamma camera. MBI studies were interpreted with access to the current screening mammogram

and assigned an assessment of 1-5 that parallels BI-RADS. Assessment of 3 or higher was considered test positive. Participants with negative reference standard (benign biopsy result or negative/benign imaging at one year) were analyzed.

#### RESULTS

Of 1638 eligible participants, 1578 (96%) had complete reference standard, of which 1557 had no diagnosis of cancer. In 1557 participants with negative reference standard, 105 (6.7%) had test positive screening MBI and were recalled for diagnostic workup. Of these 105, 70 (67%) were resolved with benign findings on immediate diagnostic mammogram/ultrasound and follow-up MBI at 6 months. Final impressions included: stable background uptake (24) or resolved focal uptake (16); appearance of fibrocystic change (14), fibroadenoma (5), lymph node (3), post-operative change (4), or stable mass (2); and previously biopsied papilloma (2). The remaining 35 of 105 (33%) underwent biopsy: ultrasound-guided in 26, magnetic resonance imaging-guided in 7, and stereotactic in 2. Pathologic findings included fibroadenoma (11), benign breast parenchyma (6), fibrocystic change (5), papilloma (4), radial scar (3), stromal fibrosis (2), pseudoangiomatous stromal hyperplasia (2), atypical ductal hyperplasia (2).

#### CONCLUSION

For non-cancer cases, adjunct MBI had a recall rate of 6.7% and benign biopsy rate of 2.3%. The most common false positive imaging finding was benign background uptake of Tc-99m sestamibi in fibroglandular tissue; the most common biopsied benign lesion was fibroadenoma.

#### CLINICAL RELEVANCE/APPLICATION

MBI demonstrated a relatively low additional false positive rate compared to that reported for other modalities under consideration for supplemental screening in the dense breast.

### SSG01-08 • Improved Diagnostic Yield in Dense Breasts with Supplemental Screening Molecular Breast Imaging

**Deborah J Rhodes MD (Presenter) ; Carrie B Hruska PhD \* ; Amy L Connors MD ; Katie N Jones MD ; Michael K O'Connor PhD \***

#### PURPOSE

We previously demonstrated that addition of Molecular Breast Imaging (MBI) using 20 mCi Tc-99m sestamibi to screening mammography (SM) increased diagnostic yield for breast cancer in dense breasts (supplemental yield of 7.5/1000 screened). After implementing radiation dose reduction techniques, we are comparing performance of incident SM and prevalent screen MBI in women with dense breasts.

#### METHOD AND MATERIALS

Women presenting for SM with heterogeneously or extremely dense breasts on past prior SM were enrolled and underwent digital SM and MBI. MBI was performed with 8 mCi Tc-99m sestamibi and dual-head cadmium zinc telluride detectors. SMs were read independently; MBIs were read in comparison with SM. MBIs were assigned an assessment score of 1-5 which parallels BI-RADS; scores of 3-5 on MBI were considered positive.

#### RESULTS

In 1651 women enrolled, 1578 (96%) completed imaging and had reference standard of pathology findings within 365 days or negative imaging at >300 days. In 1578 analyzable participants, 21 had breast cancer diagnosed. Sensitivity was 5/21 (24%) for SM alone and 19/21 (91%) for the combination of SM and MBI. Diagnostic yield was 3.2 for SM and 12.0 for the combination (p = 0.0001). Diagnostic evaluation was prompted by SM alone in 174 (11%) patients and by the combination in 280 (18%). Biopsy was prompted by SM in 21 (1.3%) patients and by the combination in 67 (4.3%). The number of breast cancers diagnosed per number of biopsies (PPV) was 24% for SM and 28% for combination. Specificity was 88% for SM alone and 82% for the combination (p = 0.0001). Fourteen patients had cancer detected only on MBI: 4 ductal carcinoma in situ (DCIS); 8 invasive ductal carcinoma (IDC); and 2 invasive lobular carcinoma (ILC); median pathologic tumor size was 12 mm, range 4-62 mm. Three of 14 were node positive. The 4 MBI occult cancers were node negative and included 1 DCIS, 1 IDC, and 2 ILC; median pathologic tumor size was 6 mm, range 3-7 mm. Two patients had cancers detected on neither modality, including a 6 mm ILC detected on MRI and a 7 mm ILC detected on prophylactic mastectomy.

#### CONCLUSION

Low dose MBI as an adjunct to SM in women with dense breasts provided a supplemental yield of 8.8 per 1000 with a modest decline in specificity.

#### CLINICAL RELEVANCE/APPLICATION

The supplemental yield of adding screening MBI to SM in women with dense breasts is preserved at a lower administered dose of 8 mCi Tc-99m sestamibi.

### SSG01-09 • Background Parenchymal Uptake of Tc-99m Sestamibi on Molecular Breast Imaging in Mammographically Dense Breasts

**Carrie B Hruska PhD (Presenter) \* ; Amy L Connors MD ; Katie N Jones MD ; Deborah J Rhodes MD ; Michael K O'Connor PhD \* ; Celine M Vachon \***

#### PURPOSE

Background parenchymal uptake (BPU), or uptake of Tc-99m sestamibi in normal fibroglandular tissue (FT), has been observed on molecular breast imaging (MBI). We describe categories of BPU and examine associated factors, including mammographic density.

#### METHOD AND MATERIALS

Screening MBI exams between April 2010-March 2012 from women with BI-RADS D3/D4 density on last mammogram were reviewed. Participants with breast implants or cancer diagnosed at screening were excluded. BPU intensity was subjectively categorized by two radiologists as photopenic (uptake in FT < subcutaneous fat), mild (uptake in FT = fat), moderate (uptake in FT up to 2x fat), or marked (uptake in FT > 2x fat). Association of BPU with age, current BI-RADS mammographic density, menopausal status, and use of hormonal medications was examined.

#### RESULTS

In 1274 screening MBI exams, BPU was photopenic in 273 (21%), mild in 826 (65%), moderate in 136 (11%), and marked in 39 (3%). Moderate/marked BPU occurred in 31% (99/315) of women age 40-49 compared to 8% (76/959) of women age 50 and older (p

#### CONCLUSION

Moderate/marked BPU occurred more often in denser breasts and in women who were younger, pre- or perimenopausal, or on exogenous hormones. In each density category, substantial proportions of both moderate/marked and photopenic BPU were observed, establishing that similar-appearing FT on mammography can demonstrate considerable differences in BPU on MBI.

#### CLINICAL RELEVANCE/APPLICATION

BPU may reflect underlying functional activity of mammographically dense tissue. Additional studies are needed to determine if BPU can help predict an individual's density-related breast cancer risk.

### Breast - Tuesday Posters and Exhibits (12:15pm - 12:45pm)

Tuesday, 12:15 PM - 12:45 PM • Lakeside Learning Center



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## LL-BRS-TU1A • Breast Cancer Phenotype and Ki67 Status Influence the Diagnostic Performance of MRI in Prediction of Response to Neoadjuvant Chemotherapy

Enida Bufi (Presenter); Paolo Belli MD; Marialuisa Di Matteo; Antonio Cipriani; Melania Costantini MD; Lorenzo Bonomo MD

### PURPOSE

The estimation of response to neoadjuvant chemotherapy (NAC) is useful for the surgical decision in breast cancer. We addressed the diagnostic reliability of conventional MRI vs. Diffusion Weighted Imaging (DWI) according to different tumor subtypes, including HER2 positive/HR positive (Hybrid phenotype), and to Ki 67 expression.

### METHOD AND MATERIALS

Two-hundred-twenty-five patients underwent MRI before and after NAC, including morphological assessment (RECIST classification) and DWI with apparent diffusion coefficient (ADC). The complete pathological response  $\diamond$  pCR (outcome variable) was assessed (Mandard classification).

### RESULTS

### CONCLUSION

The diagnostic reliability of MRI in predicting the response to NAC depends on the tumor phenotype and on Ki 67 expression. Care must be taken when establishing by MRI the pCR status in the Luminal and Hybrid subgroups and in patients with lower Ki 67 expression. In these cases, calculation of the ADC may facilitate the diagnosis.

### CLINICAL RELEVANCE/APPLICATION

Conventional MRI has limited diagnostic reliability in specific patients categories (Luminal/Hybrid subgroups and lower Ki67 expression); DWI may be helpful in these cases.

## LL-BRS-TU2A • Positive Predictive Value of Foci and Influences of Background Parenchymal Enhancement

Sheetal M Bhalani MD (Presenter); Dipti Gupta MD; Sonya Bhole MD; Ellen B Mendelson MD \*

### PURPOSE

A strong association between increased MR imaging background parenchymal enhancement (BPE) and breast cancer risk has been proposed in the literature (King et al). As the positive predictive value (PPV) of biopsied foci in the literature is highly variable, we sought to study the PPV of foci at our institution as well as to identify whether BPE influences the positive biopsy rate of foci.

### METHOD AND MATERIALS

This IRB approved retrospective HIPAA compliant study included 325 MRI guided core biopsies performed on patients who underwent MRI for extent of disease and high risk screening between March 2012 and February 2013. Original MRI reports were reviewed for study indication, type of enhancing lesion (focus, mass, or non mass enhancement), BPE, location, and kinetics. Pathology reports were reviewed for biopsy results. Information was organized and analyzed in Excel.

### RESULTS

61/325 MRI guided core biopsies were recommended for suspicious foci. Benign pathology was demonstrated in 49/61 (80.3%) lesions, high risk surgical lesions were identified in 7/61 lesions (11.5%), and malignancy was identified in 5/61 lesions (8.2%). 3/5 malignant lesions were ipsilateral to the index lesion and 4 /7 high risk lesions were ipsilateral to the index lesion. 0/10 foci biopsied in high risk screening patients were positive. Of the 38 foci in minimal or mild BPE, 3 (7.8%) lesions were malignant and 2 were high risk surgical lesions. Of the 23 foci in moderate or marked BPE, 2 (8.6%) lesions were malignant and 5 were high risk surgical lesions. Visually assessed kinetic patterns were not significant predictors of carcinoma.

### CONCLUSION

Positive predictive value for enhancing foci at our institution is low at 8.2% and even lower when the focus is in the contralateral breast (3.2%). Although increased BPE has been suggested to be an important risk factor, our study demonstrated that the malignancy rate of foci is not significantly different in minimal/mild BPE compared to mod/marked BPE.

### CLINICAL RELEVANCE/APPLICATION

Given the low positive predictive value of foci in the contralateral breast (3.2%), short interval MRI imaging follow up could be considered if supported by a larger sample size.

## LL-BRS-TU3A • Analyzing Spatial Heterogeneity in DCE-MRI Parametric Maps to Optimize the Prediction of Therapeutic Response in Breast Cancer

Xia Li (Presenter); Lori R Arlinghaus PhD; Anuradha Bapsi Chakravarthy MD \*; Richard G Abramson MD \*; Vandana G Abramson MD, MS; Jaime Farley; Thomas Yankeelov PhD \*

### PURPOSE

To determine if analyzing the spatial heterogeneity in quantitative DCE-MRI pharmacokinetic parametric maps after the first cycle of treatment can improve the ability to separate pathologic complete responders (pCRs) from non-pCRs in breast cancer patients undergoing neoadjuvant chemotherapy (NAC).

### METHOD AND MATERIALS

33 patients underwent DCE-MRI at baseline ( $t_1$ ) and after one cycle of NAC ( $t_2$ ). At surgery, 12 patients were pCRs and 21 patients were non-pCRs. The DCE-MRI data were analyzed with the extended Tofts-Kety model which returned the efflux constant ( $k_{ep}$ ). The histogram of  $k_{ep}$  at  $t_2$  was analyzed through the leave-one-out method as follows: 1) select one patient, 2) compute the Euclidean distance between the patient's  $k_{ep}$  histogram and the histogram obtained from all tumor voxels of the non-pCRs ( $d_{non-pCR}$ ), and between the patient and the histogram obtained from the pCRs ( $d_{pCR}$ ), 3) define the patient as  $\diamond$ non-pCR  $\diamond$  if  $d_{non-pCR} < d_{pCR}$ , otherwise define as  $\diamond$ pCR  $\diamond$ , 4) repeat the procedure for all patients. The Wilcoxon rank sum test and receiver operator characteristic (ROC) analysis were performed to determine the ability of the  $k_{ep}$  histogram at  $t_2$  to predict treatment response. The  $k_{ep}$  maps at  $t_1$  and  $t_2$  were then spatially registered to determine the voxels which displayed an increased  $k_{ep}$  from  $t_1$  to  $t_2$ . Those voxels were selected and the corresponding histograms were again analyzed using the same method described above.

### RESULTS

Without registration, the histogram of  $k_{ep}$  at  $t_2$  can separate the pCRs significantly ( $p = 0.007$ ) and predict treatment response with an area under the ROC curve of 0.75. After registration, the ability of the  $k_{ep}$  histogram to predict treatment response was improved ( $p = 0.001$ , AUC = 0.80). The sensitivity, specificity, accuracy, and precision were 83%, 67%, 73%, and 59%, respectively, before registration. Those statistical values improved to 83%, 76%, 79%, and 67% after registration.

### CONCLUSION

The quantitative DCE-MRI parameter  $k_{ep}$  can predict pCR in breast cancer patients after the first cycle of NAC. After serial registration, the histograms of the spatially registered data improve the ability to differentiate between eventual responders and non-responders.

### CLINICAL RELEVANCE/APPLICATION

Analysis of the spatial heterogeneity of early changes in DCE-MRI data are able to improve the ability to predict complete pathologic response in breast cancer patients after the first cycle of therapy

## **LL-BRS-TU4A • Can the Low Energy Mammogram Done during Contrast-enhanced Digital Mammography Replace Standard Mammography?**

**Mark A Francescone MD (Presenter) ; Maxine S Jochelson MD ; D. David Dershaw MD ; Janice S Sung MD ; Mary Hughes MD ; Chaya Moskowitz ; Junting Zheng ; Elizabeth A Morris MD**

### **PURPOSE**

To compare the low energy contrast-enhanced digital mammography (CEDM) image done after intravenous iodine injection to standard mammography.

### **METHOD AND MATERIALS**

This was an IRB approved HIPAA compatible study. Low-energy CEDM images of 170 breasts in 88 patients (6 unilateral mastectomies) were compared to standard digital mammograms performed within 6 months. Images were qualitatively assessed side-by-side by a non-blinded reader. The following parameters were tabulated: posterior nipple line to pectoral muscle (PNL) distance; compression force on the MLO projection; compression thickness on the MLO projection. Wherever possible, the following additional parameters were tabulated: the number or extent of dominant calcifications; the size of masses, asymmetries, or distortions. Parameters were summarized using median, range, mean and standard deviation (SD). A mixed linear regression using a generalized estimating equation (GEE) method was performed to examine whether each parameter was different between two imaging techniques. Fisher's exact test was used to compare the count of calcifications. To assess agreement between two image techniques, intra class correlation coefficient (ICC) along with the 95% confidence interval (95%CI) were estimated for continuous measurements, and kappa statistics were estimated for the count of calcifications.

### **RESULTS**

No qualitative difference or statistical difference was found in any of the image parameters between the two imaging techniques. The two techniques had excellent agreement on compression thickness; PNL distance; calcification size or extent; and mass, asymmetry or distortion size (ICC range from 0.817-0.997). The count of calcifications perfectly agreed between two image techniques (kappa = 1.000). There was slight agreement on compression force (ICC = 0.287).

### **CONCLUSION**

The same equipment and technical settings are used in both studies, and the Kedge of iodine is above the kV of the low energy CEDM. As expected, low energy CEDM images demonstrate excellent agreement with standard digital mammography despite the prior administration of intravenous contrast, and could be used for routine breast imaging.

### **CLINICAL RELEVANCE/APPLICATION**

Since there is no substantial difference between the images, low energy CEDM could replace the standard mammogram.

## **LL-BRS-TU5A • Adjunct Diagnosis of Dual-energy Contrast Enhanced Subtracted Mammography in Women with Dense Breasts: Interobservers Blind Reading Analysis**

**Yun-Chung Cheung MD (Presenter) ; Yu-Ching Lin MD ; Yung-Liang Wan MD ; Pei-Chin Huang ; Kee-Min Yeow ; Yung-Feng Lo MD ; Hsiu-Pei Tsai ; Shir-Hwa Ueng ; Chee-Jen Chang**

### **PURPOSE**

Dense breast parenchyma potentially obscures a breast lesion. This study was to analyze the adjunct diagnosis of dual-energy contrast enhanced subtracted mammogram (CESM) in dense breasts.

### **METHOD AND MATERIALS**

Reviewed 156 CESM examinations from Feb/2012 to Dec/2012, 89 cases with BIRADS 3 or 4 dense breasts were enrolled for the study. CESM of bilateral breasts was standardized performed with sequence of craniocaudal views and mediolateral oblique views respectively within 2 to 3 minutes and 3 to 6 minutes after bolus contrast medium injection (rate= 3 ml/sec, dose= 1.5 ml/kg). Four radiologists with different experiences of mammographic reporting (29 years, 17 years but quit in recent 5 years, 6 years and 2 years) blindly read the Mx alone, and then followed with CESM. Suspicious benign (BIRADS 1,2,3) and malignancy (BIRADS 4,5) were individually classified in cases. Sensitivity, specificity and accuracy of diagnosis were statistically analyzed, as well as the learning curve by generalized estimating equation for logistic regression model.

### **RESULTS**

Total 100 lesions (28 benign lesions and 72 breast cancers) had histologic proved. Averagely, enhancement was observed in 96.87% cancers and 44.64% in benign lesions. Combining with CESM improved cancer diagnosis in 19.82% sensitivity (71.47% to 92.7%), 16.07% specificity (51.78% to 67.85%) and 19.82% accuracy (65.93% to 85.75%) as comparing to Mx. The diagnosis consistency of interobservers was much higher in MX + CESM than Mx alone (0.6235 VS 0.3869 by kappa ratio). The probability of correct prediction would be achieved from 80% to 90% after 75 consecutive case readings.

### **CONCLUSION**

CESM high-consistently improved the sensitivity, specificity and accuracy in dense breasts than Mx alone. Benign contrast enhancement was occasionally present, however the diagnosis prediction could be mended by a loaded cases reading.

### **CLINICAL RELEVANCE/APPLICATION**

Additional CESM is easily learned to improve the cancer diagnosis in dense breasts, with high consistency in wide-ranged mammographic experiences.

## **LL-BRS-TU6A • Breast Density and Its Correlation with Invasive Breast Cancer Prognostic Indicators**

**Gary Esses BS (Presenter) ; Shabnam Jaffer MD ; Janet R Szabo MD ; Steven J Esses MD ; Emily B Sonnenblick MD ; Neesha Patel ; Laurie R Margolies MD**

### **PURPOSE**

To determine the correlation between dense breasts (DB) and invasive breast cancer prognostic indicators

### **METHOD AND MATERIALS**

IRB approved retrospective review identified 159 women > 30 who were diagnosed with an invasive breast cancer within 2 years of receiving a mammogram. Density data from the mammogram reports were divided into dense (BI-RADS 3 and 4) and not dense (BI-RADS 1 and 2) categories and correlated with pathological characteristics of the tumors in these women. The pathology characteristics were taken from pathology reports of biopsies and tumor resections and included estrogen, progesterone and her2 receptor status. Additionally, the stage of the tumors was determined using TNM data from the pathology reports.

### **RESULTS**

Median age at diagnosis for invasive cancer was 61 years (range 33-89). 67/93 (72%) patients in the not dense category and 40/66 (61%) in the dense category were diagnosed with stage 1 cancer. The remaining patients 26/96 (28%) in the not dense category and 26/66 (39%) in the dense category had Stage 2 or greater cancer. Her2 receptor positivity was positively correlated with the dense group (p=0.003). Tumors that were both Her2 and estrogen receptor positive were also positively correlated (p=.023) with the dense group. There was no statistically significant association with the dense group and positive receptor status for the estrogen receptor (p=0.092) or positive receptor status for the progesterone receptor (p=0.863).

### **CONCLUSION**

Patients with dense breast tissue (BI-RADS 3 and 4) who are diagnosed with invasive cancer have poorer prognostic indicators than patients who are not dense (BI-RADS 1 and 2). Dense breast patients are more likely to be diagnosed with a cancer more advanced than

stage 1 and are more likely to have tumors positive for her2 and estrogen receptors, a sign of poor prognosis, than not dense breast patients.

#### CLINICAL RELEVANCE/APPLICATION

As those with DB are detected with cancer at later stages and with poor prognostic indicators, additional screening methods might help women with DB achieve the full benefit of early detection.

### **LL-BRS-TU7A • Dedicated Dual-Head Molecular Breast Imaging (MBI) as an Adjunct to Mammography in Patients with Dense Breast Tissue and/or Elevated Risk for Breast Cancer**

**Robin B Shermis MD (Presenter) ; Keith D Wilson MD**

#### PURPOSE

Purpose: The aim of this study was to retrospectively evaluate the potential benefits of dedicated dual-head molecular breast imaging (MBI) as an adjunct in patients with difficult mammograms due to dense breast tissue and/or elevated risk of developing breast cancer.

#### METHOD AND MATERIALS

Materials and Methods: MBI was performed on patients with mammographically dense breast tissue and/or elevated risk of developing breast cancer. Patients ranged in age from 33-88 with an average of 53.7 years. Menopausal status was reported on 80 patients. Breast density was BI-RADS D3 or D4 (breast density > 50%) in 89% (79 of 94) making mammography interpretation difficult. Risk assessment was calculated in 83 of 95 patients using modified GAIL model, 29% (28 of 83) were high to very high risk (>15% increased risk). All of the patients underwent bilateral MBI scanning after intravenous injection of 8mCi Tc-99m- sestamibi. Imaging acquisition was initiated within 5 minutes using the LumaGEM dual head, planar, solid state digital system with cadmium zinc telluride (CZT) technology. Standard cranio-caudal and medio-lateral oblique views of each breast were obtained.

#### RESULTS

Results: Of the 100 patients assessed, evaluation was done on 94, 6 were excluded, 5 who had known breast cancer, and 1 subject whose MBI was non-diagnostic. Of the 94 subjects evaluated, 5 had cancer (two on mammography, five on MBI). The number of breast cancers diagnosed per number of biopsies performed was 12% (2 of 17) for mammography and 29% (5 of 17) for MBI. 78 had negative MBI exam, of those 24 were high risk or very high risk for developing breast cancer (>15% increased risk), 49 had dense to extremely dense breast tissue (BI-RADS D3 or D4 -breast density > 50%), 22 were both high risk and had dense breast tissue. 16 patients were clinically symptomatic, 15 of which had mammographic density 3 or 4 making mammography difficult to interpret. MBI was able to resolve these as negative in all 16 symptomatic patients.

#### CONCLUSION

Conclusion: MBI is an effective adjunct imaging modality in problem solving for patients who present with very dense breast tissue and/or elevated risk of developing breast cancer.

#### CLINICAL RELEVANCE/APPLICATION

MBI enables practitioners to expand their armamentarium in the fight to detect breast cancer while at the same time containing cost.

### **LL-BRE-TU8A • A Customizable Breast Phantom for Practicing Interventional Procedures Utilizing 3D Printing Technologies and Materials Engineering**

**Ramin Javan MD (Presenter)**

#### PURPOSE

The purpose was to develop a customizable breast phantom for practicing ultrasound-guided biopsies and cyst aspirations as well as stereotactic biopsies and needle localizations.

#### METHOD AND MATERIALS

Autodesk 3D Studio Max was used to design a mold of the left breast. A grid with a radial pattern was also designed representing a clock-face with holes that were each one-centimeter apart radially. Cysts were created using latex finger cots filled with colored water. Masses of high or low echogenicity were created by injecting sodium alginate solution mixed with food coloring with or without hydrogel particles into calcium chloride solution. The breast parenchyma was made with ballistic grade gelatin after being poured into the breast mold that was 3D printed using ceramic material. Ceramics were used to allow for easy separation of the breast model from the mold after congealing. The grid was 3D printed using polyamide material, which allows for high level of detail and rigidity. The masses and cysts were then mounted onto the tip of long needles of varying length, which had been passed through the desired holes of the grid. This process allows for a coordinate of clock-face, anteroposterior distance from the chest wall and radial distance from the nipple for each mass or cyst. The grid was then placed onto the mold in an upside-down fashion, submerging the masses and cysts into the gelatin before it was placed in cold temperature. Particles of gypsum were also used at the tip of some needles for simulating breast calcifications.

#### RESULTS

A dual-modality customizable breast interventional phantom was successfully created using a combination of 3D printing and materials engineering techniques. A limitation is the use of gelatin, which is not durable and multiple passages of biopsy needles leave air tracks behind, creating artifacts for subsequent use. As an alternative, polyvinyl alcohol (PVA) cryogel can be implemented for a more durable model. This, however, requires a controlled set of freeze-thaw cycles of dissolved fully-hydrolyzed PVA, which can be cumbersome.

#### CONCLUSION

Models for practicing ultrasound and stereotactic breast interventional procedures may be created using 3D printing techniques and a variety of low-cost materials.

#### CLINICAL RELEVANCE/APPLICATION

Trainees can use this model as a bridge to performing procedures on actual patients. This can also be used in hands-on workshops or for examining purposes.

### **LL-BRE-TU9A • Seeing through the Fog: A Review of the Hot Topic of Breast Density**

**Phoebe E Freer MD (Presenter)**

#### PURPOSE/AIM

(1) To bring the radiologist up-to-date with evidence suggesting density as a risk factor for cancer; (2) To review the evidence for screening dense breasts including mammography, ultrasound, MRI, and emerging modalities; (3) To give the radiologist a context and increased understanding of this hot topic to be able to appropriately respond to recent legislative changes in many states (including California, Connecticut, Texas and Florida) regarding breast density.

#### CONTENT ORGANIZATION

This review will define breast density and correlate breast density with pathology and the historical perspective. Evidence discussing breast density as a risk factor for breast cancer will be reviewed. Screening literature will be reviewed with a focus on density for different modalities, including mammography, ultrasound, and MRI. The review of the evidence will include DMIST, ACRIN 6666 as well as the emerging evidence of newer modalities such as automated whole breast ultrasound, nuclear medicine, and tomosynthesis. A review of the recent state legislation will focus on the evidence to support these legislative changes. Future questions and need for further studies will be proposed.

#### SUMMARY

The radiologist will improve their understanding of the current hot topic, and will be better able to respond to questions from patients,

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### LL-BRS-TU1B • MR Imaging of Breast before and after Neoadjuvant Chemotherapy: Does Breast Parenchymal Enhancement in the Contralateral Normal Breast Change after Chemotherapy?

**Akiko Shimauchi MD (Presenter)** ; **Hiroyuki Abe MD** ; **Federico Pineda BS** ; **David V Schacht MD** ; **Charlene A Sennett MD** ; **Gillian M Newstead MD \*** ; **Kirti M Kulkarni MD**

#### PURPOSE

To investigate the change of breast parenchymal enhancement (BPE) on MRI, in the contralateral normal breast of patients who received neoadjuvant chemotherapy (NAC) for breast cancer.

#### METHOD AND MATERIALS

20 patients with breast cancer (mean age, 57 years; age range, 35-87 years) treated with NAC who had pre-chemo and post-chemo (pre-surgery) MRI between Jan 2010 and Jan 2012 were reviewed retrospectively. BPE of the contralateral normal breast was analyzed using Dynacad. Regions of interest (ROIs) were traced manually on pre and 5 dynamic T1WI post contrast series, at the same 4 locations of the normal breast on pre-NAC and post-NAC scans. Average relative increase in intensity (%) compared to the intensity on precontrast images within the ROIs was obtained at each of the 5 post contrast time points, and the values from the 4 ROIs were averaged to give a single mean relative signal increase per scan. The effect of NAC on the change of BPE was evaluated using the student *t* test. Change in categorical scales (minimal, mild, moderate or marked) to rate BPE by radiologists was also evaluated, using the Chi-square test. Subgroup analysis based on menopausal status (premenopausal (n=8), postmenopausal (n=12)) was performed.

#### RESULTS

The average relative signal increase at the 5 time points were 15.2, 31.1, 39.7, 46.2 and 50.5% on pre-NAC scans, and 5.7, 14.9, 20.1, 23.4 and 26.2% on post-NAC scans. Statistically significant differences were found at all time points ( $p=0.013, 0.002, 0.001, p$  In both premenopausal and post menopausal subgroups, a statistically significant decrease in average relative signal increase was found at the 2nd through 5th time points.

#### CONCLUSION

BPE in the contralateral normal breast showed a statistically significant decrease after NAC compared to pre-NAC scans, both in early and delayed postcontrast images. The significant decrease was seen regardless of menopausal status.

#### CLINICAL RELEVANCE/APPLICATION

Evaluation of functional changes in breast tissue due to NAC may improve the understanding of the influence of NAC on hormonal levels and hemodynamics in pre and post menopausal breast cancer patients

### LL-BRS-TU2B • Frequency of Malignancy and Imaging Characteristics of Probably Benign Lesions Seen on Breast MRI

**Andy Anderson MD** ; **Sujata V Ghate MD (Presenter)** ; **Jay A Baker MD \*** ; **Sora C Yoon MD**

#### PURPOSE

To evaluate BI-RADS 3 MRI lesions and accurately characterize them using the latest BI-RADS MRI lexicon.

#### METHOD AND MATERIALS

We retrospectively reviewed breast MRI exams with final assessment of probably benign (BI-RADS 3) from among 4,279 consecutive breast MR exams performed between Jan. 2005 and Dec. 2009. Studies with at least 2-years follow-up imaging confirming stability or resolution of lesion and cases with biopsy confirmation were included. Cancer yield was compared to imaging characteristics.

#### RESULTS

Of 4,279 breast MR exams, 282 (6.6%) with 332 lesions were assessed as BI-RADS 3. 280 lesions [121 (43.2%) foci, 84 (30.0%) masses and 74 (26.4%) non-mass enhancements (NME)] had adequate follow up. 12 of 280 lesions were malignant with a cancer yield of 4.3%. One (0.4%) lesion was characterized as nipple retraction and skin thickening. Foci were characterized as multiple (at least 3) or individual (fewer than 3). None of the 52 cases of multiple foci were malignant regardless of kinetics. Of 69 individual foci, 3 (4.3%) were malignant, including 1.9% (1 of 53) with persistent kinetics and 12.5% (2 of 16) with plateau or washout kinetics (ns;  $p=0.13$ ; Fischer Exact test). Among all NME labeled probably benign, 5.1% (3 of 61) with persistent enhancement were malignant compared with 18.8% (3 of 13) with plateau or washout kinetics which approached statistical significance ( $p=0.06$ ). NME was further characterized as symmetric vs asymmetric. No cases (0 of 16) of symmetric NME were malignant compared with 10.5% (6 of 58) of asymmetric NME (ns;  $p=0.22$ ). Among asymmetric NME, 6.4% (3 of 47) with persistent enhancement were malignant compared with 27.3% (3 of 11) with plateau or wash-out kinetics (ns;  $p=0.075$ ). For 84 masses assigned BI-RADS 3, 3.4% (2 of 61) demonstrating persistent, 0% (0 of 14) plateau, and 11.1% (1 of 9) washout kinetics were malignant (ns;  $p=0.37$ ).

#### CONCLUSION

The 4.3% risk of malignancy for these MR BI-RADS 3 lesions is slightly higher than the accepted 2% risk for mammographic lesions. Results suggest kinetics should be considered when assigning BI-RADS 3 final assessment, particularly for foci and NME, although a larger sample size could confirm these findings.

#### CLINICAL RELEVANCE/APPLICATION

Further knowledge of imaging characteristics and outcomes of BI-RADS 3 lesions on breast MRI could help determine which lesion features are appropriate for placement into this category.

### LL-BRS-TU3B • Using Compression Sonoelastography to Monitor Neoadjuvant Chemotherapy of Breast Cancer

**Katerina A Busko (Presenter)** ; **Andrey V Mishchenko MD** ; **Vladislav Semiglazov MD, MMedSc** ; **Tatyana Y Semiglazova MD** ; **Veronika V Klimentko**

#### PURPOSE

of this study was to evaluate the capabilities of sonoelastography to monitor neoadjuvant chemotherapy of breast cancer and to determine correlation between reduction stiffness of cancer and grade of pathology response.

#### METHOD AND MATERIALS

Compression sonoelastography was performed after the conventional sonography. The elasticity image was evaluated by using the scoring system described by Itoh et al. and for all lesions the Strain-Ratio (StR) was calculated. Statistical analysis was performed using the 'Statistics' 6.1.

A total of 36 women were included in the group. The measurement of maximum diameter and stiffness values of breast cancer were calculated three times: before treatment, after 2 cycles of chemotherapy and after finishing the treatment. The response of breast cancers to neoadjuvant chemotherapy was evaluated by using the histological grading system described by I.D. Miller.

RESULTS

CONCLUSION

CLINICAL RELEVANCE/APPLICATION

Compression sonoelastography, strain-ratio, neo-adjuvant chemotherapy, breast cancer.

#### **LL-BRS-TU4B • Initial Experience with a Breast Computed Tomography Guided Biopsy System (BCT-GBx) for Cone Beam Breast CT (CBBCT)**

**Posy J Seifert** DO (Presenter) ; **Renee Morgan** RT ; **Andrea L Arieno** BS

PURPOSE

To prove the efficacy of using a BCT guided breast biopsy bracket system for lesion retrieval in phantom and subject studies.

METHOD AND MATERIALS

Under IRB approval, 45 phantom biopsy studies were performed using the BCT-GBx bracket system. This consisted of small, medium, and large phantoms with 50%/50% glandular and adipose background composition. Each phantom contained 10 masses and 5 calcification clusters of varying sizes. All phantoms were biopsied under both BCT and stereotactic guidance following an imaging protocol. Post biopsy imaging was performed in all cases to confirm lesion retrieval. Dose comparison for phantom imaging was recorded for both modalities. After successful completion of phantom studies, 4 subjects consented to have breast lesions biopsied with the BCT-GBx bracket system. Subject data consisted of breast density, lesion characterizations, size, imaging-pathologic concordance and results of open surgical biopsy if performed.

RESULTS

Phantom mass and calcium retrieval was 100% for both BCT-GBx and stereotactic biopsy, evidenced by a specimen radiograph. Dose was found to be equivalent to or less than the standard stereotactic approach. Four subjects with masses; with an average size of 3.4 cm (range 2.3 to 4.8 cm), were successfully biopsied and had pathology results concordant with imaging.

CONCLUSION

Initial experience with BCT-GBx bracket system has shown to be equivalent to stereotactic biopsy in phantom studies with equivalent or decreased dose. Preliminary BCT subject biopsies show concordance to imaging.

CLINICAL RELEVANCE/APPLICATION

Breast CT is a new technology that may identify lesions not seen by other imaging modalities; CT guided breast biopsy may be necessary for diagnosis.

#### **LL-BRS-TU5B • Cone Beam Breast Computed Tomography (CBBCT) on Breast Cancer Assessment**

**Lu Yin** MD (Presenter) ; **Zhao Xiang Ye**

PURPOSE

METHOD AND MATERIALS

This study was performed from October 2012 to March 2013. 28 patients with pathologically confirmed breast cancer were studied. All patients met the inclusion criteria and were enrolled under an IRB approved study protocol. The CBBCT exam was performed after FFDM. 6 patients had contrast-enhanced CBBCT (CE-CBBCT). The CBBCT and FFDM images were reviewed separately. Patient demographics, breast density, lesion type, size on CBBCT and FFDM were recorded. Vessels around the lesion on CBBCT and CE-CBBCT were evaluated and the ?CT number (CT number difference between CBBCT and CE-CBBCT) were recorded. The accuracy of CBBCT and FFDM in breast cancer diagnosis and the detection of masses (ill-defined, lobulated and speculated), and calcifications were compared with Chi-square test.

RESULTS

There was no statistically significant difference in detecting breast cancer between CBBCT and FFDM ( $p > 0.05$ ). The difference between CBBCT and FFDM in the detection of lobulated masses and calcifications had no statistics significance ( $p > 0.05$ ). There were statistically significant differences in detecting ill-defined and speculated masses on two modalities ( $p$

CONCLUSION

CBBCT can provide high quality 3D images to visualize various manifestations of breast cancer and accurate localization of the lesions. Vessels around the lesions can be clearly displayed in the 3D space to help with the diagnosis of breast cancer. CE-CBBCT could be used to further help with breast cancer diagnosis and evaluating extent of disease.

CLINICAL RELEVANCE/APPLICATION

CBBCT can provide high quality 3D images without compression of the breast with radiation dose comparable to FFDM.

#### **LL-BRS-TU6B • Effect of Reduced Radiation Dose on Breast Density Estimation in Digital Mammography: Data from the ACRIN 4006 Trial**

**Despina Kontos** PhD (Presenter) ; **Jae Y Choi** DPhil ; **Brad M Keller** PhD ; **Emily F Conant** MD \* ; **Andrew D Maidment** PhD \*

PURPOSE

Accurate breast density estimation is becoming increasingly important for personalized breast cancer screening recommendations. We investigate the feasibility of obtaining reliable density measures from digital mammograms acquired at reduced radiation dose.

METHOD AND MATERIALS

Bilateral, raw digital mammography (DM) images (Selenia, Hologic Inc.) from the ACRIN 4006 trial were retrospectively analyzed. For each exam, one set of DM images was acquired with standard dose, while another was acquired with about 15% reduction relative to the standard dose, per ACRIN 4006 protocol. Breast density was measured quantitatively with fully-automated FDA-cleared software (Quantra v.2.0, Hologic, Inc.), including BIRADS density, area percent density (PD%), and volumetric percent density (VD%). The agreement between BI-RADS density categories from standard-dose and low-dose images was estimated using Cohen's weighted

kappas. Linear regression and the Pearson correlation were used to test agreement for the continuous PD% and VD% estimates between standard-dose and low-dose mammograms.

#### RESULTS

Seventy-four image sets, each from a different study participant, were available for analysis (a total of 592 bilateral CC and MLO images). High agreement ( $k=0.87$ , 95% CI 0.83-0.91) was observed for BIRADS density estimates from standard-dose and low-dose mammograms. The correlation between standard-dose and low-dose PD% and VD% was  $r=0.94$  ( $p=0.95$ ) ( $p$   $R^2$  values of the linear regression for PD% were  $0.95\pm 0.01$ ,  $1.41\pm 0.48$ , and  $0.90\pm 0.04$ , respectively; while for VD% were equal to  $0.92\pm 0.02$ ,  $0.86\pm 0.23$ , and  $0.90\pm 0.02$ , respectively).

#### CONCLUSION

Our results show strong agreement between density estimates from standard-dose and low-dose digital mammograms acquired at a 15% reduction of radiation dose. This suggests that reliable density estimation is feasible from images obtained at reduced dose. Larger studies are needed to validate these findings at lower radiation dose levels.

#### CLINICAL RELEVANCE/APPLICATION

Reliable density estimates at lower radiation dose could be used for purposes such as evaluating response to risk-reduction interventions and triaging women to the most appropriate screening modality

### LL-BRS-TU7B • Breast Cancer Staging: Comparison of Whole-body Hybrid MR/PET and PET/CT Imaging: Initial Experience

**Onofrio A Catalano** MD (Presenter) ; **Carlo Iannace** MD ; **Maria Lepore** MD ; **Alexander R Guimaraes** MD, PhD \* ; **Bruce R Rosen** MD, PhD \* ; **Dushyant V Sahani** MD ; **Peter F Hahn** MD, PhD \* ; **Mark Vangel** PhD ; **Angelo Luongo** ; **Emanuele Nicolai** ; **Andrea Soricelli** MD ; **Marco Salvatore** MD

#### PURPOSE

To compare the diagnostic staging performance and SUV measurement accuracy of whole-body hybrid MR/ PET with PET/CT in patients with breast cancer.

#### METHOD AND MATERIALS

In this prospective IRB approved study, 23 consecutive patients with breast cancer underwent whole-body hybrid FDG PET/CT (Gemini TF, Philips) and same day MR/PET (Biograph mMR, Siemens). PET/CT and MR/PET studies were independently evaluated by two readers. Attenuation correction of MR/PET images was performed with Dixon sequences. The tumor with the highest FDG uptake (primary cancer or metastases) -to-liver SUV ratios were calculated and compared between PET/CT and MR/PET.

#### RESULTS

#### CONCLUSION

MR/PET imaging of breast cancer is feasible and provides diagnostic image quality in the assessment of the primary cancer and of possible metastases. MR/PET did not understage any patient when compared to PET/CT. Similar lesion characterization and tumor stage were found in comparing PET/CT and MR/PET images in 18/23 patients.

#### CLINICAL RELEVANCE/APPLICATION

MR/PET might represent an innovative and valid tool for accurate staging of breast cancer patients.

### LL-BRE-TU8B • Imaging Presentation of Variant Breast Diseases on Contrast-enhanced Tomosynthesis: Comparison with Conventional Breast Imaging Techniques and Correlation with Histology Results

**Chia-Ling Chiang** (Presenter) ; **Chen-Pin Chou** MD \*

#### PURPOSE/AIM

At the end of this review, radiologists will be familiar with

- 1) the common imaging features of variant breast diseases on conventional digital mammography, breast tomosynthesis, contrast-enhanced mammography, contrast-enhanced breast tomosynthesis, and MR images, and histology correlation,
- 2) the advantage and disadvantage of different contrast-enhanced breast imaging modalities.

#### CONTENT ORGANIZATION

The common features of imaging presentation of variant breast diseases on contrast-enhanced mammography and tomosynthesis, comparison with conventional non-enhanced mammography, tomosynthesis, and MR imaging, and correlation with histology results.

- benign (fibroadenoma, fibrocystic disease, radial scar and tubular adenoma),
  - malignant (DCIS, invasive lobular carcinoma, and invasive ductal carcinoma), and
  - premalignant (atypical ductal hyperplasia, atypical lobular hyperplasia) breast lesions are reviewed.
- The advantages and disadvantages of different contrast-enhanced breast imaging modalities are discussed.

#### SUMMARY

Contrast-enhanced mammography and tomosynthesis are new-developed diagnostic tools that provide information acquisition including 3D morphology, microcalcification and vascularity of suspicious breast lesion in one modality.

### LL-BRE1147-TUB • MRI Appearance of Breast Cancer Treated with Neoadjuvant Chemotherapy (NAC): Influence of Receptor Status and Pathologic Residual Cellularity

**Kirsten Gaarder** MD (Presenter) ; **Kirti M Kulkarni** MD ; **Jeffrey Mueller** MD ; **Hiroyuki Abe** MD ; **Charlene A Sennett** MD ; **David V Schacht** MD ; **Akiko Shimauchi** MD ; **Gillian M Newstead** MD \*

#### PURPOSE/AIM

- To review the influence of receptor profile and residual cellularity on MRI findings in breast cancer patients undergoing neoadjuvant chemotherapy (NAC).
- To better identify patients showing residual invasive cancer post-NAC despite no or minimal enhancement on MRI and to understand factors influencing this rad-path discrepancy.
- To better delineate extent of residual disease and determine appropriate surgical treatment post NAC.

#### CONTENT ORGANIZATION

1. 10 cases of breast cancer will be shown with pre- and post-NAC MRI and histopathologic images.
2. Differences in imaging response associated with different receptor profiles and patterns of pathologic response to therapy will be reviewed.
3. Pathologic staging of post-NAC breast cancers will be discussed.

#### SUMMARY

Major teaching points:

1. Some breast cancers become less cellular post NAC without significantly decreasing in size. These cancers may have no or minimal contrast enhancement on MRI. Evaluation of non-subtracted contrast and delayed images is of increased importance in order to evaluate the extent of residual tumor.
2. ER+Her2- cancers more often have subtle imaging findings after treatment as compared to triple negative and Her2+ cancers.

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**BOOST: Breast-Case-based Review (An Interactive Session)**

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**Tuesday, 03:00 PM - 04:15 PM • S103CD**

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**RO** **OI** **BR**

**MSRO36 • AMA PRA Category 1 Credit™:1.25 • ARRT Category A+ Credit:1.5**

**Co-Director**

**Fergus V Coakley, MD**

**Co-Director**

**Bruce G Haffty, MD**

**Moderator**

**Bruce G Haffty, MD**

**Sharad Goyal, MD**

**Liane E Philpotts, MD \***

**Brigid Killelea, MD**

**LEARNING OBJECTIVES**

1) To present diagnostic imaging, radiation oncology and surgical issues in the workup and selection of breast cancer patients being considered for breast cancer treatment, focusing on nodal management issues. 2) To understand the surgical approach in the primary and neoadjuvant setting in patients being considered for sentinel node biopsy or axillary dissection, and how this affects the radiotherapy approach. 3) To improve knowledge and understanding of appropriate imaging evaluation of the regional lymphatics in these various clinical scenarios. 4) To apply these principles in the surgical, imaging, and radiotherapeutic management of several practical cases of patients being considered for breast cancer treatment, focusing on the regional nodal evaluation and management.

**ABSTRACT**

Regional nodal evaluation and management is undergoing rapid change due to implementation of neoadjuvant systemic therapy and sentinel node sampling, and evolving evidence regarding the benefit of regional nodal irradiation. There remain controversies regarding the appropriate management of patients, imaging issues, surgical issues and radiotherapeutic approach in the evaluation and management of the regional lymphatics, both in the primary treatment of breast cancer, in the neoadjuvant therapy setting, and in the setting of local-regional recurrence. In this panel a surgeon, diagnostic radiologist and radiation oncologist will discuss several cases being considered for regional nodal evaluation and management. Appropriate workup, surgical approach and radiation approach for each case will be discussed. The panelists will present the most recent information on controversies in the surgery, diagnostic imaging and radiation therapy in managing the regional lymphatics in patients with breast cancer.

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**Breast Imaging (Screening and Density)**

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**Tuesday, 03:00 PM - 04:00 PM • Arie Crown Theater**

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**DM** **BR**

**SSJ01 • AMA PRA Category 1 Credit™:1 • ARRT Category A+ Credit:1**

**Moderator**

**Emily F Conant, MD \***

**Moderator**

**Martin J Yaffe, PhD \***

**SSJ01-01 • Patient Awareness of Breast Density and Interest in Supplemental Screening Tests for Women with Dense Breasts among Women at a County Hospital Compared to Women at an Outpatient Radiology Clinic of an Academic Medical Center**

**Jennifer Trinh MD ; Long Trinh MD (Presenter) ; Kevin K Lee MD ; Haatal B Dave MD, MS ; Kei Hanafusa MD ; Jafi A Lipson MD**

**PURPOSE**

We compared patient awareness of breast density and interest in supplemental screening tests for women with dense breasts among women obtaining screening mammograms at a county hospital compared to at an outpatient radiology clinic of an academic medical center.

**METHOD AND MATERIALS**

Over a three month period, a nine question survey was given to 153 women at a county hospital prior to their screening mammogram appointments. Surveys were available in English, Spanish, and Vietnamese. Women were asked if they were aware of their breast density. They were then informed about the decreased sensitivity of mammography in dense breast and the association between dense breasts and cancer risk. They were asked about their interest in and willingness to pay for additional screening tests such as whole breast ultrasound and contrast enhanced spectral mammography if they had dense breast. The Student's test (two tailed) was used to compare the survey results with the responses obtained from a similar survey conducted at an outpatient radiology clinic.

**RESULTS**

5% of women (6 out of 132) were aware of their breast density compared to 24% (25 out of 105) at the outpatient radiology clinic (p

**CONCLUSION**

Both populations have an interest in knowing their breast density and in additional screening studies despite false positives. However, women receiving care at the county hospital are less willing to incur out-of-pocket expenses in contrast to their counterparts at the outpatient radiology clinic. This study demonstrates the potential disparity in healthcare if supplemental screening tests are not covered by insurance.

**CLINICAL RELEVANCE/APPLICATION**

Five states require radiologists to inform patients of their breast density. With the exception of one state, coverage for additional screening tests remains a medical and political debate.

**SSJ01-02 • The Relationship of Breast Density in Mammography and Magnetic Resonance (MR) Imaging in Women at High Risk for Developing Breast Cancer and Women with Breast Cancer**

**Freya Schnabel MD ; Jennifer Chun MPH ; Marissa L Albert MD,MSc (Presenter) ; Jiyon Lee MD ; Shira Schwartz ; Linda Moy MD**

**PURPOSE**

Mammographic breast density (BD) is associated with a 4 to 6-fold increased risk for developing breast cancer. Background parenchymal enhancement (BPE) in MRI has also been correlated with breast cancer risk. The purpose of our study was to evaluate the relationship between BD, BPE, and FGT (assessment of fibroglandular tissue with contiguous MR images) in women with breast cancer (BC) and at high risk (HR) for developing breast cancer.

**METHOD AND MATERIALS**

From January 2010 to February 2013, 475 women enrolled in our longitudinal databases and underwent mammography and MRI at our

institution. Variables included age, BD, BPE, FGT, family history of breast cancer (FHBC), BRCA status, atypical hyperplasia (AH), and lobular carcinoma in situ (LCIS). BD was defined by ACR classifications 1-4. FGT was assessed on a similar scale. BPE was categorized as minimal, mild, moderate, or marked. Statistical analyses included Pearson's Chi Square, Fisher's Exact Tests, and logistic regression.

#### RESULTS

A total of 403 (85%) women had BC and 72 (15%) were at high risk for developing BC. In the HR group, the etiology of breast cancer risk (FHBC, BRCA status, AH, and/or LCIS) had no relationship to BD, FGT, and BPE. In the BC group, there was also no relationship between background risk factors with BD, FGT, and BPE. However, when we compared the HR and BC groups, we found that BD ( $p=0.0005$ ), BPE ( $p$

#### CONCLUSION

Increased BD, BPE and possibly FGT are seen in women with breast cancer when compared with high risk women. This suggests that women with dense breasts and increased BPE and FGT may be at an increased risk of developing breast cancer. The odds ratios in our analysis may give a sense of the magnitude of risk that may be useful in improving quantitative breast cancer risk assessment models.

#### CLINICAL RELEVANCE/APPLICATION

As BD, BPE, and FGT may be associated with breast cancer, our study supports the need to include them as risk factors in developing better quantitative and individualized risk assessment models.

### SSJ01-03 • Younger Women with Breast Cancer Show Highest Risk from Increased Density Together with Abnormal Density Regression with Age

**Nicholas M Perry MD (Presenter) ; Stephen W Duffy ; Sue E Milner BSC ; Kefah Mokbel MD ; Katja Pinker-Domenig MD**

#### PURPOSE

To assess whether the link between quantitatively measured breast density and associated cancer risk differs between younger and older women, and if so, could this relate to differing patterns of density regression with age in breast cancer patients compared to healthy controls.

#### METHOD AND MATERIALS

282 histopathologically verified breast cancer cases (age range 30-83) and 317 healthy controls matched by date of birth, age at examination and laterality of mammogram used for density determination were included in this IRB approved retrospective study. All breast cancer cases and healthy controls underwent FFDM with breast density measured separately on MLO and CC images using an automated volumetric breast density measurement system (Hologic, Quantra). For each cancer case, the contralateral mammogram was used. Breast density as percentage (%) of fibroglandular tissue was analysed by Quantra. After log transformation we performed polynomial regression to assess the age effect on breast density risk in cases and controls.

#### RESULTS

Breast cancer patients showed higher mammographic density than controls up to the age of 50. Healthy controls demonstrated a significant decline in log % density with age following a linear pattern resulting in the equation:  $[\log(\text{density}) = 3.6926 - 0.0126 \times \text{age}]$ . In breast cancer patients there was a significant departure from linearity, and a term in the square of age was required, as follows:  $[\log(\text{density}) = 5.6531 - 0.0822 \times \text{age} + 0.0006 \times \text{age}^2]$ . Both the coefficient for age and that for the square of age were highly significant ( $p$

#### CONCLUSION

Conclusion The data suggest that automated volumetric breast density measurement is predictive of breast cancer risk in younger women from the age of 30 and that the risk of breast cancer may be related to an altered pattern of density regression with age

#### CLINICAL RELEVANCE/APPLICATION

Younger women are at highest risk of density-associated breast cancer and early estimation of density may be useful in offering enhanced screening to some.

### SSJ01-04 • Correlation of Breast Cancer Incidence with Breast Density as Assessed by an Automated Assessment Tool in the TOMMY Trial

**Fiona J Gilbert MD (Presenter) ; Oliver Morrish ; Richard Black MS ; Lorraine Tucker ; Paula Willsher ; Stephen W Duffy**

#### PURPOSE

To assess the relationship of breast density and breast cancer in a UK screening population.

#### METHOD AND MATERIALS

Women recalled to assessment following routine National Health Service breast screening and women attending family history screening were recruited into the UK tomosynthesis trial - TOMMY Trial (A comparison of TOMosynthesis with digital MammographY). Volumetric breast density (Vbd) was measured from the 2D full field digital mammography (FFDM) images of both breasts using an automated assessment tool (Quantra, Hologic Inc.). The relationship between breast density, age (in 10 year age bands) and cancer incidence was assessed. Pathology reports were used to confirm cancer cases.

#### RESULTS

Volumetric breast density (Vbd) of 5,713 women aged 34-85 was examined. Density ranged from 1% - 47% with mean Vbd of 11.21% across the cohort. The mean Vbd decreased with each increasing decade: 30-39: 21.42%; 40-49: 13.57%; 50-59: 11.09%; 60-69: 9.34%; 70-79: 8.87%; 80-89: 8.86%. The table shows the percentage of women with cancer in each age band/density category (cancers/total cases). Using logistic regression, for all age groups, there was a significant trend in increasing probability of cancer with increasing density, after adjusting for age ( $p=0.004$ ). The age adjusted odds ratio for density 17-47 relative to 1-6 was 1.72 (95% CI 1.20-2.45). The trend did not differ significantly by age.

Analysis of data for the 40-49 FH screen cases and the 50-69 assessment cases show that there is a trend for cancer risk with increased breast density.

#### CONCLUSION

Breast density decreases with age as reported in the literature. Breast density is related to cancer incidence in the ages 40-69 year olds using this automated breast density technique, consistent with the findings of other studies using different density measures. However the FH sample is small with few cancers and the assessment cohort may not be representative of population breast density. Further work needs to be undertaken in terms of establishing which Quantra values should be used to define breast density.

#### CLINICAL RELEVANCE/APPLICATION

This automated breast density tool analysing 2D digital mammograms demonstrates a relationship with cancer risk.

### SSJ01-05 • The Complementary Roles of Breast Density and Parenchymal Texture in Breast Cancer Risk Assessment: A Case-Control Study with Digital Mammography

**Brad M Keller PhD (Presenter) ; Jinbo Chen PhD ; Yan Wang MSc, PhD ; Yuanjie Zheng ; James C Gee PhD ; Emily F Conant MD \* ; Despina Kontos PhD**

#### PURPOSE

Mammographic percent density (PD%) is a strong risk factor for breast cancer. We investigate if quantitative measures of parenchymal texture, which capture the local appearance and structure of breast tissue, can provide complementary information to PD% for breast cancer risk assessment.

#### METHOD AND MATERIALS

Contralateral, mediolateral oblique view digital mammography images from 106 women with unilateral invasive breast cancer and 318

age and side-matched controls were retrospectively analyzed. Breast PD% and a total of 24 parenchymal texture features, including histogram statistics (11), run-length (3), gray-level co-occurrence (7) and structure features (3) were extracted using validated software. Established risk factors for each woman's family history of breast cancer, ethnicity, age at menarche, parity, and number of biopsies were available via archived questionnaire. A logistic regression model with feature selection comprised of texture features adjusted for PD% and standard risk predictors was compared to a model with only standard risk factors and PD% as input variables. Area under the curve (AUC) of the receiver operating characteristic (ROC) was used to evaluate model performance. DeLong's test was used to compare the two models.

#### RESULTS

Standard risk factors and PD% alone have an AUC of 0.64 (p

#### CONCLUSION

Measures of breast parenchymal texture provide statistically significant, complementary information regarding a woman's risk for breast cancer, after adjusting for standard risk factors and breast PD%, potentially leading to improvements in breast cancer risk estimation.

#### CLINICAL RELEVANCE/APPLICATION

Breast cancer risk assessment may be improved by using measures of local parenchymal tissue texture and structure, in addition to breast density and standard demographic and reproductive risk factors.

### SSJ01-06 • Non-invasive Optical Assessment of Breast Density and Identification of High-risk Subjects

**Paola Taroni** PhD (Presenter) ; **Giovanna Quarto** PhD ; **Antonio Pifferi** PhD ; **Rinaldo Cubeddu** ; **Francesca Ieva** ; **Anna Maria Paganoni** ; **Francesca Abbate** MD ; **Nicola Balestreri** ; **Serena Ganino** ; **Simona Menna** ; **Enrico Cassano**

#### PURPOSE

Breast density is a strong independent risk factor for breast cancer. At present it is assessed through mammography, thus implying the use of ionizing radiation. The ability to non-invasively identify high-risk women could allow earlier design of personalized screening paths and preventive interventions.

Optical techniques can provide functional and structural information on tissue in absolutely non-invasive way. We exploited time domain diffuse optical spectroscopy to assess both tissue composition in terms of key constituents and scattering parameters that are related to the microscopic structure of tissue and specifically to breast density.

#### METHOD AND MATERIALS

Time domain multi-wavelength (635-1060 nm) optical mammography was performed on 147 subjects. Average breast tissue composition (water, lipid, collagen, oxy- and deoxyhemoglobin) and scattering parameters (amplitude and slope) were estimated using the diffusion approximation to the radiative transfer theory to model photon propagation in tissue.

Mammographic density was classified through BI-RADS categories.

To develop a procedure for the identification of high-risk women, the mammographic density was dichotomized, comparing subjects in BI-RADS categories 1 to 3 to subjects in category 4, and applying regression logistic analysis to the optically derived parameters.

#### RESULTS

An increase in BI-RADS category corresponds to increasing amounts of optically estimated water and collagen content, while lipid content decreases. A gradual increase is also observed in scattering amplitude and slope. Such observations are consistent with known differences in composition and microscopic structure between fatty and fibroglandular (dense) tissue.

The best regression logistic model for the risk probability resulted to depend on collagen content and scattering parameters. It provides a total misclassification error of 12.3%, corresponding to a simple kappa of 0.84, which compares favorably with the reproducibility of BI-RADS measures even intra-radiologist.

#### CONCLUSION

An optical tool was developed to assess non-invasively breast density, and provided promising initial results for the identification of high-risk subjects.

#### CLINICAL RELEVANCE/APPLICATION

The optical estimate of breast density is non-invasive, feasible in clinical practice, and could allow the design of more effective screening and preventive paths for high-risk subjects.

### ISP: Breast Imaging (Computed Tomography)

Tuesday, 03:00 PM - 04:00 PM • E450A



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SSJ02 • AMA PRA Category 1 Credit™:1 • ARRT Category A+ Credit:1

#### Moderator

**John M Boone**, PhD \*

#### Moderator

**Carl J D'Orsi**, MD \*

### SSJ02-01 • Breast Imaging Keynote Speaker: Breast CT

**John M Boone** PhD (Presenter) \*

#### PURPOSE

Breast CT is an emerging technology that will likely have a role to play in clinical breast imaging in the next few years. This RSNA Integrating Science and Practice (ISP) scientific session is the first to be dedicated exclusively to breast CT per se, and this reflects the advancements in breast CT technology as well as the growing catalog of widespread research imaging with prototype breast CT systems. In this introduction, a brief review of breast CT technology will be discussed to familiarize the audience with the capabilities and limitations of these systems.

### SSJ02-02 • Is Contrast Enhanced Dedicated Breast Computed Tomography Superior to Digital Breast Tomosynthesis and Digital Mammography in the Evaluation of BI-RADS 4 and 5 Breast Lesions?

**Shadi Aminololama-Shakeri** MD (Presenter) ; **Anita Nosratieh** ; **Karen K Lindfors** MD \* ; **John M Boone** PhD \*

#### PURPOSE

To compare the conspicuity of BIRADS 4 and 5 lesions on digital breast tomosynthesis (DBT), contrast enhanced breast CT (CEbCT) and digital mammography (DM).

#### METHOD AND MATERIALS

105 patients with 103 BIRADS 4 or 5 lesions were prospectively enrolled in our IRB-approved study. Patients had DM & DBT (14), DM & CEbCT (45), or DM, DBT & CEbCT (44). All lesions were biopsied. Patients received 100 ml of IV iodixanol 320 at a rate of 3 ml/s for CEbCT. 2 experienced radiologists independently assigned a conspicuity score (CS) of 0-10 for each biopsied lesion (0=not seen, 10=excellent conspicuity). Results are shown as mean CS+/-SD. Significant differences among conspicuity of lesions on DM, DBT & CEbCT (p

#### RESULTS

Of 103 breast lesions, 58 (56%) were malignant and 45 (44%) were benign. 27 (47%) of the malignant lesions were masses and 31

(53%) were calcifications. Of 45 benign lesions, 18 (40%) were masses and 27 (60%) were calcifications. Malignant masses were significantly more conspicuous on CEbCT than on DBT or DM (9.7+/-0.5 n=23 vs 7.0+/-2.9 n=13 and 6.9+/-2.7 n=27 respectively p < .001).

CEbCT and DBT are promising new techniques for detection of breast lesions. We show that CEbCT and DBT are similar to DM in detection of malignant calcifications and benign masses. But malignant masses are more conspicuous and benign calcifications are less conspicuous on CEbCT than DBT & DM. While these results favor CEbCT for detection of malignant masses in comparison to the other 2 modalities, the latter observation underscores the potential of decreasing false positive evaluations.

#### CLINICAL RELEVANCE/APPLICATION

DBT and CEbCT are emerging technologies showing promise as complementary tools to DM.

### SSJ02-03 • Is Lesion Depiction on Contrast Enhanced Dedicated Breast Computed Tomography Affected by Contrast Timing?

**Shadi Aminololama-Shakeri MD (Presenter) ; Peymon Gazi MS ; Karen K Lindfors MD \* ; John M Boone PhD \***

#### PURPOSE

Patients undergoing contrast enhanced dedicated breast computed tomography (CEbCT) have sequential imaging of both breasts following an intravenous injection of iodine based contrast material. This sequential scanning protocol with one breast imaged at a slightly more delayed time post contrast than the contralateral side has raised questions regarding lesion depiction. The goal of this study was to measure lesion depiction as a function of time after contrast injection.

#### METHOD AND MATERIALS

90 consecutive patients with BIRADS 4 or 5 lesions were prospectively enrolled. All patients had CEbCT after IV injection of 100 ml of iodixanol 320 at a rate of 3 ml/s, followed by core biopsy. Two experienced radiologists independently reviewed each study and assigned a conspicuity score (CS) of 0-10 for each biopsied lesion (0=not seen, 10=excellent conspicuity). A subset of patients (50) also had qualitative assessment of the background breast parenchymal enhancement, subjectively categorized into minimal, mild, moderate or marked by the readers and correlated to the early and late contrast delay times. Time from contrast injection to CEbCT imaging ranged from 70 to 492 sec. Contrast delay times of 70-95s were defined as early (n=73) and times ranging from 165 to 492s were defined as late (n=17). CS and delay times are shown as mean +/-SD. Significant differences among conspicuity of lesions in early versus late delay time groups (p < .05).

#### RESULTS

Breast lesions were equally conspicuous in the early and late contrast delay time groups with CS of 7.3 +/- 3.2, n=39 and 7.1 +/- 3.7, n=39 respectively. Background parenchymal enhancement categories were equally distributed with early and delayed contrast times. 83% (34/41) of breasts imaged at the early contrast time showed minimal/mild and 17% (7/41) showed moderate/ marked background parenchymal enhancement. 78% (7/9) of the breasts imaged at the late contrast delay time showed minimal/mild and 22% (2/7) showed moderate/ marked background parenchymal enhancement.

#### CONCLUSION

There is no correlation between conspicuity scores of BIRADS 4 and 5 breast lesions and contrast timing on CEbCT. Contrast time does not correlate with background parenchymal enhancement and does not affect conspicuity of breast lesions on CEbCT.

#### CLINICAL RELEVANCE/APPLICATION

CEbct lesion depiction is not contrast time dependent.

### SSJ02-04 • Dedicated High-resolution Breast CT Can Outperform Digital Mammography and Breast Tomosynthesis at Equivalent Dose Levels

**Willi A Kalender PhD (Presenter) \* ; Daniel Kolditz PhD \* ; Ann-Christin Roessler MSc ; Christian Steiding MSc \* ; Evelyn Wenkel MD ; Ruediger Schultz-Wendtland**

#### PURPOSE

There is general consensus that computed tomography (CT) can provide good soft-tissue discrimination and dynamic contrast-enhanced studies of the breast, but with insufficient spatial resolution and dose values exceeding the limits set for screening examinations. We re-evaluated if this assumption still holds true for an innovative high-resolution breast CT (bCT) system.

#### METHOD AND MATERIALS

We compared the performance of a bCT prototype (CT Imaging GmbH, Erlangen, Germany) to two clinical systems of two different manufacturers for each digital mammography (DM) and breast tomosynthesis (BT) with respect to detectability of the structures presented by the American College of Radiology (ACR) accreditation phantom. bCT examines one breast at a time with the patient lying prone on the patient bed without exposing the body trunk. The prototype employs a new cadmium telluride detector with 100  $\mu$ m pixel size, single photon counting electronics and close to 100% detection efficiency [Kalender WA et al. Eur Radiol 2012; 22(1):1-8]. The tests focused on the question if fibers down to 0.75 mm, masses down to 0.50 mm, and specks down to 0.24 mm were clearly distinguished as recommended by the ACR. Tests were also performed to determine image quality and dose. We did not add overlaying structures, which would be potentially confounding the ACR structures for DM and BT.

#### RESULTS

Acceptance testing for all 5 systems confirmed that they met the requirements for screening mammography; the bCT system provided better than 100  $\mu$ m spatial resolution at average glandular dose levels below 5 mGy. Measurements of the ACR phantom revealed the following: DM and BT showed fibers, masses and specks as required; bCT went beyond this and revealed even the finest structures presented in the ACR phantom, i.e. fibers of 0.4 mm, masses of 0.25 mm and specks of 0.16 mm.

#### CONCLUSION

Fully 3D high-resolution breast CT showed performance superior to DM and BT, even in the benevolent situation with no confounding structures superimposed. Smaller structures may have to be introduced in test phantoms to provide adequate tests for finer details.

#### CLINICAL RELEVANCE/APPLICATION

High-resolution breast CT appears to offer potential for superposition-free fully 3D imaging of the breast at improved detail resolution and dose levels accepted for screening procedures.

### SSJ02-05 • Cone Beam Breast Computed Tomography's Ability to Detect Mammographically Occult Lesions

**Posy J Seifert DO (Presenter) ; Andrea L Arieno BS ; Renee Morgan RT**

#### PURPOSE

To review lesions that were mammographically occult and imaged with cone beam breast Computed Tomography (CT) with or without contrast.

#### METHOD AND MATERIALS

From June 2008 to December 2012, 411 subjects were prospectively enrolled in 2 IRB approved studies; all had non contrast CT (NCCT) and 69 had contrast enhanced CT (CECT). 27 lesions in 25 subjects were considered to be mammographically occult at diagnostic work-up and are the basis of this study; all had NCCT and 18 also had CECT. Data recorded included subject demographics, method of detection, lesion characteristics, core biopsy pathology and open surgical pathology when applicable.

#### RESULTS

25 subjects with 27 lesions were determined to be mammographically occult but detected by diagnostic work-up; all were masses. Of the 27 lesions, 19 were detected by breast CT. Average lesion size at diagnostic work-up was 1.5cm (range 0.3 to 4cm). Average lesion size on breast CT was 1.4cm (range 0.3 to 4.5cm). Overall, 10 lesions were biopsy-proven malignant; 9 invasive and 1 non-invasive. Sixteen

lesions were biopsy-proven benign and 1 atypical. Eight lesions were mammographically occult and also CT occult, but found on ultrasound. One was biopsy proven invasive ductal carcinoma, one was atypical and 6 were biopsy proven benign. 8 mammographically occult lesions were detected by CT only; 6 seen on both NCCT and CECT, 1 only on CECT and 1 only on NCCT (this subject did not have CECT). After additional work-up, 5 were biopsy proven invasive carcinomas and 3 were benign. Two of the 5 malignancies were seen and biopsied with MRI, 2 were seen on MRI, but went directly to surgery; the fifth malignancy, seen only on CT, proceeded to surgery for final diagnosis. The 3 benign findings were seen and biopsied with US.

#### CONCLUSION

In this small study, breast CT (NCT and CECT) showed value in detecting mammographically occult lesions. CT detected 19 lesions that were not detected by mammography and additionally was able to detect one new lesion not detected on any other imaging. Out of all cancers in this cohort, only one was not seen by CT. This study showed that CT has the potential to have high sensitivity for the detection of breast lesions.

#### CLINICAL RELEVANCE/APPLICATION

Breast CT is a new imaging technology that may have a role in the detection of breast disease. In this small study cohort, breast CT demonstrated the ability to detect mammographically occult lesions.

### **SSJ02-06 • Clinical Application and Analysis of Contrast-enhanced Cone-beam Breast CT (CE-CBBCT) in Differentiating Benign and Malignant Breast Lesions**

**Peng Han MD, MBBS (Presenter) ; Zhao Xiang Ye**

#### PURPOSE

To evaluate the contrast enhancement and the optimal enhancement timing for contrast-enhanced cone-beam breast computed tomography (CE-CBBCT) in differentiating benign and malignant breast lesions.

#### METHOD AND MATERIALS

Twenty-one subjects were enrolled under an Institutional Review Board (IRB) approved study protocol in Tianjin Cancer Hospital, China, and had CE-CBBCT before biopsy and treatment. All subjects were female. They were between 36 and 68 years old with a median age of 52.2. The subjects received diagnostic mammography or ultrasound within two weeks and were categorized as BIRADS 4 or 5. The CE-CBBCT exam included one pre-contrast scan and two post-contrast scans (initiated at 40 seconds and 120 seconds from the start of injecting contrast material). All statistical analyses were performed in SPSS.

#### RESULTS

#### CONCLUSION

Both benign and malignant lesions had more enhancements at 120s than 40s after the contrast injection. Malignant lesions had more enhancement compared to benign lesions. CE-CBBCT may improve the conspicuity of breast lesions, detect minimal disease in the case of multiple lesions, and improve the early detection and diagnosis of breast cancer.

#### CLINICAL RELEVANCE/APPLICATION

Cone-beam breast CT is a dedicated breast CT with low radiation dose and short scan time. True three-dimensional breast image can be reconstructed after a circular scan of the breast.

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## **Breast Interventional Procedures**

**Tuesday, 04:30 PM - 06:00 PM • S406B**



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**RC415 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5**

### **RC415A • Stereotactically-guided Breast Biopsy**

**Cecilia L Mercado MD (Presenter)**

#### LEARNING OBJECTIVES

1) Understand the basis of performing stereotactically-guided breast biopsies. 2) Understand the practical use, indications, pitfalls and limitations of the procedural technique. 3) Demonstrate understanding of the importance of concordance and multidisciplinary management of results.

#### ABSTRACT

Stereotactically-guided breast biopsy has become a common procedure routinely used in the diagnosis of breast abnormalities. This discussion will review the basics of the procedural techniques and will focus on the indications and practical usage of stereotactically-guided breast biopsies. It will also detail troubleshooting techniques that may be useful while performing difficult cases; these include apparent lesion movement, targeting errors, targeting far posterior or superficial breast lesions and targeting lesions in the thin breast. Contraindications and pitfalls of the technique will be outlined, and limitations of the procedure will be elucidated. The discussion will also emphasize the importance of radiologic-pathologic concordance and the importance of a multidisciplinary approach to management of biopsy results.

### **RC415B • US-guided Biopsy**

**Mary C Mahoney MD (Presenter) \***

#### LEARNING OBJECTIVES

1) Discuss the types of US-guided breast intervention. 2) Review technical considerations related to US-guided intervention. 3) Describe post-biopsy management.

#### ABSTRACT

The proliferation of image-guided biopsies has been driven by the high levels of accuracy for percutaneous techniques, advantages over surgery, as well as a recognition that most lesions undergoing breast biopsy are benign and do not require surgery. US has emerged as the preferred guidance method for interventional procedures for several reasons. These include better patient tolerance, the speed with which the procedure can be performed, the benefit of real time visualization, greater accessibility to areas of the breast and axilla, lack of ionizing radiation, and lower cost.

### **RC415C • I-125 Seed Localization**

**Michelle D McDonough MD (Presenter)**

#### LEARNING OBJECTIVES

1) Understand procedural technique for I-125 seed localization utilizing mammographic and US guidance. Be able to describe advantages and disadvantages of I-125 seed localizations compared to conventional hookwire localizations. 2) Be able to describe advantages and disadvantages of I-125 seed localizations compared to conventional hookwire localizations. 3) Understand importance of an intergrated multidisciplinary approach and involvement in Nuclear Regulatory requirements.

## ABSTRACT

I-125 seeds are small radioactive sources measuring approximately 5mm that can be deployed thru a hollow needle. These seeds can be detected with a gamma probe in the operating suite and are therefore suitable to be placed for breast biopsy or lumpectomy localization for non palpable lesions. This discussion will focus on the advantages of implementing an I-125 seed localization program as compared to the use of a hookwire for localization of breast lesions for surgical excision including; no significant migration, uncoupling of the radiology and the surgery schedule, improved patient satisfaction and comfort, decreased tissue volume at time of surgery and an increased negative margin rate. Disadvantages to be detailed include; inability to place I-125 seeds under MRI guidance, significant restriction and hurdles to be overcome due to radiation safety concerns that vary widely between states and required integration between multiple specialties to track and retrieve seeds. Basic placement techniques will be reviewed using mammographic and ultrasonic guidance.

## High-Resolution Radionuclide Breast Imaging (An Interactive Session)

Wednesday, 08:30 AM - 10:00 AM • S505AB

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**NM** **BR**

**RC511** • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

### RC511A • Breast-specific Gamma Imaging: A Novel Approach to Breast Cancer Diagnosis

**Rachel F Brem MD** (Presenter) \*

#### LEARNING OBJECTIVES

1) To understand the principles of Breast Specific Gamma Imaging. 2) To understand the literature supporting the use of BSGI. 3) Understand the clinical uses of BSGI. 4) Understand how to integrate BSGI into a clinical breast imaging practice. 5) Understand how to biopsy lesions visualized with BSGI. 6) To review some of the ongoing developments in BSGI.

### RC511B • Positron Emission Mammography and Molecular Breast Imaging

**Wendie A Berg MD, PhD** (Presenter) \*

#### LEARNING OBJECTIVES

1) Understand currently approved uses of dedicated positron emission tomographic breast imaging ('positron emission mammography (PEM)'), including local staging, response to primary chemotherapy, and evaluation of possible recurrence. 2) Discuss areas for future research in high-resolution radionuclide breast imaging.

### RC511C • Algorithms in Breast Imaging

**Amy L Connors MD** (Presenter)

#### LEARNING OBJECTIVES

1) Identify strengths and weaknesses of breast MR, breast specific gamma imaging (BSGI)/molecular breast imaging (MBI) and positron emission mammography (PEM) in common diagnostic and screening settings. 2) Apply knowledge of MR and nuclear breast imaging techniques to determine appropriate use for specific indications including staging of known breast cancer, neoadjuvant chemotherapy response, evaluation of possible recurrence post-breast conservation therapy, and screening of patients at increased risk of breast cancer.

## ABSTRACT

## BI-RADS® Update and Challenge (An Interactive Session)

Wednesday, 08:30 AM - 10:00 AM • E450A

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**BR**

**RC515** • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

**Stamatia V Destounis**, MD  
**Edward A Sickles**, MD  
**Ellen B Mendelson**, MD \*  
**Constance D Lehman**, MD, PhD \*

#### LEARNING OBJECTIVES

1) Understand the use of the BI-RADS lexicon in describing lesions found on mammography, ultrasound, and MR imaging. 2) Utilize the appropriate BI-RADS assessment categories for mammography, ultrasound, and MR imaging. 3) To use the BI-RADS lexicon in everyday practice and issue meaningful, unambiguous breast imaging reports.

#### ABSTRACT

The subjective interpretation of breast lesions with mammography, ultrasound, and MR-imaging is difficult to evaluate and therefore difficult to improve. The medical audit is the only way to measure breast imaging performance in a manner that includes not only technical, but also interpretive capabilities of the system. The 'Breast Imaging Reporting and Data System' (BI-RADS) is a quality assurance tool, designed to standardize breast imaging reporting, reduce confusion in breast imaging interpretations, and facilitate outcome monitoring. Through a medical audit and outcome monitoring, the system provides important peer review and quality assurance data to improve the quality of patient care. The BI-RADS is the product of a cooperative effort between members of various committees of the American College of Radiology. The BI-RADS was first introduced in 1992 and has become a widely accepted tool all over the world. However, there is a need for continuous teaching of the BI-RADS classification because it is intended for use in everyday practice and should make it possible to issue meaningful, unambiguous breast imaging reports. This BI-RADS session has been organized to provide participants with an introduction to the most important sections of this system. These are the breast imaging lexicon for mammography, ultrasound, and MR imaging. Beside the theoretical background, participants will be trained and tested on how to apply the BI-RADS.

## Breast Imaging (Digital Breast Tomosynthesis Screening Outcomes)

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

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**DM** **BR**

**SSK01** • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

**Moderator**  
**Stephen L Rose**, MD \*  
**Moderator**  
**Margarita L Zuley**, MD

### SSK01-01 • Breast Cancer Screening Pre and Post-tomosynthesis: Comparison of Recall Rate, Biopsy Positive Predictive Value, and Cancer Detection Rate

**PURPOSE**

To compare the recall rate, biopsy positive predictive value, and cancer detection rate prior to and following the implementation of screening tomosynthesis.

**METHOD AND MATERIALS**

This retrospective analysis was IRB approved and HIPAA compliant. Results from all digital screening mammography exams performed without tomosynthesis from March through December 2011 and results from all digital screening mammography exams performed with tomosynthesis from March through December 2012 were reviewed. Diagnostic cases were excluded. All studies were interpreted by radiologists with fellowship training in breast imaging. Recall rates, biopsy positive predictive values, and cancer detection rates were determined. The biopsy positive predictive value was defined as the number of BI-RADS 4/5 biopsies positive for malignancy divided by the number of BI-RADS 4/5 cases that underwent biopsy. Cancer detection rate was calculated by dividing the total number of malignancies identified (including BI-RADS 3 cases undergoing biopsy that showed malignancy and high risk lesions at biopsy that were upgraded to malignancy at surgical excision) by the total number of screening exams. Statistical analysis was performed using a two-sample test of proportions.

**RESULTS**

A total of 11,818 patients underwent digital mammography screening and 11,794 patients underwent digital mammography plus tomosynthesis screening. The recall rate for the pre tomosynthesis group was significantly higher at 8.6%, compared with 6.0% for the tomosynthesis group (p

**CONCLUSION**

The addition of tomosynthesis to digital mammography in this screening population significantly reduced the recall rate without decreasing the biopsy positive predictive value or cancer detection rate.

**CLINICAL RELEVANCE/APPLICATION**

A 30% decrease in recall rate following the addition of tomosynthesis to mammography screening may result in decreased patient anxiety and healthcare costs.

**SSK01-02 • Implementing Digital Breast Tomosynthesis (DBT) in a Screening Population: PPV1 as a Measure of Outcome**

**Emily F Conant MD (Presenter) \* ; Fei Wan ; Mathew Thomas BS ; Marie Synnestvedt ; Susan P Weinstein MD ; Susan G Roth MD ; Despina Kontos PhD ; Anne Marie McCarthy ; Nandita Mitra**

**PURPOSE**

DBT has been reported to decrease both false positive recalls from screening and to improve cancer detection rates. The purpose of this study is to compare the impact of DBT on PPV1 in a prospective screening population.

**METHOD AND MATERIALS**

In October 2011, we began screening all of our patients with DBT and thus far, have imaged over 17,000 women. For the group and for each of six radiologists, all trained in DBT interpretation, the following metrics were compared for the 16 months of DBT screening and for the year prior of digital mammography (DM) screening: Total volume of cases read, recall volumes and rates, cancer detection rate and PPV1. PPV1 was defined as the proportion of positive screening mammograms (0, 4 or 5) from which cancer was diagnosed.

**RESULTS**

Thus far, outcome data for 15,633 women imaged with DBT have been compared to the prior year of 10,753 patients imaged with DM. The average recall rate for the group of 6 readers decreased from 10.40% to 8.78%. After generalized estimating equation based on adjustment to account for variability in the readers' volumes over time, the recall rate was significantly higher under DM versus DBT with an OR = 1.23, 95% CI: [1.07, 1.40](p=0.002). By reader, DM recall rates ranged from 15.32-5.72%; DBT recall rates ranged from 13.03-4.84%. 5 of the 6 readers decreased their recall rates; 1 reader had no change. Overall, the cancer detection rate increased from 3.51 to 5.24/1000 with DBT (p>0.05). 4 of the 6 readers increased their cancer detection rate; 2 readers had minimal decreases (both had decreases in recall). The one reader with an overall stable recall rate increased her cancer detection rate from 3.4 to 6.3/1000. The DM PPV1 for the readers ranged from 2.5 to 12.1%. With DBT, 5 of the 6 readers increased their PPV1 significantly (new range from 4.7 to 11.7%). 1 reader had no significant change in PPV1 but a slight drop in recall. The overall PPV1 increased for the group was from 4.1% to 6.0% (p=0.044).

**CONCLUSION**

The implementation of DBT in a large screening program demonstrated a reduction in recall rates and an increase in cancer detection rates that varied by reader. The balance of these outcomes for each reader, as measured by PPV1, showed significant improvements for 5 of 6 readers and stability for 1 reader.

**CLINICAL RELEVANCE/APPLICATION**

Screening outcomes as measured by PPV1 improved with DBT implementation in a large, prospective population.

**SSK01-03 • Recall Rates on Baseline Screening Mammography: Initial Experience Using Digital Breast Tomosynthesis (DBT)**

**Anabel M Scaranelo MD, PhD (Presenter) ; Karina Bukhanov MD ; Hadas Moshonov PhD ; Supriya R Kulkarni MD, DMRD ; Pavel Crystal MD**

**PURPOSE**

To determine differences in the recall rate between Digital Mammography with Breast Tomosynthesis (DBT) and standard 2D-view FFDM (2D) in baseline screening.

**METHOD AND MATERIALS**

REB approved study initiated March 2012 and lasting 362 days, informed consent obtained from all consecutive women scheduled for baseline mammography randomized to 2 clinical sites-teaching hospitals. One site performed DBT (Dimensions, Hologic, Bedford, MA) and the other 2D (Senograph 200D, GE Medical Systems, Milwaukee, Wis). Certified DBT radiologists reported all exams at both sites without the knowledge of the study. Recall rates were calculated for each site and stratified by lesion type, breast density and age. Fisher's exact tests used to determine statistically significant relationships

**RESULTS**

853 women, (90% screening and 10% diagnostic baseline mammography); n=451 site withDBT; n=402 site with2D. Of 451 women, 37% declined tomosynthesis, where 245 had screeningDBT. The mean age was 44.33 (ranged 26-71) in the group withDBT and 43.51 (ranged 26-79) with2D screening (n=364). The DBT group recall rate was 13.1% compared to 18.7% for 2D (p=0.066) with a trend to statistical significance. Recall rates stratified by lesion type demonstrated significantly lower recall rates for asymmetries (21.9% vs. 60.3%, p=0.0001) but not for calcifications (18.8% vs. 8.8%, p=0.198) when comparing DBT to 2D. There was no significant difference in distribution of breast densities between the two cohorts (p=0.459). Lower recalls in DBT for non-dense breasts showed statistical trend (p=0.0672): fatty breasts (5.5% vs. 23.5%, p=0.1774), scattered densities (12.5% vs. 20.13%, p=0.1568), heterogeneously dense (14.2% vs. 20.2%, p=0.2080), and extremely dense (15% vs. 5%, p=0.3216), (DBT vs 2D, respectively). There was no significant difference in the mean age of patients with or without recall (p=0.591). Lower recall rates using DBT: for women older than 50 years (13.5% vs. 19.6%, p=0.4646) and aged 26-49 years (12.9% vs. 18.4%, p=0.1305) (DBT vs. 2D respectively

**CONCLUSION**

A lower recall rate was found in the group of women undergoing DBT and the benefit using this technology for asymmetries was demonstrated

**CLINICAL RELEVANCE/APPLICATION**

Baseline DBT significantly reduces recall rates for asymmetries. Not receiving recall for additional views reduces women anxiety, less radiation when considered all additional views associated.

#### **SSK01-04 • Trends in Time to Interpretation of Tomosynthesis Based Screening Examinations with Increasing Experience**

**Per Skaane MD, PhD (Presenter) \* ; Ellen B Eben MD \* ; Ingvild N Jebesen \* ; Unni Haakenaasen MD \* ; Mona Krager MD \* ; Mina Izadi MD \* ; Gunnar Jahr \* ; Ulrika Ekseth MD \***

##### **PURPOSE**

Interpretation time using tomosynthesis (DBT) for breast cancer screening is longer than that required for FFDM. We assess trends in time to interpretation of tomosynthesis screening examinations during prospective batch readings as a function of radiologists' experience reading tomosynthesis.

##### **METHOD AND MATERIALS**

As an integral part of an ongoing prospective clinical trial we record time to interpretation of each case. Seven radiologists interpreted over 2000 examinations each. We computed the time to interpretation of these examinations as a function of their experience. We compared their interpretation time during the first and the last 200 cases and compared these times with the average time to interpretation of FFDM read similarly in a batch mode during the trial.

##### **RESULTS**

The average time to interpretation was 42.3 seconds for FFDM (over all cases). For the seven readers analyzed (reading between 2035 and 5532 tomosynthesis exams), average interpretation times for FFDM plus tomosynthesis were 84.5 +/- 24.5 seconds and 59.7 +/- 8.7 second during the first and last 200 cases, respectively (p

##### **CONCLUSION**

Interpretation time of tomosynthesis examinations is longer than that of FFDM. However it decreases with experience trending toward approximately 60 seconds after reading 2000 examinations.

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

Interpretation time with DBT decreases with experience approaching about 60 sec per exam after interpretation of 2000 examinations. DBT interpretation time is acceptable for high-volume screening.

#### **SSK01-05 • ACRIN PA 4006: Comparison of Dose in Digital Breast Tomosynthesis and Standard Two-View Mammography for Prospective Breast Cancer Screening**

**Mathew Thomas BS (Presenter) ; Yohei Matsutani ; Emily F Conant MD \* ; Andrew D Maidment PhD \***

##### **PURPOSE**

To compare the cumulative mean glandular dose (MGD) in digital mammography (DM) and digital breast tomosynthesis (DBT) in a prospective breast cancer screening trial.

##### **METHOD AND MATERIALS**

This trial compared cumulative dose per breast from two imaging scenarios: standard of care DM versus an image set of low-dose 2-view DM combined with 2-view DBT (Hologic Selenia Dimensions). A paired design was used so that each patient underwent both types of imaging. Low-dose 2-view DM and DBT was conducted at 15% reduced dose. The cumulative MGD was calculated in 495 women from exposure parameters of 2262 standard-DM and 1980 low-dose DM/DBT acquisitions. Extra views in standard-DM were obtained in some patients at clinical discretion. No additional low-dose DM/DBT views were obtained. To adjust for additional views in the standard-DM group, the mean dose of all standard-DM views was used for cumulative dose comparison. The following screening paradigms were defined: Standard DM (CC/MLO) vs. low-dose ACRIN-Limited (DM+MLO; DBT+MLO+CC), and low-dose ACRIN-Complete (DM+MLO+CC; DBT+MLO+CC). Comparison of MGD per breast between protocols was made by 2-sided paired t-test.

##### **RESULTS**

The ACRIN-Limited MGD at Site A and Site B were 4.94 mGy and 5.29 mGy, respectively. The ACRIN-Complete MGD was 6.35 mGy and 6.56 mGy at Site A and B, respectively. The standard-DM MGD was 4.81 mGy and 3.52 mGy at Site A and B, respectively. An additional 23.9% and 6.7% standard-DM views were obtained at site A and B, respectively. After adjusting for extra views, the standard-DM MGD was 3.85 mGy and 3.28 mGy at Site A and B, respectively. The ACRIN-limited MGD did not differ significantly from standard-DM at Site A (p=0.10) but was greater than standard-DM at Site B (p

##### **CONCLUSION**

Three-view, low-dose combination-DM/DBT screening is achievable at MGD comparable to the dose of routine screening mammography. The clinical use of additional standard-DM views significantly affects the cumulative MGD during routine breast cancer screening.

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

Prospective 3-view combination DM/DBT screening can be achieved at cumulative mean glandular dose comparable to those in standard mammography screening.

#### **SSK01-06 • Synthesized 2D Mammograms: A Review of Our First 100 Cases**

**Andres Alcazar Peral (Presenter) ; Olivia Benitez ; Carmen Estrada ; Slavina Mancheva ; Alejandro Tejerina ; Angeles Franco Lopez**

##### **PURPOSE**

Retrospectively, we compare synthesized 2D Mammograms combined with Digital Breast Tomosynthesis versus combination-mode imaging which include 2D Digital Full Field Mammography (DFFM) combined with Tomosynthesis.

##### **METHOD AND MATERIALS**

Two expert radiologists assessed 100 mammograms retrospectively in two different ways. The first aspect of interpretation consisted in using 3D Digital Tomosynthesis combined with 2D DFFM and the second one included 3D Tomosynthesis combined with reconstructed synthetic 2D Mammography. In both cases previous mammograms were provided and reviewed. All 100 mammograms were positive for some kind of findings; 69 patients were placed under BIRADS 2 category which showed lesions stable for two years, the rest 31 patients were classified as BIRADS 3, 4 or 5 with a proper histological correlation.

##### **RESULTS**

-In 97 cases nodules, microcalcifications and architectural distortions were diagnosed by both imaging techniques. - In 2 cases, the architectural distortion was the main finding and could only be detected with Digital 3D Tomosynthesis. - In 1 case, the architectural distortion was visualized on synthesized 2D Mammography and Tomosynthesis but not on conventional DFFM. -Most sites of architectural distortion, nodule's contours and calcifications were more visible with synthesized 2D Mammography than DFFM - Our radiologists felt more confident in the detection of microcalcification and architectural distortion using the synthetic mode of imaging. -The use of synthesized 2D Mammography improves the characterization of the lesions compared to FDDM

##### **CONCLUSION**

- Synthesized 2D Mammography has at least the same sensitivity as the conventional 2D mammography. -More clinical trials are needed to evaluate better the specificity of the synthesized 2D mammography in different kind of lesions. -As other studies show, Digital Breast Tomosynthesis combined with 2D Mammography has better sensitivity than 2D Mammography alone.

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

Digital 3D Breast Tomosynthesis and Synthesized 2D Mammography increase the mammograms' sensitivity and decrease the radiation dose compared to conventional 2D mammography and Tomosynthesis.

## SSK01-07 • Radial Scar: A Diagnostic Challenge in Breast Cancer Screening Using Tomosynthesis

**Per Skaane MD, PhD (Presenter) \* ; Randi Gullien RT \* ; Ellen B Eben MD \* ; Unni Haakenaasen MD \* ; Ingvild N Jebesen \* ; Mona Krager MD \* ; Jon Lomo MD**

### PURPOSE

Radial scar is a benign lesion presenting with distortion or spiculations on mammography that mimic cancer. Diagnosis requires open surgical biopsy. The purpose of the study was to analyse the number of mammographic findings later confirmed as radial scars on excisional biopsy in mammography screening comparing full-field digital mammography (FFDM) and combined FFDM plus digital breast tomosynthesis (DBT).

### METHOD AND MATERIALS

From Nov 22, 2010 to Dec 31, 2012 (one screening round), a total of 34,742 women attended an organized population-based screening program, of which 25,547 (73.5%) underwent FFDM plus DBT. All exams (bilateral CC and MLO views) were prospectively interpreted by 4 independent readers using a 5-point rating scale for probability of cancer. The trial had 4 arms: Arm A FFDM only; Arm B FFDM plus CAD; Arm C FFDM plus DBT; and Arm D synthetic 2D plus DBT. Women with distortion suspected by at least one of the 4 independent readers were discussed at arbitration meeting before decision to recall for assessment or not. Diagnostic work-up included additional mammographic views, ultrasound, MRI as problem-solver, and needle biopsy or diagnostic surgical biopsy, if indicated. Open surgical biopsy was carried out in women with highly suspicious distortion when malignancy was not confirmed at needle biopsy.

### RESULTS

A total of 31 radial scars were diagnosed at open surgery. One case having only FFDM (no DBT) was excluded in the comparison. Thus, at total of 30/25,547 (0.12%) of screened women with radial scar (♦ a false positive mammographic finding ♦) underwent surgical biopsies. In the 4 reading arms, the number of positive scores in these 30 women were: Arm A=7 (23%), Arm B=10 (33%), Arm C=25 (83%), and Arm D=23 (77%).

### CONCLUSION

Radial scars (♦ complex sclerosing lesions ♦) are much better demonstrated on tomosynthesis than on FFDM and consequently these lesions will be more commonly found using DBT. Breast lesions presenting as highly suspicious distortions need open surgical biopsy if needle biopsy does not confirm malignancy. The problem is, however, minor and diagnostic surgical biopsy was only necessary in 0.12% of women in this study.

### CLINICAL RELEVANCE/APPLICATION

The benefits of tomosynthesis in breast cancer screening including higher cancer detection rates outweigh the adverse effect of false positive mammographic findings caused by radial scars.

## SSK01-08 • Imaging and Histopathology Findings of Breast Lesions Detected by Tomosynthesis

**Laurie L Fajardo MD, MBA (Presenter) \* ; Limin Yang MD, PhD ; Jeong Mi Park MD**

### PURPOSE

To assess imaging characteristics, histopathology results, cancer detection rate and biopsy PPV3 for lesions detected only by digital breast tomosynthesis (DBT) when used in combination with 2D digital mammography (DM) in a general population-screening group.

### METHOD AND MATERIALS

Beginning September 2012, we offered DBT in addition to conventional DM to all women presenting for screening. To compare characteristics of lesions detected by DM with those detected additionally by DBT, we prospectively gathered information from biopsy recommendations for each, including: age, BI-RADS breast density rating, final BI-RADS assessment, lesion type and size, type of biopsy performed and histopathology outcomes. For all cancers diagnosed, the pathologic size, grade and lymph node status were ascertained.

### RESULTS

For 4350 women undergoing screening from 9/2012 through 3/2013, 50 biopsy recommendations were made, including 15 biopsies in 2610 women choosing to undergo DBT as part of their screening exam. Lesions recommended for biopsy by DM included: 19 calcifications of which 2 were invasive cancer, 5 DCIS and 12 benign; 14 masses of which 6 were invasive cancer and 8 were benign; and 2 focal asymmetries - both benign. Characteristics of DBT detected lesions recommended for biopsy included: 6 masses of which 5 were invasive cancers and 1 benign; and 8 architectural distortions of which 6 were invasive cancers and 4 were benign. All DBT detected lesions were visible by and biopsied using ultrasound guidance. The biopsy PPVs for 2D digital mammography and DBT were 0.37 and 0.73, respectively. Pathologically, cancers detected only by DBT comprised 7 invasive ductal carcinomas, 3 invasive lobular carcinomas and 1 mixed ductal-invasive carcinoma. A majority of DBT detected cancers were small (pathologic size: 5 = 10mm, 4 = 11-20mm, and 2 = 20mm); low or intermediate pathologic stage (6 = Elston-Ellis grade 1; 4 = grade 2; 1 = grade 3); and lymph node negative (9/11).

### CONCLUSION

Fifteen additional cancers (30% increase) were detected and PPVs improved by DBT when combined with DM in our screening population. Our early experience with suspicious lesions seen only by DBT indicates the majority are clinically significant and curable.

### CLINICAL RELEVANCE/APPLICATION

The addition of DBT to DM for screening improves cancer detection rate and biopsy PPV3 by detecting, additional small, early stage breast cancers beyond those detected by conventional DM.

## SSK01-09 • How Tomosynthesis Optimizes Patient Work Up, Throughput, and Resource Utilization

**Liane E Philpotts MD (Presenter) \* ; Vivek B Kalra MD ; Jacquelyn Crenshaw RT ; Reni S Butler MD**

### PURPOSE

To examine patient throughput with 3D mammography (tomosynthesis) versus 2D mammography for screening and diagnostic exams in terms of number of images obtained per exam and room/resource utilization at a dedicated breast center.

### METHOD AND MATERIALS

The number of mammogram exams for a one year period prior to (8/1/10 ♦ 7/31/11) and after (3/1/12 - 2/28/13) tomosynthesis introduction was retrospectively assessed. The number of screening and diagnostic exams performed on 3 digital mammography units (Selenia, Hologic, Bedford, MA) versus the same 3 digital mammography units plus one tomosynthesis unit (Dimensions, Hologic) were compared to determine volumes for individual units. Given that the number of views per screening case is similar, the number of images obtained per diagnostic case was retrospectively assessed over a one week period for the 2D cases (7/22/11-7/27/11) and the cases performed with tomosynthesis (3/4/13-3/9/13).

### RESULTS

For the one year prior to tomosynthesis, 9462 screening and 4611 diagnostic exams were performed on three digital mammography units, for a total of 14,073 exams, or 4,691 exams per unit. After the incorporation of tomosynthesis, 11,101 screening and 5357 diagnostic exams were performed for an overall increase to 16,438 total exams. On the single tomosynthesis unit, 7,913 screening and 3594 diagnostic exams were performed, for a total of 11,507 exams. The remaining 3188 screening and 1763 diagnostic exams were performed on the 3 remaining 2D units. Therefore, the single tomo unit handled 2.5 times more exams than the individual 2D units previously. The total number of views per diagnostic patient decreased 11% with tomosynthesis compared to 2D, from 4.6 to 4.1 views per patient. Spot views decreased 57%, from 0.97 to 0.42 views per patient with tomosynthesis compared to 2D, with a decrease of 67% for bilateral exams and 49% for unilateral exams.

### CONCLUSION

Tomosynthesis results in decreased number of images necessary per diagnostic case. Such expedited work up translates to better patient

throughput and resource utilization. Such information is important in factoring equipment purchases and resource scheduling.

#### CLINICAL RELEVANCE/APPLICATION

Tomosynthesis expedites patient diagnostic workup and results in better patient throughput and resource utilization.

## Breast Imaging: (Interventional Techniques and Radiology/Pathology Correlation)

Wednesday, 10:30 AM - 12:00 PM • E450A

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BR

**SSK02** • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

#### Moderator

**Susan P Weinstein**, MD

#### Moderator

**Roberta A Jong**, MD \*

#### Moderator

**Mary S Newell**, MD

**SSK02-01 • Should Flat Epithelial Atypia Identified on Stereotactic Core Needle Biopsy of Calcifications Be Excised?**

**Erin I Neuschler** MD (Presenter) ; **Alyssa Choate** MD ; **Megan Sullivan** ; **Ellen B Mendelson** MD \* ; **Elise E Saddleton** MD ; **Paula M Grabler** MD

#### PURPOSE

To assess the upgrade rate to malignancy for flat epithelial atypia (FEA) diagnosed on stereotactic core needle biopsy (SCNB) performed for calcifications and to determine if radiologic features or clinical history can be used to identify criteria for excision.

#### METHOD AND MATERIALS

An institutional review board-approved, HIPAA-compliant, retrospective review of 3919 consecutive SCNB procedures performed from 9/2008 through 12/2012 was performed. Pure FEA was present in 163 biopsies, with 146 biopsies included in the analysis. Biopsies excluded from the analysis comprised those from patients who did not have diagnostic mammography at our institution, calcifications associated with a mass or asymmetry or calcifications present in a patient with a known ipsilateral malignancy. Clinical data was collected from the patient's medical record. Mammographic imaging prompting biopsy was re-reviewed in a blinded fashion by two dedicated breast radiologists. The calcification and cluster morphology were assessed as well as stability of calcifications and extent of residual calcifications. Upgrade rate was determined by final excisional pathology. Correlation of clinical and mammographic characteristics with risk of upgrade was calculated using Chi-square and Fisher's exact tests.

#### RESULTS

98 out of 146 (67%) cases went to surgical excision at the study institution. Four of 98 cases of pure FEA demonstrated in-situ or invasive carcinoma upon excision, compatible with an upgrade rate of 4.1%. There was no significant association between personal history of breast cancer and upgrade. Likewise, there was no significant association between calcification and cluster morphology and upgrade.

#### CONCLUSION

The low upgrade rate of 4.1% for pure FEA demonstrated in this study suggests that mammographic follow-up may be a reasonable alternative to surgical excision for FEA diagnosed on SCNB for calcifications. To the authors' knowledge, this is the largest study evaluating upgrade of FEA detected on SCNB where all imaging prompting biopsy was re-reviewed.

#### CLINICAL RELEVANCE/APPLICATION

The low upgrade rate for pure FEA demonstrated in this study suggests that mammographic follow-up may be a reasonable alternative to surgical excision in patients with FEA detected on SCNB.

**SSK02-02 • Is the Risk of Malignancy at Surgery Greater When Flat Epithelial Atypia (FEA) and Lobular Neoplasia (LN) Are Found in Association at Biopsy?**

**Mona M El Khoury** MD (Presenter) ; **Isabelle Trop** MD, MPH ; **Lucie Lalonde** MD ; **Maude Labelle** MD ; **Julie David** MD

#### PURPOSE

1) To determine the frequency of malignancy at surgical excision of biopsy-proven pure FEA (2) to assess the significance of associated LN and residual microcalcifications at biopsy on the final upgrade at surgery.

#### METHOD AND MATERIALS

Retrospective review of 8907 core needle biopsies (CNB) (2009-2012) identified 110 cases of FEA (12%). Patients with associated atypical ductal hyperplasia (ADH) and ipsilateral breast cancer were excluded. Eighty-one women (mean age 54, range 38-80) of whom 5 had 2 biopsies were included. The 86 FEA lesions were pure or associated with LN in respectively 63/86 (73%) and 23/86 (27%). Overall, 63 (73%) lesions were excised and 23 (27%) were followed up (mean follow up 12 months).

#### RESULTS

Malignancy was documented at surgery in 9 /63 (14 %) patients (4 DCIS and 5 low-grade invasive cancers). The most frequent radiologic presentation was a cluster of microcalcifications (72/86 (84%) followed by a mass and distortion, in respectively 12/86 (14%) and 2/86 (2%). CNB was performed with a 10G vacuum-assisted device or a 14G spring-loaded needle in respectively 76/86 (88 %) and 10/86 (12 %) patients. The association of FEA with LN, the size of the cluster of microcalcifications and the presence of residual microcalcifications post biopsy were not significantly associated with final upgrade at surgery. There was a statistically significant association between the two parameters, needle size and radiologic presentation on one side and final upgrade at surgery on the other: FEA presenting as a mass was significantly more often upgraded to malignancy than microcalcifications (p= 0.0012) as was FEA diagnosed at biopsy with a 14G versus 11G vacuum assisted needle (p= 0.0015).

#### CONCLUSION

The 14 % upgrade rate of FEA was not significantly affected by concomitant LN at biopsy. Surgical excision of all FEA lesions, including the pure ones, is warranted. When FEA presented as a mass, it was more likely to be upgraded to malignancy.

#### CLINICAL RELEVANCE/APPLICATION

FEA is a risk lesion with no clear guidelines regarding its management. Our 14 % upgrade rate was not affected by concomitant LN or residual calcifications. We recommend excision of all FEA lesions

**SSK02-03 • Impact of Biopsy Method and Tumor Localization on Sentinel Lymph Node Mapping**

**Julia Krammer** MD (Presenter) ; **Anja Dutschke** ; **Clemens G Kaiser** MD, BA ; **Andreas Schnitzer** MD ; **Stefan O Schoenberg** MD, PhD \* ; **Klaus Wasser** MD

#### PURPOSE

This is the first study assessing the impact of both, method of biopsy (vacuum biopsy vs. core cut biopsy) and tumor localization on the evaluation of lymphoscintigraphy for sentinel node biopsy in breast cancer patients.

#### METHOD AND MATERIALS

616 patients with lymphoscintigraphy were included retrospectively from 2008 until 2012. 99mTc-labeled colloid was injected periareolarly and the sentinel lymph node was located by gamma camera. Depending on the signal intensity the scintigraphy was defined as excellent, adequate, weak or absent by two readers experienced in radiology and nuclear medicine. 44 patients had a preliminary stereotactic vacuum biopsy and 572 patients received ultrasound guided core cut biopsy for histological proof of the tumor.

#### RESULTS

Using vacuum biopsy 6 of 25 patients (24%) with a tumor localization in the upper outer quadrant showed a weak or absent lymphoscintigraphic signal. Only one of 19 patients (5%) with a tumor in another localization showed a weak or absent signal after vacuum biopsy (odds ratio 5.7). In terms of ultrasound guided core cut biopsy 33 of 315 patients (10%) showed only weak or absent signal on lymphoscintigraphy with a tumor localization in the upper outer quadrant. This was the case in 30 of 257 patients (12%) with a tumor in other localizations (odds ratio 0.9).

#### CONCLUSION

Using vacuum biopsy especially in the upper lateral quadrant could lead to a substantial reduction of quality in sentinel lymph node mapping after periareolarly radionuclide injection. A reason might be an extended trauma to the surrounding tissue constricting lymphatic circulation. Further studies should consider the impact of the interval between biopsy and sentinel lymph node mapping.

#### CLINICAL RELEVANCE/APPLICATION

Using vacuum biopsy especially in the upper outer quadrant could lead to a substantial reduction of quality in following sentinel lymph node mapping with periareolarly radionuclide injection.

### **SSK02-04 • Role of FDG PET-CT, Ultrasound and Ultrasound-guided Fine Needle Aspiration Biopsy in the Diagnosis of Axillary Lymph Nodes in Patients with Breast Cancer: Comparison of Their Diagnostic Performances**

**Yu Mee Sohn** PhD (Presenter) ; **Il Ki Hong** MD ; **Han Na Lee** MD

#### PURPOSE

The aim of this study was to compare the diagnostic performance of FDG PET-CT and those of US and US-FNA in the preoperative evaluation of axillary lymph node (ALN) status and to evaluate the factors related to false negative results of PET-CT, US, and US-FNA in nodal staging of invasive ductal carcinoma (IDC).

#### METHOD AND MATERIALS

From March 2009 to July 2012, total 226 patients were diagnosed with primary breast cancer. Among them, 107 patients were composed of this study population after exclusion of transferred patients or patients with other breast cancer besides IDC. The diagnostic performances of FDG PET-CT, US and US-FNA were compared with a pathologic report regarding the presence and the number of ALN metastasis. The SUV of PET-CT to differentiate the metastatic lymph node were also evaluated. We assessed univariate and multivariate analysis to evaluate the relationship between the clinicopathologic factors (symptoms, T-stage, hormone receptor, histologic grade) and false negative results and true negative results of PET-CT, US, and US-FNA after review of medical and pathologic reports.

#### RESULTS

Among 107 patients, forty five patients (42.1 %) showed positive results on final pathology. US-FNA had significantly higher specificity, PPV and accuracy than US and FDG PET-CT ( $p < 0.001$ ). The area under the ROC curve value of US-FNA was also significantly higher than other modalities ( $p < 0.01$ ). The cut off value of SUV of PET-CT to diagnose metastatic lymph node was 1.6 with sensitivity of 78.9 % and specificity of 75.0 %. Among three modalities, the false negative rate was highest in US (28.9 %) and the false positive rate was highest in PET-CT (25.8 %). And there was no significant clinicopathologic factors related to false negative results of three modalities.

#### CONCLUSION

US-FNA had the most excellent diagnostic tool for the preoperative evaluation of nodal status of IDC among three modalities. The cut off value of SUV of PET-CT to differentiate metastatic from benign lymph node was 1.6.

#### CLINICAL RELEVANCE/APPLICATION

Clinical relevance : US-FNA had the most excellent diagnostic tool for the preoperative evaluation of nodal status of IDC among FDG PET-CT, US and US-FNA.

### **SSK02-05 • Axillary Lymph Node Biopsy beyond Breast Cancer: What Are the Pathologic Findings of Suspicious Nodes Identified on Axillary Ultrasound?**

**Rakhee H Goel** MD (Presenter) ; **Alice S Rim** MD ; **Melanie Chellman-Jeffers** MD

#### PURPOSE

The widespread use of multimodality imaging has led to the discovery of findings of unknown clinical significance, such as the identification of hypermetabolic axillary lymph nodes on PET/CT. Clinicians are increasingly turning to breast imagers in order to assess abnormal axillary lymph nodes and obtain pathology. Our aim is to report the pathologic results for axillary lymph node biopsy in patients with otherwise normal mammograms.

#### METHOD AND MATERIALS

A retrospective review was performed for all patients who obtained an axillary lymph node needle biopsy with otherwise normal mammogram between 2009 - 2012. Data collected and analyzed was: Demographics, comorbidities, ultrasound lymph node characteristics, CT/MR imaging findings, needle biopsy results, and surgical excision results if performed.

#### RESULTS

88 patients with normal mammograms underwent ultrasound guided needle biopsy of suspicious axillary lymph nodes (mean age = 58). Forty four patients had either normal or benign proliferative pathologic results, of which 15 patients had known autoimmune diseases including rheumatoid arthritis, Churg-Strauss, and angio-edema. Six patients were diagnosed with breast cancer. Lymphoma was found on biopsy for 16 patients (18%) (for 8 patients the abnormal nodes were first noted on mammogram). Only 5 of the 16 lymphoma patients demonstrated bilateral axillary adenopathy. Additional diagnoses included polyclonal gammopathy (3 patients), granulomatous inflammation (sarcoid, BCG-related, and Cat-scratch) (5 patients), dermatopathic changes (6 patients), ovarian cancer metastatic disease (2 patients), and reactive nodes (ie associated with breast hidradenitis suppurativa) (6 patients).

#### CONCLUSION

A large number of ultrasound guided axillary lymph node biopsies lead to actionable pathologic diagnoses, including lymphoma, breast cancer, infection/inflammation, and newly diagnosed metastatic disease; emphasizing the importance of thorough evaluation of suspicious axillary lymph nodes.

#### CLINICAL RELEVANCE/APPLICATION

Axillary lymph node ultrasound with biopsy is valuable in the evaluation of non-breast cancer pathology, including malignancy, infection, and auto-immune diseases.

### **SSK02-06 • Cancer Detection Rate on Short-term, as well as Long-term Follow-up MRI after a Benign Concordant MRI-guided Breast Biopsy**

**Elana I Den** MD (Presenter) ; **Susan P Weinstein** MD ; **Susan G Roth** MD

#### PURPOSE

To determine the cancer detection rate on short-term and long-term follow-up MRI after a benign concordant MRI-guided breast biopsy.

#### METHOD AND MATERIALS

A HIPAA-compliant, IRB-approved retrospective review of medical records at a large tertiary care institution was undertaken to identify all the benign concordant MRI-guided breast biopsies performed from January 2005 to December 2011 that received follow-up MRI. All malignant and discordant cases were excluded. All longitudinal MRI follow-up (as well as mammographic and ultrasound follow-up) was reviewed through February 2013. Any subsequent core needle or excisional biopsies of the MRI-guided biopsy sites were also reviewed. The overall cancer detection rate was determined based on the follow-up MRI studies and electronic medical records.

#### RESULTS

A total of 802 MRI-guided breast biopsies were performed from 2005-2011, of which 172 had benign concordant results and MRI follow-up. The mean age at biopsy was 53.5 years (range 24-78 years). Longest follow-up times were as follows: 4 patients had up to 6 months follow-up, 33 had 6-12 months of follow-up, 37 had 1-2 years of follow-up, 31 had 2-3 years of follow-up, and 67 had greater than 3 years of follow-up. Only one patient who had a benign MRI-guided biopsy was diagnosed with ductal carcinoma in situ on follow-up; calcifications were detected at the MRI biopsy site on six-month mammography although the MRI remained negative, with only postbiopsy changes seen. No patients who had benign concordant MRI-guided biopsies were subsequently found to have pathology-proven invasive cancer.

#### CONCLUSION

The cancer detection rate on patients with MRI follow-up after a benign MRI-guided biopsy was 1/172 (0.6%). Our data suggests that there is low utility to either short-term or long-term MRI follow-up after a benign concordant MRI-guided biopsy.

#### CLINICAL RELEVANCE/APPLICATION

Short-term or long-term follow-up breast MRI does not appear to be useful for further cancer detection after a benign concordant MRI-guided breast biopsy.

### **SSK02-07 • Percutaneous Cryoablation (PCA) as Local Therapy for Patients with Breast Cancer and Bone Metastases (BCBM)**

**Claudio Pusceddu MD (Presenter) ; Luca Melis ; Sara Pilleri ; Barbara Sotgia ; Rosa Maria Fele ; Gianni Amucano ; Giovanni Battista Meloni**

#### PURPOSE

The aim was to evaluate the safety and efficacy of PCA as local therapy for patients with breast carcinomas and bone metastases.

#### METHOD AND MATERIALS

PCA was used to treat fifteen breast lesions, mean size 2,4 (range 0,8-6,7 cm) in thirteen consecutive patients, mean age 52 (36-81) with core-needle biopsy-proven breast carcinoma and bone metastases. 11 patients had one lesion and two patients had 2 lesions. The tumour and surrounding breast tissue were ablated with percutaneous CT-guided cryoablation under local anesthesia and mild conscious sedation. Cryoablation consisted of 2 cycles each of 10 minutes of freezing followed by a 4-min active thawing phase and a 4-min passive thawing phase for each one. Ten patients underwent one PCA session and two patients had 2 PCA sessions for different lesions. One patient was treated with two sessions for the same lesion.

#### RESULTS

All PCA sessions were successfully completed and all breast tumours were ablated. Morbidity consists in transient and mild ecchymotic changes and post-procedural oedema seen in six cases and alteration in skin pigmentation seen at the point of insertion of the cryoprobes in other two cases. The therapeutic outcomes were evaluated by contrast-enhanced CT or MRI at 1-, 3- and 6-month interval. The absence of contrast enhancement by the tumour on CT or MR image was considered complete tumour necrosis. During the mean follow-up of 11 months (3- 24 months) none of the patients had shown local relapses. A patient died because of liver tumour progression after 16 months.

#### CONCLUSION

Our preliminary results suggest that cryoablation of breast carcinomas and bone metastases is a well-tolerated, safe and effective procedure. However, further follow up and a prospective controlled trial is necessary to validate the procedure.

#### CLINICAL RELEVANCE/APPLICATION

In patients with breast cancer and bone metastases cryoablation can be considered as a feasible and effective treatment as local therapy for the breast tumor.

### **SSK02-08 • Clinical Experience in Noninvasive Treatment of Focal Breast Cancer with Magnetic Resonance Guided High Intensity Focused Ultrasound (MRgFUS)**

**Luisa Di Mare MD (Presenter) ; Alessandro Napoli MD ; Federica Pediconi MD ; Michele Anzidei MD ; Vincenzo Noce MD ; Carlo Catalano MD**

#### PURPOSE

To assess safety and feasibility of non-invasive high intensity 3T MR guided focused Ultrasound (MRgFUS) ablation of biopsy-proven invasive ductal breast cancer (IDC) (stage T1 M0 N0) before surgical resection and sentinel lymph node biopsy

#### METHOD AND MATERIALS

Our retrospective study included 12 patients with unifocal biopsy-proven IDC, scheduled and consented to lumpectomy and sentinel lymph node biopsy. We use 3T MRI exam (Discovery 750, GE; Gd-BOPTA, Bracco) to confirm presence and treatable location of enhancing lesion (less than 2 cm). Patient underwent day-surgery single session MRgFUS treatment using ExAblate 2100 system (InSightec), under IRB approval. Post-surgery pathology evaluation test the efficacy of the treatment.

#### RESULTS

No significant complications were observed in all subjects during or immediately after the procedure. In 10 patients, multiparametric MRI no shows enhancement at breast treatment area. Post-surgery histological evaluation confirmed the absence of residual neoplastic foci in necrotic tissue area with at least 5 mm margins of normal breast tissue in all 10 patients. In 2 cases treatment failed due to transducer malfunction, and pathologist observed 15% of residual tumor. Results demonstrate excellent agreement between pathology and post-treatment MRI

#### CONCLUSION

MRgFUS is a promise treatment to determines focal and noninvasive excision of unifocal breast cancer, according to histopathology findings.

#### CLINICAL RELEVANCE/APPLICATION

MRgFUS is an innovative incisionless technique to obtained reliable ablation of invasive breast cancer and successful clinical outcome.

### **SSK02-09 • Assessment of Breast Abscess Outcomes Following Ultrasound-guided Percutaneous Drainage**

**Christopher P Ho MD (Presenter) ; Sean Necessary MD ; Bhavika K Patel MD ; Rebecca L Seidel MD ; Kathleen R Gundry MD ; Michael A Cohen MD**

#### PURPOSE

Breast abscesses have traditionally been managed surgically. There has been an increased role for minimally invasive management utilizing ultrasound-guided percutaneous drainage. We assessed those who received percutaneous drainage and examined outcomes to determine the efficacy and viability of managing breast abscesses with minimally invasive techniques.

#### METHOD AND MATERIALS

Consecutive patients with suspected breast abscesses were reviewed spanning a period from July 2011 to March 2013. Factors including

abscess size, pre-existing patient conditions, volume of fluid aspirated, antibiotic use, and bacterial cultures were recorded. The procedure was termed **successful** if the abscess resolved following percutaneous drainage(s) and thus, surgery could be avoided.

## RESULTS

81 patients had breast abscesses by imaging and underwent ultrasound-guided percutaneous drainage. The average age of the patients was 42.2 years, average maximal measured diameter of the abscess was 4.0cm and the average volume of fluid/pus aspirated was 22.3cc. Pre-disposing factors seen included: 7 patients with HIV, 4 smokers, 10 diabetic patients, 10 with history of previous breast surgical interventions.

65 (80.2%) of the 81 abscesses resolved following percutaneous drainage. Of the successful aspirations, 53 (81.5%) resolved after a single aspiration. 12 patients required additional drainages, ranging from 1 to 3 repeat examinations, however these abscesses did ultimately heal without surgery. 16 breast abscess required surgical intervention. Among the failures requiring surgical intervention, 4 patients had large volumes of fluid aspirated (range 50 - 290 cc) on initial aspiration and 3 patients had no fluid aspirated because the fluid was either too thick or predominantly solid/phlegmonous.

## CONCLUSION

80% of breast abscesses can be managed with percutaneous drainage and antibiotics. The majority of patients require only a single aspiration. Large initial abscess size and the volume of fluid/pus aspirated appear to be factors that may predict percutaneous aspiration failure. Our experience would indicate that percutaneous drainage with concomitant antibiotics should be considered the first line of management for breast abscess.

## CLINICAL RELEVANCE/APPLICATION

Given the successful management and patient outcomes of breast abscesses treated conservatively with percutaneous drainage, a shift in the traditional treatment paradigm should be considered.

## Breast - Wednesday Posters and Exhibits (12:15pm - 12:45pm)

Wednesday, 12:15 PM - 12:45 PM • Lakeside Learning Center

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BR

**LL-BRS-WEA** • *AMA PRA Category 1 Credit*™:0.5

Host

**Emily F Conant**, MD \*

**LL-BRS-WE1A** • **Is there a Correlation of Breast Parenchymal Enhancement in MRI and SUVmax in 18FDG Breast PET-CT?**

**Doris Leithner** (Presenter); **Pascal A Baltzer** MD; **Heinrich Magometschnigg**; **Georg J Wengert** MD; **Thomas H Helbich** MD  
\*; **Katja Pinker-Domenig** MD

## PURPOSE

Breast parenchymal enhancement (BPE) is considered to reflect tissue proliferative activity due to hormonal stimulation. It is regarded as a detrimental factor on diagnostic accuracy and, on the other hand, as a risk factor for breast cancer. Our purpose was to evaluate if breast parenchymal enhancement (BPE) with contrast-enhanced MRI of the breast at 3T correlates with quantitative maximum Standardized Up-take Values (SUVmax) in 18FDG breast PET-CT.

## METHOD AND MATERIALS

130 patients undergoing 18FDG PET-CT and 3T CE-MRI of the breast due to BIRADS 4 or 5 imaging findings were included in this IRB approved prospective study. Examinations were scheduled no longer than 3 days apart. The MRI protocol included a contrast-enhanced 3D-T1-w sequence before and after application of a standard dose of 0.1 mmol/kg Gd-DOTA (Dotarem). In all patients, a prone PET-CT dataset over the breasts was acquired allowing the same patient geometry as with MRI. Patients were injected with approximately 300 MBq 18FDG. Scanning was started 45 min after injection. CT data was used for attenuation correction. In all patients BPE and breast parenchyma SUVmax of the normal contralateral breast was recorded. BPE was qualitatively assessed by two independent readers and graded as none, mild, moderate and marked. Reader 1 re-assessed all cases. Appropriate statistical tests were used to assess correlation of BPE and SUVmax, inter- and intra-reader agreement.

## RESULTS

There was no BPE in 58, mild in 54, moderate in 14 and marked in 4 patients. Due to the small number of marked BPE, moderate and marked BPE were considered together (n=28). SUVmax for patients with no BPE was 1.56 (SD 0.6), for mild BPE 1.9 (SD 0.6), for moderate/marked 2.3 (SD 0.6). SUVmax increased with BPE and there was a significant difference in SUVmax for patients with none and mild BPE (p=0.003) and none and moderate/marked BPE (p

## CONCLUSION

SUVmax of normal breast parenchyma is positively correlated with BPE in CE-MRI of the breast.

## CLINICAL RELEVANCE/APPLICATION

As higher SUVmax is expected in patients with moderate/marked BPE, a possible masking effect of lesions in such cases has to be considered.

**LL-BRS-WE2A** • **Utility of Breast MRI in Preoperative Planning for Free Flap Breast Reconstruction**

**Nidhi Sharma** MD (Presenter); **Melanie Chellman-Jeffers** MD; **Graham S Schwarz**

## PURPOSE

Noninvasive angiographic imaging modalities have been increasingly used to aid in flap design and perforator vessel mapping in free flap breast reconstruction. Few studies, however, have addressed recipient vessel mapping. Standard breast MRI is an integral tool for oncologic treatment planning at Cleveland Clinic. It is performed as part of our institutional protocol to evaluate extent of disease, and is an increasingly prominent component of national treatment guidelines. A majority of our patients obtain breast MRI prior to mastectomy and breast reconstruction. The aim of this study is to evaluate how intraoperative internal mammary (IMA/IMV) vessel measurements correlate with breast MRI measured vessel caliber.

## METHOD AND MATERIALS

Following IRB approval, IMA and IMV diameters were prospectively measured intraoperatively at anticipated microanastomotic sites with micro-calipers just prior to division of the vessels. An anatomic reference point was established. T1-weighted, contrast enhanced, and coronal STIR sequences were obtained on a 1.5T Siemens MRI unit with a dedicated breast coil and images reviewed on an AGFA workstation. Using standard workstation measurement tool software a resident and a senior breast radiologist independently noted vessel diameters at corresponding anatomic reference points. Correlation models evaluating intraoperative and MRI measurements were developed and analyzed for significance using methods of repeated measures mixed models.

## RESULTS

Thirty one vessels were evaluated (13 arteries, 18 veins) in 8 consecutive women undergoing free flap breast reconstruction (5 bilateral, 3 unilateral). Intraoperative mean IMA diameter was 2.8 mm (range 2 - 4 mm), mean IMV1 diameter was 3 mm (range 2 - 4.5 mm) and mean IMV2 diameter was 2.1 mm (range 1.5 - 3 mm). Respective MRI mean diameters were: IMA 3 mm (range 2.1 - 4 mm), IMV1 2.8 mm (range 2.2 - 4.8 mm) and IMV2 2.3 mm (range 1.6 - 2.9 mm). Significant correlation existed between intraoperative and MRI measurements for both arteries and veins (arteries r= 0.77, p=0.0056 and veins r=0.7, p=0.0045).

## CONCLUSION

Breast MRI measurements correlate well with actual IMA and IMV diameters, thereby, allowing vessel size prediction as well as anatomic localization.

#### CLINICAL RELEVANCE/APPLICATION

In centers using this modality, standard Breast MRI may be a useful adjunct in free flap planning without adding to cost of care or subjecting patients to ionizing radiation.

### LL-BRS-WE3A • Invasive Breast Cancer in Women 35 Years of Age or Younger: MR Imaging and Clinicopathologic Features

**Jin You Kim MD ; Ji Won Lee MD ; Suk Kim MD ; Suck Hong Lee ; Ji Eun Jo (Presenter)**

#### PURPOSE

Breast cancer rarely occurs in women under age 35. The purpose of this study was to retrospectively evaluate magnetic resonance imaging (MRI) findings and clinicopathologic characteristics of invasive breast cancer in young women (age < 35) and to compare them with those of breast cancers in less young premenopausal women (35 = age = 45).

#### METHOD AND MATERIALS

A total of 270 invasive breast cancers in 266 premenopausal women 45 years and younger who underwent preoperative breast MRI were identified between February 2009 and February 2013. Subjects were divided into two age groups: young group (< 35 years, n = 56) and less young group (35-45 years, n = 214).

MRI features (morphology, kinetics, T2-weighted signal intensity, and visual grading of background parenchymal enhancement), clinicopathologic data (presentation, tumor size, lymph node status, histologic grade, estrogen receptor (ER), progesterone receptor (PR), human epidermal growth factor receptor 2, p53, and Ki-67 expression), and the visibility of cancer on mammogram were compared between two groups.

#### RESULTS

On MRI, young group was more likely to have smooth mass margin (65.0% vs 15.5%,  $P < .001$ ), hyperintense signal on T2-weighted image (39.3% vs 25.2%,  $P = .037$ ), and less likely to have irregular shape (10.0% vs 40.5%,  $P < .001$ ) than less young group. No differences were found for kinetics and background parenchymal enhancement. Axillary nodal involvement (60.7% vs 36.4%,  $P = .001$ ), higher histologic grade (grade 1; 7.1% vs 17.8%, grade 2; 39.3% vs 45.8%, grade 3; 53.6% vs 36.4%;  $P = .032$ ), ER negative (46.4% vs 25.2%,  $P = .002$ ), PR negative (57.4% vs 26.2%,  $P < .001$ ), higher expression of p53 and Ki-67 (= 20% positive tumor cells; 50.0% vs 22.4% and 64.3% vs 40.2%,  $P < .001$  and  $P = .001$ , respectively) were more frequently observed in young group compared to less young group. The visibility of cancers on mammogram for young group (64.3% vs 82.2%,  $P = .004$ ) was lower than less young group, despite comparable tumor size (mean; 2.7 vs 2.6cm,  $P = .89$ ).

#### CONCLUSION

Invasive breast cancers occurring in women under 35 years of age frequently have morphologic features commonly seen in benign lesion on MRI, and are associated with aggressive histology and unresponsiveness to endocrine therapy.

#### CLINICAL RELEVANCE/APPLICATION

Breast cancers in young women (

### LL-BRS-WE4A • Pretreatment Imaging and Core Biopsy to Indicate Systemic Therapy after Minimally Invasive Breast Cancer Therapy: When Is It Safe?

**Alexander M Schmitz MD (Presenter) ; Joost Oudejans ; Thijs Van Dalen ; Paul Diest Van ; Kenneth G Gilhuijs PhD**

#### PURPOSE

In breast conserving therapy, selection of systemic therapy is based on prognostic markers from the resection specimen. This specimen is, however, no longer available after minimally invasive interventions such as MR-HIFU. Concordance in indication for systemic therapy pre- and post-operatively is, however, unknown. The aim of this study is to establish the diagnostic accuracy of pretreatment imaging and core biopsy to assess eligibility for systemic therapy. Secondly, to identify patient and tumor characteristics that affect the accuracy.

#### METHOD AND MATERIALS

A retrospective study was performed on 97 consecutively included women (age 36-83 year) with primary invasive breast carcinoma on core biopsy (May 2009 - Dec 2010). Prognostic markers were obtained in two separate arms. Biopsy-arm: ER-status, tumor grade, largest tumor diameter (LD) (mammography, ultrasound, or MRI), age, and number of positive lymph nodes (ultrasound +/- fine needle aspiration). Resection-arm: ER-status, tumor grade, LD, age, and number of positive lymph nodes (sentinel node biopsy +/- axillary node dissection). The 10-year risk of mortality and relapse using Adjuvant! Online were combined to indicate systemic therapy according to the Dutch guidelines (oncoline.nl). McNemar tests were used to assess concordance between the two arms. Sensitivity, specificity, NPV and PPV of the biopsy-arm were calculated relative to the resection-arm (gold standard). Results were stratified in subgroups.

#### RESULTS

Overall, the biopsy-arm showed high specificity (98%) and PPV (97%) to indicate systemic therapy. However, the sensitivity (68%) and NPV (72%) were lower, suggesting risk of underestimating the indication for systemic therapy ( $p > 70$  years (n=15; NPV 91%;  $p > 2.0$ cm (n=34; NPV=83%;  $p$

#### CONCLUSION

Prior to MR-HIFU, positive indication for systemic therapy based on imaging and core biopsy is accurate. Risk of underestimation exists, however, with a negative test result, unless patients are  $> 70$  years, tumor size  $> 2.0$ cm, or ER-status is negative.

#### CLINICAL RELEVANCE/APPLICATION

Using pretreatment biopsy and imaging, subgroups of patients may be at risk of undertreatment by adjuvant therapy after minimally invasive breast cancer therapy.

### LL-BRS-WE5A • The Value of Molecular Breast Imaging as a Diagnostic Adjunct to Mammography and Ultrasound in Patients Undergoing Biopsy

**Thomas S Chang MD (Presenter) ; Marcela Bohm-Velez MD ; Douglas A Kieper BS \* ; Susy L Suarez Lemcke BS \* ; Antoinette Cockroft RTRM**

#### PURPOSE

To evaluate the impact of molecular breast imaging (MBI), also called breast-specific gamma imaging, in the management of diagnostic breast patients undergoing breast biopsy.

#### METHOD AND MATERIALS

Patients who have MBI are entered into a patient registry. Patients were included in this study if they had: 1) mammography, MBI, and biopsy; and 2) BI-RADS 3 or higher on mammography, ultrasound, or MBI. Biopsy was performed at the discretion of the radiologist or at the request of the patient.

#### RESULTS

Over a 5-year, 8-month period, the registry accrued 1176 patients, of whom 214 patients with 228 lesions were included in this study. Biopsy yielded 54 malignancies (24 DCIS, 24 IDC, 6 ILC) and 174 benign results, including 22 high-risk diagnoses. Mammography and/or ultrasound were BI-RADS 4 or 5 for 158 of the 228 lesions, yielding 34 malignancies (17 DCIS, 16 IDC, 1 ILC); sensitivity = 63%, PPV = 22%. The addition of MBI resulted in 49 more biopsies, of which 18 were malignant (7 DCIS, 6 IDC, 5 ILC); combined sensitivity = 96%, PPV = 25%. The two false-negative lesions were 0.5 cm and 0.7 cm focal asymmetries without sonographic correlate and normal MBI (both IDC).

#### CONCLUSION

The addition of MBI to mammography and ultrasound provided a 53% improvement in sensitivity for the detection of breast malignancies and a significant increase in the detection of ILC (1 with conventional imaging, 6 with the addition of MBI).

#### CLINICAL RELEVANCE/APPLICATION

When added to mammography and ultrasound in the work-up of challenging cases or symptomatic patients with normal conventional imaging, MBI significantly improves breast cancer detection.

### LL-BRS-WE6A • Can 2D Central Projection Acquired during Digital Breast Tomosynthesis Replace Digital Mammography?

**Paola Clauser MD (Presenter) ; Cristina Molinari MD ; Viviana Londero MD ; Rossano Girometti MD ; Angelo Taibi PhD ; Chiara Zuiani MD ; Massimo Bazzocchi MD**

#### PURPOSE

Based on a novel approach, Digital Breast Tomosynthesis (DBT) may simultaneously acquire 2D and 3D images of the breast. Variable dose geometry is used to give a sufficient dose in the central projection for that image to be a 2D mammogram (2D-CP). We aimed to assess the detection rate for suspicious lesions (ACR-BIRADS 3-5) of Digital Mammography (DM) vs 2D-CP and the diagnostic yield (DY) of both modalities.

#### METHOD AND MATERIALS

152 women recalled from regional screening program underwent DM and DBT with 2D-CP to characterize a suspicious finding. Examinations were retrospectively reviewed by two experienced radiologists, blinded to final diagnosis, in separate sessions. They assessed breast lesions as benign or suspicious in case of ACR BIRADS scoring of 1-2 and 3-5, respectively. Discordant cases were reviewed in consensus. Agreement was assessed with weighted-kappa statistic. We estimated the diagnostic yield (DY) of both modalities for the patients who had 6 months follow up, a negative contrast enhanced Magnetic Resonance (CE-MR) or histology of the finding.

#### RESULTS

DM detected 95 lesions, and 52 were assessed as suspicious (55.3%; 95%CI=45.3%-65.3%); 2D-CP detected 93 lesions, and 51 were assessed as suspicious (54.8%; 95%CI=44.69%-64.91%). The agreement was good (k=0.78; Weighted-Kappa). Twenty-six patients underwent short-term follow up, CE-MR or histology and 13 malignant lesions were found. True positive for both modalities were 13 on 13. No false negatives were found. DM had 10 false positive and 3 true negative; 2D-CP, instead, had 8 false positive and 5 true negative. DY for DM was 61.5%, and for 2D-CP was 69.2%.

#### CONCLUSION

All-in-one, dose sparing, 2D-CP provides a good agreement with DM in detection of breast lesions, and is comparable to DM both in lesion detection and in DY for malignancy.

#### CLINICAL RELEVANCE/APPLICATION

DBT examination with 2D-CP is an all-in-one, low dose, approach that has the potential to replace DM in association with DBT.

### LL-BRS-WE7A • Biologic Significance of Benign Breast Biopsies Obtained under MRI vs. under Mammographic Guidance

**Simone Schradig MD (Presenter) ; Kevin Strobel PhD ; Nienke L Hansen MD ; Christiane K Kuhl MD \***

#### PURPOSE

It is well established that some proliferative breast lesions (so called borderline or high-risk lesions) are associated with an increased risk of future breast cancer. We investigated the prevalence of such high-risk lesions in MR-guided versus mammography-guided biopsies.

#### METHOD AND MATERIALS

Between 01-2011 and 12-2012, 439 MR guided vacuum biopsies for contrast enhancing lesions seen in breast MRI alone and 216 mammography-guided biopsies for suspicious mammographic findings, mainly suspicious microcalcifications, were performed. We investigated the fraction of proliferative high-risk lesions, such as atypical ductal (ADH) or lobular hyperplasia, LIN, flat epithelial hyperplasia (FEA), complex sclerosing lesion in MRI- versus mammography-guided biopsies.

#### RESULTS

A total 53% (232/439) of MR-guided biopsies and 62% (135/216) of mammography guided biopsies proved benign. Among the benign MR lesions, 29.7% (69/232) were high-risk lesions, with ADH in 43.5% (30/69), FEA in 39.1% (27/69), LIN in 11.6% (8/69) and complex sclerosing lesions in 5.8% (4/69). Among the benign mammographic lesions, 8.9% (12 /135) were high-risk lesions, with 66.7% (8/12) ADH and 33.3% (4/12) FEA.

#### CONCLUSION

The prevalence of high risk changes among non malignant breast lesions is significantly higher in MRI than in mammography. This needs to be considered when discussing the rate of false positive findings in breast MRI vs. mammography.

#### CLINICAL RELEVANCE/APPLICATION

The biologic importance of benign lesions detected on the basis of contrast enhancement in MRI appears to be different from that of benign lesions detected on the basis of mammographically changes

### LL-BRE-WE8A • Pictorial Review of Second-look Ultrasound Findings with MRI and Pathologic Correlation

**Paola V Nasute Fauerbach MD (Presenter) ; Silvia Perez ; Alejandro R Sebastian MD**

#### PURPOSE/AIM

The purpose of this exhibit is:

1. To review the possible MRI findings in the screening and diagnostic studies with US correlation.
2. To illustrate the second look US findings in both of these populations, emphasizing how subtle US malignant lesions can be.
3. To present the Imaging- Pathologic correlation.

#### CONTENT ORGANIZATION

1- Background of screening and diagnostic MRI indications recommended by ACR currently. 2. Description and illustration of the MRI findings in both of these populations. US findings will be shown and described following the latest BIRADS Lexicon with emphasis in the importance of a correct location correlation (patient prone versus supine) 3- Differential diagnosis based on clinical and imaging findings will be discussed. 4- Pathologic correlation will be presented. This will include benign and malignant lesions.

#### SUMMARY

The main teaching points of this presentation will be: 1. The importance of an accurate MRI and US correlation of the findings. 2. Mass-like and Non mass-like lesions can generally be seen on second- look US. 3. US findings can be very subtle specially in the high risk population. 4. MRI masses do not always correlate with a sonographic discrete mass well seen in orthogonal planes 5. The US correlate may show some benign appearing characteristics and still represent a carcinoma.

### LL-BRE-WE9A • 'It was the Worst Day of My Life': How to Decrease Patient Anxiety during Diagnostic Workups and Breast Procedures

**Angelica Robinson MD (Presenter) ; Claudia Cotes MD ; Maria R Torrone MD ; Ashley Moehring BS**

#### PURPOSE/AIM

Review medical and psychological literature dealing with anxiety provoking situations.  
Present practical procedural guidelines to decrease patient anxiety during diagnostic procedures and breast biopsies.  
Present useful bedside manner and patient discussion tips to improve the patient experience during diagnostic studies and breast procedures.

#### CONTENT ORGANIZATION

Present psychological literature explaining the basis for and detrimental effects of significant patient anxiety.  
Present medical literature discussing patient anxiety in relation to mammography.  
Procedural guidelines for diagnostic procedures and breast biopsies; i.e. how to perform procedures while provoking the least amount of patient anxiety  
Patient discussion tips including review of appropriate ways to deliver unexpected news.

#### SUMMARY

'Increased patient anxiety' is at the center of many national discussions and debates in reference to mammography. Although the current dialogue focuses on increased patient anxiety from unnecessary breast procedures, very little attention has been directed toward the radiologist's role in decreasing patient anxiety through changes in practice delivery and patient discussion. This exhibit will offer simple and realistic tools to decrease patient anxiety in a typical practice setting.

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### Breast - Wednesday Posters and Exhibits (12:45PM - 1:15PM)

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Wednesday, 12:45 PM - 01:15 PM • Lakeside Learning Center

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BR

**LL-BRS-WEB** • AMA PRA Category 1 Credit™:0.5

#### **LL-BRS-WE1B • The Yield of Pre-operative Breast MRI in Patients with Fat Density Breasts**

**Neera Malik MD** (Presenter) ; **Jean M Seely MD** ; **Barbara Deren** ; **Jacqueline C Lau MD** ; **Angel Arnaut MD, MSc**

#### PURPOSE

To determine the yield of pre-operative breast MRI in patients with fat-density breasts.

#### METHOD AND MATERIALS

Patients who underwent breast MRI in 2009 for pre-operative staging of breast cancer were recorded. Of these, those with mammography performed at our institution within 3 years of the breast MRI were identified. Patients for whom mammography had been performed elsewhere and for whom imaging was unavailable were included if mammographic findings were indicated in the breast MRI report. For patients meeting these criteria, mammographic breast density and the presence of additional multifocal, multicentric, and contralateral lesions on breast MRI not identified on mammography were recorded.

#### RESULTS

570 pre-operative breast MRIs were performed in 2009 in patients with breast cancer, of which mammographic density within 3 years of breast MRI was available in 267 cases. Of these, 33 had fat density breasts with MRI identifying additional lesions in 18% of cases. Additional lesions included multifocal disease (n=1), multicentric disease (n=3), stromal fibrosis and sclerosing adenosis (n=1), and papilloma (n=1). Of the 33 patients with fat density breasts, MRI altered management in the 4 patients with new multifocal and multicentric disease (12%). 100 patients had scattered fibroglandular parenchyma, with MRI identifying 41 additional lesions; 92 patients had heterogeneously dense breasts, with MRI identifying 44 additional lesions; and 37 patients had dense breasts, with MRI identifying 22 additional lesions. Chi-squared analysis showed a statistically significant difference between breast density and number of additional findings on MRI (p

#### CONCLUSION

Although patients with fat density breasts are 6.6X less likely to have additional findings on pre-operative breast MRI in comparison to patients with dense breasts, 12% of patients with fat density breasts had additional MRI findings that altered management. Thus, if selective use of pre-operative MRI is considered, patients with fat density breasts show relatively low benefit.

#### CLINICAL RELEVANCE/APPLICATION

Identifying a subset of patients in whom pre-operative breast MRI is of low yield and can be obviated will result in more optimal allocation of health care resources and more timely management.

#### **LL-BRS-WE2B • The Hypervascularity Paradox: Association between Asymmetric Increase in Breast Vascularity and Response to Neoadjuvant Chemotherapy in Locally Advanced Breast Cancer**

**Marialuisa Di Matteo** (Presenter) ; **Paolo Belli MD** ; **Giovanni Giuseppe Giardina MD** ; **Federico Padovano** ; **Enida Bufi** ; **Lorenzo Bonomo MD**

#### PURPOSE

The purpose of the present investigation was twofold. First, we aimed to determine the association of asymmetric increase in breast vascularity (AIBV) with clinical/pathologic and molecular profiles of breast cancer. Second, we addressed the prognostic performance of AIBV and of vascular maps reduction after Neoadjuvant Chemotherapy (NAC) in predicting the complete pathological response (pCR) to NAC.

#### METHOD AND MATERIALS

Two hundred and nineteen patients with unilateral locally advanced breast cancer (LABC) that underwent magnetic resonance imaging (MRI) before and after NAC were retrospectively enrolled. MRI included morphological assessment and DWI with apparent diffusion coefficient (ADC). Axial, sagittal and coronal maximum intensity projection images were obtained to allow a subjective comparative evaluation based on a combination of vessels numbers, diameter and signal intensity to define asymmetrical or symmetrical breasts vascularity. The pCR was assessed (Mandard classification).

#### RESULTS

In 62,5% cases, there was an AIBV ipsilateral to the LABC (p

#### CONCLUSION

LABC with ipsilateral AIBV is associated with more aggressive clinical/pathologic and molecular profiles. Nonetheless, is more sensitive to NAC and shows a higher frequency of pCR.

#### CLINICAL RELEVANCE/APPLICATION

The assessment of breast vascular maps may represent an additional tool in LABC treatment planning and in predicting tumor response to NAC, without acquisition time or cost increment.

#### **LL-BRS-WE3B • Follow-up Breast MR Imaging after Adjuvant Endocrine Therapy: Factors Influencing the Evaluation of Background Parenchymal Enhancement**

**Ji Hyun Youk MD** (Presenter) ; **Eun Ju Son MD, PhD** ; **Jeong-Ah Kim MD, PhD**

#### PURPOSE

To investigate factors influencing the evaluation of background parenchymal enhancement (BPE) at follow-up breast MR imaging after

adjuvant endocrine therapy.

#### METHOD AND MATERIALS

A total of 144 MR studies in 122 women with breast cancer and MR imaging findings of contralateral unaffected breast, before and after adjuvant endocrine therapy between January 2007 and March 2012 were retrospectively identified. Two readers working in consensus performed blinded side-by-side comparison of BPE before and after therapy. BPE was classified as the same or greater on one of the two MR studies and by using categorical scales: minimal, mild, moderate, or marked. The sign test was used to conduct a side-by-side comparison of BPE between two MR studies. Age, body mass index (BMI), menopausal status, the type of endocrine therapy (selective estrogen receptor modulator (SERM) or aromatase inhibitor (AI)), concomitant chemotherapy, follow-up duration from treatment to follow-up MR, BPE at baseline MR imaging before therapy, field strength of MR system used before and after therapy, and recurrence of breast cancer were analyzed for their association with BPE by using the  $\chi^2$  test, independent t-test, and multivariate analysis.

#### RESULTS

A decrease in BPE occurred in 82.6% (119 of 144; SERM 89.6%, AI 68.8%) of women after therapy (P

#### CONCLUSION

The different field strength of MR system used before and after therapy and moderate/marked BPE at baseline MR imaging before therapy were associated with the decrease of BPE at follow-up breast MR imaging after adjuvant endocrine therapy.

#### CLINICAL RELEVANCE/APPLICATION

When the change of BPE at follow-up MR imaging after adjuvant endocrine therapy is evaluated, the different field strength of MR system after therapy and BPE at baseline MR study should be considered.

### **LL-BRS-WE4B • MRI-Detected Additional Suspicious Lesions in Breast Cancer Patients: Probability of Malignancy according to Molecular Subtypes of Index Tumors**

**So Yoon Park** (Presenter) ; **Boo-Kyung Han** MD, PhD ; **Eun Sook Ko** MD ; **Eun Young Ko** MD, PhD ; **Soo Yeon Hahn** MD

#### PURPOSE

To evaluate the difference of the incidence and the probability of malignancy of MRI-detected additional suspicious lesions in breast cancer patients according to the molecular subtype of index tumor. .

#### METHOD AND MATERIALS

584 patients with breast cancer undergoing preoperative MRI were included in this study. Two radiologists reviewed their MRI findings and identified MRI-detected additional suspicious lesions. MRI-detected additional suspicious lesions were defined as the lesions seen only on MRI assessed more than BI-RADS category 4 (mammographically, sonographically and clinically occult). We reviewed MRI findings (mass or non-mass enhancement) and the pathologic outcomes of these lesions. According to the estrogen receptor (ER), progesterone receptor (PR) and human epidermal growth factor receptor 2 (HER2) status of index tumor, we divided the patients into 4 groups; ER+/ HER2-, ER+/ HER2+, ER-/ HER2+, and triple-negative group. We compared the incidence and pathologic outcomes of additional suspicious lesions and the positive predictive value (PPV) of MRI among each group.

#### RESULTS

Among 584 patients, 129 (22.1%) had additional suspicious lesions on MRI. Of these, 80 (13.7%) lesions were malignant. In terms of molecular subtypes, there were ER+/ HER2- breast cancer in 342 (58.3%), ER+/ HER2+ breast cancer in 114 (19.5%), ER-/ HER2+ breast cancer in 66 (11.3%), and triple-negative breast cancer in 62 (10.6%). On MRI, 72 lesions were masses (33; benign, 39; malignant), and 57 were non-mass enhancement (16; benign, 41; malignant). In triple-negative breast cancers, the malignancy rate of additional suspicious lesions was significantly lower in triple-negative breast cancer group than other groups (p=0.025) whereas the incidence of the MRI-detected additional suspicious lesions was not significantly different (p=0.066) compared with other molecular subtypes. PPV of MRI assessment did not show significant difference according to molecular subtypes (p = 0.266).

#### CONCLUSION

Although the incidence of MRI-detected additional suspicious lesion was similar according to molecular subtypes of index tumors, the malignancy rate of additional suspicious lesions on MRI was lower in triple-negative breast cancers.

#### CLINICAL RELEVANCE/APPLICATION

Little is known about malignancy rate of MRI-detected additional suspicious lesion in breast cancer patients according to molecular subtype.

### **LL-BRS-WE5B • Downgrading BI-RADS 4a and 4b Benign Masses Using Functional Images of Hemoglobin and Blood Oxygen Saturation Coregistered with Ultrasound Provide Differentiation of Breast Tumors**

**Pamela M Otto** MD (Presenter) \* ; **Kenneth Kist** MD \* ; **N. Carol Dornbluth** MD ; **A. Thomas Stavros** MD \* ; **Michael J Ullissey** MD \* ; **Philip T Lavin** PhD

#### CONCLUSION

The fused functional OA and gray scale anatomic information significantly improved downgrading of benign breast masses, especially within the critical BI-RADS 4a and 4b categories.

#### Background

Patients with breast masses were assessed with Opto-acoustics(OA). All masses were biopsied and histology was the gold standard. OA employs near-infrared laser pulses at two different wavelengths (to provide contrast between oxygenated hemoglobin in benign lesions and de-oxygenated hemoglobin in malignant lesions) to illuminate tissues through a fiberoptic bundle incorporated into a hand-held opto-acoustic probe. It detects the laser pulse induced acoustic pressure waves that are then used for reconstruction of two-dimensional functional and anatomical images. OA maps of total hemoglobin and blood oxygen saturation provide functional information that is co-registered with the morphological information from B-mode gray scale ultrasound images.

#### Evaluation

Five blinded readers independently assessed POM for OA without clinical data for 74 breast masses. All 34 cancer masses remained at original BI-RADS per site PI while, for 40 benign masses, downgrades were achieved for 12/22 BI-RADS 4a to 3 and for 3/13 BI-RADS 4b to 3. OA could potentially spare 50% of BI-RADS 4a cases and 20% of BI-RADS 4b cases.

#### Discussion

OA allows visualization of blood pooling and vascular structures superimposed onto co-registered gray scale.

### **LL-BRS-WE6B • Treatment Response in Patients Receiving HER-2/neu Pulsed Dendritic Cell Vaccine for DCIS: Can Breast MRI Predict Response?**

**Charles N Weber** MD (Presenter) ; **Susan P Weinstein** MD ; **Harvey L Nisenbaum** MD ; **Paul Zhang** MD, PhD ; **Elizabeth Fitzpatrick** ; **Jeanne Kobilnyk** ; **Brian J Czerniecki** MD,PHD ; **Susan G Roth** MD

#### PURPOSE

The HER-2/neu pulsed dendritic cell vaccine is currently an investigational therapy for treatment of HER-2/neu over-expressing DCIS. The purpose of this study is to evaluate the utility of breast MRI in predicting treatment response in patients undergoing vaccine therapy prior to definitive surgery.

#### METHOD AND MATERIALS

Patients with HER-2/neu over-expressing DCIS tumors participated in a vaccine trial. Each patient underwent a contrast enhanced breast MRI prior to and at the end of the vaccine therapy. After completion of the vaccination protocol, the patients had definitive surgical

therapy. The patient's pre- and post-vaccination MRI studies were reviewed to assess for response to vaccine therapy. The degree of contrast enhancement in the region of the DCIS was qualitatively assessed. The imaging findings were correlated with the pathology results.

#### RESULTS

58 patients were included in our study. Following vaccination, 9 demonstrated decreased enhancement on MRI, 10 demonstrated increased enhancement, 27 demonstrated no change, and 12 were negative for suspicious findings. 6 (50%) of the negative studies were proven to have no tumor at resection, while an additional 2 (16.7%) were found to have HER-2/neu negative tumor. 6 (66.7%) of 9 patients with decreased enhancement had correlating interval decreased HER-2/neu receptor activity, however only 1 (11.1%) of 9 patients with increased enhancement had interval increased HER-2/neu receptor activity. A correlation with estrogen receptor (ER) and progesterone receptor (PR) status was noted. 7 (87.5%) of the 8 patients found to have decreased enhancement were ER+ and 4 (66.7%) of 6 were PR+. Conversely, 8 (88.9%) of 9 patients with increased enhancement were ER-/PR-. There was a false positive rate of 8.7% on post-vaccination MRI.

#### CONCLUSION

Breast MRI may be useful in evaluating treatment response during HER-2/neu pulsed dendritic cell vaccine therapy for DCIS. Greatest response was seen in cases of tumor eradication or conversion to HER-2/neu negative status. There is suggestion of positive correlations between decreased and increased post-vaccination enhancement with ER+/PR+ and ER-/PR- receptor status respectively, which may be related to differing immune responses in these groups.

#### CLINICAL RELEVANCE/APPLICATION

Breast MRI may be useful in predicting treatment response in patients undergoing HER-2/neu pulsed dendritic cell vaccine therapy for DCIS.

### **LL-BRS-WE7B • Cost-Effectiveness of Tomosynthesis in Screening Mammography: Analysis by Breast Density and Patient Age**

**Vivek B Kalra MD (Presenter) ; Brian Haas MD ; Liane E Philpotts MD \***

#### PURPOSE

To determine the cost-effectiveness of tomosynthesis in screening mammography compared to 2D mammography based on relative and absolute direct costs resulting from unnecessary diagnostic workups from recalled patients between modalities.

#### METHOD AND MATERIALS

The diagnostic workups resulting from screening recalls performed with tomosynthesis and 2D mammography were tabulated from a one year period at a single institution in a HIPAA compliant, IRB-waived study. Unnecessary diagnostic workups were defined as those that subsequently returned to screening or had biopsies with non-malignant pathology. All imaging was performed on Selenia Dimensions units (Hologic, Bedford, MA). Patients were evaluated with tomosynthesis or 2D without preferential assignment. The direct costs of basic diagnostic mammographic imaging, advanced diagnostic imaging, biopsy procedure costs, and pathology interpretation costs were assessed using 2013 regional facility Medicare payment values.

#### RESULTS

During the one-year period, 13,174 patients underwent screening mammography, of which 6,116 had tomosynthesis and 7,058 had 2D mammograms. 516 (8.4%) of tomosynthesis patients were recalled and 826 (11.7%) of 2D screening mammography patients were recalled (p

#### CONCLUSION

Screening tomosynthesis decreased the overall costs of unnecessary diagnostic workups by 17.1%. Much larger cost savings were seen in younger patients and those with dense breasts, with a decrease of 46.6% in extremely dense breasts and 50.9% in patients under 40.

#### CLINICAL RELEVANCE/APPLICATION

Patients with dense breasts and younger patients demonstrate greater cost-effectiveness in screening tomosynthesis, which had an overall relative cost savings of 17.1% compared to 2D mammography.

### **LL-BRE-WE8B • Tumor Response to Neoadjuvant Chemotherapy by Dynamic Contrast-enhanced Breast MRI: A Pictorial Review of How to Assess Response and Recognize Pitfalls and Limitations**

**Laura Martincich MD (Presenter) \* ; Silvia Carabalona MD ; Eleonora Rachetta MD ; Rita Giada Spinelli MD ; Filippo Montemurro MD ; Daniele Regge MD**

#### PURPOSE/AIM

1) To review and show how to assess tumor response to neoadjuvant chemotherapy (NCT). 2) To review and illustrate imaging and clinical reasons for pitfalls and limitations in monitoring the response to NCT. 3) To illustrate a diagnostic work-up in the evaluation of Breast MRI when assessing the response to NCT.

#### CONTENT ORGANIZATION

#### SUMMARY

The exhibit will familiarize radiologists with both the assessment of tumor response to NCT by Breast MRI and the common pitfalls and limitations of the examination. An additional teaching point will be to provide a work-up for the evaluation of Breast MR exams when monitoring NCT.

### **Breast Imaging (MRI Lesion Characterization)**

**Wednesday, 03:00 PM - 04:00 PM • Arie Crown Theater**



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**SSM01 • AMA PRA Category 1 Credit™:1 • ARRT Category A+ Credit:1**

**Moderator**  
**Christiane K Kuhl , MD \***  
**Moderator**  
**Janice S Sung , MD**

### **SSM01-01 • Ability of Background Parenchymal Enhancement on Breast MRI to Predict Tumor Response to Neoadjuvant Chemotherapy**

**Kirti Magudia PhD (Presenter) ; Janice S Sung MD ; Jennifer Brooks PhD ; Jennifer B Kaplan MD ; Maxine S Jochelson MD ; D. David Dershaw MD ; Elizabeth A Morris MD**

#### PURPOSE

To evaluate if changes in background parenchymal enhancement (BPE) on breast MRI predict tumor response to neoadjuvant chemotherapy

#### METHOD AND MATERIALS

Retrospective IRB approved review identified 86 patients with biopsy proven breast cancer that underwent bilateral breast MRI both

before and after neoadjuvant chemotherapy between September 2008 and August 2012. Patients with synchronous bilateral cancers or a history of contralateral cancer were excluded. Clinicopathologic data were obtained from the electronic medical record. A breast-imaging radiologist blinded to clinical data rated the BPE level using BI-RADS criteria of the unaffected breast on pre- and post-neoadjuvant chemotherapy breast MRIs. Odds ratios (OR) and 95% confidence intervals (CI) were estimated using multinomial logistic regression adjusting for age, menopausal status and family history of breast/ovarian cancer.

#### RESULTS

Age at cancer diagnosis ranged from 25-72 years (mean: 46). Tumor size ranged from 1.4-17.0 cm (mean: 6.3). 62 (72%) patients were pre/perimenopausal and 24 (28%) postmenopausal. 36 (42%) tumors were unifocal, and 50 (58%) multifocal/multicentric. There were 36 (42%) ER+, 28 (33%) PR+, 36 (42%) HER2+, and 32 (37%) triple negative (TN) tumors. Results suggest that a decrease in BPE between pre- and post-chemotherapy MRI is associated with a complete imaging response in ER+ (OR 9.1, 95% CI 1.1, 78.3, p= 0.04) and PR+ (OR 18.8, CI 1.1,307.7, p=0.04) tumors, though the confidence intervals are wide. BPE reduction was not associated with tumor response with TN or HER 2+ tumors. Changes in BPE were also not associated with clinical stage, MR imaging features, or disease focality.

#### CONCLUSION

Tumor response to neoadjuvant chemotherapy may be associated with a decrease in BPE in patients with ER+ tumors but not with other subtypes.

#### CLINICAL RELEVANCE/APPLICATION

Although larger studies are needed to confirm these results, analysis of BPE change in patients with ER+ tumors undergoing neoadjuvant chemotherapy may be useful to predict tumor response.

### **SSM01-02 • Does Morphologic and Volumetric MR Tumor Response in Locally Advanced Breast Cancers Correlate with Disease Free Survival?**

**Chiara Iacconi MD (Presenter) ; Punam Bajaj MD, MBBS ; Elizabeth A Morris MD ; D. David Dershaw MD**

#### PURPOSE

To analyze a possible correlation between morphology prior to treatment, RECIST response, volumetric reduction, shrinkage pattern and disease free survival (DFS) in locally advanced breast cancers (LABC).

#### METHOD AND MATERIALS

This is a retrospective analysis of 52 women (mean age 44 years, range: 31-69 years) with LABC who had breast MR before and after neoadjuvant chemotherapy. Dynamic breast MR was acquired using 1.5 or 3 T scanners with dedicated breast coils. 3D-tumor volume measurements were done with automated segmentation of MR images using Sentinelle Aegis 2.0.1. Morphology of tumor at diagnosis (solitary, grouped in same quadrant, separated in different quadrants, total breast replaced by tumor), response to treatment according to RECIST, volumetric response (complete, partial volume reduction: 65-99%, stable: volume reduction < 64%) as well as shrinkage pattern (no residual enhancement, concentric shrinkage, concentric with surrounding lesions, multinodular lesions, diffuse enhancement of the breast) were evaluated and correlated to DFS defined in months after the end of chemotherapy. DFS was evaluated on mammography and PET-CT or total- body CT. Receptor status was also correlated to DFS. Pathological response was defined according to pathology report. Mantel-Cox test was used for the statistical analysis.

#### RESULTS

Agreement in the evaluation of treatment response between diameter at MR and pathology was observed in 38/52 (73%), overestimated in 4/52 (8%) and underestimated in 10/52(19%). Tumor morphology at diagnosis did not significantly correlate to DFS (p=0.33). RECIST versus volumetric response in women with complete, partial or stable disease did not significantly affect the DFS (p=0.6, 0.24 and 0.31 respectively). DFS was independent of shrinkage pattern of tumors (p=0.69). No statistical difference in DFS was found between complete and residual pathologic response (p= 0.76). The percentage of volume reduction was higher in triple negative cancers compared to others (p=0.003), but DFS was significantly lower (27 months) than the other group (66 months)( p=0.04).

#### CONCLUSION

DFS in LABC is not related to pre and post treatment breast MR morphology.

#### CLINICAL RELEVANCE/APPLICATION

DFS in locally advanced breast cancer is better predicted by tumor receptor status than tumor morphology at MR, both prior to and after treatment.

### **SSM01-03 • Breast Cancer 21-gene Assay Recurrence Score: Correlation between MR Imaging Phenotype and Genotype**

**Elizabeth J Sutton MD (Presenter) ; Kirti Magudia PhD ; Anne S Reiner MPH ; Monica Morrow MD ; D. David Dershaw MD ; Elizabeth A Morris MD**

#### PURPOSE

Oncotype Dx™ breast cancer 21-gene assay recurrence score (RS) is used clinically in early stage estrogen receptor (ER) positive breast cancer to quantify (range 0-100) the likelihood (increased with score) of recurrence and magnitude of chemotherapy benefit. The purpose of this study was to assess ER positive, HER2 negative early breast cancer pre-operative magnetic resonance imaging (MRI) features and their ability to predict the Oncotype Dx™ RS.

#### METHOD AND MATERIALS

This retrospective study received institutional review board approval and need for informed consent waived. Pre-operative MRIs were reviewed of 50 women (mean age 51; range 32-76) with ER positive, HER2 negative early invasive ductal carcinoma (IDC) and an Oncotype Dx™ (Genomic Health) RS (mean score 23; range 0-78). MRI features included mass shape, margin, internal enhancement, T2 signal, diameter (mean 1.4 cm, range 0.5-2.8 cm), volume (mean 1.4 cc, range 0.1-8.0 cc) and dynamic time-intensity contrast enhancement kinetics. Clinical and pathologic data was collected. Exclusion criteria included prior history of cancer and BRCA genetic carriers.

#### RESULTS

All 50 women had stage 1 or 2A ER positive, HER 2 negative IDC. Increased Oncotype Dx™ recurrence score was significantly associated with increased tumor volume (Spearman correlation=0.35; p=0.01) and an increased percent of the tumor having plateau dynamic kinetics upon segmentation (Spearman correlation=0.32; p=0.03). Increased Oncotype Dx™ recurrence score was significantly associated with irregular tumor shape (p=0.03) and increased tumor (hyperintense and heterogeneous) T2 signal (p=0.002).

#### CONCLUSION

Several IDC MRI features are significantly associated with an increased Oncotype Dx™ RS, which has prognostic and predictive significance.

#### CLINICAL RELEVANCE/APPLICATION

MRI IDC phenotype is significantly associated with their genotype supporting the advent of radiogenomics and possible role in directing targeted therapy.

### **SSM01-04 • Imaging and Clinicopathologic Factors Associated with Recurrence in Triple-negative Breast Cancers**

**Min Sun Bae MD, PhD (Presenter) ; Woo Kyung Moon ; Nariya Cho MD ; Jung Min Chang MD ; Su Hyun Lee MD ; Won Hwa Kim MD, MS ; Hye Ryoung Koo MD ; Hye Mi Gweon MD ; Mirinae Seo MD ; A Jung Chu MD**

#### PURPOSE

Triple-negative breast cancer (TNBC) defined as a tumor that is negative for estrogen receptor (ER), progesterone receptor (PR), and HER2 is a biologically aggressive subgroup with poor prognosis. The aim of this study was to identify imaging and clinicopathologic factors associated with breast cancer recurrence in patients with TNBC.

#### METHOD AND MATERIALS

Of 3237 patients with invasive breast cancer diagnosed between January 2003 and December 2008, 515 patients who underwent breast-conserving surgery or mastectomy were diagnosed with TNBC. 55 patients who had neoadjuvant chemotherapy were excluded. Among 459 patients (median age, 47 years; range, 21-81 years), 69 (15%) had locoregional (n=32) or distant (n=37) recurrence after a median follow-up of 51 months. The imaging and clinicopathologic data were examined. The univariate and multivariate analyses were performed.

#### RESULTS

Age, family history of breast cancer, histologic type, histologic grade, surgical margin status, and adjuvant therapy showed no significant differences between recurrent group and non-recurrent group ( $P > .0969$ ). In the multivariate analysis, preoperative breast MRI ( $P < .0001$ ), mammographic breast density ( $P = .0034$ ), and LN metastasis ( $P = .0005$ ) were independent factors associated with recurrence in TNBC patients. The recurrence was more frequent in women without preoperative MRI (n=66) compared to women with preoperative MRI (n=393) (35% vs 12%; adjusted odds ratio [OR], 4.81; 95% confidence interval [CI], 2.51 to 9.20), in women with dense breasts (BIRADS density 3 or 4; n=319) compared to women with non-dense breasts (BIRADS density 1 or 2; n=140) (17% vs 10%; OR, 2.86; 95% CI, 1.14 to 5.78), and in patients with LN metastasis (n=138) compared to patients without LN metastasis (n=321) (24% vs 11%; OR 2.72; 95% CI, 1.55 to 4.81).

#### CONCLUSION

Risk factors associated with breast cancer recurrence were the lack of preoperative MRI, dense breast tissue on mammography, and LN metastasis. These factors can be predictive of the likelihood of recurrence in TNBC patients.

#### CLINICAL RELEVANCE/APPLICATION

The use of preoperative breast MRI should be considered for TNBC patients with dense breast tissue.

### SSM01-05 • Invasive Breast Cancer MRI Phenotype and Receptor Status as Predictors of Clinical Outcome

**Kirti M Kulkarni MD (Presenter) ; Kirsten Gaarder MD ; Lingyun Xiong MD ; Hiroyuki Abe MD ; Maryellen L Giger PhD \* ; Gillian M Newstead MD \* ; Charlene A Sennett MD ; Akiko Shimauchi MD ; David V Schacht MD**

#### PURPOSE

Can aggressive MRI characteristics and receptor profile of invasive breast cancers be used to predict clinical outcome and metastases/recurrence rates?

#### METHOD AND MATERIALS

54 patients (mean age 56 yo) with biopsy-proven invasive breast cancer and staging MRI (1.5T Phillips) at University of Chicago from 2002-2003 were included in a HIPAA-compliant retrospective study. Patients with prior history of invasive or in-situ breast cancer or distant metastases at time of breast cancer diagnosis were excluded. Imaging and clinical notes were reviewed to identify local recurrence or distant metastases. Average follow up time was 7.8 years. All breast cancers were measured on MRI as maximum diameter in axial dimension. Aggressive MRI morphologic features such as non-mass enhancement (NME), rim or heterogeneous enhancement and multifocality were analyzed in consensus by two board-certified fellowship-trained radiologists. Receptor profiles of all cancers were obtained from pathology reports.

#### RESULTS

Histology yielded IDC 46/54 (85%) and ILC 8/54 (15%). 9/54 (17%) of the total patients developed distant metastases. Average time to metastases was 2.8 years, range 0.7 to 6.8 yrs. Histology of all metastatic cancers was IDC. 33% of cancers were grade 2 and 37% were grade 3. Grade 3 tumors metastasized in (6/20) 30% of cases and grade 2 in (1/18) 6%; tumor grade was not included in the pathology report in 2 cases. Cancers were categorized based on receptor profile as triple negative (9/54; 17%), Her2+ (12/54; 22%), and ER+Her2- (33/54; 61%). ER+ Her2- cancers metastasized in 9% (3/33) and all were unifocal. Her+ cancers metastasized in 25% (3/12) (1 unifocal, 2 multifocal) and triple negative cancers in 33% (3/9) (1 unifocal, 2 multifocal). Analysis of the MRI morphologic features showed that 25% of rim-enhancing tumors, 22% with NME, 18% of multifocal and 16% of unifocal cancers metastasized.

#### CONCLUSION

Pilot data shows that grade 3, triple negative, NME and multifocal IDC have higher rates of metastases compared to unifocal, low grade, and ILC. Distant metastases presented as late as 6.8 yrs after diagnosis. We intend to analyze a total of 200 patients in our final study.

#### CLINICAL RELEVANCE/APPLICATION

To determine the group of patients that can benefit from close follow up and metastatic work up to prevent or detect local recurrence/distant metastases.

### SSM01-06 • MR Imaging Phenotype of Breast Cancer: Kinetic Assessment for Molecular Subtypes

**Eric M Blaschke MD (Presenter) ; Hiroyuki Abe MD**

#### PURPOSE

To evaluate the dynamic contrast enhanced MR kinetic characteristics of newly diagnosed breast cancer in molecular subtypes.

#### METHOD AND MATERIALS

Breast MRI examinations of 200 patients with newly diagnosed breast cancer at the University of Chicago Medical Center from 2011 through 2012 were reviewed. Cases of newly diagnosed IDC were sorted by molecular subtype (17 triple negative, 7 Her2+, 73 Luminal A/B) and lesion segmentation and kinetic analyses were performed on a dedicated workstation. For kinetic assessment, 50% and 100% thresholds were employed for display of medium and rapid uptake, respectively. Kinetic profiles in terms of percent volume for 6 kinetic types (medium-persistent, medium-plateau, medium-washout, rapid-persistent, rapid-plateau, rapid-washout) relative to the whole volume of the lesion were obtained. Statistical analysis of the kinetic profiles was performed using the student's T-test.

#### RESULTS

Percent volume of Her2 positive lesions with greater than 50% uptake at early phase was significantly greater compared with luminal A/B (98.7 +/- 1.14 vs. 91.5 +/- 3.05;  $P .0004$ ) and all others (98.7 +/- 1.14 vs. 91.9 +/- 2.62;  $P .0002$ ). There was a nonsignificant trend towards higher >100% uptake at early phase in Her2 positive lesions versus Luminal A/B (87.3 +/- 9.77 vs. 69.3 +/- 6.94;  $P .11$ ) and all other subtypes (87.3 +/- 9.77 vs. 71.4 +/- 5.87;  $P .199$ ). No significant difference in uptake ratios was noted for Her2 positive vs. triple negative tumors or triple negative tumors vs. all other subtypes. No significant difference was observed in BIRADS assessment of kinetic patterns.

#### CONCLUSION

Her2 positive breast cancer demonstrates a unique MRI kinetic phenotype with significantly increased rapid uptake ratios compared to other molecular subtypes.

#### CLINICAL RELEVANCE/APPLICATION

MRI kinetic phenotypes of newly diagnosed breast cancer may provide a means of predicting molecular subtype and thus aid early treatment planning.

US MR DM BR

SSM02 • AMA PRA Category 1 Credit™:1 • ARRT Category A+ Credit:1

Moderator

Sughra Raza, MD

Moderator

Priscilla J Slanetz, MD, MPH \*

**SSM02-01 • Triple-negative Breast Cancers: Multimodality Imaging Features of Tumors with and without Androgen Receptor Expression****Min Sun Bae MD, PhD (Presenter) ; Woo Kyung Moon ; Won Hwa Kim MD, MS ; Su Hyun Lee MD ; Jung Min Chang MD ; Nariya Cho MD ; Hye Ryoung Koo MD ; So Yeon Park**

## PURPOSE

Androgen receptor (AR) is expressed in approximately 15% to 25% of triple-negative breast cancer (TNBC) and emerging data suggests that AR may serve as a therapeutic target for a subset of TNBC. We retrospectively reviewed imaging findings for 102 patients with TNBC on mammogram, ultrasound (US), and MRI to determine if AR-positive and AR-negative tumors have distinguishing imaging features.

## METHOD AND MATERIALS

A total of 102 consecutive patients (median age, 52 years; range, 28-81 years) with triple-negative (ER-/PR-/HER2-) invasive breast cancers and immunohistochemical data on AR status were included in this study. Two dedicated breast radiologists (5 and 22 years of breast imaging experience, respectively) reviewed the mammogram, US, and MRI without knowledge of the clinicopathological findings based on the ACR BIRADS lexicon. If different imaging findings were assigned by the two readers, a consensus was reached after the findings were discussed. A cutoff value of 10% was used to define AR positivity. The association of AR status with all imaging features was assessed with Fisher exact test.

## RESULTS

Twenty-four (24%) patients had AR-positive TNBC and 78 (76%) patients had AR-negative TNBC. Lesion shape on mammogram ( $P = .008$ ), US ( $P = .001$ ), and MRI ( $P = .001$ ), lesion margins on mammogram ( $P = .004$ ) and US ( $P = .003$ ), echo pattern on US ( $P = .009$ ), calcifications on mammogram ( $P < .0001$ ), and lesion type on MRI ( $P = .003$ ) were significantly associated with AR status. AR-positive TNBC was more likely to have irregular masses (88% vs 41%), indistinct margins (84% vs 56%), and non-complex hypoechoic masses (96% vs 65%) and be associated with calcifications (54% vs 12%) or nonmass-like enhancement (17% vs 0%).

## CONCLUSION

Our results suggest that AR-positive and AR-negative TNBC have different imaging features.

## CLINICAL RELEVANCE/APPLICATION

Understanding the imaging heterogeneity of TNBC may be helpful in identifying a subset of TNBC with AR expression, which has been shown to be associated with increased mortality among TNBC patients.

**SSM02-02 • Are Suspicious Breast MRI Lesions with an Ultrasound Correlate Higher Histological Grade Tumors?****Punam Bajaj MD, MBBS (Presenter) ; Junting Zheng ; D. David Dershaw MD ; Chaya Moskowitz ; Elizabeth A Morris MD**

## PURPOSE

To determine if suspicious breast MRI lesions proven to represent invasive ductal carcinoma with an ultrasound correlate are of different histological grade compared with ultrasound occult lesions.

## METHOD AND MATERIALS

Institutional review board approved retrospective study of 310 MRI examinations performed between 2008 and 2011 yielded 350 suspicious lesions for which biopsy was recommended. Subsequent high resolution targeted ultrasound was performed and histopathological grade of carcinomas was recorded as I (low), II (intermediate) or III (high). Statistical analysis was performed applying the Fisher's exact test, Kruskal-Wallis test and exact Wilcoxon rank sum test.

## RESULTS

Targeted ultrasound demonstrated a correlate in 181/350 (52%) suspicious MRI lesions yielding 63/181 (35%) malignant lesions. The remaining 169 (48%) lesions which were sonographically occult, yielded 25/169 (15%) malignant lesions. Sonographic correlates were seen for 72% (63/88) of malignant lesions. Of these, 87% (55/63) were invasive carcinomas and 13% (8/63) were ductal carcinomas in situ.

Histological grade was available for 46 invasive ductal carcinomas with ultrasound correlate (3(6.5%), 13(28.3%) and 30(65.2%) were histological grade I, II and III, respectively) and 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 ( $p=0.163$ ). 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 ( $p$

## CONCLUSION

When a suspicious breast MRI lesion has an ultrasound correlate, it is more likely to represent invasive carcinoma of higher histological grade.

## CLINICAL RELEVANCE/APPLICATION

The presence of an ultrasound correlate for a suspicious breast MRI lesion may indicate a more aggressive cancer.

**SSM02-03 • Breast Cancer Invisible to Ultrasound: What Does the Ultrasound Show? Characteristics of MR Discovered Breast Cancers Not Recognized on Second-look Ultrasound Examination****Phillip B Shaffer MD (Presenter)**

## PURPOSE

Investigate the US appearance of regions with positive MR scans later proven to be cancer.

## METHOD AND MATERIALS

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

## RESULTS

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

three distinct patterns were seen: Normal tissue (7 pts), Heterogeneous without mass (4 pts), and small mass with benign characteristics (5 pts). When segregated by histology, the following was observed: IDC: Group QP- 10 pts Group B- 4 pts. ILC: Group QP- 2 pts Group B- 2 pts. DCIS: Group Q-2 pts Group B-10 pts.

#### CONCLUSION

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

#### CLINICAL RELEVANCE/APPLICATION

Many breast cancers are unrecognizable on ultrasound. Even a totally normal ultrasound does not rule out breast malignancy.

### **SSM02-04 • Breast MRI as a Problem-solving Tool in the Evaluation of Mammographically and Ultrasonographically Detected Architectural Distortions: Are There Any Predictive Parameters?**

**Rubina Noemi Cavallin** (Presenter) ; **Claudio Losio** MD ; **Marta Maria Panzeri** ; **Elena Venturini** MD ; **Giulia Cristel** MD ; **Alessandro Del Maschio** MD

#### PURPOSE

Despite accounting for only 3% of mammographically detected findings, architectural distortion (AD) may be caused by a wide range of benign and malignant breast lesions, and it is the 3rd most common presentation of non palpable breast cancer. Because of its indefinite mammographic and ultrasonographic features, percutaneous or surgical biopsy is mandatory. In our study we evaluated the potential role of dynamic Breast MRI including diffusion-weighted imaging (DWI) as a problem-solving tool in mammographically and ultrasonographically detected AD

#### METHOD AND MATERIALS

Out of 232 patients undergoing MRI for problem solving, 34 were examined for a mammographic or ultrasonographic AD. MRI (1.5T) included T2-TSE sequences, dynamic study and DWI (b-values: 0, 900 s/mm<sup>2</sup>). 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.

### **SSM02-05 • Evaluation with Digital Mammography (DM), DM Combined with Digital Breast Tomosynthesis (DBT), Ultrasound (US) and Dynamic Breast MRI of Pathological Response after Neoadjuvant Chemotherapy (NC) Treatment of Breast Carcinoma**

**Giovanna Mariscotti** ; **Manuela Durando** (Presenter) ; **Pier Paolo Campanino** ; **Maddalena Rigo** ; **Elisa Regini** ; **Mattia Robella** ; **Laura Bergamasco** ; **Paolo Fonio** ; **Giovanni Gandini** MD

#### PURPOSE

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

#### METHOD AND MATERIALS

44 patients (mean age 49.2 years; range 31-71) with locally advanced breast cancer who underwent NC were enrolled in the study. We retrospectively evaluated size and response of tumours to NC by DM, DM combined with DBT, US and MRI before, during and at the end of treatment. We assumed as gold standard the tumour size measured at pathology. Patients were divided into responders (with pathologic complete (pCR) or partial response (pPR)) and non-responders (NR). Measurements were considered concordant if they were  $\pm 10$  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 time ( $r=0.9$ ;  $p=0.005$ ). The size agreement with pathology was 29 (95%CI 10-55)% for US, 36(14-62)% for DM, 33(12-62)% for DM+DBT, 54(27-79)% for MRI. For pPR patients (18/44), size estimates by imaging showed a linear decrease during treatment ( $r=0.9$ ;  $p=0,008$ ). The size agreement was 69(41-89)% 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 7.1(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 Etxano** MD (Presenter) ; **María 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).

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## Physics (X-ray Imaging Techniques)

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**Wednesday, 03:00 PM - 04:00 PM • S406B**

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**SSM21 • AMA PRA Category 1 Credit™:1 • ARRT Category A+ Credit:1**

**Moderator**

**Andrew Karellas, PhD \***

**Moderator**

**Wei Zhao, PhD \***

**SSM21-01 • Introduction and Benefits of an Anti-scatter Grid in Digital Breast Tomosynthesis**

**Colin Auclair** Dipl Eng, MSc (Presenter) \* ; **Jeffrey Shaw** PhD, MS \* ; **Mathias Cisaruk** DIPLENG \* ; **Remy Klausz** DiplEng \* ; **Henri Souchay** PhD \*

## PURPOSE

Conventional grids for mammography (MG) with septa perpendicular to the chest wall are not suitable for digital breast tomosynthesis (DBT) because the trajectory of the x-ray tube relative to the grid moves the source out of the grid focus line. The performance of a new 3D-grid, compatible with DBT and MG, was evaluated and its benefits compared with a conventional grid for MG, and with no grid at equal dose for DBT.

## METHOD AND MATERIALS

The septa of the 3D-grid are designed to be parallel to the tube sweep trajectory. To eliminate grid line visibility, the septa interspace is matched to the detector pixel pitch. During image acquisition, the 3D-grid moves with sub-mm amplitude, preserving tissue visibility at chestwall side. Grid performance was determined using methods derived from IEC 60627 standards, which allows to estimate the theoretical image quality improvement at same dose for average breasts. Evaluation of the image quality performance in 2D used a CDMAM phantom sandwiched between 2cm PMMA plates. For DBT, image quality performance was compared from the detectability of inserts in an ACR phantom imaged directly and on top of 2.5cm PMMA. All images were acquired on a Senographe Essential (GE Healthcare) using the same technique factors for each comparison.

## RESULTS

For 5cm PMMA and at 28kV MoMo, primary transmission of the 3D-grid was  $70.1\% \pm 0.5\%$ , indicating that the grid contribution to  $SDNR^2$  for average breast patient was  $0.99 \pm 0.03$ .

For MG, automatic CDMAM scoring (CDMAM Analyser, Artinis) provided similar IQF scores for the 3D-grid (122) and conventional grid (127) when using the same acquisition parameters.

For DBT, at the central plane of the inserts, ACR phantom scores were similar with ( $13.3 \pm 0.5$ ) and without ( $13.2 \pm 0.5$ ) grid. When adding 2.5 cm PMMA, ACR phantom scores were higher with ( $10.3 \pm 0.5$ ) than without ( $8.3 \pm 0.5$ ) grid. In addition, the 3D-grid significantly improved signal uniformity throughout the phantom.

## CONCLUSION

The 3D-grid demonstrated a potential of improving detectability of features for breasts above the average thickness, while preserving the dose in DBT.

## CLINICAL RELEVANCE/APPLICATION

For breasts above the average thickness, most difficult to image in mammography, the 3D-grid offers scatter rejection benefits comparable to MG grids, yet capable of operating both in MG and in DBT.

**SSM21-02 • X-ray Differential Phase Contrast Tomosynthesis Imaging based on a Clinical Digital Breast Tomosynthesis System**

**Ke Li** MS (Presenter) ; **John W Garrett** MS \* ; **Yongshuai Ge** ; **Guang-Hong Chen** PhD \*

## PURPOSE

To systematically investigate the feasibility and clinical relevance of graing-based x-ray differential phase contrast (DPC) tomosynthesis imaging constructed based on the hardware setup of a clinical digital breast tomosynthesis (DBT) system.

## METHOD AND MATERIALS

The feasibility of DPC tomosynthesis imaging was first demonstrated using a benchtop system (40 kVp, 80 micron pixel size), from which tomosynthetic images of three different contrasts (refraction angle, phase shift, and absorption) of physical phantoms were acquired. Next, the feasibility of DPC tomosynthesis imaging using the hardware setup of a clinical digital breast tomosynthesis system with a rotary x-ray source and static detector (Hologic Selenia Dimensions) was studied using a framework that quantitatively relates the detection performance of DPC tomosynthesis with the associated absorption DBT. X-ray spectrum, noise power spectrum, and MTF of the absorption DBT involved in the framework was physically measured and the imaging task was created based on the materials' phase and absorption properties provided by NIST.

## RESULTS

Reconstructions of physical phantoms show improved signal difference to noise ratio (SDNR) compared with absorption images acquired under the same exposure ( $SDNR_{PMMA} = 5.9$  and  $0.6$  for DPC and absorption, respectively). Equivalent spatial resolution for the two contrast mechanisms was observed. Design parameters of the DPC tomosynthesis system are compatible with the current clinical DBT system. The accuracy of the framework that predicts detectability in DPC-DBT was validated experimentally, and it suggests that the DPC mechanism will result in improved detectability of both small objects (e.g. calcification) and irregular-shaped objects (e.g. spiculated lesions).

## CONCLUSION

It is feasible to build a DPC tomosynthesis system using the hardware setup of an existing clinical DBT system. The system shows promise in improving lesion and calcification detectability, and therefore merits further investigation.

#### CLINICAL RELEVANCE/APPLICATION

This study demonstrates potential improvement in lesion/calcification detection performance by combining the DPC mechanism with the tomosynthesis imaging method.

### SSM21-03 • Dynamic Four-dimensional Contrast-enhanced Tomosynthesis

**Brian C Lee** (Presenter) ; **Susan Ng** \* ; **Johnny Kuo** PhD \* ; **Peter A Ringer** BS \* ; **Andrew D Maidment** PhD \*

#### PURPOSE

To explore the feasibility of performing four-dimensional dynamic contrast-enhanced tomosynthesis (4D DCE-DT).

#### METHOD AND MATERIALS

A custom bench-top tomosynthesis system was designed and built to perform 4D DCE-DT. The system consists of a stationary x-ray source and selenium x-ray detector, and a computer-controlled filter wheel with a variety of filter materials and thicknesses; phantoms are mounted on a rotary stage set atop of an x-y linear translation stage. A computer system coordinates all components, including a contrast injector. Images are acquired using a slow-scanning method in which each projection image is acquired after a fixed delay. Between each acquisition the phantom orientation is changed; it is also possible to change the x-ray energy and filter type, as well as perform injections. Both temporal and dual-energy subtraction are supported. Real-time reconstructions are performed by backprojection filtering using a customized commercial software package. A dynamic flow phantom was constructed and imaged to test the feasibility of 4D DCE-DT. One projection was acquired per energy per angle per timepoint and reconstructions were performed on subsets of these images; e.g., if projections 1 through N are used in the reconstruction for one timepoint, projections 2 through N+1 are used for the next timepoint.

#### RESULTS

Real-time reconstruction is possible to allow viewing of arbitrary tomographic planes and timepoints. Measured data from reconstructed waveforms of iodine concentration over time observed in the dynamic flow phantom matched the expected iodine concentration over time after convolution with a square wave with width equal to the number of projections per reconstruction. Experiments involving binary pulses of iodine (simulating the movement of a bolus of iodine through a vessel) confirmed the linearity and shift-invariance of the system. It can be observed that as the number of projections per timepoint/reconstruction decreases an increase in temporal resolution is achieved at the cost of a decrease in tomographic ability.

#### CONCLUSION

4D dynamic contrast-enhanced tomosynthesis can be performed in a dose-efficient fashion.

#### CLINICAL RELEVANCE/APPLICATION

4D dynamic contrast-enhanced tomosynthesis should allow for measurement of both spatial and temporal characteristics of blood flow and lesion perfusion.

### SSM21-04 • Characterization of the Dependence of the Modulation Transfer Function in Tomosynthesis on Acquisition Geometry and Reconstruction Parameters

**Brian C Lee** (Presenter) ; **Raymond Acciavatti** ; **Andrew D Maidment** PhD \*

#### PURPOSE

To characterize the spatial dependence of the in-plane modulation transfer function (MTF) in tomosynthesis and investigate the influence of the acquisition geometry.

#### METHOD AND MATERIALS

The in-plane MTF was calculated from measured edge spread functions using a custom test tool consisting of a 0.250 mm thick lead sheet affixed to a 5.88 mm acrylic sheet. Images were obtained using a non-clinical benchtop tomosynthesis system; reconstructions were performed using customized commercial software (Briona, RTT Inc., Villanova PA). The dependence of the MTF was measured with respect to the following factors: 1) the offset of the reconstruction plane from the plane containing the edge; 2) the obliquity of the reconstruction plane with respect to the detector; 3) the number of projections per reconstruction; and 4) the acquisition's angular range. Findings were validated by developing an analytical model of the MTF (accounting for blurring due to focal spot size, magnification, detector element size, out-of-focus plane, and reconstruction filter) and by replicating the experiment on a clinical tomosynthesis system.

#### RESULTS

The MTF is degraded when the edge is located between two reconstruction planes. The degree of degradation of the MTF increases as the distance between the edge and the reconstruction plane increases and as the angular range of acquisition increases. Degradation increases very slightly as the obliquity of the reconstruction plane with respect to the detector increases over the range 0° to 32°. The number of projections per reconstruction does not affect the degradation. The simulated MTFs generated by the analytical model were concordant with findings on the MTF degradation factors, and the validation experiment on the clinical tomosynthesis system provided independent confirmation that the MTF degrades with increasing distance between the edge and the reconstruction plane.

#### CONCLUSION

The MTF of tomosynthesis systems is anisotropic and varies with sub-slice spacing. Reconstruction of oblique planes results in minimal degradation of the MTF and thus may be clinically acceptable.

#### CLINICAL RELEVANCE/APPLICATION

Sub-slice misalignment of objects with the reconstructed DBT slices may adversely affect the conspicuity of small clinical features such as calcifications.

### SSM21-05 • Comparative Performance Evaluation of Contrast-detail in Full Field Digital Mammography Systems Using Hotelling Observer Signal to Noise Ratio versus Automated CDMAM Image Analysis

**Ioannis Delakis** PhD, MSc (Presenter) ; **Robert Wise** ; **Eugenia Kulama** MSc ; **Donald Mcrobbie**

#### CONCLUSION

We compared the Hotelling observer SNR against the CDMAM technique, to evaluate the performance of FFDM detectors. Results showed that the Hotelling observer SNR methodology is more consistent and can be more representative of the system's performance characteristics.

#### Background

Image quality evaluation plays an important role in ensuring and enhancing the diagnostic value of mammography studies. According to EUREF ([www.euref.org](http://www.euref.org)), image quality in mammography is assessed using images acquired with the Contrast Detail mammography (CDMAM) phantom (Artinis medical systems, Netherlands). However, CDMAM analysis can suffer from intra-observer variations, limited statistics and structural differences between CDMAM phantoms. The purpose of this work was to evaluate detector performance for a range of full field digital mammography systems using Hotelling observer SNR analysis and ascertain whether it can be an alternative to CDMAM evaluation.

#### Evaluation

FFDM units used in West of London Breast Screening were evaluated. Detector performance was first analysed using CDMAM phantom methodology. As part of Hotelling observer SNR analysis, the generalised normalised noise power spectrum (GNAPS) was measured by collecting flat field images of a 5cm PMMA phantom. The generalised modulation transfer function (GMTF) was measured by placing a

0.2mm Tungsten edge in the middle of the PMMA phantom. This setup allowed for scatter and focal spot unsharpness to be incorporated in the measurements. The Hotelling observer SNR was calculated for input signal originating from gold discs of varying thicknesses and diameters.

#### Discussion

The Hotelling SNR values were used to estimate the threshold gold thicknesses for each diameter as per CDMAM analysis. The Hotelling SNR technique was more consistent than CDMAM results. There were small differences between the two techniques, especially in small diameter details, which can be attributed to structural characteristics of the CDMAM, as confirmed by previous comparative work from our group. Overall, the Hotelling SNR technique showed variations in the performance of FFDM detectors, demonstrating the use of this metric as a differentiator.

### **SSM21-06 • Improving Image Quality for Digital Breast Tomosynthesis: Automatic Detection and Inpainting Method for Metal Artifact Reduction**

**Yao Lu** PhD (Presenter) ; **Heang-Ping Chan** PhD ; **Jun Wei** PhD ; **Lubomir M Hadjiiski** PhD ; **Ravi K Samala** PhD

#### PURPOSE

Image quality is an important factor that will affect breast cancer detection in digital breast tomosynthesis (DBT). The high-attenuation metal clips embedded in the breast marking a previous biopsy site cause errors in the estimation of attenuation along the ray paths intersecting the clips during reconstruction, which result in interplane and inplane metal artifacts (MAs). Because of the small number of projection views (PVs) acquired in a limited angular range, the voxel value errors in the artifact region cannot be compensated for. This causes stronger MAs for DBT than those for CT reconstruction. We developed a new MA reduction (MAR) method to improve image quality.

#### METHOD AND MATERIALS

Our MAR method uses iterative detection and segmentation to automatically generate a clip location map for each PV. Correlation among different PVs is used to reduce false positive detections. Iterative diffusion-based inpainting is designed to replace the labeled clip pixels with estimated tissue intensity from the neighboring regions in each PV. The inpainted PVs are then used for DBT reconstruction. A voting technique is used to determine the location and shape of the clips and label them in the reconstructed volume. The MAR method does not depend on specific reconstruction techniques. With IRB approval and informed consent, DBT of human subjects was acquired with a GE prototype system (60° arc, 21 PVs, 3° increments). 20 DBT views from 10 breasts of various densities with clips were reconstructed with and without MAR. Five breasts had multiple large clips from lumpectomy, two of which and five other breasts had microclips from core biopsy. The improvement in MAs was visually assessed.

#### RESULTS

The clip detection rate in the PVs was 100% with no false positives. The interplane and inplane MAs were reduced to a level that was not visually apparent in the reconstructed slices regardless of the size and number of clips in the breast. The visibility of microcalcifications and breast tissues along the ray paths of the clips was improved.

#### CONCLUSION

The inpainting-based MAR method reduced the MAs while preserving the structured background and microcalcifications. The visibility of breast lesions obscured by the MAs was improved.

#### CLINICAL RELEVANCE/APPLICATION

DBT has strong potential to improve breast cancer detection. Reducing the MAs in DBT can improve detection and assessment of subtle breast lesions, especially recurrence near the biopsy site.

### **Radiation Oncology and Radiobiology (Breast)**

**Wednesday, 03:00 PM - 04:00 PM • S104A**



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**SSM22 • AMA PRA Category 1 Credit™:1 • ARRT Category A+ Credit:1**

#### Moderator

**Allen G Meek**, MD

#### Moderator

**Katherine L Griem**, MD \*

### **SSM22-01 • Statistical Analysis Using a Quality Reports Program to Retrospectively Review Patients with Early Stage Left-sided Breast Cancer: A Pilot Project**

**Houman Vaghefi** MD, PhD ; **Fang Liu** PhD ; **Adams W Moore** MD \* ; **Benjamin E Nelms** PhD, MS \* ; **Greg Robinson** \* ; **James A Wheeler** MD, PhD (Presenter) ; **Ingrid Bowser** RN

#### ABSTRACT

##### **Purpose/Objective(s):**

The evaluation of the radiation oncology treatment plan for patients with early stage left-sided breast cancer requires a balance between coverage of the target tissues and avoidance of the heart and lungs.

Quality Reports is a software system developed to allow the user to design dose volume constraints which can then be saved into statistical libraries for subsequent comparison with other patients who were already treated or for whom treatment planning is in progress.

##### **Materials/Methods:**

This is a pilot study of 20 patients with early stage breast cancer who were treated by a single physician to the whole left breast using tangent fields. These treatment plans were then retrospectively reviewed.

Two different scoring systems were evaluated. The first system gave a single point for each dose constraint satisfied. The second scoring system gave a weighted value for each dose constraint satisfied. The results of the two scoring systems were then compared.

##### **Results:**

Both scoring systems followed a normal distribution. There was good agreement between the two systems; the concordance correlation coefficient (95% CI) was 0.79 (0.62, 0.89). The weighted system (as a percent possible) was 2.75% higher on average than the unweighted scores (p-value = 0.002). The patients who developed skin desquamation tended to have lower quality scores on both systems compared to the rest (by 1.1% and 1.7%, for the unweighted and weighted systems, respectively), but given the small sample size and the relatively large variability in the difference of the scores, this was not statistically significant.

##### **Conclusions:**

It is possible with this methodology to compare the quality of breast treatment plans, but a much larger patient database including information on treatment outcomes is necessary to establish the optimal scoring system.

### **SSM22-02 • Influence of Registration Based on the Different Reference Markets on the Displacement of the Geometry Consisted of All Clips in the Cavity for External-beam Partial Breast Irradiation at Moderate Deep Inspiration Breath Holding**

**Jianbin Li** (Presenter)

### **SSM22-03 • Intra-operative Radiotherapy in Early Breast Cancer-First Experience in the Middle East**

**Yasir Bahadur** (Presenter)

#### ABSTRACT

**Purpose:** We report our early experience using the Intrabeam low-kV X-ray generator for intra-operative radiotherapy (IORT) in early breast cancer.

**Methods:** This phase 2 prospective study was performed between December 2010 and November 2012. All female patients eligible for breast-conserving surgery, with biopsy proven invasive ductal carcinoma, clinical mass 3 cm, lymphovascular invasion, multifocal lesion with area of >3 cm, extensive DCIS (>25%, or >3 cm), or lymph node metastasis. Patients received 46 Gy in 23 fractions over 4.5 weeks, using 2 whole-breast tangential fields and photons in the range of 6-15 MV. Early and late toxicity features were recorded using RTOG toxicity criteria.

**Results:** 45 female patients were included, with a median age 54 years (range, 27-79 years); the majority was more than 45 years (37 cases, 73.3%). Most of patients (36 cases, 80%) had tumor Conclusion: IORT for early stage breast cancer patients using the Intrabeam delivery system was easily implemented in our center, with an acceptable toxicity profile.

### SSM22-04 • Comprehensive Chest Wall Irradiation: A Dosimetric Description of Tomotherapy and Linac-based IMRT

**Christopher D Abraham** MD (Presenter)

#### ABSTRACT

##### **Purpose/Objectives(s)**

Intensity modulated radiation (IMRT) for whole breast irradiation has been found to improve homogeneity while decreasing dose to critical structures including the heart and lung. However, there exists a paucity of data examining the role of IMRT in comprehensive chest wall and regional nodal irradiation. Therefore, the objective of this study is to generate dosimetric descriptions of two common inverse-planned IMRT delivery methods: Tomotherapy and linac-based IMRT (LB-IMRT).

##### **Materials/Methods:**

Women with locally advanced left sided breast cancer who underwent radiation to a PTV encompassing any residual breast tissue, chest wall, all levels of the axilla, interpectoral lymph nodes, infraclavicular lymph nodes, and the supraclavicular lymph nodes between April 2004 and March 2011 were retrospectively identified. A sample of 45 women were analyzed including 25 treated using Tomotherapy and 20 treated using LB-IMRT. The PTV and organs at risk were contoured at the time of initial treatment planning by the treating radiation oncologist. The dose to the PTV ranged from 50Gy to 50.4Gy. Mean dosimetric parameters were analyzed for the PTV, ipsilateral and contralateral lung.

##### **Results:**

The mean PTV V45Gy was 99% and 97% for Tomotherapy and LB-IMRT, respectively. The mean ipsilateral lung V5Gy was 79% for Tomotherapy and 75% for LB-IMRT. The ipsilateral lung mean V20Gy was 22% and 27% while mean ipsilateral lung dose was 15Gy and 17Gy for Tomotherapy and LB-IMRT, respectively. Contralateral lung mean V5Gy was 52% for Tomotherapy and 45% for LB-IMRT while V20Gy was 5.3% and 4.7%.

##### **Conclusions:**

Comprehensive chest wall irradiation using inverse-planned IMRT techniques remains to be adequately described in the literature. We retrospectively analyzed cases to better characterize the dosimetry of this treatment method. Further studies are required to validate these findings and to determine anatomic characteristics to optimize the benefits of both delivery methods for women undergoing comprehensive treatment.

### SSM22-05 • Does Morbid Obesity Disadvantage Breast-conserved Treated Patients with Pre-invasive or Early Stage Breast Cancers?

**Federico L Ampil** MD (Presenter) ; **Gloria Caldito** PhD ; **Benjamin Li** MD ; **Gary Burton** MD ; **Roger H Kim** MD ; **Quyen Chu** MD

#### PURPOSE

The literature supports the association between obesity and poor prognosis of breast cancer (BCa) in both pre- and post-menopausal women. It is unclear whether these patients may benefit from standard of care interventions. This study compares the outcomes between morbidly obese (MO) and non-morbidly obese (NMO) breast-conserved treated (BCT) patients with pre-invasive or early stage breast cancers.

#### METHOD AND MATERIALS

We performed a retrospective cohort study of 100 patients who had undergone BCT (with negative surgical margins including postoperative whole breast 50 Gy irradiation) for minimally invasive BCa during the period from 1992 to 2005. Each patient's body mass index (BMI) was calculated and the subjects were classified into the NMO group (BMI score

#### RESULTS

At a median follow-up of 96 months (range 17-215 months), the local recurrence rates were similarly 4% in the MO and NMO patients (p=0.99); the corresponding regional failure rates were 8% and 3% (p=0.29). Although the 10-year overall survival prospect favored the NMO patients compared to the MO women (96% and 79% respectively, p=0.02), there was no significant difference in the 10-year disease-free survival rates between the compared groups (91% and 89% respectively, p=0.66). There were no differences between the MO and NMO patients in age, tumor estrogen/progesterone/HER-2 neu receptors and grade and the presence of co-morbid illness.

#### CONCLUSION

In this single institution's experience, morbid obesity did not adversely affect long-term patient outcomes after BCT for minimally invasive breast cancers. It is suggested that the treatment options for select women with BCa should not be lessened on account of an excessively large body habitus.

#### CLINICAL RELEVANCE/APPLICATION

Morbid obesity should not ordinarily disqualify breast cancer patients from receiving breast conserving therapy.

### SSM22-06 • Clinical Outcomes with a Radiation Therapy System: Results of a Prospective Trial

**Tamer Refaat Abdelrhman** MD,PhD (Presenter) ; **William Small** MD ; **Jonathan B Strauss** MD ; **Kevin Bethke** MD ; **Judith A Wolfman** MD \* ; **Krystyna D Kiel** MD ; **Ellen B Mendelson** MD \*

#### PURPOSE

To report the treatment induced adverse events (AEs), and treatment outcomes of accelerated partial breast irradiation (APBI) delivered with the MammoSite Radiation Therapy System (RTS) in breast cancer patients undergoing breast conservative treatment.

#### METHOD AND MATERIALS

This is a prospective clinical trial that was approved by the IRB. The study included female breast cancer patients undergoing breast conservative treatment in the form of surgery and APBI delivered with the MammoSite RTS. The study included postmenopausal women with Invasive carcinoma =2cm, grade 1-2 ductal carcinoma in situ =2cm, or Grade 3 ductal carcinoma in situ =1cm. Exclusion criteria included extensive lobular carcinoma in-situ, Paget's disease of the breast, multifocal or multicentric tumor, extensive intraductal component, bilateral breast cancer, pregnancy or breast feeding, and patients with collagen vascular disease (except rheumatoid arthritis), bleeding disorder, postoperative infection, or prior breast irradiation. Patients and tumor characteristics, treatment-induced acute AEs based on CTC for AEs version 2.0, chronic AEs according to RTOG scale, treatment outcomes; local control (LC), disease free survival (PFS) and overall survival (OS) and cosmetic outcomes are reported.

#### RESULTS

The study included 36 eligible patients treated consecutively in Northwestern Memorial Hospital between November 2003 and August 2009. The age range was 45 - 83 years. A total of 29 patients had invasive disease (median size 1.1cm), while 7 patients had in situ disease only (median size 0.8cm). The skin distance in most of the patients (91.7%) was =1cm; only 3 patients (8.3%) had skin distance < 1 cm. The median balloon diameter was 5 cm (range 4 - 6 cm). At a median follow-up of 42 months (range 4 - 65 months), LC, PFS and OS were 100%. None of the patients experienced any grade III or IV acute or chronic AEs. However, cosmesis was not a focus of the

study, 94% of patients stated good / excellent cosmesis during their last follow up visit.

#### CONCLUSION

APBI delivered with the MammoSite (RTS) is a feasible, tolerable and effective treatment modality in breast cancer patients undergoing breast conservative treatment.

#### CLINICAL RELEVANCE/APPLICATION

APBI delivered with the MammoSite Radiation Therapy System is a feasible, tolerable and effective treatment modality in breast cancer patients undergoing breast conservative treatment.

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### Essentials of Breast Imaging

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Wednesday, 03:30 PM - 05:00 PM • S100AB

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BR

MSES44 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

#### MSES44A • How to Get the Most Out of Breast Ultrasound

Paula B Gordon MD (Presenter) \*

##### LEARNING OBJECTIVES

This course will cover the technical aspects of performing breast ultrasound. The quality of the examination depends on the choice of the optimal transducer for the task at hand, adjusting scan parameters such as gain and focal zones, and the proper use of compound imaging and harmonics. The addition of Doppler, extended field of view, 3D, elastography and automated breast ultrasound will be discussed.

#### MSES44B • How to Find Breast Cancer When It Is Still Small

Laszlo Tabar MD (Presenter) \*

##### LEARNING OBJECTIVES

1) Learn the skills necessary for reading the mammograms of asymptomatic women. 2) Be familiar with the varying appearances of a normal mammogram. 3) Increase confidence in reading large numbers of full field digital mammograms at lower call-back rates. 4) Minimize call-back rates without missing cancers. 5) Improve skills in detecting early phase breast cancer at digital mammography screening. 6) Be able to guide the diagnostic workup using mammography, ultrasound and interventional methods.

##### ABSTRACT

Population-based mammography screening has brought about a paradigm shift in our approach to the diagnosis and treatment of breast cancer, since the spectrum of the disease has shifted from primarily palpable, advanced cancer to mainly impalpable tumors that have exceedingly good prognosis. Early detection of breast cancer with high quality mammography screening and treatment at an early stage has succeeded in lowering the death rate from breast cancer by nearly 50% among women who have attended screening regularly. The challenge of successful screening should be met with a commitment to master the complexities of image production, the variations in normal breast anatomy, the heterogeneity of breast diseases, and the progressive nature of breast cancer. Comparison of the imaging findings with large section and subgross histologic images facilitates understanding of the underlying pathophysiologic processes leading to the findings. These comparisons will enable the radiologist to better differentiate normal from pathologic, improving both the sensitivity and specificity of mammographic interpretation. The predominance of early-stage disease has created a revolutionary new era for those involved in the diagnosis and treatment of breast cancer patients. Early detection of breast cancer challenges current standards of care.

#### MSES44C • Probably Benign - Rules of the Game

Jay A Baker MD (Presenter) \*

##### LEARNING OBJECTIVES

1) Review features of mammographic, sonographic, and MRI lesions that can be closely followed rather biopsied. 2) Review protocol and timing for imaging at follow-up. 3) Review findings that should not be labeled Probably Benign.

##### ABSTRACT

This presentation will cover the topic of using BI-RADS 3 final assessment category Probably Benign in breast imaging. Appropriate use of Probably Benign will be discussed for lesions seen on mammography, ultrasound, and breast MRI. Evidence from the medical literature supporting use of Probably Benign will be covered, and the circumstances that lack sufficient evidence will also be discussed.

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### Breast US

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Thursday, 08:30 AM - 10:00 AM • N227

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US BR

RC615 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

#### RC615A • High-Quality Breast US

Janice S Sung MD (Presenter)

##### LEARNING OBJECTIVES

1) To review basic ultrasound principles used to create high quality images. 2) To understand appropriate breast ultrasound technique and documentation. 3) To improve knowledge regarding breast ultrasound accreditation, including image evaluation and biopsy case assessment.

#### RC615B • Whole Breast US Screening

Stuart S Kaplan MD (Presenter) \*

##### LEARNING OBJECTIVES

1) To understand the rationale for the use of breast ultrasound as a supplementary screening modality for women with dense breasts. 2) To review results of screening ultrasound studies such as cancer detection rates, stage at detection, and false positive biopsy rates. 3) To discuss implementation issues such as performance and interpretation time, reimbursement, and automated whole breast ultrasound.

##### ABSTRACT

#### RC615C • US Evaluation of Lymph Nodes

**Robert A Schmidt MD (Presenter) \***

**LEARNING OBJECTIVES**

1) How the anatomy of a lymph node affects its sonographic appearance. 2) How metastases alter the sonographic appearance of a lymph node. 3) Several methods of distinguishing whether an abnormal node is more likely metastatic or a benign reactive lymph node. 4) The landmarks that define the axillary lymph node levels, how to assess axillary lymph node levels, and breast cancer metastases spread from level to level in most cases. 5) How to assess a lymph node for peri-nodal invasion and how to perform a biopsy to prove its presence. 6) The various methods of performing biopsy of axillary lymph nodes and how ultrasound guided biopsy of axillary lymph nodes affect management of the breast cancer patient. 7) How ultrasound contrast agents could help assess axillary nodes.

**Emerging Breast Imaging Strategies**

**Thursday, 08:30 AM - 10:00 AM • S504CD**

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**BR**

**RC617 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5**

**Moderator**  
**Jafi A Lipson , MD**

**RC617A • Diffuse Optical Spectroscopic Imaging**

**Bruce Tromberg MD (Presenter)**

**LEARNING OBJECTIVES**

1) To understand principles of light transport in tissue and the biological origins of DOSI functional contrast. 2) To review applications of DOSI in breast cancer and evaluate its utility in the context of conventional imaging.

**RC617B • Contrast Enhanced Mammography**

**John M Lewin MD (Presenter) \***

**LEARNING OBJECTIVES**

1) To discuss the indications and utility of contrast-enhanced mammography (CEM) and contrast-enhanced tomosynthesis (CET). 2) To understand the feasibility, limitations, and technical issues of CEM / CET. 3) To compare the utility of CEM and CET against non-contrast techniques and discuss future directions.

**RC617C • High Resolution Dynamic Contrast Enhanced Breast MRI**

**Brian A Hargreaves PhD (Presenter)**

**LEARNING OBJECTIVES**

1) Be able to select appropriate spatial and temporal resolution parameters to run a dynamic contrast-enhanced (DCE) breast MRI sequence. 2) Explain to colleagues the difference between temporal resolution and temporal footprint for fast DCE scans. 3) List 3 different approaches to fat suppression, and be able to set up a scan protocol using at least one of these on the learner's scanner.

**Breast Imaging: Interoperability Challenges and Solutions**

**Thursday, 10:30 AM - 12:00 PM • S501ABC**

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**IN DM BR**

**ICII51 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5**

**Judith A Wolfman , MD \***  
**Julian Marshall \***  
**Paul Morgan \***

**LEARNING OBJECTIVES**

1) Review the clinical problems once common in the interpretation of digital screening and diagnostic mammograms on vendor-independent and general purpose PACS workstations. 2) Understand the technical solutions provided in the IHE Mammography Image integration profile to those problems. 3) Explore the similar challenges now being faced in the secondary review of Stereotactic Mammography images sets acquired during breast biopsy, while clearly understanding the differences in interpretation requirements. 4) Learn how the new IHE Stereotactic Mammography Image integration profile provides a complete set of solutions to address those challenges. 5) Explore new interoperability challenges presented as Breast Tomosynthesis is adopted. 6) Understand the technical solutions currently available within the DICOM standard that address those challenges, if properly implemented in commercial equipment.

**ABSTRACT**

The purpose of this session is to review the once prevalent interoperability challenges in Full-Field Digital Mammography acquisition and display that were successfully addressed using the IHE Mammography Image integration profile, and to explore new challenges and solutions in the areas of Digital Stereotactic Mammography (used in breast biopsy) and Breast Tomosynthesis.

**Breast Imaging (Ultrasound Screening)**

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

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**US OI BR**

**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**

**Glenys Da Costa MBBS (Presenter) ; Janice S Sung MD ; Christopher E Comstock MD ; D. David Dershaw MD ; Elizabeth A Morris MD**

**PURPOSE**

To evaluate the added cancer detection and false positive rate of a technologist-performed handheld screening breast ultrasound program

**METHOD AND MATERIALS**

IRB approved retrospective review was performed on 890 consecutive women who underwent screening hand held high resolution breast ultrasound performed by a breast ultrasound technologist between October 2011-February 2013. Radiologist performed targeted

ultrasound only in cases in which a solid or indeterminate lesion was identified by the sonographer. Clearly benign findings, such as simple and complicated cysts, were neither recorded nor re-evaluated by the radiologist. 63 probably benign or suspicious lesions were identified.

#### 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 fibroglandular 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 ; Hyunji 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 cancer. 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 the largest for the 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**

#### PURPOSE

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.

#### METHOD AND MATERIALS

Twenty-five patients were consecutively recruited from women who were scheduled to undergo a breast biopsy for at least one BIRADS 4 or 5 lesion identified in a diagnostic setting in this IRB approved study. The enrolled subjects subsequently underwent imaging of the breast(s) of concern using a dedicated FDA-approved ultrasound system that allowed both a hand-held breast ultrasound (HHBUS) and automated breast volumetric scanning (ABVS) to be performed with the same imaging parameters. Five experienced breast imaging

radiologists reviewed the randomized cases in a reader study. Each reader was asked to compare side-by-side the breast ABVS exam to the HHBUS exam, including the lesion recommended for biopsy. Each reader was asked to specify the lesion type, size and imaging features, BIRADS score, probability of malignancy for each lesion for each modality and then they were asked to compare the lesion characteristics of shape and margins between the two modalities using a seven-point confidence scale for two sets of modality comparisons.

#### 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.

### SSQ01-05 • Comparison of Transverse versus Coronal View of Automated Breast Ultrasound in Lesion Detection

**Sun Young Lee MD (Presenter) ; Joo Hee Cha ; Eun Young Chae ; Hak Hee Kim MD ; Hee Jung Shin MD ; Hyunji Kim MD**

#### PURPOSE

To compare the performance of coronal view of automated breast ultrasound (ABUS) with that of transverse view in the lesion detection

#### METHOD AND MATERIALS

Three breast radiologists independently interpreted the ABUS images from 113 women, 14 with negative findings and 99 with known breast lesions (99 benign and 53 malignant findings). The readers were asked to detect the presence or absence of the abnormalities using transverse and coronal view in the different reading session. If a lesion was detected, we evaluated the location, characteristics of lesions. Intraclass correlation coefficients and kappa statistics were used for statistical analysis. Time to review and interpret an examination was also evaluated.

#### RESULTS

The detection rate of malignant lesions was 95.6% and 87.4% for transverse and coronal view ( $p=0.0089$ ). The detection rate of benign lesions was 72.4% and 56.6% for transverse and coronal view ( $p=0.0001$ ). Larger lesions are more consistently detected by coronal view: detection rates were 7.4% at 5 mm or smaller; 48.4% at 6-10 mm; 80.1% at 11-15 mm; 89.1% for lesions larger than 15 mm ( $p$

#### CONCLUSION

The detection rate of coronal view was significantly lower than that of transverse view for both benign and malignant lesions.

#### CLINICAL RELEVANCE/APPLICATION

Coronal view can be used as an additional method to transverse view. However, the role of coronal view by ABUS is not yet established, which needs to undergo further studies.

### SSQ01-06 • Performance of Whole Breast Ultrasound in Women with Dense Breasts Following 3D Tomosynthesis Mammography

**Regina J Hooley MD (Presenter) \* ; Jaime L Geisel MD ; Madhavi Raghu MD \* ; Melissa A Durand MD ; Cary P Gross MD ; Susan H Busch ; Liane E Philpotts MD \***

#### PURPOSE

Both whole breast ultrasound (WBUS) and 3D tomosynthesis (DBT) mammograms are being more widely utilized in the United States and both modalities can detect cancers not visualized on conventional digital mammography. The purpose of this study is to determine the performance of WBUS in women with a recent prior normal DBT mammogram.

#### METHOD AND MATERIALS

A retrospective chart review was performed on 1039 consecutive women who underwent handheld WBUS between 10/1/2011 and 9/20/2012 and who had a prior normal DBT mammogram performed within 12 months before the WBUS examination. All WBUS exams were performed by a breast ultrasound technologist and were immediately reviewed and interpreted by a radiologist.

#### RESULTS

The average patient age was 52.3 years (S.D. +/- 9.5 years, range 27-94). The average time between the mammogram and WBUS was 32 days (639 patients had both exams on the same day). Of the 1039 WBUS exams, 599 were prevalence screenings and 440 were incidence screenings. 906 (87.2%) were BI-RADS 1 or 2, 102 (9.8%) were BI-RADS 3 and 31 (3.0%) were BI-RADS 4. There were no BI-RADS 5 lesions. Ultrasound guided aspiration or biopsy was performed in 38 women, including 10 BI-RADS 3 and 30 BI-RADS 4 lesions. Two BI-RADS 4 lesions were malignant infiltrating ductal carcinomas. Both cancers were found on a prevalence WBUS and both were not seen on DBT, even in retrospect. The overall positive predictive value of BI-RADS 4 lesions was 6.5%. The cancer detection rate was 1.9/1000.

#### CONCLUSION

Supplemental WBUS performed in addition to DBT can detect mammographically occult breast cancers, although the rate is lower than previous studies of WBUS performed in addition to conventional mammography

#### CLINICAL RELEVANCE/APPLICATION

Multiple studies have demonstrated that supplemental WBUS has a cancer detection rate of 3-5/1000, although the performance of WBUS as a supplement to DBT mammography has yet to be determined.

### SSQ01-07 • Supplemental Ultrasound (US) Screening in Patients with a History of Lobular Neoplasia (LN)

**Kanchan Phalak MD (Presenter) ; Basak E Dogan MD ; Denai Milton MS ; Therese Bevers MD ; Wei T Yang MD**

#### PURPOSE

To investigate the role of US screening as an adjunct to annual mammography (M) in breast cancer detection in women with a history of LN

#### METHOD AND MATERIALS

A retrospective review was performed of the clinicopathology database at a single institution between 11/2004 and 11/2011 and yielded 195 women with biopsy proven lobular carcinoma in situ (LCIS) and/or atypical lobular hyperplasia (ALH) who underwent screening M, screening US, and/or screening MR. Patients with a concurrent diagnosis of breast cancer or those lost to follow-up were excluded. M, US, and when available, MRI findings were reviewed. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and cancer detection rate of each screening test was determined.

#### 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 30-83). 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 US was 30% (7%-65%), specificity (95% CI), PPV (95% CI), and NPV (95% CI) were 100% (97%-100%), 100% (29%-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% (29%-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, MBBCh (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.

## Breast Imaging (CAD/Quantitative Imaging)

Thursday, 10:30 AM - 12:00 PM • E450A



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SSQ02 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

#### Moderator

**Despina Kontos**, PhD

#### Moderator

**Jennifer A Harvey**, MD \*

#### Moderator

**Christopher E Comstock**, MD

### SSQ02-01 • Computer Derived Texture Features on DCE-MRI Can Separate ER+ Breast Cancers with Low and High Oncotype DX Scores

**Tao Wan** PhD (Presenter) ; **Boris N Bloch** MD ; **Donna M Plecha** MD \* ; **Cheryl Thompson** BS ; **Hannah Gilmore** ; **Norbert Avril** MD ; **C. Carl Jaffe** MD ; **Lyndsay Harris** MD ; **Anant Madabhushi** MS \*

#### PURPOSE

Oncotype DX (ODX) is a gene-expression based assay for predicting response to hormonal therapy in estrogen receptor positive (ER+) breast cancers (BCa) patients. The goal of this study was to identify whether computer derived texture features on DCE-MRI can distinguish low and high ODX scores (i.e. ER+ BCa patients who would and would not benefit from adjuvant chemotherapy), thereby providing a non-invasive pertherapeutic gene-expression assessment tool predicting tumor treatment response.

#### METHOD AND MATERIALS

A total of 57 ER+ BCa patient studies were collected, in which 21 breast MRIs were acquired from a Phillips 1.5T magnet with a 7-channel breast coil, and 36 MRIs were acquired using a Siemens 1.5T magnet with a 8-channel breast coil, including DCE images obtained prior to, during, and after administration of 0.1 mmol/kg of Gd-DTPA. Each study was accompanied by: i) lesion annotations from an expert radiologist; and ii) ODX scores. A set of 6 morphological features, 3 pharmacokinetic features, 12 enhancement kinetic features (EKF), 12 intensity kinetic features, 312 textural kinetic features, 6 dynamic local binary patterns (DLBP), and 5 dynamic histogram of oriented gradients (DHoG) features were extracted and used to characterize the appearance of the breast lesions. The computed features were evaluated by a linear discriminate analysis (LDA) classifier in terms of their ability to distinguish ER+ BCa with low or high ODX scores via a 2-fold randomized cross validation scheme.

#### RESULTS

The DHoG, DLBP, and EKF texture features yielded AUC values of 0.85, 0.82, and 0.80 in conjunction with the 2-class LDA classifier for separating low and high ODX ER+ breast lesions.

#### CONCLUSION

This work to our best knowledge, the first attempt to quantitatively correlate texture measurements on DCE-MRI to patient outcome prediction via the ODX assay. Our results suggested that the DHoG, DLBP, and EKF were robust and stable DCE-MRI markers in distinguishing between low and high ODX scores.

#### CLINICAL RELEVANCE/APPLICATION

An MRI-based assay to identify ER+ BCa patients that could non-invasively predict which patients would benefit from adjuvant chemotherapy, and could serve as a complement to Oncotype DX assay.

### SSQ02-02 • Computerized Characterization of Mass and Non-mass-Like Lesions on Breast MRI

**Hui Li** PhD (Presenter) ; **Maryellen L Giger** PhD \* ; **Li Lan** ; **Sunny Y Duan** ; **Stephan Hu** ; **Gillian M Newstead** MD \* ; **Hiroyuki Abe** MD ; **Michelle Lindgren** MD

#### PURPOSE

To investigate the potential usefulness of quantitative imaging analysis on characterizing both mass and non-mass-like enhancement breast lesions in the task of distinguishing between malignant and benign lesions

#### METHOD AND MATERIALS

Study was performed on 123 biopsy-proven lesions from 103 MRI studies acquired between January 2009 and April 2010, including 35 benign mass, 50 malignant mass, 11 benign non-mass-like and 27 malignant non-mass-like lesions. Our quantitative imaging analysis method incorporated computerized 3D lesion segmentation and feature extraction, including kinetic, enhancement-variance kinetic, morphological, size, and texture features. Output from the system yielded the probability of malignancy from a Bayesian artificial neural network (BANN). Classification performance was evaluated with a leave-one-case-out method using ROC analysis with area under the ROC curve as the figure of merit.

#### RESULTS

For mass lesions, the kinetic features of time to peak and curve shape index statistically differed between malignant and benign lesions. However, kinetic features did not contribute significantly in the diagnostic task with non-mass-like breast lesions. By merging computer-selected features with BANN classifiers, AUC values of 0.88 (SE=0.03), 0.95 (SE=0.02), and 0.82 (SE=0.08) were obtained in the task of distinguishing between malignant and benign lesions on the entire dataset, between malignant and benign mass lesions, and between malignant and benign non-mass-like lesions, respectively.

#### CONCLUSION

Kinetic characteristics are useful in differentiating malignant from benign mass lesions; however, their performance is reduced when the lesions are non-mass-like. Thus, quantitative analysis for diagnostic decision-making should be performed separately on mass and non-mass-like lesions.

#### CLINICAL RELEVANCE/APPLICATION

In order to improve clinical diagnostic accuracy, quantitative analysis for diagnostic decision-making should be performed separately on mass and non-mass-like lesions in the classification task.

### SSQ02-03 • Use of Quantitative 3D Breast Image Analysis to Inform DCIS Staging

**Stephanie M Burda** (Presenter) ; **Maryellen L Giger** PhD \* ; **Li Lan** ; **Kathy Rodogiannis** ; **Hui Li** PhD ; **Gillian M Newstead** MD \* ; **Ken Yamaguchi** ; **Koichi Ishiyama** MD ; **Hiroyuki Abe** MD ; **Michelle Lindgren** MD ; **Adam Starkey**

#### PURPOSE

Uncertainty on which ductal carcinoma in situ (DCIS) cases will progress to invasive breast cancer currently results in overtreatment. Our purpose was to discern quantitative characteristics of pure DCIS, DCIS with an invasive component, and invasive cancers without DCIS to inform prognosis of patients with lesions presenting initially as DCIS.

#### METHOD AND MATERIALS

Retrospective, IRB-approved review of our radiology database 2005-2012 identified 303 pathology-proven cancers with correlative MR imaging. Histology yielded 54 pure DCIS lesions, 56 with both DCIS and invasive pathology, and 193 invasive cancers without DCIS. Quantitative 3D image analysis yielded morphological, kinetic, and texture lesion descriptors following semi-automated lesion segmentation. ROC analysis was performed on these image-based phenotypes comparing pure DCIS lesions, DCIS lesions with an invasive component and invasive cancers without an in situ component.

#### RESULTS

The combination of features that best distinguished pure DCIS from invasive cancer included kinetic feature time to peak, texture features of contrast and correlation, and morphological features of circularity, margin, and surface area. The combination of features that was best able to distinguish pure DCIS from invasive cancers with a DCIS component included contrast, margin, and ratio of surface area to volume. The margin characteristics (determined by spiculation and sharpness) and contrast (the difference between the average gray level of the cancer and the surrounding area) were found to be insightful in both comparisons. Time to peak was also significant in the comparison of Pure DCIS and invasive cancers, yielding an AUC value of 0.77. Round-robin evaluation of an LDA yielded AUCs of 0.85 and 0.74 distinguishing pure DCIS from invasive cancers and invasive cancers with a DCIS component, respectively.

#### CONCLUSION

Image-derived quantitative phenotypes, which indicate a likelihood of invasive disease-of pure DCIS, could patient guide management of DCIS lesions, thus potentially reducing overtreatment.

#### CLINICAL RELEVANCE/APPLICATION

Image-derived quantitative phenotypes, which indicate a likelihood of invasive disease-of pure DCIS, could patient guide management of DCIS lesions, thus potentially reducing overtreatment.

#### **SSQ02-04 • Undetected Breast Cancers on Commercial Breast MRI CAD (Computer-aided Detection) System**

**Chae Hyun Kim** (Presenter) ; **Seon Hyeong Choi** ; **Ji Yeon Park** ; **Yoonjung Choi MD** ; **Shin Ho Kook MD**

##### **PURPOSE**

To evaluate the immuno-histological factors of breast cancer not detected on breast MRI CAD system.

##### **METHOD AND MATERIALS**

The study included 327 preoperative breast MRI of histologically proven breast cancer from July 2011 to February 2013. We retrospectively reviewed the MRI CAD results, corresponding immune-histopathologic features, lesion size and age to determine factors affecting MRI CAD detectability. We categorized tumors into two groups: detected and undetected groups.

##### **RESULTS**

Of the 327 cases, the CAD system marked 259 (79.2%) lesions correctly and 68(20.8%) were undetected on breast MRI CAD. The mean size and age were 18 mm (range:1-70) and 50.0 yo (SD:9.9) in the undetected group and 22.8 mm (range: 3-120) and 51.4 yo (SD: 10.7) in the detected group. Detectability rates for IDCs, DCIS were 86.7% (208 of 240) and 44.6 % (25 of 56), respectively. The tumor type was a significant (p

##### **CONCLUSION**

Though the commercial breast MRI CAD system showed good performance, about 20% of breast cancers were not detected on MRI CAD. DCIS, low nuclear grade, low Ki-67 percentage, and HER-2 negative influenced the breast MRI CAD detectability in breast cancer patients.

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

DCIS, low nuclear grade, low Ki-67, and HER-2 negative can influence CAD detectability. So, radiologist should check immunohistologic profiles and original images when interpreting breast MRI CAD.

#### **SSQ02-05 • Immunohistological Factors Affecting the Breast Cancer Size Measurement by MRI Computer-aided Detection (CAD) System**

**Ji Yeon Park** (Presenter) ; **Seon Hyeong Choi** ; **Yoonjung Choi MD** ; **Chae Hyun Kim** ; **Shin Ho Kook MD**

##### **PURPOSE**

To investigate immunohistological factors affecting the breast tumor size measurement discrepancy between the MRI CAD and the pathologic specimen.

##### **METHOD AND MATERIALS**

We retrospectively reviewed the 244 cases of breast MRI CAD images and pathologic findings of the 244 patients who underwent operation for breast cancer between July 2011 and December 2012. We compared the CAD generated tumor size with tumor size measured on pathologic specimen. We classified the tumors into three groups: underestimated, adequately measured and overestimated group. We investigated the statistical difference in histopathology including histologic type, presence of DCIS, extensive intraductal component, nuclear grade, ER, PR and HER-2, among the 3 groups.

##### **RESULTS**

Median tumor size on CAD and specimen were 20 mm (2-163 mm) and 17 mm (0.8-82 mm), respectively. Adequately measured group was 68.6% (n=168). Invasive ductal carcinoma (IDC) showed significantly more adequate measurement, compared with DCIS (p=0.025). Among IDC, the presence of extensive intraductal component was significantly higher in overestimated group (p

##### **CONCLUSION**

Size assessment using breast MRI CAD was accurately measured in 68.6%. On MRI CAD, breast cancer size was frequently overestimated in cases of DCIS, the presence of extensive intraductal component, and HER-2(+).

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

Accurate tumor size measurement is critical to surgical plan for breast conservation. Size assessment by breast MRI CAD is accurate but it can be overestimated in cases of DCIS, EIC, and HER-2(+).

#### **SSQ02-06 • Quantitative MRI-based Phenotypes of Triple Negative Breast Cancers**

**Hui Li PhD** (Presenter) ; **Maryellen L Giger PhD \*** ; **Li Lan** ; **Hiroyuki Abe MD** ; **Michelle Lindgren MD** ; **Eric M Blaschke MD** ; **Gillian M Newstead MD \***

##### **PURPOSE**

To investigate the potential usefulness of quantitative image analysis on characterizing the molecular subtypes of breast cancer in order to better understand the difference between triple negative and other molecular subtypes of breast cancer

##### **METHOD AND MATERIALS**

Study was performed on 168 biopsy-proven breast cancer MRI studies acquired between November 2008 and August 2011, in which 40 cases were triple negative (ER-, PR-, and HER2-) breast cancers and 128 cases were of other molecular subtypes including Luminal A, Luminal B, and HER2. Quantitative MRI analysis included: 1) 3D lesion segmentation based on a fuzzy c-means clustering algorithm; 2) computerized feature extraction; 3) leave-one-out linear stepwise feature selection; and 4) discriminant score estimation using Linear Discriminant Analysis (LDA). The classification performance between triple negative and other molecular subtypes of breast cancer was evaluated using ROC analysis with area under the ROC curve (AUC) as the figure of merit.

##### **RESULTS**

The triple negative classification, in a round-robin evaluation, yielded AUC values of 0.90 (SE=0.05) and 0.67 (SE=0.05) on 3T and 1.5T MR scanners, respectively, in the task of distinguishing between triple negative and other molecular subtypes, statistically significantly higher than an AUC value of 0.5 (p-value

##### **CONCLUSION**

The results from this study indicate that quantitative MRI analysis shows promise in the discrimination of triple negative breast cancer from other molecular subtypes of breast cancer.

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

Identification of the molecular subtypes of breast tumors is expected to allow for improved prognostic assessment and more effective cancer treatment plans.

#### **SSQ02-07 • Features of Undiagnosed Breast Cancers at Screening Breast MRI: Potential Utility and Limitation of Computer-aided Evaluation**

**Mirinae Seo MD** (Presenter) ; **Nariya Cho MD** ; **Min Sun Bae MD, PhD** ; **Eun Bi Ryu MD** ; **Jung Min Chang MD** ; **Hye Ryoung Koo MD** ; **Su Hyun Lee MD** ; **Won Hwa Kim MD, MS** ; **Woo Kyung Moon** ; **Hye Mi Gweon MD** ; **A Jung Chu MD**

##### **PURPOSE**

To evaluate the features of undiagnosed cancers at prior screening breast MRIs in patients who subsequently developed breast cancers and the potential utility and limitation of computer-aided evaluation (CAE).

##### **METHOD AND MATERIALS**

Between March 2004 and March 2013, 65 pairs of dynamic contrast enhanced breast MRIs including prior negative screening MRIs and

subsequent MRIs with developed cancers (mean interval 36.5 months, range 5.4 - 96.7 months) were identified. The mean histological sizes of developed cancers was 2.0cm (range 0.5 - 9.5 cm) for invasive cancers (n=44) and 1.9cm (range 0.5 - 4.1 cm) for DCIS (n=21). Visible findings, their maximum lesion size and actionability, as well as causes for overlooked cancers on prior MRI were determined and classified by two experienced radiologists in consensus. A commercially available CAE program was retrospectively applied to the prior MRIs with visible findings for generation of kinetic features including washout, plateau, and persistent enhancement proportions. Presence of a washout component on CAE was also described.

#### RESULTS

Of the 65 areas where cancer later developed, 51% (33 of 65) of prior MRIs had visible findings and their mean lesion size was 1.0cm (range 0.4 - 5.2 cm). Of these visible findings, 24% (8 of 33) were classified as actionable and 76% (25 of 33) as underthreshold. Causes for actionable findings were mimicking of physiologic enhancement (n=3), mismanagement after benign results of biopsy (n=3), and satisfaction of search (n=2). Those of underthreshold findings were small lesion size (n=6), moderate to marked background parenchymal enhancement (n=11), mimicking of post-op scar (n=7), and peripheral location (n=1). Twenty three of the visible findings were available for CAE and the washout component was found in 14. However, 4 of 14 lesions with a washout component were not marked due to marked background enhancement with multiple enhancing lesions with a washout component. CAE did not show the washout component in 9 of 23 lesions.

#### CONCLUSION

On prior screening breast MRIs in which cancer later developed, 51% (33 of 65) had visible findings (24% actionable, 76% underthreshold). The addition of CAE has the potential to identify 43% (10 of 23) of overlooked findings. Yet, there are still some limitations on CAE.

#### CLINICAL RELEVANCE/APPLICATION

When an enhancing lesion shows a washout component on MR-CAE of screening breast MRI, closer attention is warranted.

### SSQ02-08 • Evaluation of a Commercial CAD System for Detecting Lesions at Breast Digital Tomosynthesis

**Lia Morra PhD \***; **Silvano Agliozzo PhD \***; **Luca A Carbonaro MD \***; **Manuela Durando (Presenter)**; **Barbara Pesce MD**; **Giovanna Mariscotti**; **Alberto Bert PhD \***

#### PURPOSE

To evaluate the performance of a commercial computer aided detection (CAD) system (CAD BREAST DTS, im3D S.p.A.) for detecting lesions at digital breast tomosynthesis (DBT) on an independent testing set.

#### METHOD AND MATERIALS

The CAD system was retrospectively tested on a set of 143 patients. Craniocaudal (CC) and mediolateral oblique (MLO) DBT projections were acquired with a Hologic Selenia Dimensions system and reconstructed with the Briona library (Real Time Tomography LLC). All patients signed an informed consent form. A total of 80 histologically confirmed malignant lesions (57 masses, 18 microcalcification clusters and 6 masses with associated microcalcifications) were detected and annotated by experienced radiologists who drew a 3D bounding box around each lesion view. CAD BREAST DTS yields both masses and microcalcification clusters candidates. For masses, a CAD true positive was registered when the CAD marking overlapped by at least 20% the radiologists marking; for microcalcification clusters, when at least two of the microcalcifications identified by CAD fell within the radiologists marking. A CAD false positive was registered in all other cases, to avoid chance matchings. Masses with associated microcalcifications were considered correctly identified if CAD marked at least a mass or a microcalcification cluster.

#### RESULTS

At the selected operating point, per-lesion sensitivity was 89% (95% C.I. 80-94%). The system detected 48/56 masses, 17/18 microcalcification clusters and 6/6 masses with microcalcifications. Mean number of false positives per view was  $2.8 \pm 1.9$  (mean  $\pm$  standard deviation), of which 2 were marked as masses and 0.8 as microcalcification clusters.

#### CONCLUSION

The DBT CAD sensitivity is comparable to that observed for 2D digital mammography CAD systems, with a fairly low number of false positives per view. Further work, especially on difficult cases such as screening interval cancers, and comparing reading with and without CAD, is needed to understand its role in clinical practice.

#### CLINICAL RELEVANCE/APPLICATION

A commercial CAD system for masses and microcalcification clusters detection is evaluated on an independent testing set.

### SSQ02-09 • Quantitative MRI Morphological Features of Breast Cancer: Correlation with Immunohistochemical Biomarkers and Subtypes

**Min Sun Bae MD, PhD (Presenter)**; **Mirinae Seo MD**; **Woo Kyung Moon**; **Nariya Cho MD**; **Jung Min Chang MD**; **Hye Ryoung Koo MD**; **Won Hwa Kim MD, MS**; **Su Hyun Lee MD**; **Hye Mi Gweon MD**

#### PURPOSE

To investigate the correlation of the tumor roundness measured quantitatively at contrast-enhanced magnetic resonance imaging (MRI) and immunohistochemical biomarkers and subtypes in breast cancer.

#### METHOD AND MATERIALS

After IRB approval, we retrospectively reviewed 280 consecutive women (median age, 50 years; range, 28-79 years) with 282 invasive breast cancers (< 5 cm size). All patients underwent preoperative breast MRI. Images were assessed independently by the two radiologists who were unaware of pathological findings. Tumor roundness was measured quantitatively by a software developed in-house and was calculated according to the following equation:  $\text{roundness} = 4\pi \times A / P^2$  (A is the cross-sectional area of the tumor and P is the measured perimeter length of the tumor). The means of values measured by the two observers were recorded and interobserver variability was calculated. Associations between the tumor roundness (1-100 %) and biomarker (estrogen receptor [ER], progesterone receptor [PR], HER2, and Ki67) features were evaluated using Pearson's correlation coefficient and a multiple linear regression analysis. Tumor roundness was compared between breast cancer subtypes (luminal A, luminal B, HER2-enriched, and triple-negative).

#### RESULTS

Interobserver agreement for MRI measurements was moderate with intraclass correlation coefficients of 0.75 (95% confidence interval: 0.67-0.80). A moderate inverse correlation was observed between the ER score and tumor roundness ( $-0.408$ ,  $P < .0001$ ). PR score, Ki67 index, and tumor grade correlated with the tumor roundness ( $P < .0001$ ). In multiple linear regression, ER score ( $P < .0001$ ) and Ki67 index ( $P = .003$ ) were independent factors determining tumor roundness. Triple-negative tumors showed the highest mean roundness score compared with other subtypes (67.3 for triple-negative vs. 55.9 for HER2-enriched, 53.8 for luminal B, and 51.7 for luminal A;  $P < .0001$ ).

#### CONCLUSION

Tumor roundness measured quantitatively at MRI correlated with ER score and Ki67 index in breast cancer. Triple-negative tumors showed the highest mean roundness score compared with other subtypes.

#### CLINICAL RELEVANCE/APPLICATION

Our data may have implications for possibly stratifying breast cancer patients with different clinical outcomes by using MRI morphological features.

BR

**LL-BRS-THA • AMA PRA Category 1 Credit™:0.5****Host**  
**Sarah M Friedewald, MD \*****LL-BRS-TH1A • Lack of Sentinel Lymph Node Drainage in Breast Cancer: Relationship with Pathological Results and Previous Surgery****Isabel Roca MD, PhD (Presenter); Rodrigo Cardenas MD; Diego Villasboas-Rosciolesi MD; Carina Espinet MD; Amparo Garcia-Burillo MD; Octavi Cordoba MD; Isabel Rubio MD; Joan Castell Conesa MD, PhD****PURPOSE**

In patients without drainage to sentinel lymph node (SLN) in lymphoscintigraphy (planar images and SPECT/CT), we describe the intra-operative use of the gamma probe and/or blue dye injection, the pathological results and the relationship with previous breast surgery.

**METHOD AND MATERIALS**

We include 57 consecutive women (age: 62a +/-14, 30-87y, Dec2006-Mar2013) without visualization of SLN in lymphoscintigraphy imaging (148MBq 99mTc-albumin nanocolloid, retroareolar injection). Images have been obtained 2-4 hours after tracer injection, performing a 4-hour reinjection (same dose) in patients with 2-day protocol. In all cases SLN have been searched with intra-operative gamma probe and/or blue dye.

**RESULTS**

In our series the no drainage rate on images has been 4% (57/1406 consecutive patients). Intraoperative gamma probe has detected SLN in 13/57 patients (23%), obtaining 23 SLN (8 positive) in 4/13 patients (31%). Nine patients underwent intraoperative blue dye, getting drainage in 5/9 (56%), with only 1/5 positive SLN (same SLN found by gamma probe). 23/57 patients (40%) had not been submitted to lymphadenectomy: 10 patients due to negative SLN, 13 patients due to previous lymphadenectomy. 34/57 patients (60%) underwent lymphadenectomy: 30 patients without drainage, 4 patients with positive SLN. 557 nodes have been excised, 107/557 positive in 17/34 patients. The 4 patients with positive SLN had more positive nodes in 2 cases and the SLN were the only one positive node in the other 2 patients. In 50% of the patients without drainage (17/34), all the nodes excised during lymphadenectomy were negative. 17/57 of the patients (30%) had previous breast surgery: 13 lumpectomy and lymphadenectomy (all of them submitted to a new lumpectomy, lymphadenectomy performed before), and 4 lumpectomy with SLN biopsy (all of them submitted to a new lumpectomy and lymphadenectomy, 1 positive).

**CONCLUSION**

A high rate (50%) of lymphatic spread has been found in patients with lack of SLN drainage in planar and SPECT-CT images. The intraoperative use of the gamma probe allows the identification of SLN in 13/57 patients (23%), avoiding lymphadenectomy in 10 patients (17,5% of the series) due to negative SLN.

**CLINICAL RELEVANCE/APPLICATION**

Even in case of no drainage in lymphoscintigraphy imaging, the use of intraoperative gamma probe allows the detection of SLN in nearly a quarter of the series, avoiding lymphadenectomy in 17,5% of the

**LL-BRS-TH2A • Fluorodeoxyglucose Uptake in Breast Cancer Can Be Influenced by Physiological Estrogen Fluctuations during the Menstrual Cycle****Kanae K Miyake MD (Presenter); Yuji Nakamoto MD, PhD; Shigehira Saji; Tomoharu Sugie; Kensuke Kurihara; Koya Nakatani MD, PhD \*; Shotaro Kanao MD; Masakazu Toi; Kaori Togashi MD, PhD \*****PURPOSE**

The physiological plasma estrogen concentration is consistently maintained in lower range such as 10 to 30 pM in postmenopausal women. However in premenopausal women, it changes more widely due to menstruation cycle and ranges around 0.01 nM to 10 nM. The purpose of this study was to evaluate whether the physiological fluctuation of estrogen level affects fluorodeoxyglucose (FDG) uptake in breast cancers of premenopausal patients.

**METHOD AND MATERIALS**

Thirty-three premenopausal females (age 42±5 ys) with solid mass-type invasive breast cancer, who underwent positron emission tomography/computed tomography with FDG before therapy, were retrospectively analyzed. The maximal standardized uptake values (SUVmax) in primary breast cancer were compared among the patients, according to the menstruation cycle, in each clinicopathological subtype. In in vitro study, ER-positive T47D human breast cancer cells were previously incubated under different concentrations of 17β-estradiol (E2) level, and FDG uptake was evaluated after exposure to various doses of E2.

**RESULTS**

In patients with ♦Luminal A♦ breast cancer, FDG uptake was significantly higher during the late menstrual period (after day10: 6.2±2.2, n=8) than during the early menstrual period (day 1-9: 3.5±2.0, n=7) (p=0.026). There was no significant difference between the two periods in other subtypes, i.e. ♦Luminal B (HER2-negative)♦ (n=10), ♦Luminal B (HER2-positive)♦ (n=3), and ♦Triple-negative♦ (n=5). In the in vitro study, E2 augmented FDG uptake in T47D cells in a dose- and time-dependent manner, which was inhibited by ER-agonists, such as tamoxifen and fulvestrant. With exposure with 0.01 nM, 0.1 nM, 1 nM and 10 nM E2 after incubation in E2-free medium, mean FDG uptake reached 114%, 121%, 150% and 147%, respectively, by 24 hr, and 153%, 173%, 174% and 178%, respectively, by 48hr. With the baseline E2 level of 0.01 nM, FDG uptake was significantly increased when E2 level was elevated to =1 nM. However, when the baseline E2 level was 0.1 nM, no significant elevation of uptake was observed when E2 level increased up to 1 to 10 nM.

**CONCLUSION**

Our preliminary data suggest that, in premenopausal patients with possibly lower baseline E2 level, FDG uptake in ♦Luminal♦-type cancer could be elevated after E2 surges during the menstrual cycle.

**CLINICAL RELEVANCE/APPLICATION**

Fluorodeoxyglucose uptake in breast cancer can be influenced by physiological estrogen fluctuations during the menstrual cycle.

**LL-BRS-TH3A • Dynamic Contrast-enhanced MR Imaging: A Potential Predictor to Pathologic Complete Response of Breast Cancer after Neoadjuvant Chemotherapy****Yuan Jiang (Presenter); Xiaoying Wang MD; Naishan Qin; Li Guo****PURPOSE**

To retrospectively evaluate the feasibility of time intensity curve (TIC) in dynamic contrast-enhanced MR imaging (DCE-MRI) in prediction of pathologic complete response (pCR) after neoadjuvant chemotherapy (NAC) in breast cancer.

**METHOD AND MATERIALS**

## RESULTS

### CONCLUSION

TIC in DCE-MRI has the potential capability in predicting pCR after NAC in breast cancer.

### CLINICAL RELEVANCE/APPLICATION

DEC-MRI can be used in breast cancer-response evaluation after NAC and can help predict pCR.

## **LL-BRS-TH4A • The State of Screening Mammography from 2004 to 2011: Screening Rates are Down Nationwide as USPSTF Guidelines are Ignored**

**Martey S Dodoo** PhD (Presenter) ; **Richard Duszak** MD ; **Danny Hughes** PhD ; **Geraldine B McGinty** MD

### PURPOSE

To estimate rates and intervals between repeated screening mammography examinations for elderly Medicare beneficiaries, using recently published repeat imaging classification criteria.

### METHOD AND MATERIALS

A 5% national random sample of Medicare beneficiary physician office and outpatient hospital claims data for female elderly beneficiaries, 66 years and above was used. From that data we selected beneficiaries enrolled continuously in Medicare and alive throughout each of 2 periods five years apart: 2004-2006, and 2009-2011. These periods are essentially pre- and post- publication of the revised 2009 US Preventive Services Task Force (USPSTF) recommended changes. Administrative claims for screening mammography were identified using the appropriate CPT/HCPCS/ICD-9 codes. From the dates of service for those claims, we computed screening rates and intervals between repeated screenings. The rates and intervals were compared for the 2 periods, by age group, and by state of beneficiary residence. Denominators were defined using the Neiman Health Policy Institute classification system.

### RESULTS

There were 1,081,981 elderly females in our 2004-2006 beneficiary group, and 866,792 in our 2009-2011 group. Average screening rates were 53.3% in 2004-2006 but dropped to 48.2% in 2009-2011. Far fewer (29.1%) of the 2004-2006 group underwent repeated screening, and even fewer (22.8%) in the 2009-2011 group underwent repeated screening. Screening rates were down for every elderly age group and in every state. Screening intervals were centered around 12, not 24 months. After the revised USPSTF guidelines fewer Medicare women are undergoing screening mammography. Women who undergo repeated screening seem to have maintained the 12-month interval between screenings (average 14.5 months in 2004-2006, and 13.9 months in 2009-2011).

### CONCLUSION

Only 48% of Medicare elderly beneficiaries underwent any screening mammography in a recent 3-year window, and only 22% underwent any repeated screening. Those who underwent repeated screenings overwhelmingly did so at 1-year (not 2-year) intervals.

### CLINICAL RELEVANCE/APPLICATION

Screening mammography intervals have remained static despite 2009 USPSTF recommendations, but overall screening rates have declined. Increasing compliance and patient access merits attention.

## **LL-BRS-TH5A • Does Background Enhancement Influence Diagnostic Accuracy of Breast MRI?**

**Nienke L Hansen** MD (Presenter) ; **Simone Schradig** MD ; **Alexandra Barabasch** ; **Kevin Strobel** PhD ; **Christiane K Kuhl** MD

### PURPOSE

Purpose of our study was to determine the influence of the degree of background enhancement on sensitivity, specificity and positive predictive value (PPV) of breast MRI.

### METHOD AND MATERIALS

335 women with 494 breasts underwent dynamic contrast-enhanced breast MRI in our institution (median age 55, 25-86 years) from May 2010 to November 2012. Background enhancement in MRI was scored on a 4-point-scale from absent to strong. BIRADS diagnoses were assigned per breast. BIRADS6 lesions were excluded from analysis. Diagnoses were validated either by biopsy (BIRADS 4/5) or MRI follow-up (BIRADS 1-3) (average 14 months, 12-27 months). Sensitivity, specificity and PPV were calculated and compared for all classes of background enhancement. Fisher's exact test was used for statistical analysis.

### RESULTS

A total 378 (77%) benign and 116 (23%) malignant diagnoses were validated in the 494 breasts. 9% (45/494) of lesions were classified as DCIS (mean size 28 mm, range 7-100 mm), 14% (71/494) as invasive carcinoma (mean size 17 mm, range 0.5-11 mm). The distribution of MR-ACR categories in the 335 patients was as follows: MR-ACR1 in 187/335 (56%), 2 in 92/335 (27%), 3 in 41/335 (12%), and MR-ACR4 in 15/335 (4%). Sensitivity of MRI in breasts categorized as MR-ACR1, 2, 3, and 4 was 98% (64/65), 100% (31/31), 100% (15/15), and 100% (5/5), respectively (p=1). Specificity of breast MRI in breasts categorized as MR-ACR1, 2, 3, and 4 was 83% (175/211), 72% (76/105), 57% (26/46) and 38% (6/16) (p=0.00019). PPV was 64% (64/100), 52% (31/60), 43% (15/35) and 33% (5/15).

### CONCLUSION

Background enhancement does not seem to interfere with our ability to identify invasive breast cancers and DCIS in MRI. This, however, is achieved at the expense of specificity and PPV, which decreases significantly with stronger background enhancement.

### CLINICAL RELEVANCE/APPLICATION

The accuracy of breast MRI decreases with increasing background enhancement; a compromise on specificity appears unavoidable. However, PPV levels appear still acceptable in women with MR-ACR 3 and 4.

## **LL-BRS-TH6A • Diffusion Tensor Imaging for Prediction of Pathologic Response to Neoadjuvant Chemotherapy in Patients with Breast Cancer**

**Hee Jung Shin** MD (Presenter) ; **Nola M Hylton** PhD ; **Lisa Wilmes** PhD ; **David Newitt** PhD ; **Ella F Jones** PhD ; **Rebekah McLaughlin**

### PURPOSE

To investigate tumor apparent diffusion coefficient (ADC) and fractional anisotropy (FA) measured by diffusion tensor imaging (DTI) as predictors of pathologic complete response (pCR) in patients with locally advanced breast cancer (LABC) after neoadjuvant chemotherapy (NAC).

### METHOD AND MATERIALS

In this HIPAA-compliant institutional review board-approved study, forty patients with LABC (mean tumor size, 4.0 cm; range, 0.6-9.9 cm) were enrolled between September 2010 and November 2012. MR imaging including DTI was performed on a 1.5T scanner before NAC (MR1) and after one cycle of taxane-based treatment (MR2). ADC and FA prior to treatment and after one cycle of NAC were measured from DTI data. Pretreatment values (MR1), early treatment values (MR2), and early percent change of these variables (between MR1 and MR2) were compared between pCR and non-pCR groups using the Mann-Whitney U test. Receiver operating characteristic (ROC) curve analysis was performed to assess the diagnostic performance of each parameter and the area under the ROC curve (AUC) was compared.

### RESULTS

After one cycle of treatment, 9 patients (22.5%) showed pCR and 31 patients (77.5%) showed non-pCR. Prior to pretreatment, only tumor ADC showed a statistically significant difference between pCR and non-pCR groups ( $1.07 \pm 0.20 \times 10^{-3}$  vs.  $1.12 \pm 0.10 \times 10^{-3}$  mm<sup>2</sup>/sec, respectively) ( $P=0.029$ ). After one cycle of treatment, patients with pCR had statistically significantly higher percent changes of tumor ADC (P)

#### CONCLUSION

Patients with pCR showed significantly lower pretreatment ADCs than those with non-pCR. Early percent change in both ADC and FA was associated with pCR. These results suggest that both diffusion related parameters provide information that can be used for early assessment of response to NAC in patients with LABC.

#### CLINICAL RELEVANCE/APPLICATION

The prediction of pCR using DTI-based quantitative measurements of fractional anisotropy could help determine surgical planning and predict long-term outcome.

### LL-BRE-TH7A • The Density Dilemma

**Julie Bykowski MD ; Christian S Welch MD (Presenter) ; Jade Quijano De Guzman MD ; Haydee Ojeda-Fournier MD**

#### PURPOSE/AIM

Advocacy organizations have been successful in enacting legislation in 5 states and endorsed or proposed bills in 17 additional states requiring breast imagers to directly notify the patient if her breasts are dense. This exhibit will outline the variability in the state law requirements and implications for patient counseling regarding options for surveillance in an effort to reduce confusion and misinformation.

#### CONTENT ORGANIZATION

Review of BIRADS breast density categories, with image examples. Review of enacted and proposed state laws for breast density reporting, and variability of mandates for insurance coverage. Summary of possible benefits, pitfalls and costs of alternative or adjunct screening modalities. Review of Connecticut experience with whole breast ultrasound. Our institution's recommendations for patients and clinicians.

#### SUMMARY

The growing trend of state mandates for notification regarding breast density may result in confusion and misinformation. Review of current enacted and proposed laws, the reliability of breast density assessment, and adjunctive screening options is provided in an effort to accurately address these concerns with patients and referring providers.

### LL-BRE-TH8A • Revisiting High Risk Breast Lesions: Radiopathologic Correlation and Management through Clinical Vignettes?

**Mona M El Khoury MD (Presenter) ; Lucie Lalonde MD ; Maude Labelle MD ; Julie David MD ; Isabelle Trop MD, MPH**

#### PURPOSE/AIM

The purpose of this exhibit will be to:

- 1- Review the range of high risk lesions that might be encountered at percutaneous imaging guided biopsies, including atypical ductal hyperplasia (ADH), lobular neoplasia (Atypical lobular hyperplasia (ALH) and Lobular carcinoma in situ (LCIS)), flat epithelial atypia (FEA), papilloma, mucocoele-like lesions, radial scar and phyllodes.
- 2- Illustrate the imaging presentation of these high risk lesions
- 3- Discuss the importance of radio-pathologic correlation
- 4- Propose the optimal management for each of these lesions based on the most recent literature.

#### CONTENT ORGANIZATION

- 1- Through clinical cases, each high risk entity will be discussed in terms of its:
  - a. Pathophysiology
  - b. Imaging presentation (mammography, sonography, MRI)
  - c. Radiopathologic correlation
  - d. Management approaches

#### SUMMARY

To this day, high-risk lesions remain challenging in terms of diagnosis and management. Through clinical and radiologic examples, the different high-risk lesions of the breast will be described, with an emphasis on radiopathologic correlation with the goal that the clinical team can propose a plan for subsequent optimal management.

## Breast - Thursday Posters and Exhibits (12:45pm - 1:15pm)

### Thursday, 12:45 PM - 01:15 PM • Lakeside Learning Center

BR

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### LL-BRS-THB • AMA PRA Category 1 Credit™:0.5

### LL-BRS-TH1B • Diffusion-weighted Imaging and 18F-fluorodeoxyglucose (FDG) PET/CT for Breast Cancer: Prognostic Value of Apparent Diffusion Coefficient (ADC) and Maximum Standardized Uptake Value (SUVmax) of Breast Cancer

**E Rang Song (Presenter) ; Keum Won Kim MD ; Hye Young Jang ; Young Jun Cho MD ; Cheol Mog Hwang MD ; Dae Ho Kim ; Dong Ki Cho MD ; Minjae Yoon**

#### PURPOSE

To correlate 18F-fluorodeoxyglucose (FDG) maximum standardized uptake value (SUVmax) and diffusion-weighted imaging (DWI) apparent diffusion coefficient (ADC) for clinicopathological prognostic factors and to compare the prognostic value of these indexes in breast cancer.

#### METHOD AND MATERIALS

50 breast cancers of 49 patients (age range : 37 - 83 years, mean age : 53 years) who underwent preoperative FDG PET/CT and DWI, were studied retrospectively. The breast cancers included 4 ductal carcinoma in situ (DCIS) and 46 invasive ductal carcinomas (IDC). The relationships both SUVmax and ADC with clinicopathological prognostic factors (age, tumor size, invasiveness, histologic grade, nodal metastasis, ER receptor status, PR receptor status, and HER-2 neu status) were evaluated by univariate and multivariate regression analysis and the degree of correlation was determined by Spearman's rank test. The patients were divided into a better prognosis group (n=16) and a worse prognosis group (n=34) based on invasiveness (DCIS or IDC) and the modified Nottingham prognostic index (NPI). Their prognostic values were examined by receiver operating characteristic (ROC) analysis.

#### RESULTS

SUVmax was significantly associated with histological grade and tumor size (p

#### CONCLUSION

SUVmax and ADC correlated with invasiveness, histologic grade, and nodal metastasis status. And these indexes are negatively correlated each other and possible to predict the prognosis of breast cancer

#### CLINICAL RELEVANCE/APPLICATION

FDG PET-CT and diffusion-weighted imaging (DWI) predict the prognosis of breast cancer

## LL-BRS-TH2B • Low-dose Molecular Breast Imaging: Factors to Consider When Establishing a Clinical Protocol

**Douglas A Kieper** BS (Presenter) \* ; **Marcela Bohm-Velez** MD

### PURPOSE

The purpose of this prospective trial was to evaluate the clinical factors impacting tracer delivery and breast tissue distribution in patients undergoing MBI examinations.

### METHOD AND MATERIALS

Patients scheduled for MBI were imaged using a Dilon 6800 Gamma Camera following the SNM Practice Guidelines for Breast Scintigraphy (2010). Patients were randomized into three groups to receive a 185, 370, or 555 MBq dose. A "straight stick" single-syringe injection technique was used and the activity in each syringe was measured before and after injection. Imaging was conducted within 10 minutes of injection and an image photon density (PD) in counts/cm<sup>2</sup>/MBq was calculated for each image. A bilateral PD value was calculated for each patient and then plotted against dose delivered, patient weight and age along with breast size and tissue density. Delayed imaging was conducted to determine tracer washout.

### RESULTS

44 patients were enrolled in the study. On average, only 76% of the patient dose was delivered, 24% remaining in the syringe after injection. There was a linear relationship between the injected dose and PD for each patient, but a broad range of PD of within the population (+/- 36%) with a strong correlation between patient weight and PD. Correlations between PD and patient age, breast tissue density and breast size were poor. The effective half-life of MIBI in the breast tissue was calculated to be 134 minutes.

### CONCLUSION

These data suggest that there are at least three critical areas that need to be addressed by low-dose protocols. First, the injection technique needs to be improved and validated by checking the post-injection syringe for undelivered dose. Second, the use of a patient weight adjusted dose model may be useful. Third, the patient throughput should be designed to minimize injection-to-imaging time. Patient factors such as age, breast size and tissue density do not significantly influence tracer uptake.

### CLINICAL RELEVANCE/APPLICATION

Low-dose MBI is a recent advancement in breast imaging needing robust clinical protocols. This work investigates patient and clinical variables that need to be addressed in their development.

## LL-BRS-TH3B • Quantitative Shear Wave Elastography: Correlation to Prognostic Histologic Features of Breast Cancer

**Wing-Fai F Au** MBBS (Presenter) ; **Sandeep Ghai** MD ; **Fang-I Lu** MD ; **Hadas Moshonov** PhD ; **Hemi Dua** MD ; **Pavel Crystal** MD

### PURPOSE

To correlate prognostic histologic features of breast cancer to quantitative shear wave elastography (SWE) parameters.

### METHOD AND MATERIALS

53 patients (mean age 58 years) with 56 breast cancers (mean size 15 mm) were included in this prospective study. 89% of the cancers were invasive ductal carcinomas. SWE was performed with the Aixplorer ultrasound system (Supersonic Imagine, Aix-en-Provence, France). 3 quantitative SWE parameters (mean elasticity: E mean, maximum elasticity: E max, elasticity ratio: E ratio) were recorded. Cancer size was determined from ultrasound. Histologic grade, lymphovascular invasion (LVI), lymph node status and biomarker profile of the cancer (estrogen receptor:ER, progesterone receptor:PR, human epidermal growth factor receptor 2:HER 2) were determined from the surgical pathology reports. Correlation between these features and the SWE parameters was assessed.

### RESULTS

Significant positive correlation was found between cancer size and all SWE parameters (correlation for E mean: 0.518, E max:0.510, E ratio:0.580; all P-values 0.05). There was a trend towards a significant correlation between lymph node status and E mean, E max (positive lymph node: E mean:177.8, E max:209.1; negative lymph node: E mean:122.1, E max:145.7; P-values 0.062, 0.047 respectively). There was significant correlation between LVI and all 3 SWE parameters (positive LVI: E mean:190.5, E max 217.8, E ratio:16.9; negative LVI: E mean:115.6, E max:142.6, E ratio:9.2; all P-values 0.05). In multivariate analysis, significant correlation was found between cancer size and all SWE parameters, LVI and E mean (all P-values

### CONCLUSION

Cancer size and LVI were significantly correlated with the SWE parameters. There was no significant correlation between histologic grade, lymph node status, or cancer biomarker profile and the SWE parameters.

### CLINICAL RELEVANCE/APPLICATION

Shear wave elastography is of value to predict prognosis of breast cancer since LVI is associated with worse outcome of the disease.

## LL-BRS-TH4B • Utility of a Quantitative Analysis of Contrast Enhancement to Discriminate between Benign and Malignant Entities Using a Linear Principal Component Analysis (PCA) Method

**Claudia R Seuss** MD (Presenter) ; **Ana P Klautau Leite** MD ; **James S Babb** PhD ; **Melanie Freed** PhD ; **Kai T Block** ; **Sunghoon Kim** ; **Linda Moy** MD

### PURPOSE

To determine if a quantitative analysis of the contrast enhancement from an indeterminate lesion and its background parenchyma (BP) improves the differentiation between benign and malignant lesions.

### METHOD AND MATERIALS

This IRB approved retrospective review was performed on 45 women who underwent an MRI guided biopsy between November 2011 and January 2013. The MR biopsy imaging was performed using a temporal resolution of 55 sec/frame for 5 consecutive frames. A single reader manually drew a region of interest (ROI) around the lesion. A second ROI was drawn around the entire breast on 3 separate images that did not contain the lesion. The quantitative analysis of dynamic signal enhancement in the BP was performed using a linear principal component analysis (PCA) method. The quantitative analysis for the lesion was calculated using the initial enhancement ratio (IER), defined as the percent increase of the signal between the first and third frames, and the delayed enhancement ratio (DER), defined as the percent increase of the signal between the first and fifth frames. IER and DER were measured for the lesion and BP. Correlation was made to the kinetic curve, mammographic breast density (BD) and background parenchymal enhancement (BPE).

### RESULTS

Our cohort consisted of 45 women: 13 with invasive ductal carcinoma (IDC), 12 with ductal carcinoma in situ (DCIS) and 20 with benign lesions. The IER and DER for the lesion was able to discriminate between benign lesions and IDC (p value 0.017 and 0.039). The area under the ROC curve (AUC) for BD was 0.671, kinetic curve was 0.669, IER 0.719 and DER 0.719. The quantitative measures had better ability than the ordinal measures to discriminate between benign and malignant lesions in that each of the lesion's IER and DER had a higher AUC than the BD and kinetic curves. There was no significant difference however, between any pair of measures in terms of AUC (p>0.69). A trend was noted with IDC being associated with increased BP (0.82) but not with BPE (p=.228).

### CONCLUSION

IDC had higher IER and DER values consistent with the rapid initial rise seen in malignant lesions. Higher BD but not BPE was seen in the patients with cancers compared to those with benign lesions.

### CLINICAL RELEVANCE/APPLICATION

Quantitative analysis of enhancement curves can distinguish between benign and malignant lesions more accurately than ordinal

measures. There was no increased incidence of cancer with increased BPE.

## **LL-BRS-TH5B • What Do Women Think? Knowledge and Opinions of Women Regarding Breast Density Legislation and Supplemental Whole Breast Ultrasound**

**Regina J Hooley MD (Presenter) \* ; Reni S Butler MD ; Cary P Gross MD ; Susan H Busch ; Liane E Philpotts MD \***

### **PURPOSE**

Connecticut law 09-41 requires radiologists to inform patients with mammographically dense breast tissue that they may benefit from the addition of whole breast ultrasound (WBUS). The purpose of this study is to determine patient awareness of breast density and compliance with supplemental WBUS.

### **METHOD AND MATERIALS**

During the period from 1/17/13 to 4/3/13, 236 patients were asked to complete a 12 item self-administered survey assessing knowledge about breast density and WBUS. Breast cancer risk was determined by medical record review. All women had a prior mammogram demonstrating heterogeneous or extremely dense breast tissue. A total of 221/236 patients had analyzable data.

### **RESULTS**

Of the 221 patients, the average age was 52.1 years (median 50 years, range 21-90 years). Breast cancer risk was as follows: very strong, 5% (11/221); intermediate, 10% (23/221); weak or unknown, 85% (187/221). 94% (207/221) were aware of their breast density, with 90% (199/221) informed by their physician and 65% (143/221) receiving WBUS because their doctor ordered the exam. History of prior WBUS was seen in 68% (151/221) and 63% (95/151) received yearly WBUS. The majority of women (91%, 201/221) reported WBUS was important in finding mammographically occult cancer, while 45% (99/221) reported increased anxiety due to breast density awareness and 89% (197/221) reported choosing WBUS despite an increased risk of additional testing. Of 45 women who did not have WBUS, 33% (15/45) reported never discussing breast density with their doctors and 16% (7/45) stated they were not familiar with WBUS. Compared to average risk women, women with elevated risk were more likely to know their breast density (33/34 vs 174/187), more likely to have had a prior WBUS (29/34 vs 140/187) and more amenable to additional testing (32/34 vs 165/187), although this was not statistically significant ( $p > 0.05$ ).

### **CONCLUSION**

Since implementation of CT 09-41, 90% of women surveyed with dense breast tissue discuss breast density with their physicians and 89% of women report choosing WBUS despite a risk of false positive results. Less than 50% of patients with dense breasts report increased anxiety due to breast density awareness.

### **CLINICAL RELEVANCE/APPLICATION**

Many women are aware of breast density and the limitations of mammography. Women with dense breasts are amenable to supplemental WBUS despite the chance of requiring additional testing or biopsy.

## **LL-BRS-TH6B • Detection of Breast Cancer with Addition of Screening Ultrasound: Results from a Single Health Screening Center**

**Jung Min Chang MD (Presenter) ; Hye Ryoung Koo MD ; Woo Kyung Moon**

### **PURPOSE**

To determine the supplemental breast cancer detection yield of screening ultrasound (US) in women at a health screening center.

### **METHOD AND MATERIALS**

Between January and December 2008, 6096 women underwent screening mammography (MG) and US at a single health screening center. Of those women, 3731 received prevalence screens and 2365 received incidence screens. Follow up exams were available for 1950 women receiving prevalence screens. Of these 1950 women, 281 women were excluded for positive or suspicious findings on MG. Finally, 1669 women with negative MG constituted our study population. When classified by BI-RADS breast composition, 570 were found to have fatty breasts, and 1099 showed dense breasts. BI-RADS final assessments were analyzed retrospectively, and the reference standard was defined as a combination of pathology and 12-month follow-up. The cancer detection rate (yield), positive predictive value (PPV1) of recalled cases (BI-RADS category 3, 4, 5), and positive predictive value (PPV3) of biopsies following US with negative MG were calculated.

### **RESULTS**

Among a total of 1669 women who underwent US with negative MG, 1159 (75.0%) were classified as BI-RADS category 1 or 2, 415 (20.0%) were classified as BI-RADS category 3, and 95 (5.0%) were classified as BI-RADS category 4 (4A [n=87], 4B [n=5], 4C [n=3]). Core biopsies were recommended and performed for 90 breast lesions, with five lesions being malignant (all BI-RADS category 4). The mean size of invasive cancer was  $1.0\text{cm} \pm 0.4$  (range 0.7-1.5cm). All women with breast cancers had dense breasts. Of the 5 cancer diagnoses, 2 were invasive ductal cancer, 1 was mixed invasive ductal and lobular cancer, and 2 were ductal carcinoma in situ. The cancer detection rate was 3 (5/1669 \*1000) per 1000 screens (95% CI, 1.1-7.2). The PPV1 for recall was 0.01 (5/ 510; 95% CI, 0.004-0.023), and the PPV3 for biopsies was 0.06 (5/90; 95% CI, 0.02-0.13). The number of screens needed to detect 1 cancer was 334 (95% CI, 299-371) for US with negative MG.

### **CONCLUSION**

The addition of screening US to negative MG identified 3 cancers per 1000 screens in normal population, slightly lower than the cancer detection rate in high risk screening with much higher number of false-positives.

### **CLINICAL RELEVANCE/APPLICATION**

Our study supports the benefit of screening breast US in women, especially with dense breasts. However, adding US to MG in this group may not be appropriate without reducing false positives.

## **LL-BRE-TH7B • Managing Breast Abscesses: What is the Radiologist's Role?**

**Sean Necessary MD ; Christopher P Ho MD (Presenter) ; Michael A Cohen MD**

### **PURPOSE/AIM**

Breast abscess is a common problem encountered in the emergency department and outpatient clinic. Traditionally it has been managed with surgical incision and drainage (IandD), however there is increasing data to support ultrasound-guided percutaneous drainage as the first line of management. Outcomes are often successful and the complication rate is lower than that of traditional surgical IandD. In this exhibit we will review the typical clinical and imaging presentation of breast abscesses and review the radiologist's role in the management and treatment of them.

### **CONTENT ORGANIZATION**

- 1) Clinical presentations of patients presenting with breast abscesses
- 2) Imaging appearance of breast abscesses and specifically the findings to support an attempt at percutaneous drainage
- 3) Procedural steps for image-guided percutaneous drainage and outline appropriate follow-up/management recommendations

### **SUMMARY**

Breast abscesses can be treated successfully with minimally invasive ultrasound-guided percutaneous drainage and antibiotic therapy. The radiologist should be familiar with the clinical and imaging presentations of breast abscesses as they can be confused with a malignant process and not all infections are amenable to percutaneous drainage. With this knowledge, the radiologist can become the lead therapist in managing many of these acute clinically significant lesions.

## **LL-BRE-TH8B • Physics and Quality Control in Breast Imaging: What Every Radiology Resident and Practicing Radiologist Needs to Know**

**Katharine D Maglione MD (Presenter) ; Janet R Szabo MD ; Neesha S Patel MD ; Anita Mehta MD, MSc ; Emily B Sonnenblick MD ; Laurie R Margolies MD**

#### PURPOSE/AIM

The upcoming American Board of Radiology (ABR) Exam of the Future will include up to 110 questions emphasizing physics content. The purpose of this exhibit is to review mammography physics and quality improvement for those taking the new ABR exam and for practicing radiologists.

#### CONTENT ORGANIZATION

Similar to the new ABR examination, this exhibit will emphasize images and practical applications. Topics are from the ABR Diagnostic Radiology Core Examination Study Guide (updated 8/5/2011). These include: optimizing film or digital mammograms (target/filter, grid, scatter, radiation dose), recognition and correction of artifacts, digital mammography workstations (equipment parameters and image processing). Quality assurance topics include quality determinants: patient positioning, image processing, optimal technique, and equipment. Mammography Quality Standards Act requirements will be reviewed. The presentation will conclude with an interactive quiz using multiple choice and matching questions, modeled after sample practice questions released by the ABR.

#### SUMMARY

As reflected by the new ABR exam, it is essential that practicing radiologists are familiar with mammography physics and quality improvement. In concordance with the ABR, we review core topics with an emphasis on images and practical application.

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### Digital Breast Tomosynthesis

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**Thursday, 04:30 PM - 06:00 PM • E451B**

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**RC715 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5**

#### RC715A • Clinical Implementation

**Lawrence W Bassett MD (Presenter)**

#### LEARNING OBJECTIVES

1) Identify the key practical issues affecting the clinical implementation of digital tomosynthesis. 2) Understand the technical aspects of digital tomosynthesis that will impact clinical workflow and IT resources. 3) Integrate changes to current workstation read-out protocols to allow for efficient interpretation of digital tomosynthesis studies.

#### ABSTRACT

Author will discuss approaches of image acquisition in digital breast tomosynthesis (DBT). The basics of DBT image interpretation and potential challenges of clinical digital breast tomosynthesis will be reviewed.

#### RC715B • Interpretation

**Emily F Conant MD (Presenter) \***

#### LEARNING OBJECTIVES

1) Understand the basics of DBT image presentation and interpretation. 2) Review DBT applications in screening and diagnosis. 3) Identify potential challenges in clinical implementation of DBT.

#### RC715C • Research Evidence

**Etta D Pisano MD (Presenter) \***

#### LEARNING OBJECTIVES

1) Understand the published literature on the use of tomosynthesis for breast cancer screening. 2) Understand the proposed trial design for the Tomosynthesis Mammographic Imaging Screening Trial (TMIST) and what that trial adds to the available data on tomosynthesis.

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### MR Imaging-guided Breast Biopsy (Hands-on Workshop)

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**Thursday, 04:30 PM - 06:00 PM • E260**

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**RC750 • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5**

**Amy D Argus , MD \***  
**Mary C Mahoney , MD \***  
**Laura B Shepardson , MD**  
**Carol H Lee , MD**  
**Simone Schradling , MD**  
**Habib Rahbar , MD**  
**Jiyon Lee , MD**  
**Roberta M Strigel , MD,MS**  
**Sandra Brennan , MBBCh, MSc**  
**Tanya W Stephens , MD**  
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**Kirti M Kulkarni , MD**  
**Andrew Bowman , MD, PhD**  
**Stephen J Seiler , MD**  
**Mary S Newell , MD**  
**Hal D Kipfer , MD**

#### LEARNING OBJECTIVES

1) Establish criteria for MR Image-guided breast biopsy patient selection. 2) Cultivate a working understanding of MR Image-guided biopsy and needle localization instrumentation and implementation. 3) Basic MR Image-guided biopsy and needle localization parameters and requirements for appropriate coil, needle and approach selection. 4) Discuss practice integration issues. 5) Benefits and limitations of availability of MR Image-guided biopsy/needle localization in your practice.

#### ABSTRACT

This course is intended to provide both basic didactic instruction and hands-on experience in the application of MRI guided breast biopsy and needle localization. Because MRI is having a progressively larger role in the evaluation of breast cancer each year, there has been a

tremendous increase in the need for MRI guided biopsy and needle localization of the identified abnormalities, since many of these can only be identified at MRI. This course will be devoted to the understanding and identification of: 1) appropriate patient selection 2) optimal positioning for biopsy 3) target selection and confirmation 4) various biopsy technologies and techniques 5) potential problems and pitfalls

## Clinical Breast MR Imaging (An Interactive Session)

Friday, 08:30 AM - 10:00 AM • E450A

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**RC815** • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

### RC815A • Breast MRI: Suspicious Lesions

**Christiane K Kuhl** MD (Presenter) \*

#### LEARNING OBJECTIVES

1) To review breast MR imaging features used to distinguish suspicious from benign lesions. 2) To understand the appropriate use of the ACR Breast MR lexicon. 3) To review the management of suspicious breast MR findings.

#### ABSTRACT

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### RC815B • Breast MRI: BI-RADS 3

**Christopher E Comstock** MD (Presenter)

#### LEARNING OBJECTIVES

1) Understand appropriate use of the ACR BI-RADS in MR Interpretation. 2) Review interesting cases using BI-RADS lexicon.

### RC815C • MR-guided Biopsy

**Carol H Lee** MD (Presenter)

#### LEARNING OBJECTIVES

1) To review technical considerations in MR guided biopsy. 2) To discuss potential pitfalls associated with MR biopsy and how to handle them. 3) To understand appropriate post-biopsy management and follow-up.

#### ABSTRACT

## US-guided Interventional Breast Procedures (Hands-on Workshop)

Friday, 08:30 AM - 10:00 AM • E264

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**RC852** • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

**Jocelyn A Rapelyea**, MD  
**Priscilla J Slanetz**, MD, MPH \*  
**Shambhavi Venkataraman**, MD  
**Liane E Philpotts**, MD \*  
**Ermelinda Bonaccio**, MD  
**Stephen J Seiler**, MD  
**Bruno D Fornage**, MD  
**Rachel F Brem**, MD \*  
**William R Poller**, MD \*  
**Margaret M Szabunio**, 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

## Breast Imaging (Issues in Screening)

Friday, 10:30 AM - 12:00 PM • E450B

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**SST01** • AMA PRA Category 1 Credit™:1.5 • ARRT Category A+ Credit:1.5

#### Moderator

**Susan G Roth**, MD

#### Moderator

**Sarah M Friedewald**, MD \*

### SST01-01 • Mammography Outcomes by Screening Interval: Does Biennial Screening Affect Prognosis?

**Laura Billadello** MD (Presenter) ; **Riti Mahadevia** ; **Paula M Grabler** MD ; **Ellen B Mendelson** MD \* ; **Lilian Wang** MD

#### PURPOSE

In 2009, the U.S. Preventative Services Task Force announced the recommendation for biennial screening mammography for women aged 50-74 years, despite evidence of mortality reduction with annual screening mammography beginning at age 40, as supported by the American College of Radiology (ACR), Society of Breast Imaging (SBI), and American Cancer Society (ACS). The purpose of this study is to use secondary endpoints of tumor size and lymph node positivity to compare the efficacy of screening mammography performed at various time intervals.

#### METHOD AND MATERIALS

Under IRB approval, a retrospective review of all screen-detected breast cancers between 2007-2010 was performed. Patients were

divided into groups 1-3 based on time interval between screening mammograms, defined as 3 years. The three groups were controlled in terms of age, breast density, high risk status, and family history of breast cancer. Audit data as outlined by ACR BI-RADS, including % stage 0 or 1 cancers, % minimal cancer, and % positive axillary lymph nodes, were compared for the three groups. The size of invasive cancers was also compared.

#### RESULTS

There were 419 screen-detected cancers during the study period. 34 patients were excluded due to unknown screening interval or lack of surgical pathology and 24 patients were excluded for cancer detection on baseline mammography. To adjust for differences in age between groups, patients >75 years were excluded. This resulted in 332 patients, 207 in group 1, 73 in group 2, and 52 in group 3. There was no significant difference in age, breast density, high risk status, family history, or index histology between groups. The % stage 0 or 1 cancer and % minimal cancer did not differ between the groups ( $p=0.057$  and  $p=0.498$ , respectively). The size of invasive cancers was also not statistically different between the three groups (ANOVA,  $p=0.165$ ). However, lymph node positivity was lowest in group 1, which was a statistically significant difference (8.7% vs. 20.5% and 15.4%,  $p=0.002$ ).

#### CONCLUSION

Screening mammography performed at an interval

#### CLINICAL RELEVANCE/APPLICATION

Screening mammography performed at an interval less than that recommended by the USPSTF significantly reduces the rate of lymph node positivity, thereby improving patient prognosis.

### SST01-02 • Incidental Breast Lesions: Factors Associated with Increased Risk of Malignancy and Lack of Follow-up

**Eniola T Obadina MD (Presenter) ; Roberta M Strigel MD,MS ; Richard J Bruce MD \* ; Alejandro Munoz Del Rio PhD ; Frederick Kelcz MD, PhD**

#### PURPOSE

To evaluate the rate of malignancy of incidental breast lesions (IBLs) detected on non-breast imaging examinations, factors associated with malignancy, and compliance with recommended follow-up.

#### METHOD AND MATERIALS

Following IRB approval, a retrospective review of the electronic medical record using keyword search was performed to identify all patients (pts) without a known history of breast cancer who had an IBL detected on a non-breast imaging examination from 9/2008 to 8/2012. Outcomes were determined by follow-up with dedicated breast imaging and results of biopsy, if performed. Imaging modality of detection, IBL size, pt age and location at the time of the exam, follow-up and final outcome were recorded. Rates of imaging follow-up and malignancy were calculated. Kruskal-Wallis and Fisher's exact tests were used to identify factors associated with malignancy and compliance with follow-up.

#### RESULTS

293 pts were identified and ranged in age from 14 to 100 years (mean 59.6 years). 36/293 (12%) of pts were in the Emergency Department (ED) at the time of their non-breast imaging exam, 49/293 (17%) were inpatients, and 208/293 (71%) were outpatients. IBLs ranged in size from 0.4 to 7.2 cm (mean 1.53 cm). 242 pts had IBLs detected on CT (83%), compared to 25 pts with MRI-detected IBLs (8.5%) and 25 pts with PET-detected IBLs (8.5%). One pt had an IBL detected on a myocardial perfusion stress test. 121/293 (41%) pts underwent follow-up with dedicated breast imaging. There was a significantly increased rate of noncompliance with follow-up in ED pts (30/36; 83%), compared to 32/49 (65%) inpatients and 110/208 (53%) outpatients ( $p$

#### CONCLUSION

Incidental breast lesions ultimately diagnosed as breast cancers are not rare (21%) and were most likely to represent malignancy if discovered on PET imaging. IBLs discovered as part of an ED visit were the most likely not to undergo follow-up.

#### CLINICAL RELEVANCE/APPLICATION

Incidental breast lesions identified on non-breast imaging exams represent malignancy in up to 21% of cases, emphasizing the need for dedicated breast imaging follow-up of these incidental findings.

### SST01-03 • Surveillance of Women with Personal History of Breast Carcinoma Using MRI

**Haiquan Liu (Presenter) ; Yanqing Hua MD ; Huadong Miao ; Weijun Peng MD**

#### PURPOSE

To determine the capability of MRI in detecting the second breast carcinoma among women with a personal history of breast carcinoma.

#### METHOD AND MATERIALS

This retrospective review of breast MRI examinations performed from 2007 to 2011 yielding 798 women who had a personal breast history. Of the 798 patients, 445 had adequate follow up data and 348 had MRI, mammography and ultrasound within 6 months intervals. The sensitivity, specificity of MRI in detecting the second breast carcinoma was calculated. The recall rate and PPV of MRI was also calculated.

#### RESULTS

Of the 798 patients, 49 second breast carcinoma was found and the incidence of the second breast carcinoma was 6.1%. Forty-five breast carcinomas were detected by MRI. The sensitivity and specificity of MRI in detecting the second breast carcinoma was 91.8% and 92.2%, respectively. The recall rate of MRI was 9.5% and PPV was 59.2%. The sensitivity of MRI, mammography and ultrasound in detecting the second breast carcinoma was 90.3%, 48.4% and 77.4%, respectively. The specificity was 95.3%, 93.4% and 95.9%, respectively.

#### CONCLUSION

We found that breast MRI surveillance of women with a personal history of breast cancer was clinically valuable in finding malignancies with a reasonable recall rate and PPV.

#### CLINICAL RELEVANCE/APPLICATION

For woman with history of breast carcinoma, breast MRI examination is valuable, especially when a patient has equivocal Clinical and Imaging Findings.

### SST01-04 • Sensitivity, Specificity and Recall Rates for An Abridged Breast MRI Protocol in a Pure High-risk Screening Population

**Laura Heacock MS, MD (Presenter) ; Amy N Melsaether MD ; Kristine M Pysarenko MD ; Samantha L Heller MD, PhD ; Ana P Klautau Leite MD ; Linda Moy MD**

#### PURPOSE

To evaluate the sensitivity, specificity and recall rates for an abridged MRI protocol.

#### METHOD AND MATERIALS

A retrospective review of 128 asymptomatic women with 195 findings who had a screening MRI was performed by 2 readers. Each reader was trained with 100 cases with a known cancer in an abridged protocol. Initially they evaluated the precontrast T1, first post-contrast T1 and first subtraction T1 post-contrast images blinded to the history and prior films. Then they assessed the images given the above information and once more with the addition of the pre-contrast T2 images. The scan time for the 3 T1-sequences was 4 mins; the scan time for the T2-sequence was 4 mins. The time to interpret the study and the confidence score was assessed for each study. Comparison was made to the original diagnostic interpretation.

## RESULTS

Of 128 women, 22 (17.2%) BRCA carriers, 1 (0.8%) chest radiation, 73 (57%) family history, 20 (15.6%) personal history of breast cancer, 12 (9.4%) had atypia. Mean age was 48 years, range 25-82 years. Mean lesion size was 1.2cm (range 0.3 - 8cm). Of the 128 exams, 20 (15.6%) were originally assessed as BIRADS 1, 62 (48.4%) as BIRADS 2, 24 (18.8%) as BIRADS 3, 22 (17.2%) as BIRADS 4. Using the abridged protocol, 26 (20.3%) exams were assessed as BIRADS 0, 25 (19.5%) as BIRADS 1, 19 (14.8%) as BIRADS 2, 28 (21.9%) as BIRADS 3, 30 (23.4%) as BIRADS 4. Sensitivity was 100%; 3 cancers (2 DCIS and one invasive cancer) were identified by the readers. However, the specificity was 58% and an additional 31 findings were identified by the readers. Mean time for interpretation for readers was 50 secs (range 0.33 - 4.5 minutes). Both readers showed a significant increase in confidence (p

## CONCLUSION

An abridged breast MRI in a pure screening population had a high sensitivity but low specificity and high recall rates. The addition of T2 images and prior films helped decrease the recall rate.

## CLINICAL RELEVANCE/APPLICATION

In an abridged screening breast MRI exam, the number of sequences necessary to decrease the false-positive findings needs to be further evaluated.

### SST01-05 • Screening Breast MRI in Patients Previously Treated for Breast Cancer: Diagnostic Yield for Cancer and False Positive Interpretation Rate

**Catherine S Giess MD (Presenter) ; Patricia S Poole MD ; Sona A Chikarmane MD ; Dorothy A Sippo MD ; Robyn L Birdwell MD**

## PURPOSE

To determine the cancer detection rate and rate of false positive interpretation of screening breast MRI in women previously treated for cancer

## METHOD AND MATERIALS

IRB approved, retrospective review of the breast MRI database from 2009-2011 identified 3297 contrast enhanced screening exams, 1498 (45.4%) in women previously treated for breast cancer. MRI reports were reviewed to determine MRI findings, BIRADS assessments and patient demographics. The longitudinal medical record was reviewed to determine outcomes of short interval surveillance, biopsy results and cancers detected. False positive studies were considered BIRADS 3 assessments with no evidence of cancer on follow up or BIRADS 4/5 assessments benign on biopsy.

## RESULTS

Patient age ranged from 26-88, mean 54 years. 10.1% (152/1498) exams were performed in known genetic mutation carriers. 11.2% (168/1498) screening exams were assessed as abnormal, including 79/1498 (5.3%) BIRADS 3 and 89/1498 (5.9%) BIRADS 4/5. Follow up data on BIRADS 3 exams included 40 (50.6%) without malignancy by imaging and/or clinical follow up  $\geq$  24 months, 27 (34.2%) with < 24 months stability, and 12 (15.2%) upgraded to BIRADS 4/5, with 5 (41.7%) cancers. Cancer rate for BIRADS 3 lesions was 6.3%; 3 of 5 upgraded cancers occurred in mutation carriers. Biopsy results for BIRADS 4/5 exams were available in 81 lesions, with 22 (27.2%) cancers. Overall, 27 (1.8%) of 1498 screening MR exams had malignancy diagnosed during the study period. Average time interval from original cancer diagnosis was 7.8 years (range 1-23 years). 24/27 cancers had negative mammograms within 6 months prior to new cancer diagnosis. 7/27 (22%) of cancers were diagnosed in mutation carriers; an additional 8/27 (29.6%) were diagnosed in women with a positive family history.

## CONCLUSION

Screening breast MRI in women previously treated for breast cancer detected cancer in 1.8% examinations, with a minority of exams requiring short term surveillance or biopsy, and positive predictive value of 27.2% for biopsies recommended. Nearly half of screen detected cancers in this population occurred in women without a genetic mutation or a positive family history of breast cancer.

## CLINICAL RELEVANCE/APPLICATION

Screening breast MRI in women previously treated for cancer detects mammographically occult cancers, with acceptable positive predictive values and low false positive interpretation rates.

### SST01-06 • Breast MRI Screening in Women Who had Undergone Breast Conserving Therapy for Cancers

**Hye Mi Gweon MD (Presenter) ; Nariya Cho MD ; Ann Yi MD ; Woo Kyung Moon**

## PURPOSE

The American Cancer Society reports insufficient evidence to recommend for or against MRI in surveillance of asymptomatic women with a personal history of breast cancer. The purpose of this study, therefore, was to retrospectively investigate the outcomes of the first round of MRI screening in women who had undergone breast conserving therapy for breast cancers.

## METHOD AND MATERIALS

Between January 2008 and March 2012, 808 women who had undergone breast conserving therapy for breast cancers and subsequent screening breast MRI were identified. All women had an annual screening mammography prior to beginning MRI screening and all the results were negative. Women without at least 12-month follow-up data (n=102) and had metastatic disease (n=2) were excluded. A total of 704 women (median age 48, range 20-72 years) (initial stage 0: 27.3%, stage I: 37.2%, stage II: 30.3%, stage III: 5.3%) with 1069 screening breast MR examinations (one round: 389, two rounds: 265, three rounds: 50) formed our study group. The reference standard was based on biopsy and/or 12-month follow-up. The cancer detection rate, sensitivity, specificity, and positive predictive value (PPV) based on biopsy performed at the first round screen were analyzed. Median follow-up duration was 18.5 months (range, 12-53 months).

## RESULTS

Of the 704 women, cancer was detected at MRI in 10 women (1.4%) at a median interval of 33 months (range, 14-56 months) between surgery and detection. The ten cancers included 7 (70%) invasive cancers and 3 (30%) DCIS and were found in 6 (60%) ipsilateral and 4 (40%) contralateral breasts and were 100% node negative among those staged. The median histologic size of the invasive cancers was 0.8cm (range, 0.4-1.4cm). Two (0.3%) interval cancers were found 6 months later by mammography and ultrasound, respectively. The sensitivity, specificity, and PPV of MRI were 83.3% (10 of 12), 98.0% (678 of 692), and 41.7% (10 of 24).

## CONCLUSION

A single MRI screening in women who had undergone breast conserving therapy for cancers detected 14 mammographically occult, node-negative breast cancers per 1000 women.

## CLINICAL RELEVANCE/APPLICATION

Previous history of breast cancer therapy is a reasonable indication for breast MRI screening.

### SST01-07 • Foci Detected on Screening MRI: Can They Be Safely Followed or Is Biopsy Required?

**Dipti Gupta MD ; Raman Verma MD ; Morgan R Goldberg MD (Presenter) ; Erin I Neuschler MD ; Angelique C Floerke MD ; Riti Mahadevia ; Ellen B Mendelson MD \***

## PURPOSE

While breast MRI has been established as the most sensitive tool for detecting breast malignancy, the increasing number of studies performed has led to an increasing number of MRI-guided biopsies. Previous studies demonstrate a highly variable positive predictive value of biopsied foci, ranging from 3% to 28%. This study attempts to evaluate the malignancy rate of suspicious foci identified on screening MRI and to determine if short-term follow-up can be safely performed in lieu of biopsy.

#### METHOD AND MATERIALS

In this IRB approved, HIPAA compliant retrospective study, 188 MRI-guided core biopsies of foci performed between January 2006 and March 2013 were retrieved from the report search system and reviewed. Suspicious foci identified during screening of the contralateral breast on MRI performed for extent of disease as well as suspicious foci on high-risk screening MRI were included. A focus was considered suspicious if it showed washout or plateau delayed phase kinetics, was the only enhancing focus in that breast or was more prominent than the background parenchymal enhancement. Foci biopsied in the breast ipsilateral to a known malignancy were excluded.

#### RESULTS

117/188 foci biopsied were in the ipsilateral breast as the known malignancy on MRI performed for extent of disease and were excluded. A total of 71/188 eligible patients were identified, which included 43 suspicious foci in the contralateral breast on MRI performed for extent of disease and 28 foci on high-risk screening MRI. 4/71 (5.6%) suspicious foci were positive for malignancy while 20/71 (28%) were high-risk lesions. Among suspicious foci on high-risk screening MRI, 3/28 (11%) were malignant and 5/28 (17%) had a high-risk pathology. 1/43 (2.2%) foci were malignant in the contralateral breast on extent of disease studies and 15/43 (35%) were high-risk lesions. The malignant and high-risk lesions are more likely to have type 2 and 3 kinetics ( $p=0.004$ ) compared to benign foci.

#### CONCLUSION

The malignancy rate of foci is low in the contralateral breast on MRI performed for extent of disease. Given this, it may be reasonable to follow foci in the contralateral breast, instead of recommending biopsy.

#### CLINICAL RELEVANCE/APPLICATION

As the rate of malignancy for a focus in the contralateral breast on extent of disease MRI is 2.2%, short interval follow up instead of biopsy may be reasonable.

### **SST01-08 • Impact of the Transition from Screen-film to Digital Screening Mammography on Interval Cancer Characteristics and Treatment-A Population based Study from the Netherlands**

**Joost Nederend MD (Presenter) ; Lucien Duijm MD, PhD ; Marieke W Louwman ; Frits H Jansen MD ; Adri C Voogd**

#### PURPOSE

In most breast screening programs screen-film mammography (SFM) has been replaced by full-field digital mammography (FFDM). We compared interval cancer characteristics at SFM and FFDM screening mammography.

#### METHOD AND MATERIALS

We included all 297 screen detected and 104 interval cancers in 60,770 SFM examinations and 427 screen detected and 124 interval cancers in 63,182 FFDM examinations, in women screened in the period 2008-2010. Breast imaging reports, biopsy results and surgical reports of all cancers were collected. Two radiologists reviewed prior and diagnostic mammograms of all interval cancers. They determined breast density, described mammographic abnormalities and classified interval cancers as missed, showing a minimal sign abnormality or occult.

#### RESULTS

The referral rate and cancer detection rate at SFM were 1.5% and 4.9% respectively, compared to 3.0% ( $p$

#### CONCLUSION

FFDM resulted in a significantly higher cancer detection rate, but sensitivity was similar for SFM and FFDM. Interval cancers are more likely to be occult at prior FFDM than at prior SFM screening mammography, whereas their tumor characteristics and type of surgical treatment are comparable.

#### CLINICAL RELEVANCE/APPLICATION

Data on the impact of this transition on mammographic characteristics and tumor characteristics of interval breast cancer detected cancers are very limited.

### **SST01-09 • Breast Imaging Utilization Trends in the Medicare Population from 2005 to 2011**

**Richard E Sharpe MD, MBA (Presenter) ; David C Levin MD \* ; Vijay M Rao MD ; Laurence Parker PhD**

#### PURPOSE

This study aims to describe the utilization trends in screening mammography, diagnostic mammography, breast US and breast MR in the Medicare population from 2005 to 2011.

#### METHOD AND MATERIALS

The Medicare Part B Physician/Supplier Procedure Summary Master Files from 2005 through 2011 were used to determine the annual utilization rate of screening mammography, diagnostic mammography, breast ultrasound, and breast MR. Procedure volume counts were determined by tabulating global and professional component claims. Utilization rates per 1,000 women beneficiaries were calculated by dividing volume counts by the number of Medicare women beneficiaries for each year. Utilization rate and compound annual growth rate (CAGR) trends were evaluated.

#### RESULTS

For the 2005-2009 period, screening mammography utilization increased from 312 per 1,000 women in 2005 to 323 in 2009 (CAGR from 2005-2009=+0.9%); it then decreased to 311 in 2011 (CAGR for 2009-2011: -1.9%). Diagnostic mammography utilization decreased from 96 in 2005 to 92 in 2009 (CAGR=-1.3%); it further decreased to 86 in 2011 (CAGR: -3.4%). Breast MR utilization rate increased from 1.4 in 2005 to 3.9 in 2009 (CAGR=+28.4%); it then decreased to 3.6 in 2011 (CAGR=-3.7%). Breast US utilization increased from 37 in 2005 to 43 in 2009 (CAGR=+4.3%); it then increased to 45 in 2011 (CAGR=+1.7%).

#### CONCLUSION

For all breast examinations, the rate of change from 2005 to 2009 compared to 2009 to 2011 in all cases decreased, either going from a positive growth to a less positive rate, a positive to a negative rate, or from a negative to a more negative growth rate. Decreases in screening mammography, diagnostic mammography and breast MR utilization in recent years may be in part attributable to changes in the USPSTF recommendations. Continued increases in breast US utilization, albeit at a slower rate after 2009, may be secondary to whole breast US techniques and interest in US evaluation of women with mammographically dense breasts.

#### CLINICAL RELEVANCE/APPLICATION

In recent years, there has been negative growth in the utilization of all breast imaging examinations.

## **Disclosure Index**

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**L**

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**M**

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**N**

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**O**

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**P**

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**R**

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**W**

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