# Breast Imaging and Interventional

BR001-EB-X

# Whole Mount Pathology of the Breast: Large Format Pathology Sections for Better Radiology- Pathology Correlation

All Day Location: BR Community, Learning Center

**Awards**
**Certificate of Merit**

**Participants**
Keiko Tsuchiya, Chicago, IL (*Presenter*) Nothing to Disclose
David V. Schacht, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Kirti M. Kulkarni, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Raveena Reddy, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Jeffrey Mueller, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Hiroyuki Abe, MD, Chicago, IL (*Abstract Co-Author*) Consultant, Seno Medical Instruments, Inc

## TEACHING POINTS

To discuss the pitfalls of assessing surgical specimens with the standard pathology technique (tissue size typically 22 x 22 mm on slides), including difficulty in size measurement of large and/or extensive lesions, assessment of margin status, orientation of specimen, and radiology- pathology correlation. To discuss the benefits of performing large format pathology (tissue size up to 100 x 80 mm) in terms of radiology- pathology correlation, by providing exemplary cases of large format pathology slides correlated with mammographic, sonographic and MR images. To describe the equipment needed for this technique, and the process of making the large format pathology slides.

## TABLE OF CONTENTS/OUTLINE

We will discuss insufficiencies in the current pathology technique, and why we need large format pathology, by comparing regular and large format techniques. A step by step manual with pictures for making large format pathology slides will be presented. . Mammographic and MR images of various breast cancer subtypes, extensive breast cancer, cancer with positive margins, and cancer post neoadjuvant chemotherapy with pathology correlation using large format pathology images will be shown.

BR002-EB-X

# Benign Inflammatory Breast Lesions Mimicking Malignancy; Radiological Features and Clinico-Pathological Correlation

All Day Location: BR Community, Learning Center

**Participants**
Hye-Won Kim, MD, Iksan, Korea, Republic Of (*Presenter*) Nothing to Disclose
Yoogi Cha, Jeonrabukdo Iksan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Guy Mok Lee, Iksan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The image findings of some benign inflammatory breast disease overlap with those of malignancy. Some of inflammatory lesions are presenting painless lump that makes confusion on clinically differentiate with malignancy. The purpose of this exhibit is to describe the radiological features and clinico-pathological findings of various benign inflammatory breast lesions which are mimicking breast cancer.

## TABLE OF CONTENTS/OUTLINE

Contents; 1) Acute Mastitis, 2) Abscess, 3) Plasma Cell Mastitis (Periductal mastitis), 4) Idiopathic Granulomatous Lobular Mastitis, 5) Tuberculous mastitis, 6) Lymphocytic Mastitis (Diabetic Mastopathy), 7) Fat necrosis, 8)Diseases associated with cosmetic augmentation and foreign bodies Summary; On mammography, a focal asymmetry or irregular mass are common. Irregular hypoechoic mass is common finding on ultrasound. Sometimes perilesional edema looks like echogenic halo. Increased vascularity on color-Doppler US also common. MRI shows well enhancement and diffusion restriction in abscess or idiopathic granulomatous lobular mastitis similar to breast cancer. Clinical history such as puerperal stage, trauma, diabetes mellitus and foreign body implantation makes easy to diagnosis. Tissue sampling through US-guide core biopsy or aspiration help to proper diagnosis and management.

BR003-EB-X

# Mucocele-like Lesions of the Breast: Imaging-pathologic Correlation

All Day Location: BR Community, Learning Center

**Participants**
Hyo Soon Lim, MD, Jeollanam-Do, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jang Mi Baek, Hwasun-eup. Hwasun-gun Jeonnam, Korea, Republic Of (*Presenter*) Nothing to Disclose
Shin Jung Kim, Gwangju, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Suk Hee Heo, MD, Hwasun-Gun, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jin Woong Kim, MD, Jeollanamdo, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hyun Ju Seon, MD, Hwasun-Eup, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sang Soo Shin, MD, Gwangju, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1. To review the mammographic and sonographic findings of mucocele-like lesions of the breasts and to correlate the imaging findings with the pathologic findings. 2. To know that core biopsy results of mucin extravasation or mucocele like lesion warrant close radiologic-pathologic correlation and should consider excision.

## TABLE OF CONTENTS/OUTLINE

A. Definition of mucocele-like lesions of the breast B. The spectrum of mucocele-like lesion of the breast 1. Pure mucocele-like lesion 2. Mucocele-like lesion with atypical ductal hyperplasia (ADH) 3. Mucocele-like lesion with ductal carcinoma in situ (DCIS) 4. Mucocele-like lesion with invasive mucinous carcinoma C. Imaging findings of mucocele-like lesions with pathologic correlation 1. Mammographic findings 2. Sonographic findings D. How to manage of mucocele-like lesions or mucin extravasation in breast core biopsy.

BR004-EB-X

# Not Just for Women. Spectrum of Appearances and Presentations in 21 Cases of Biopsy-proven Male Breast Cancer at a Single Institution over the Past 10 Years

All Day Location: BR Community, Learning Center

**Participants**
Sara K. Floyd, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Sandra S. Rao, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Mariana Solari-Font, MD, River Forest, IL (*Abstract Co-Author*) Nothing to Disclose
Judith A. Wolfman, MD, River Forest, IL (*Abstract Co-Author*) Nothing to Disclose
Julie M. Franz, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The purpose of this exhibit is: 1. To review the clinical presentations of male patients who are ultimately found to have primary breast malignancies. 2. To identify the most common imaging characteristics of breast cancer in men using mammography, ultrasound and breast MRI. 3. To describe risk factors associated with male breast cancer, often unknown to the patient until after diagnosis.

## TABLE OF CONTENTS/OUTLINE

Spectrum of clinical presentations of biopsy-proven breast cancer in menDemographic information average age ethnicity risk factorsBIRADS imaging characteristics mammography (size, shape, margin, density, presence or absence of calcifications, associated features, location) ultrasound (echogenicity, posterior features, vascularity, size, shape, margin, orientation) MRI (signal and enhancement characteristics, kinetic assessment, size, shape, margin, location)

BR005-EB-X

# Multimodality Imaging Evaluation of Incidental Breast Lesions Detected on Positron Emission Tomography/Computed Tomography (PET/CT)

All Day Location: BR Community, Learning Center

**Participants**
Shin Young Kim, Cheonan, Korea, Republic Of (*Presenter*) Nothing to Disclose
Ye Ri Yoon, Cheonan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Deuk Young Lee, Cheonan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sang Mi Lee, Cheonan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Ultrasonography (US) is the primary important modality in making a diagnosis of breast lesions. Today, PET/CT is increasingly being used in work up of most types of malignancy, and incidentally detected additional lesions are being increased. On the other hand, it cannot help making false positive/negative on PET/CT, so correlation with other imaging modality is necessary.So we discuss incidental breast lesions detected on PET/CT, compared to USG, mammography, CT and MRI findings.1. To provide brief mechanism, advantage and pitfall of PET/CT, USG and mammography.2. To illustrate PET/CT findings of incidental breast lesions with compared to USG, mammography, chest CT and MRI.

## TABLE OF CONTENTS/OUTLINE

1.Synchronous and metachronous breast cancer. 2. Unusual site of local recurrence of breast cancer in ipsilateral chest wall. 3. Malignancy including invasive ductal carcinoma, ductal carcinoma in situ and mucinous carcinoma which presented as mass or calcification. 4. Internal mammary and axillary recurrence after breast cancer surgery. 5. Benign lesions including inflammation, calcified/non calcified fibroadenoma, complex fibroadenoma, papilloma, slerosing adenosis, atypical ductal hyperplasia, fibrocystic change, usual ductal hyperplasia. 6.Physiologic uptake or pseudolesion. 7.Post operative change and seroma.

BR006-EB-X

# Breast Biopsy Markers: Purpose, Features, and Imaging Appearances

All Day Location: BR Community, Learning Center

**Participants**
Katherine Simon, MD, New York, NY (*Presenter*) Nothing to Disclose
Michele B. Drotman, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The purpose of this exhibit is to:1. Describe the purpose of using biopsy markers2. Familiarize the viewer with the different markers used for breast biopsy3. Recognize the appearance of various biopsy markers in different imaging modalities, including mammography, ultrasound, and MRI

## TABLE OF CONTENTS/OUTLINE

1. Purpose of biopsy markers a. To aid correlation across imaging modalities, particularly to confirm that a sonographic lesion correlates with a mammographic or MRI finding b. To aid in needle/seed localization if lesion is malignant or high risk and must be surgically resected c. To permanently identify a lesion with benign pathology in order to avoid future biopsy of the same lesion d. To mark a lesion prior to neoadjuvant chemotherapy; if there is complete response to therapy, a lesion may no longer be visible on imaging or pathologically2. Features of biopsy markers a. Shapes b. Names c. Imaging appearance d. Composition i. Metal (Titanium, BioDur® 108, Iconel® 625, 316L Stainless steel) ii. Other components: microfiber pellet, bioabsorbable suture-like mesh, etc. e. Every biopsy marker has the potential to migrate; the radiologist placing the marker should describe the position of the marker relative to the lesion to facilitate accurate lesion needle/seed localization3. Sample cases4. Summary

BR007-EB-X

# Breast Manifestation of Systemic Disease and Generalized Condition

All Day Location: BR Community, Learning Center

**Participants**
Young Mi Park, MD, PhD, Busan, Korea, Republic Of (*Presenter*) Nothing to Disclose
Yoon Nae Seo, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sun Joo Lee, MD, Busan , Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hye Jung Choo, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Systemic disease and condition can affect the breast and cause concern related to diagnosis and treatment. These lesions particularly that some have characteristic appearances, while others may mimic cancer and require tissue confirmation. Despite the rarity of these manifestations of systemic disease and condition, knowledge of these conditions is critical to the appropriate evaluation and treatment.

## TABLE OF CONTENTS/OUTLINE

We introduce breast manifestation of systemic disease and condition by classifying as follows: Inflammation (lupus mastitis) Neoplasm (metastases, lymphoma, multiple myeloma) Endocrinopathy (pituitary adenoma with ductectasia, diabetic mastopathy, lactating adenoma, Kallmann's syndrome with gynecomastia, pseudogynecomastia) Infection (sparganosis, tuberculosis) Organ dysfunction (unilateral breast edema due to acute renal failure) Medication (cyclosporin induced fibroadenoma) Miscellaneous condition (Cowden syndrome with breast cancer, Mönckeberg medial calcific sclerosis, neurofibromatosis with breast cancer)

BR100-ED-X

# Radiologic-pathologic Discordances in Core Biopsy. Working Hand-in-Hand with the Pathologist in Order to Improve Performance

All Day Location: BR Community, Learning Center

**Participants**
Rosa M. Lorente-Ramos, MD, PhD, Madrid, Spain (*Presenter*) Nothing to Disclose
Javier Azpeitia Arman, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Teresa Rivera Garcia, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Isabel Casado Farinas, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Understand the possible causes of discordance between radiological diagnosis and pathology findings in core needle biopsy. Suggest useful clues and tricks which could help to achieve an improvement in diagnosis. Analize difficult cases from our database, illustrating mammograms, US and MR imaging features and pathological correlates of core biopsy and excisional specimens of cases posing a challenge in radiopathologic correlation.

## TABLE OF CONTENTS/OUTLINE

We present:1. Causes of mistake:- Missing calcifications . Calcifications in specimen may have disappeared after staining, the pathologist may find holes/tears in tissue, calcium oxalate.- Correlation of non-mass lesions : focal assimetry on mammograms, non-mass enhancement on MR:pathology fibrotic breast tissue, psudoangiomatous stromal hyperplasia (PASH), also found in 25% of all benign breast biopsies.- Difficult lesions :Atypical hyperplasia, Papilary lesions2. Tricks.- Imaging the specimen . Correlate calcifications seen on mammogram with those seen on radiograph of specimen. - Submitting cores with and without calcifications separately may help.- Discordant diagnoses must be always reviewed , sometimes repeated core biopsy or surgery are mandatory.- Don' try to diagnose everything : The main aim of core biopsy is to suggest the correct management of that lesion.

BR102-ED-X

# Correlation of MR Imaging with Predictive Pathologic Models of Response after Neoadjuvant Therapy in Different Subtypes of Locally Advanced Breast Cancer. A Radiopathologic Review of Standard Concepts, Usefulness and Limitations

All Day Location: BR Community, Learning Center

**Awards**
**Certificate of Merit**

**Participants**
Rosa M. Lorente-Ramos, MD, PhD, Madrid, Spain (*Presenter*) Nothing to Disclose
Javier Azpeitia Arman, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Teresa Rivera Garcia, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Isabel Casado Farinas, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Miguel Angel Lara Alvarez, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Esther Dominguez-Franjo, MD, PhD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Understand the classification of subtypes in breast carcinoma. Illustrate analysis and stimation of response after neoadjuvant therapy both on pathology and imaging, emphasizing correlation of diagnostic models trying to integrate pathology and imaging. Analize the goals and limitations of MR in the monitoring of response, reviewing predictors of discordance in different subsets of patients, adequate evaluation for each subtype of breast cancer, pathological, clinical and imaging parameters.

## TABLE OF CONTENTS/OUTLINE

A case-based review with pathological correlates will illustrate: Molecular classification of breast cancer. Pathological response. Relevant prognostic variables. Partial and complete response. Predictive pathologic models of response (Miller Payne, cancer burden) with MR imaging correlation. 3. MR parameters. Correlation with pathologic prognostic variables and items to report. Tumor size, volume and lesion features. Tumor bed: tumor distribution patterns and patterns of response on MR. Contrast enhancement kinetics. Diffusion weighted MR. ADC values. 4. MR limitations MR-pathology discrepancies Evaluation of lymph nodes. MR and US features pre and post treatment with pathologic correlation.

BR103-ED-X

# Papillary Lesions of the Breast: A Radiopathological Pictorial Review and Diagnostic Work-up

All Day Location: BR Community, Learning Center

**Participants**
Rosa M. Lorente-Ramos, MD, PhD, Madrid, Spain (*Presenter*) Nothing to Disclose
Javier Azpeitia Arman, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Isabel Casado Farinas, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Teresa Rivera Garcia, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Eva Cueva Perez, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

To review clinical presentation, imaging features and pathologic findings in papillary lesions of the breast. To illustrate imaging findings (mammogram, ductography, US, MR) of cases from our series of breast papillary lesions with pathologic correlation. To analize and discuss the specific management of those lesions, including imaging and interventional procedures. To emphasize pitfalls, diagnostic difficulties and differential diagnosis.

## TABLE OF CONTENTS/OUTLINE

We present: Clinical signs and symptoms. Imaging findings: Mammograms, ductography, US, MR-MR ductography. Differential diagnosis. Diagnostic work-up and recommendations for management. Interventional procedures. Tips and tricks. Pathologic entities: Intraductal papilloma, Papilloma with atypia (atypical papilloma), Papilloma with DCIS, Papillary DCIS, Encapsulated papillary carcinoma, Solid papillary carcinoma.

BR104-ED-X

# Normal Breast Implants. What We Must Know to Avoid Misinterpretations

All Day Location: BR Community, Learning Center

**Awards**
**Certificate of Merit**

**Participants**
Carla A. Cres, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
Flavio I. Shitara, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
Erica Federicci, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
Paula C. Moraes, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
Luis Fernando D. Silva, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
Ana C. Racy, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
Marcelo B. Funari, MD, Ribeirao Pires, Brazil (*Abstract Co-Author*) Nothing to Disclose
Renato L. Ribeiro, MD, San Paolo, Brazil (*Presenter*) Nothing to Disclose

## TEACHING POINTS

Nowadays there are many different types of breast implants and some of them with particular landmarks that could lead to misinterpretations by unexperienced radiologists.We selected 10 types of implants from different manufacturers commonly used in plastic surgery.The purpose of this exhibit is: To demonstrate the most common types of breast implants, especially some specific landmarks and main anatomical features that could lead to misinterpretations; To demonstrate in detail the microscopic anatomical characteristics of breast implants shell; To correlate the findings of both in vitro and in vivo through different imaging modalities: mammography, ultrasound and MRI.

## TABLE OF CONTENTS/OUTLINE

Anatomical characteristics of breast silicone implants in detail through in vitro handling.Microscopic characteristics of different implants shell.Imaging findings: mammography, ultrasound and MRI.Comparison of in vivo and in vitro findings using different imaging methods, outlining specific landmarks.The major teaching points are:To demonstrate the normal aspects of breast implants not only through in vitro handling including microscopic approach, but also through different imaging modalities;To outline some specific implants landmarks in different imaging modalities that could be misinterpreted by unexperienced radiologists;

BR105-ED-X

# Blind Spots on Breast MRI: Review of Commonly Missed Findings. A Primer for Residents and Fellows

All Day Location: BR Community, Learning Center

**Participants**
Brian Manfredi, MD, Morristown, NJ (*Abstract Co-Author*) Nothing to Disclose
Jay Patel, MD, Morristown, NJ (*Presenter*) Nothing to Disclose
Nishith Patel, MD, Morristown, NJ (*Abstract Co-Author*) Nothing to Disclose
Alan M. Ropp, MD, Brooklyn, NY (*Abstract Co-Author*) Nothing to Disclose
Paul Friedman, DO, Morristown, NJ (*Abstract Co-Author*) Nothing to Disclose
Benjamin M. Schneider, MD, Westfield, NJ (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1. Common areas of missed pathology on breast MRI includes the lungs, heart, liver and thoracic spine2. Having a routine search pattern which includes reviewing common "blind spots" will decrease the likelihood of missing significant non-breast pathology3. Review of prior imaging will increase the ability to diagnose benign findings without recommending additional imaging and will also decrease the likelihood of missing significant non-breast pathology

## TABLE OF CONTENTS/OUTLINE

A review of the normal anatomy on breast MRI is followed by a presentation of cases of incidental and significant pathology seen outside the breast parenchyma.Cases are presented in a quiz format to emphasize common 'blind' spots. Correlation with other imaging modalities will be provided in select cases.Abnormalities presented include:Lung: nodule, infiltrateCardiac: cardiomegaly, pericardial cystLiver: simple cyst, hemangiomaBones: hemangiomaSoft tissue: axillary schwanommaOther: gastric tumor, splenic cyst

BR106-ED-X

# Dual-energy Contrast Enhanced Spectral Mammography. Imaging Findings Interpretation

All Day Location: BR Community, Learning Center

**Participants**
Athanasios N. Chalazonitis, MD, MPH, Athens, Greece (*Abstract Co-Author*) Nothing to Disclose
Christina Gkali, MD, Athens, Greece (*Presenter*) Nothing to Disclose
Andromachi Zourla, MD, PhD, Athens, Greece (*Abstract Co-Author*) Nothing to Disclose
Eleni Feida, Athens, Greece (*Abstract Co-Author*) Nothing to Disclose
Christos Tzimas, MD, Athens, Greece (*Abstract Co-Author*) Nothing to Disclose
Irene Papaspirou, Athens, Greece (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1. To demonstrate the spectrum of Dual-energy Contrast Enhanced Spectral Mammography (CESM) imaging findings in benign and malignant breast lesions.2. To present an easy interpretation CESM imaging findings algorithm.3. To review the potential pitfalls.

## TABLE OF CONTENTS/OUTLINE

Dual-energy Contrast Enhanced Digital Mammography (CESM) helps to highlight unusual blood flow patterns by tracking the uptake and washout of iodinated contrast medium in suspicious breast lesions.Evaluation of low-energy images is based on BI-RADS classification.Evaluation of low and high-energy combination images is based on type of enhancement as mass like lesions (shape, margins, internal pattern) and as non-mass like lesions (type of distribution and symmetry of the enhancing areas).Enhancement intensity of the lesion(s)/areas is categorised in 4-steps according to a qualitative scale (type 0=no enhancement, type 1=very low enhancement, type 2=moderate enhancement, type 3=strong enhancement).Type 2 and type 3 enhancing masses are considered to be probably malignant.Regional, segmental and ductal non mass lesions as well as enhancing asymmetries are considered to be probably malignantIn our educational exhibit more than 80 cases will be in details presented as a pictorial review with their histological proven result.

BR107-ED-X

# Ultrasound Elastography Pitfalls: Special Tips to Avoid Misdiagnosis!

All Day Location: BR Community, Learning Center

**Participants**
Christina Gkali, MD, Athens, Greece (*Presenter*) Nothing to Disclose
Athanasios N. Chalazonitis, MD, MPH, Athens, Greece (*Abstract Co-Author*) Nothing to Disclose
Eleni Feida, Athens, Greece (*Abstract Co-Author*) Nothing to Disclose
Andromachi Zourla, MD, PhD, Athens, Greece (*Abstract Co-Author*) Nothing to Disclose
Constantine Dimitrakakis, MD, Athens, Greece (*Abstract Co-Author*) Nothing to Disclose
Alexandra Tsigginou, Athens, Greece (*Abstract Co-Author*) Nothing to Disclose
Aris Giannos, Athens, Greece (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1. To review an appropriate breast Strain and A.R.F.I. (Acoustic Radiation Force Impulse) elastography examination protocol.2. To present technical factors which influence the elastographic evaluation of breast lesions.3. To present lesion characteristics that affect the elastographic evaluation of them.4. To provide a special tips chart in order to avoid misdiagnosis.

## TABLE OF CONTENTS/OUTLINE

Both benign and malignant breast lesions were examined in our Radiology Department with ultrasound elastography imaging in more than 100 consenting patients. All cases were paired with cytological or/and histological confirmation.In our educational exhibit we will present a dedicated Strain (elasticity score and strain ratio) and A.R.F.I. (Virtual Touch Tissue Imaging/VTI and Virtual Touch Tissue Quantification/VTQ) elastography examination protocol for benign and malignant breast lesions. We will also analyze in details technical factors and lesion characteristics which can influence the elastographic evaluation. Finally, a special tips chart will be presented as an examination tool to avoid misdiagnosis due to elastography pitfalls.A great variety of different sample cases will help the participant to understand the spectrum of breast elastography pitfalls and guide him, or her on how to avoid them.

BR108-ED-X

# False-friends in Breast Imaging. A Quiz Presenting the Challenge of Benign-looking Malignant Lesions

All Day Location: BR Community, Learning Center

**Awards**
**Certificate of Merit**

**Participants**
Rosa M. Lorente-Ramos, MD, PhD, Madrid, Spain (*Presenter*) Nothing to Disclose
Javier Azpeitia Arman, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Teresa Rivera Garcia, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Isabel Casado Farinas, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

To review usually-benign imaging findings which may hide a malignant lesion, emphasizing pitfalls, diagnostic difficulties and differential diagnosis. To analize the relationship between mammograms, US and MR imaging features and pathologic findings in benign-looking malignant lesions. To illustrate imaging findings of challenging lesions from our series with their pathologic correlates.

## TABLE OF CONTENTS/OUTLINE

Although the majority of breast carcinomas show malignant features at imaging, benign-looking malignant lesions may appear, causing a delay in correct diagnosis and treatment.We present a series of challenging cases in a quiz format. Imaging findings (mammograms, US, and MR) and pathologic correlation will be presented, emphasizing diagnostic difficulties and differential diagnosis in the discussion of each case. How pathologic correlation informs imaging interpretation will be highlighted.The list of cases includes: mucinous or colloid, medullary, papillary (encapsulated and solid papillary carcinoma), low-grade ductal and neuroendocrine carcinomas and malignant phyllodes tumors. Tricky lesions, either benign or malignant will also be presented for comparison.

BR109-ED-X

# Between a Rock and a Hard Place (to Biopsy): Management Algorithm and Pathologic Correlation of Nipple Areolar Calcifications

All Day Location: BR Community, Learning Center

**Awards**
**Cum Laude**

**Participants**
Amanda N. Chu, MD, Dallas, TX (*Presenter*) Nothing to Disclose
Stephen J. Seiler, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Jessica H. Porembka, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The purpose of this exhibit is to: 1. Review imaging of benign and malignant causes of calcifications in the nipple areolar complex. 2. Provide a management algorithm for nipple areolar calcifications. 3. Discuss procedural considerations and provide examples for biopsy of nipple areolar calcifications.

## TABLE OF CONTENTS/OUTLINE

Screening and Diagnostic Evaluation ? Benign Causes of Nipple Areolar Calcifications • Skin Calcifications • Cutaneous Horns • Intraductal Papilloma • Post-Surgical Changes • Mimics of Nipple Calcifications - Nipple Discharge - Artifacts Related to Substances on the Skin ? Malignant Causes of Nipple Areolar Calcifications • Paget's Disease • Ductal Carcinoma In Situ • Invasive Ductal Carcinoma ? BI-RADS Assessment and Management Recommendations • Application of the BI-RADS Lexicon • Assessment AlgorithmProcedural Considerations ? Fine Needle Aspiration ? Ultrasound-guided Core Needle Biopsy ? Vacuum-assisted Core Needle Biopsy

BR110-ED-X

# Demystifying Distortions: The Spectrum of Disease in Architectural Distortion Detected By Tomosynthesis

All Day Location: BR Community, Learning Center

**Participants**
Aaron L. Harman, MD, Providence, RI (*Presenter*) Nothing to Disclose
Lindsey M. Negrete, MD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Ana P. Lourenco, MD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Martha B. Mainiero, MD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Michele Lomme, MD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Digital breast tomosynthesis (DBT) has emerged as a powerful adjunctive tool to complement the limitations of conventional mammography. Architectural distortion in particular is often subtle or occult on mammography. Recent studies highlight the possibility of cancers presenting as distortions detected only by DBT. Many processes can change breast architecture, especially after procedural manipulation. Thus, having an accurate surgical history is key. Additionally, knowledge of the many benign and malignant causes of architectural distortion on imaging is important in guiding management of distortions detected on DBT.

## TABLE OF CONTENTS/OUTLINE

The exhibit will first present a background of DBT technology, its advantages and limitations, and future potential value for breast imaging evaluation. We will then define architectural distortion and delineate features that characterize this finding on both digital mammography and DBT. A variety of distortions secondary to prior surgeries, previous biopsies, radial sclerosing lesions, and even hematomas will be shown. Malignant etiologies including invasive ductal and lobular carcinoma will be demonstrated. The format for each entity presented will be organized as follows: a) overview b) imaging c) pathologic correlation, when available d) management and utility of further diagnostic evaluation.

BR112-ED-X

# Breast Cancer Molecular Subtypes: A Primer for Radiologists

All Day Location: BR Community, Learning Center

**Participants**
Lorell Ruiz-Flores, MD, Houston, TX (*Presenter*) Nothing to Disclose
Alexander Damron, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Tamara Ortiz-Perez, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Karla A. Sepulveda, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The purpose of this exhibit is:1. Define each of the molecular subtypes of breast cancer, including: Luminal A, Luminal B, Human epidermal growth factor receptor-2 (HER2) positive, and Triple-negative. 2. Describe therapy options and prognostic implications of each molecular subtype of breast cancer.3. Explain the clinical features of breast cancer that differ by molecular subtype.4. Discuss the utility of MRI pre-operatively and following neoadjuvant chemotherapy in predicting tumor response of the different subtypes.5. Define the impact of imaging and molecular subtype on surgical management

## TABLE OF CONTENTS/OUTLINE

Definitions Luminal A Luminal B HER-2 positive Triple negative Demographics Race Menopausal status Adjuvant therapy options Prognostic implications Survival rates Recurrence rates Role of preoperative MRI Staging Identifying ipsilateral multifocal / multicentric disease Screening for occult contralateral disease Predicting pathological tumor response following neoadjuvant chemotherapy differently for molecular subtypes of breast cancer Impact of imaging and molecular subtype on surgical management

BR113-ED-X

# Molecular Imaging of Breast Cancer: Pictorial Review with Pathologic Correlation

All Day Location: BR Community, Learning Center

**Participants**
Ken Yamaguchi, MD, Saga, Japan (*Presenter*) Nothing to Disclose
Takahiko Nakazono, MD, PhD, Saga, Japan (*Abstract Co-Author*) Nothing to Disclose
Takateru Ootsuka, Saga, Japan (*Abstract Co-Author*) Nothing to Disclose
Tetsuyoshi Hirai, MD, Saga, Japan (*Abstract Co-Author*) Nothing to Disclose
Ryoko Egashira, MD, Saga, Japan (*Abstract Co-Author*) Nothing to Disclose
Masanori Masuda, MD, Saga, Japan (*Abstract Co-Author*) Nothing to Disclose
Hiroyuki Irie, MD, PhD, Saga, Japan (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

To identify the molecular makers of breast cancer including angiogenesis, proliferation, metabolism, hormone receptor, human epidermal growth facter2 To review the radiologic findings of each molecular maker and intrinsic subtype of breast cancer To correlate the radiologic findings with histopathology

## TABLE OF CONTENTS/OUTLINE

Pathophysiology of molecular makers -Review of imaging findings based on imaging modalities including mammography, ultrasound, MRI and PET Review of imaging findings based on intrinsic subtype of breast cancer including Luminal A/B type, HER2 enrich type and triple negative cancer Future directions and summary

BR114-ED-X

# Evaluation of Multiple Imaging Presentations of Mucinous Carcinoma of the Breast

All Day Location: BR Community, Learning Center

**Participants**
Gerald T. Drocton III, MD, Wichita, KS (*Presenter*) Nothing to Disclose
Kamran Ali, MD, Wichita, KS (*Abstract Co-Author*) Nothing to Disclose
Lisa S. May, MD, Wichita, KS (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

This presentation emphasizes two main teaching points:1. The importance of considering mucinous carcinoma when viewing both benign and malignant pathology in the breast so that management is directed appropriately.2. Lesions which may have features typically associated with benignity (complex cyst, clustered microcysts) in younger demographics should be more aggressively managed in older (>50) demographics.

## TABLE OF CONTENTS/OUTLINE

Introduction on mucinous carcinoma of the breast Incidence Clinical findings ManagementReview of pathology findings Histologic findings Gross pathologyReview of imaging findings Mammography Ultrasound MRICases of mucinous carcinoma demonstrating different imaging findingsSummary

BR116-ED-X

# Unusual Male Breast Masses

All Day Location: BR Community, Learning Center

**Participants**
Shaza Alsharif, MD, Jeddah, Saudi Arabia (*Presenter*) Nothing to Disclose
Nuha A. Khoumais, MD, Riyadh, Saudi Arabia (*Abstract Co-Author*) Nothing to Disclose
Romuald Ferre, montreal, QC (*Abstract Co-Author*) Nothing to Disclose
Anabel M. Scaranelo, MD, PhD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Asma Tulbah, Riyadh, Saudi Arabia (*Abstract Co-Author*) Nothing to Disclose
Benoit D. Mesurolle, MD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Male breast can be affected by the same variety of conditions affecting the female breast with less frequency than females probably due to the lack of hormonal influence and consequently glandular subdevelopment. Most of male breast masses are benign with gynecomastia being the most common entity encountered. Primary male breast cancer accounts for less than 1% of the total number of breast cancers. We will review a variety of male breast masses collected from four institutions around the world with comprehensive multimodality imaging (mammography, ultrasound and MRI).By the end of this presentation the reader will be familiar with variety of male breast masses and will be able to follow an algorithm for diagnosis.

## TABLE OF CONTENTS/OUTLINE

1. Discuss the demographics of male breast tumors2. Describe the diagnostic algorithm for evaluating the male breast masses3. Review the imaging features of rare male breast masses and mimickers of breast cancer. Cases presented includes angiomyxoma, angiolipoma, benign mixed tumor, breast abscess, ductal carcinoma in situ (DCIS), lipoma, liposarcoma, lymphoma, nodular fasciitis, Paget's disease, papillary lesion, pseudoangiomatous stromal hyperplasia (PASH), pilomatricoma, invasive papillary carcinoma, sebaceous cyst among others4. Discuss the impact of early and accurate diagnosis on the management options

BR118-ED-X

# Eyes Wide Open - Extramammary Findings on Breast MRI

All Day Location: BR Community, Learning Center

**Awards**
**Certificate of Merit**
**Identified for RadioGraphics**

**Participants**
Yiming Gao, MD, New York, NY (*Presenter*) Nothing to Disclose
Hildegard B. Toth, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Linda Moy, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

To review incidental findings encountered on breast MRI, discuss their significance in different patient demographics, appropriate differential and management considerations. To emphasize that a history of breast or other malignancy warrants careful evaluation of incidental findings on breast MRI, which may impact staging and treatment. Findings in the liver, lung, bone, nodes, deserve particular attention to exclude breast cancer metastasis. Acute cardiopulmonary, or non breast neoplastic findings, are clinically relevant and may require further evaluation. A systematic approach aids diagnosis. Correlation with patient history and prior imaging is essential.

## TABLE OF CONTENTS/OUTLINE

1) Recognize incidental breast MR findings are most likely to be clinically relevant in those with a history of breast or other malignancy, prompting further workup. 2) Understand the frequency and distribution of incidental findings on breast MRI, most commonly in the liver, lung, mediastinum, bone, and less commonly in the spleen, gallbladder, kidney, thyroid, vascular structures and soft tissues. 3) Construct a systematic diagnostic approach by understanding normal imaging appearance of anatomic structures on standard breast MRI sequences. 4) Case based presentation of diagnostic pearls, clinical correlation, and management of incidental findings on breast MR.

BR119-ED-X

# Initial Experience with Contrast Enhanced Spectral Mammography (CESM) in a Multimodality State-of-the- Art Breast Imaging Facility

All Day Location: BR Community, Learning Center

**Awards**
**Cum Laude**

**Participants**
Sandeep Ghai, MD, Toronto, ON (*Presenter*) Nothing to Disclose
Frederick Au, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Rachel P. Fleming, MD, Etobicoke, ON (*Abstract Co-Author*) Nothing to Disclose
Pavel Crystal, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1. CESM can overcome many of limitations of mammography (MG) and improve lesion detection.2. CESM has sensitivity comparable to MRI and better than MG and ultrasound, in the detection of Index-breast cancer.3. CESM has lower sensitivity than MRI in the detection of additional ipsilateral cancers, but specificity is higher.

## TABLE OF CONTENTS/OUTLINE

INTRODUCTION:CESM is an advanced application of Full-field Digital mammography in which MG is performed after intravenous injection of iodinated contrast agent. Lesions are detected due to their increased vascularity (enhancement).CESM: TECHNIQUE: Post contrast injection, low and high energy images of the breast are obtained. Combining these 2 images leads to 'Iodine' image with cancellation of background tissue density.INDICATIONS AND USES: 1. Breast cancer staging 2. Problem solving tool 3. Potential High risk screeningCOMPARISON TO MG/ULTRASOUND/MRI (Review of Literature).LIMITATIONS OF CESM: 1. There is no biopsy capability with CESM. Lesions seen on CESM, with no mammographic and ultrasound correlate, would need MRI biopsy. 2. Coverage of posterior breast tissue may be suboptimal in some patients. 3. Similar to MRI background enhancement can be a limitation of CESM in pre-menopausal women.

BR120-ED-X

# Do Not Look at the Breast Only: Extramammary Incidental Findings on Breast MRI

All Day Location: BR Community, Learning Center

**Participants**
Esther Dominguez-Franjo, MD, PhD, Madrid, Spain (*Presenter*) Nothing to Disclose
Maria Martinez Martinez-Losa, Arganda del Rey, Spain (*Abstract Co-Author*) Nothing to Disclose
Trinidad Villarejo, Parla, Spain (*Abstract Co-Author*) Nothing to Disclose
Josefa Galobardes Monge, MD, Parla, Spain (*Abstract Co-Author*) Nothing to Disclose
Rosa M. Lorente-Ramos, MD, PhD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Ana Maria Garcia Morena, Arganda del Rey, Spain (*Abstract Co-Author*) Nothing to Disclose
Ana Isabel Fernandez Martin, Arganda del Rey, Spain (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Understand the definition and prevalence of extramamary findings on MRI breast Identify extramamary findings Review the most common incidental findings Provide algorithms to evaluate and recommended managmente of the findings

## TABLE OF CONTENTS/OUTLINE

Several cases will be presented in a quiz format. Some of the lesions were missed on initial lecture of the case, in part due because the main attencion was focused on the breast findings. Cases will be review, differential diagnosis and recomended managemente will be provide. The list of cases includes: Liver lesions Chest wall lesions Lung lesions Other lesions

BR121-ED-X

# Male Breast MRI: When Is It Helpful? Our Experience over the Last 10 Years as a Pictorial Review

All Day Location: BR Community, Learning Center

**Participants**
Kyungmin Shin, MD, Houston, TX (*Presenter*) Nothing to Disclose
Gary J. Whitman, MD, Houston, TX (*Abstract Co-Author*) Book contract, Cambridge University Press

## TEACHING POINTS

Understand the role of breast MRI in men Review of male breast MRI with pictorial examples using BI-RADS 5th edition descriptors Understand and be able to identify when breast MRI may be indicated and appropriate in male patients in addition to mammography and ultrasound Understand and learn how to overcome the challenges of male breast MRI

## TABLE OF CONTENTS/OUTLINE

Brief introduction for indications and role of breast MRI in men Examples of different indications for male breast MRI performed at our institution Pictorial examples of male breast MRI for differing indications and review of why it may be helpful in certain situations in addition to mammography and ultrasound Pitfalls and differences regarding male breast MRI compared to female breast MRI Summary

BR122-ED-X

# Contrast-enhanced Ultrasound for Assessment of Axillary Lymph Node Status in Breast Cancer: Why and How to Do It

All Day Location: BR Community, Learning Center

FDA Discussions may include off-label uses.

**Participants**
Takayoshi Uematsu, MD, PhD, Nagaizumi, Japan (*Presenter*) Nothing to Disclose
Kazuaki Nakashima, MD, Nagasaki, Japan (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The major teaching points of this exhibit are: 1. Contrast-enhanced US is useful in the detection and confirmation of axillary lymph node metastasis in breast cancer. 2. The presence of a perfusion defect of lymph nodes and the fast wash in of arterial flow in the defect area using reinjection are confirmative signs of metastasis.

## TABLE OF CONTENTS/OUTLINE

1. Introduction 2. Illustrate the normal anatomy of axillary lymph node 3. Sonazoid-enhanced US techniques for assessment of axillary lymph node status 3. Illustrative cases with pathological findings 4. Discussion 6. Summary

BR123-ED-X

# Metastatic Breast Cancer: Imaging Considerations for the Abdominal Imager

All Day Location: BR Community, Learning Center

**Participants**
Gary A. Dellacerra, DO, New Hyde Park, NY (*Presenter*) Nothing to Disclose
Gregory M. Grimaldi, MD, Manhasset, NY (*Abstract Co-Author*) Nothing to Disclose
Priya K. Shah, MD, Manhasset Hills, NY (*Abstract Co-Author*) Nothing to Disclose
Barak Friedman, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Brief demonstration of regional nodal spread of breast cancer Pictorial review of common and uncommon patterns of metastatic disease with a focus on subtle imaging findings Highlight differences in patterns of spread between invasive ductal and invasive lobular carcinoma

## TABLE OF CONTENTS/OUTLINE

Background regarding breast cancer and metastatic diseaseRegional nodal spread: Axillary, Retropectoral, Supraclavicular, Internal mammary Patterns of Metastatic Disease: Chest: Parenchymal, Lymphangitic, Pleural Liver: Subtle parenchymal disease, Pseudocirrhosis Biliary disease Peritoneum: Peritoneal disease, mesenteric infiltration Gynecological disease Osseous diseaseDifferences in pattern of spread between invasive ductal and invasive lobular carcinomaSummary

BR124-ED-X

# The Incognito Carcinoma: Spectrum of Imaging Manifestations of Invasive Lobular Carcinoma on Mammography, Tomosynthesis, US, and MRI

All Day Location: BR Community, Learning Center

**Participants**
Sagine A. Berry-Tony, MD, New Hyde Park, NY (*Presenter*) Nothing to Disclose
Ruth D. Sarmiento, MD, New Hyde Park, NY (*Abstract Co-Author*) Nothing to Disclose
Suzanne McElligott, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Monica M. Sheth, MD, Lake Success, NY (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Purpose: To review the pathophysiology and imaging features of ILC and demonstrate how a multimodality approach is important in establishing a diagnosis and guiding patient management ILC rarely calcifies and fails to incite a desmoplastic reaction, thus diminishing its clinical palpability and mammographic visibility. ILC may only present on one view mammographically, usually the CC. ILC is an excellent attenuator of sound waves on ultrasound causing marked acoustic shadowing. MRI is superior to US and mammography in detecting tumor extent, multifocal disease, and plays a key role in patient management.

## TABLE OF CONTENTS/OUTLINE

1. Introduction2. Imaging Features Mammography: Occult, Mass/Focal asymmetry, Architectural distortion (AD), Asymmetry Tomosynthesis only AD US: Hypoechoic shadowing mass, Focal shadowing, 'Golden Gate Sign" MRI: Solitary irregular mass, Multiple enhancing foci surrounding a dominant mass, Foci with interconnecting enhancing strands/septa; Role in determining extent of disease 3. Conclusion The clinical and mammographic elusive nature of ILC makes the diagnosis and management of this carcinoma uniquely challenging. It is important for radiologist to be aware of the varied features of ILC in order to optimize technique, suggest the diagnosis prior to biopsy, and guide patient management.

BR125-ED-X

# 'In Tomo We Trust - Digital Breast Tomosynthesis as a Crucial Tool in Detecting Subtle Architectural Distortion'

All Day Location: BR Community, Learning Center

**Participants**
Ruth D. Sarmiento, MD, New Hyde Park, NY (*Presenter*) Nothing to Disclose
Sagine A. Berry-Tony, MD, New Hyde Park, NY (*Abstract Co-Author*) Nothing to Disclose
Monica M. Sheth, MD, Lake Success, NY (*Abstract Co-Author*) Nothing to Disclose
Suzanne McElligott, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1. Architectural distortion (AD) is the third most common mammographic finding of non-palpable breast cancer. Detecting AD can be challenging. A diagnostic approach that utilizes a combination of modalities can offer the best chance at detecting and working up AD.2. Digital breast tomosynthesis (DBT) improves the sensitivity of detecting AD on screening mammography. AD can be seen better or only on DBT as compared to conventional digital mammography (DM), including DM spot compression views.3. For patient's with AD seen on DM and/or DBT, the absence of an US or MRI correlate can suggest an etiology that is more likely benign.

## TABLE OF CONTENTS/OUTLINE

Introduction A presentation of cases of IDC, ILC, DCIS, and benign etiologies that presented with mammographic AD Differential diagnosis and image findings of AD Benign causes Radial scars and complex sclerosing lesions Postsurgical or post-biopsy changes Sclerosing adenosis Fat necrosis Malignant causes IDC ILC DCIS Sample cases and imaging findings AD seen better on DBT US and MR correlate AD seen only on DBT US and MR correlate Summary Utilizing DBT to detect subtle AD can improve the detection rate of breast cancers that may otherwise be occult on conventional DM.

BR126-ED-X

# AXILLAration: Benign and Malignant Axillary Pathology Encountered in Breast Imaging

All Day Location: BR Community, Learning Center

**Participants**
Rebecca L. Seidel, MD, Atlanta, GA (*Presenter*) Nothing to Disclose
Rohini Komarla, MD, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose
Jean M. Kunjummen, DO, Atlanta, GA (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Abnormalities in the axilla are often detected on breast imaging examinations. It is important that the breast imager be familiar with the normal anatomy of the axilla, and be adept at identifying abnormal findings. The purpose of this exhibit is to:1. Review normal axillary anatomy2. Illustrate malignant pathology identified in the axilla with radiologic/pathologic correlation3. Discuss benign entities that may manifest in the axilla with radiologic/pathologic correlation

## TABLE OF CONTENTS/OUTLINE

Anatomy of the axillaImaging findings of normal vs. abnormal axillary lymph nodesMalignancies detected on imaging of the axilla to include1. Metastatic disease from breast primary2. Metastatic disease from non-breast primary3. Lymphoma4. Other tumors of the axillaBenign conditions diagnosed in the axilla to include1. Tattoo pigment in a lymph node2. Silicone lymphadenopathy3. Lymphoid hyperplasia4. Systemic inflammatory conditions

BR127-ED-X

# Everything You Wanted to Know about Phyllodes Tumor but Were Afraid to Ask - An Overview of the Radiology, Pathology and Management of Phyllodes Tumor in the Breast

All Day Location: BR Community, Learning Center

**Participants**
Mansi A. Saksena, MD, Boston, MA (*Presenter*) Nothing to Disclose
Elena Brachtel, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The phyllodes tumor, also known as cystosarcoma phyllodes, is a fibroepithelial tumor of the breast. It demonstrates unique pathological features and warrants specific management. The teaching points of this exhibit are:1. To familiarize the learner with the clinical presentation and pathophysiology of phyllodes tumor .2. To describe the radiological features of phyllodes tumor with pathological correlation and illustrate them with cases. 3. To describe the management and follow up of patients diagnosed with phyllodes tumor .

## TABLE OF CONTENTS/OUTLINE

Introduction Pathophysiology of phyllodes tumor Case based review of clinical symptoms, radiology and pathology with radiologic-pathologic correlation. Pitfalls in diagnosis Management options Recommendations for follow up imaging Conclusion and summary

BR128-ED-X

# Are You Dense, Too? An Approach for Difficult MR Mammography to Differentiate Cancerous Tissues from Surrounding Dense Breast

All Day Location: BR Community, Learning Center

FDA Discussions may include off-label uses.

**Participants**
Katsuhiro Nasu, MD, PhD, Tsukuba, Japan (*Presenter*) Nothing to Disclose
Manabu Minami, MD, PhD, Tsukuba, Japan (*Abstract Co-Author*) Nothing to Disclose
Hiroaki Takahashi, MD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Ultra-high b value DWI and Ultra-early phase contrast dynamic imaging are useful to differentiate cancerous tissue from normal but dense breast tissue. The combined interpretation of T2WI, DWI, dynamic contrast imaging and high-resolution thin slice imaging can depict the correct expanse of cancers in dense breasts.

## TABLE OF CONTENTS/OUTLINE

Table contents/outline Population and clinical characteristics of dense breast females Problems of breast cancer diagnosis in dense breast females Ultra-high b-value DWI and Ultra-early phase dynamic contrast imaging: The introduction of new imaging modalities for differentiating cancers from normal breast tissues Combined image interpretation employing FS-T2WI, DWI, dynamic contrast imaging and thin slice high-resolution imaging Radiological-pathological correlation of resected breasts

BR129-ED-X

# Current Update of the Dense Breast Notification Movement and a Retrospective Review of Our Institution's First 6 Month Experience Following the Enactment of the Dense Breast Notification Law in Our State

All Day Location: BR Community, Learning Center

**Participants**
Adam Fang, MD, Burlington, MA (*Presenter*) Nothing to Disclose
Sama Alshora, MD, Burlington, MA (*Abstract Co-Author*) Nothing to Disclose
Jeanette Y. Chun, MD, Burlington, MA (*Abstract Co-Author*) Nothing to Disclose
Audrey L. Hartman, MD, MS, Burlington, MA (*Abstract Co-Author*) Nothing to Disclose
Michelle R. McSweeney, DO, Winchester, MA (*Abstract Co-Author*) Nothing to Disclose
Meera Sekar, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Cathleen M. Kim, MD, Burlington, MA (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1.Review, educate and provide an update on the current status of the Dense Breast Notification legislation.2.Relative risks of breast density as well as the pros and cons of currently available screening modalities adjunctive to 2D conventional mammography.3.Our institution's initial six month experience following implementation of the bill.

## TABLE OF CONTENTS/OUTLINE

1.Review of the Dense Breast Notification movement and the inconsistencies of the bill across the country.2.Review the federal Breast Density and Mammography Reporting Act bill.3.Review 5th Edition ACR BI-RADS classification of breast tissue density and relative risk for developing breast cancer.4.Review mammography's sensitivity and specificity relative to tissue density.5.Review pros and cons of adjunct screening - whole breast ultrasound, breast MRI, tomosynthesis, molecular breast imaging.6. Our Institution's initial six month experience following implementation of the bill. We will provide the number and percentage of patients who contacted our breast imaging center for adjunct screening; and the number and type of adjunct screening if performed. This will assist other institutions in planning and allocating resources if the bill is approved at the federal or state level.

BR130-ED-X

# Detection of 2D and 3D Mammography Occult Cancers with ABUS Technology

All Day Location: BR Community, Learning Center

**Participants**
Christina C. Clemow, DO, Rocky River, OH (*Presenter*) Nothing to Disclose
Rachna Dutta, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Katie Davis, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1. ABUS is proven to identify occult cancers missed on 2D mammography2. Recent experience at our institution provides evidence that ABUS can detect cancer not visible on 3D tomosynthesis studies in dense breasts. A review of Medline/Pubmed yielded no published reports of ABUS detected cancers not seen on 3D tomosynthesis in patients with dense breasts. 3. ABUS may allow for earlier cancer detection, changing treatment course, and should therefore be considered as a supplemental screening tool in patients with dense breasts

## TABLE OF CONTENTS/OUTLINE

Discuss dense breasts as an independent risk factor for developing breast cancer.Review secondary screening options for dense breasts.Review standard screening mammography protocol and decision factors leading to the offering of secondary screening exams to patients with dense breasts.Pictorial case presentation showcasing our initial experience with ABUS and the detection of mammographically occult malignancies on both 2D and 3D tomosynthesis.Case presentation of ABUS detected malignancies with correlation of imaging features on handheld diagnostic ultrasound and biopsy with rad-path correlation.Discuss ABUS as a secondary screening tool for dense breasts and the implication of early detection of small cancers and improved treatment course.

BR131-ED-X

# Pseudoangiomatous Stromal Hyperplasia of the Breast: Mammographic, Sonographic and Magnetic Resonance Features

All Day Location: BR Community, Learning Center

**Participants**
Juan Villa, Boston, MA (*Presenter*) Nothing to Disclose
Vandana M. Dialani, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Priscilla J. Slanetz, MD, MPH, Belmont, MA (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The purpose of this exhibit is to: Review the pathophysiology of Pseudoangiomatous Stromal Hyperplasia (PASH) of the breast Describe the most common imaging findings of PASH on mammography, ultrasound (US) and MRI Determine when the pathologic diagnosis is concordant with imaging findings.Teaching points: PASH is a benign breast disease characterized by myofibroblastic proliferation with anastomosing channels and slit-like spaces. It is a common entity and may be present in up to 23% of biopsies. The importance of recognizing PASH lies in discriminating it from malignant disease (particularly angiosarcoma) to avoid unnecessary surgery. The most common mammographic findings of PASH include non-calcified, circumscribed mass or developing focal asymmetry. On US, PASH commonly presents as a circumscribed, oval, hypoechoic mass, which often mimics fibroadenoma. PASH presents as a mass and rarely clumped non-mass enhancement with variable signal on T1- and T2-weighted sequences and commonly demonstrates Type I or II kinetics, frequently categorizing it as a benign entity.

## TABLE OF CONTENTS/OUTLINE

PathophysiologyClinical PresentationImaging Findings using sample cases Mammography Sonography MRI Radiologic pathologic concordance using sample casesConclusions-

BR132-ED-X

# Comparison of Contrast-Enhanced Ultrasound (CEUS) and MRI in Evaluating Invasive Breast Cancer - What We've Learned So Far

All Day Location: BR Community, Learning Center

FDA Discussions may include off-label uses.

**Participants**
Mollie A. Rashid, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose
Sandy C. Lee, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Arman Danielian, MS, Glendale, CA (*Abstract Co-Author*) Nothing to Disclose
Edward G. Grant, MD, Los Angeles, CA (*Abstract Co-Author*) Research Grant, General Electric Company ; Medical Advisory Board, Nuance Communications, Inc
Bhushan Desai, MBBS, MS, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Mary W. Yamashita, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Linda Hovanessian-Larsen, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1. To understand the basic principles and techniques of contrast enhanced ultrasound (CEUS) and investigate its role in imaging breast cancer2. Provide illustrative examples of CEUS compared to MRI in patients with newly diagnosed invasive carcinoma3. To compare and contrast qualitative and quantitative parameters of these tumors on CEUS with established parameters on MRI 4. Correlate the findings of CEUS and MRI to histopathology and receptor status5. Include case examples of nonenhancing breast cancer subtypes on CEUS and their corresponding MRI findings, and possible explanations for these findings

## TABLE OF CONTENTS/OUTLINE

A. Background and significance of CEUSB. Literature reviewC. Review of limitations of current modalitiesD. Show case examples of patients at our institution that have biopsy proven invasive breast carcinoma with an initial CEUS and MRI prior to treatmentE. Correlate imaging findings with histopathology/receptor status F. Provide preliminary data comparing tumor size, percent necrosis, and enhancement patterns between CEUS and MRIG. Provide illustrative examples of nonenhancing invasive cancer subtypes on CEUS and their corresponding MRI findingsH. Discuss our institution's initial and subsequent modifications in technique for CEUS exams I. Discuss the future of CEUS and applications in breast cancer imaging

BR133-ED-X

# Comparison of DCIS on Full-Field Digital Mammography, C-View, and Digital Breast Tomosynthesis

All Day Location: BR Community, Learning Center

**Awards**
**Cum Laude**

**Participants**
Esther Hwang, MD, New York, NY (*Presenter*) Nothing to Disclose
Janet R. Szabo, MD, Hickory, NC (*Abstract Co-Author*) Nothing to Disclose
Emily B. Sonnenblick, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Laurie R. Margolies, MD, New York, NY (*Abstract Co-Author*) Consultant, FUJIFILM Holdings Corporation;

## TEACHING POINTS

To recognize the varied appearance of DCIS on full-field digital mammography (FFDM), synthesized mammography (C-view), and digital breast tomosynthesis (DBT). To understand the benefits and limitations of C-view compared to the other modalities in detecting DCIS by using a case-based interactive approach. To recognize potential C-view artifacts that may mimic DCIS.

## TABLE OF CONTENTS/OUTLINE

Review the epidemiology and incidence of DCIS. Discuss the role of mammography in diagnosing DCIS before development of invasive cancer. Compare the appearances of punctate, coarse heterogeneous, and amorphous calcifications of DCIS on FFDM, C-view, and DBT. Different cases of DCIS have varying degrees of conspicuity on FFDM, DBT and C-view; some are more conspicuous on synthesized images while others are less apparent. This will be illustrated with examples of various biopsy-proven cases of DCIS, some very similar in appearance and others with subtle to marked differences in appearance when comparing different imaging modalities. Examples of calcifications more clearly seen on FFDM than on the synthesized image or on DBT will illustrate the possibility that eliminating the FFDM may lead to missing some cases of DCIS. Illustrate artifacts on C-view that may mimic DCIS.

BR134-ED-X

# Diagnosis and Management of Recurrent Breast Cancer: Current Concepts and Future Directions

All Day Location: BR Community, Learning Center

**Awards**
**Certificate of Merit**

**Participants**
Anubha Wadhwa, MD, Milwaukee, WI (*Presenter*) Nothing to Disclose
Mary Beth Gonyo, MD, Milwaukee, WI (*Abstract Co-Author*) Nothing to Disclose
Julie R. Sullivan, MD, Milwaukee, WI (*Abstract Co-Author*) Nothing to Disclose
Kelly M. England, MD, Milwaukee, WI (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1.To understand the risk factors and predictors associated with loco regional recurrence of breast cancer.2. To show the imaging findings of local relapse of tumor after breast conservation treatment and after mastectomy.3. Current recommendations for surveillance for recurrent disease in breast cancer patients.4. To understand the available treatment options for breast cancer relapse and future directions.

## TABLE OF CONTENTS/OUTLINE

1.Review of literature in understanding the predictors of recurrent breast cancer tumor size and pathology nodal status choice of surgical intervention age of the patient role of adjuvant therapy2. Understand the imaging findings of breast tumor recurrence on mammography, US, CT and MRI. recurrent disease( invasive and in situ) post lumpectomy. patterns of disease relapse after mastectomy( cutaneous, remnant breast tissue or chest wall). axillary recurrence3. Surveillance post breast cancer treatment Recommendations after breast conservative therapy. Surveillance in patients with breast reconstruction: role of various imaging modalities Future directions: Molecular imaging, Tomosynthesis and whole breast ultrasound?4. Treatment options for locoregional recurrent breast cancer.5. Prevention of recurrent disease: Can we do better?

BR135-ED-X

# Between a Rock and a Hard Place: Mammographic Evaluation of Calcifications in the Setting of Breast Implants

All Day Location: BR Community, Learning Center

**Participants**
Susan O. Holley, MD, PhD, Saint Louis, MO (*Presenter*) Research Consultant, Biomedical Systems
Catherine M. Appleton, MD, Saint Louis, MO (*Abstract Co-Author*) Scientific Advisory Board, Hologic, Inc; Royalties, Oxford University Press;

## TEACHING POINTS

Evaluation of mammographic calcifications in the setting of breast implants can be difficult: a variety of imaging techniques may be necessary in order to localize/characterize calcifications. This exhibit will demonstrate a series of cases that posed exceptional diagnostic and logistic challenges, and will provide strategies for the radiologist faced with diagnostic evaluation and biopsy in this context.

## TABLE OF CONTENTS/OUTLINE

The cases will be presented in quiz format. Each case will illustrate a particular diagnostic challenge, and will discuss aspects of patient positioning and imaging modality/technique necessary to see and interpret the findings. In cases that require tissue sampling, strategies to address the logistic challenges in biopsy/localization will also be discussed. The list of cases includes DCIS; capsular calcifications; benign calcifications associated with apocrine cysts; fat necrosis; and skin calcifications.

BR137-ED-X

# The Developing Asymmetries: A Unique Descriptor of Mammography

All Day Location: BR Community, Learning Center

**Participants**
Flavia B. Sarquis, MD, Vicente Lopez, Argentina (*Presenter*) Nothing to Disclose
Karina Pesce, Vicente Lopez, Argentina (*Abstract Co-Author*) Nothing to Disclose
Bernardo O. Blejman, MD, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Maria Jose Chico, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Roxana A. Gerosa, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Vanina Kuznicki, Vicente Lopez, Argentina (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The purpose of this exhibit is to: Define the mammographic developing asymmetry and distinguish it from an asymmetry and a focal asymmetry with illustrative examples .Review the variety of possible etiologies. Discuss tools useful in the work-up of a developing asymmetry, including diagnostic mammography, targeted US, and digital breast tomosynthesis. Recommend relevant percutaneous tissue biopsy considerations in the assessment and management of its entity.

## TABLE OF CONTENTS/OUTLINE

Review the BIRADS fifth edition definition of mammographic " Developing asymmetry". Describe the Differential Diagnosis . Discuss the diagnostic work-up of developing asymmetries, requiring a deliberate diligent search involving comparison to at least one (often more than one) prior examination, including diagnostic evaluation with additional projections, breast US and digital breast tomosynthesis. Illustrate examples with histopathologic correlation.

BR139-ED-X

# Sclerosing Lymphocytic Lobulitis: Revisiting An Uncommon Breast Cancer Mimicker

All Day Location: BR Community, Learning Center

**Participants**
Lucy T. Sato Watanabe, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
Giselle G. Mello, PhD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
Monica M. Stiepcich, MD, PhD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
Luciano F. Chala, MD, Sao Paulo, Brazil (*Presenter*) Nothing to Disclose

## TEACHING POINTS

Review definition, pathophysiology and histopathological basisLearn mammographic, sonographic and MRI featuresDiscuss appropriated management

## TABLE OF CONTENTS/OUTLINE

Definition and diagnostic criteriaPathophysiology: diabetes is not the only associated factorCase-based review illustrating mammographic, sonographic, MRI and clinical background featuresNatural history of the disease: Biopsy could be avoided in some patients?Suggested Management

BR140-ED-X

# Noncalcified Ductal Carcinoma in Situ: The Danger that Lies Beneath

All Day Location: BR Community, Learning Center

**Awards**
**Certificate of Merit**

**Participants**
Lumarie Santiago, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Rosalind P. Candelaria, MD, Houston, TX (*Presenter*) Nothing to Disclose
Elsa M. Arribas, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Monica L. Huang, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Marion E. Scoggins, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Beatriz E. Adrada, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Gaiane M. Rauch, MD, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Deborah Thames, RT, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Gary J. Whitman, MD, Houston, TX (*Abstract Co-Author*) Book contract, Cambridge University Press

## TEACHING POINTS

Diagnosing noncalcified ductal carcinoma in situ (DCIS) is problematic since it can be occult or present as a subtle mass or asymmetry on mammography. This exhibit delivers practical information on this topic to radiologists by: Illustrating key imaging findings of noncalcified DCIS using different modalities Providing pathologic correlates for imaging findings Reviewing differential diagnoses for noncalcified DCIS Examining challenges in reaching a proper diagnosis

## TABLE OF CONTENTS/OUTLINE

Imaging characteristics by modality Pathologic features Differential diagnoses Pitfalls in diagnosis Interventional procedures for diagnosis Illustrative cases Summary of teaching points References

BR141-ED-X

# Not Just Shades of Grey - A Review of the ACR BI-RADS Ultrasound Lexicon

All Day Location: BR Community, Learning Center

**Participants**
Rosalind P. Candelaria, MD, Houston, TX (*Presenter*) Nothing to Disclose
Beatriz E. Adrada, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Monica L. Huang, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Lumarie Santiago, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Xuan-Loc Nguyen, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Bruno D. Fornage, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Ultrasound is a breast cancer screening and diagnostic tool. The most suspicious ultrasound features will determine the BI-RADS assessment category. Ultrasound diagnostic accuracy relies on the correlation of sonographic findings with other imaging findings (e.g., mammogram and MRI) and with the clinical examination. Appropriate use of the lexicon descriptors and BI-RADS assessment categories helps guide management and facilitate communication with clinicians.

## TABLE OF CONTENTS/OUTLINE

Background history of BI-RADS Illustrative examples of terminology a. Examples of tissue composition b. Examples of masses c. Examples of calcifications d. Examples of associated features e. Examples of special cases Assignment of BI-RADS assessment categories and appropriate follow up Literature review of interobserver variability and positive predictive value of descriptors Self-assessment with interactive cases Review of key teaching points References

BR142-ED-X

# Multi-methods Radiological Appearance of Male Breast Disease

All Day Location: BR Community, Learning Center

**Participants**
Karina Pesce, Vicente Lopez, Argentina (*Presenter*) Nothing to Disclose
Flavia B. Sarquis, MD, Vicente Lopez, Argentina (*Abstract Co-Author*) Nothing to Disclose
Bernardo O. Blejman, MD, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1-To describe he characteristic imaging and pathologic features of benign and malignant male breast diseases 2-To recognize differentiation between benign and malignant processes in male breast imaging 3-To discuss the utility of the different image techniques on the study of the male breast diseases with special approach of three-dimensional tomosynthesis.

## TABLE OF CONTENTS/OUTLINE

1-Introduction2-Normal Anatomy of the male breast3-Benign pathology of the male breast: Gynecomastia, lipomas, infections, Diabetic mastopathy,4-Malignant pathology of the male breast: carcinomas, sarcomas5- Male breast carcinoma: a clinicopathological and immunohistochemical characterization.6-Appearances mammography, Tomosynthesis and US in the evaluation of male breast disease7-Diagnostic algorithm8-Conclusion

BR143-ED-X

# Laser Ablation Therapy for Early Stage Breast Cancer: How it is Done and What it Looks Like on Imaging

All Day Location: BR Community, Learning Center

FDA Discussions may include off-label uses.

**Participants**
Ellie S. Kwak, MD, Fort Lee, NJ (*Presenter*) Nothing to Disclose
Victoria Mango, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Margaret Chen, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Lauren C. Friedlander, MD, White Plains, NY (*Abstract Co-Author*) Nothing to Disclose
Elise Desperito, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Rend Al-Khalili, MD, MBBCh, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Ralph T. Wynn, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Richard S. Ha, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The U.S. Food and Drug Administration approved the use oflaser ablation therapy (LAT) for the treatment offibroadenomas in 2007.Currently, there are ongoing clinical trials to assess thesafety and efficacy of LAT for early stagebreast cancer. Given the recent increase in LAT use for benignlesions and the potential for new indications in the near future,it is essential for radiologists to understand the procedure andpost-ablation appearance on different imaging modalities.The purpose of this exhibit is to discuss1) Details of LAT technique2) Advantages, limitationsand common complications of LAT3) Pre- and post-ablation images on different modalities

## TABLE OF CONTENTS/OUTLINE

How it is done: detailed review of the LAT procedure Advantages of LAT Limitations and contraindications Potential complications Case-based review of pre- and post-ablation imagesincluding a. Pre- and post-ablation mammography b. Pre- and post-ablation ultrasound c. Pre- and post-ablation breast MRI

BR144-ED-X

# Missed Breast Carcinoma .'How Can We Learn from Our Mistakes?

All Day Location: BR Community, Learning Center

**Participants**
Flavia B. Sarquis, MD, Vicente Lopez, Argentina (*Abstract Co-Author*) Nothing to Disclose
Karina Pesce, Vicente Lopez, Argentina (*Presenter*) Nothing to Disclose
Bernardo O. Blejman, MD, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Maria Jose Chico, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1-To evaluate the causes and the main categories of diagnostic errors in breast cancer as a method for improving education in radiology. 2-To determine the causes and characteristics of breast carcinomas missed by mammography 3- To discuss and to outline the major guidelines to overcome these factors aiming to an optimum mammographic examination and interpretation by radiologists.

## TABLE OF CONTENTS/OUTLINE

IntroductionDefinition of diagnostic errorCauses of missed carcinomas were categorized into : (1) Dense breast parenchyma obscuring a lesion; (2) Perception and Interpretation error; (3) Unusual lesion characteristics; and (4) Poor technique (5) Poor positioning.Errors in Assessment and ManagementRole of Double ReadingRole of TomosynthesisConclusion: Diagnostic errors should be considered not as signs of failure, but as learning opportunities.

BR146-ED-X

# Foreign Body Granulomas of the Breast: Mammographic and Ultrasonographic Findings

All Day Location: BR Community, Learning Center

**Participants**
Karina Pesce, Vicente Lopez, Argentina (*Presenter*) Nothing to Disclose
Flavia B. Sarquis, MD, Vicente Lopez, Argentina (*Abstract Co-Author*) Nothing to Disclose
Bernardo O. Blejman, MD, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Maria Jose Chico, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1-To illustrate the various imaging findings of foreign body granulomas (FBGs) of the breast 2-To review the imaging features of incidental foreing body granulomas demonstrated on mammographic and ultrasound correlation.

## TABLE OF CONTENTS/OUTLINE

1-Introduction 2- Foreign materials have included suture materials, silicone, paraffin, gunpowder, retained silastic drain, retained surgical sponge or gossypiboma and carbon particles used for localization of a nonpalpable breast lesions. 3-Mammographic, sonographic features 4-Cases series 5-Conclusion

BR147-ED-X

# Fibroepithelial Lesions of the Breast: Imaging-pathologic Correlation

All Day Location: BR Community, Learning Center

**Participants**
Flavia B. Sarquis, MD, Vicente Lopez, Argentina (*Abstract Co-Author*) Nothing to Disclose
Karina Pesce, Vicente Lopez, Argentina (*Presenter*) Nothing to Disclose
Bernardo O. Blejman, MD, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Maria Jose Chico, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Carlos M. Lamattina, MD, Vicente Lopez, Argentina (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1-To review the radiological features of fibroepithelial lesion of the breast and establish the radiopathological 2- To discuss the main differential diagnosis of these entities

## TABLE OF CONTENTS/OUTLINE

1-Introduction2-Classification: fibroepithelial lesion of the breast: Fibroadenoma, Phyllodes tumorOther bening fibrous lesions: Sclerosing lobular hyperplasia, Diabetic fibrous mastopathy, Focal fibrosis, Pseudoangiomatous stromal hyperplasia ( PASH), Fibromatosis3-Imaging spectrum: mammography, Tomosynthesis, conventional ultrasound, and MRI appearances4-Correlation between imaging features and pathology findings5-Differential diagnosis6-Conclusion

BR148-ED-X

# Evolving Strategies in Breast Cancer Screening: The High Risk Patient

All Day Location: BR Community, Learning Center

**Participants**
Wenjia Wang, MD, Cambridge, MA (*Presenter*) Nothing to Disclose
Thomas Zorc, Cambridge, MA (*Abstract Co-Author*) Nothing to Disclose
Audrey D. Duva-Frissora, MD, Cambridge, MA (*Abstract Co-Author*) Nothing to Disclose
Laura S. Sheiman, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Review breast cancer risk factors. Review the available mathematical risk assessment models and their strengths and weaknesses. Review screenig guidelines, including rationale, current recommendations, and efficacy.

## TABLE OF CONTENTS/OUTLINE

Risk factors and their relative weights of importance Risk assessment models Specific risk factor utilization Strengths and weaknesses Current research Radiologic screening guidelines Initiation and termination of screening Supplemental screening with MRI and whole breast ultrasound Emerging technologies Male patients Example cases

BR149-ED-X

# 'Enhance' Your Diagnostic Work Up: How to Use Contrast Enhanced Spectral Mammography (CESM) in Your Practice

All Day Location: BR Community, Learning Center

**Participants**
Rachel O. McEachern, MD, Charlottesville, VA (*Presenter*) Nothing to Disclose
Carrie M. Rochman, MD, Charlottesville, VA (*Abstract Co-Author*) Nothing to Disclose
Brandi T. Nicholson, MD, Charlottesville, VA (*Abstract Co-Author*) Consultant, Siemens AG
Ray C. Mayo III, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Jennifer A. Harvey, MD, Charlottesville, VA (*Abstract Co-Author*) Researcher, Hologic, Inc; Researcher, VuCOMP, Inc; Researcher, Matakina Technology Limited; Shareholder, Matakina Technology Limited; Shareholder, Hologic, Inc
Heather R. Peppard, MD, Charlottesville, VA (*Abstract Co-Author*) Consultant, Siemens AG; Research Grant, Hologic, Inc

## TEACHING POINTS

Contrast Enhanced Spectral Mammography (CESM) is an emerging technology to identify and evaluate suspicious imaging findings. This exhibit will show how to incorporate CESM into multi- modality and/or second look diagnostic evaluation in a variery of clinical scenarios.

## TABLE OF CONTENTS/OUTLINE

Clinical indications and contraindications for diagnostic CESM Imaging technique for dual energy contrast enhanced spectral mammography in a diagnostic setting Use of CESM in a multimodality imaging work up for suspicious mammographic findings and in determining extent of disease Utility of CESM in a second look diagnostic evaluation following abnormal screening MRI Use of CESM for biopsy planning including potential benefit and pitfallsCase examples of CESM use in the diagnostic setting: Diagnostic evaluation of suspicious imaging findings and short term Bi-Rads 3 imaging follow up Demonstrating extent of disease on CESM Second look evaluation of abnormal screening MRI findings for evaluation and localization Localization of findings in multi-modality biopsy planning and for confirming biopsy clip placement Monitoring treatment response after neoadjuvant chemotherapy Short term six month CESM imaging follow-up following concordant biopsy

ï¿½bï¿½2`gï¿½

BR151-ED-X

# Radiological Features of Primary and Secondary Breast Lymphoma: What Radiologists Need to Know

All Day Location: BR Community, Learning Center

**Participants**
Alejandra Salgado, MD, Capital Federal, Argentina (*Abstract Co-Author*) Nothing to Disclose
Daniel C. Mysler SR, MD, Capital Federal, Argentina (*Presenter*) Nothing to Disclose
Leandro J. Carballo, MD, BEng, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Lisandro Paganini, MD, Capital Federal, Argentina (*Abstract Co-Author*) Nothing to Disclose
Tiare A. Pineiro, MD, Capital Federal, Argentina (*Abstract Co-Author*) Nothing to Disclose
Andres Kohan, MD, Capital Federal, Argentina (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

To review the radiological features of primary and secondary breast lymphoma in mammography, US, MR and 18F-FDG PET/CTTo review the different BI-RADS assessment and recommendations regarding these lesions in the 2013 BI-RADS.

## TABLE OF CONTENTS/OUTLINE

Pathophysiology of primary Lymphoma of the breast and secondary breast involvement in systemic lymphomaReview of imaging findings Digital Mammogram Ultrasound MRI PETSample cases and differential diagnosisBIRADS assessment and recommendations according to the 2013 5th editionSummary

BR152-ED-X

# Axillary Pathology: The Forgotten Corner of Mammography

All Day Location: BR Community, Learning Center

**Participants**
Charlotte F. Longman, MBChB, MRCS, London, United Kingdom (*Presenter*) Nothing to Disclose
Rohit S. Malliwal, MBBS, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Tamara Suaris, MBBS, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Sylvia O'Keeffe, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The axilla is an important review area for accurate interpretation of mammographic images. A full and comprehensive pictorial review of a broad spectrum of axillary pathology from benign common findings to more unusual cases is presented. This will include:1.An outline the normal appearance of the axilla on standard and supplementary mammographic views2.A review of axillary pathology:Comparisons of the imaging features of nodal versus extra-nodal disease. Descriptions of key presenting features of primary breast carcinoma in the axilla. Outlines of the radiological features of a variety of nodal pathology including primary breast cancer with nodal disease,localised inflammatory/ infective causes, iatrogenic and systemic bilateral causes. Review of more unusual non-nodal, non-breast pathologies3.Teaching points to highlight when further imaging/ investigation is required

## TABLE OF CONTENTS/OUTLINE

Detailed pictorial review to include, and allow differentiation of the following pathologies:Normal axillary appearances including nodal features (size and distribution)Nodal pathology: benign versus malignant versus mimicsNon-nodal axillary pathology Breast: primary breast lesions/ calcificationExtra-mammary: including soft tissue sarcoma, small cell carcinoma and worm infectionCross sectional correlates for mammography where appropriate.

BR153-ED-X

# Imaging of Breast Implants for Residents: A Pictorial Review

All Day Location: BR Community, Learning Center

**Awards**
**Certificate of Merit**

**Participants**
Lucia I. Beccar Varela, MD, Vicente Lopez, Argentina (*Abstract Co-Author*) Nothing to Disclose
Maria Soledad Nocetti, MD, Vicente Lopez, Argentina (*Abstract Co-Author*) Nothing to Disclose
Bernardo O. Blejman, MD, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Mariano Lamattina, MD, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Florencia Melendez, MD, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Flavia B. Sarquis, MD, Vicente Lopez, Argentina (*Presenter*) Nothing to Disclose

## TEACHING POINTS

Learn through pictures and diagrams normal and abnormal findings of breast implants.Evaluate the usefulness of the different breast diagnostic modalities in diagnosing implant rupture and other complications.

## TABLE OF CONTENTS/OUTLINE

Radiology residents must be familiar with the normal and abnormal findings of common breast implants, as the number of women with this clinical condition is increasing. Patients have breast implants for cosmetic augmentation, correction of congenital malformations or reconstruction after mastectomy. Imaging in these patients, including mammography, ultrasonography and magnetic resonance should provide information about prothesis integrity and detect breast diseases unrelated to implants, such as breast cancer. The purpose of this work is to review the most common implant types and location, early and late postoperative complications and implant intracapsular and extracapsular rupture. We include an opportunity for self assessment with interactive case review, to be able to recognize normal imaging features as well as those that should suggest rupture or other incidental findings.

BR155-ED-X

# Contrast-enhanced Ultrasonography (CEUS) of Breast Cancer Metastatic Axillary Lymph Nodes. Imaging-pathology Correlations and Potential Pitfalls

All Day Location: BR Community, Learning Center

**Participants**
Tomoyuki Ohta, Tokyo, Japan (*Presenter*) Nothing to Disclose
Makiko Nishioka, MD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Norio Nakata, MD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Kunihiko Fukuda, MD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

(1) To review CEUS image of breast cancer metastatic axillary lymph nodes. (2) To demonstrate basic findings suggestive of metastasis and imaging-pathology correlation. (3) To discuss potential pitfalls of CEUS of breast cancer metastatic axillary lymph nodes.

BR157-ED-X

# Imaging Spectrum of Breast Cancer Metastatses and Patterns of Metastatic Spread

All Day Location: BR Community, Learning Center

**Awards**
**Certificate of Merit**
**Identified for RadioGraphics**

**Participants**
Vignesh A. Arasu, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
Elissa R. Price, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Cody W. McHargue, BA, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Kimberly M. Ray, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Miguel Hernandez Pampaloni, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Rizwan Aslam, MBBCh, San Francisco, CA (*Abstract Co-Author*) Research support, Bayer AG
Bonnie N. Joe, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Nola M. Hylton, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Benjamin L. Franc, MD, Sacramento, CA (*Abstract Co-Author*) Nothing to Disclose
Spencer C. Behr, MD, Burlingame, CA (*Abstract Co-Author*) Research Grant, General Electric Company; Consultant, General Electric Company

## TEACHING POINTS

1. Review recent recategorization of breast cancer into molecular subtypes and implications for different types of metastatic pathways.2. Describe common and uncommon imaging appearance of breast cancer metastatic disease, with emphasis of optimal search patterns based on potential pathways of metastatic spread

BR158-ED-X

# A Diagnostic Dilemma: When Metastatic Disease Disseminates to the Breast

All Day Location: BR Community, Learning Center

**Participants**
Tali Amir, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
Philip A. Di Carlo, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Ashley Cimino-Mathews, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Lisa A. Mullen, MD, Luthvle Timon, MD (*Abstract Co-Author*) Nothing to Disclose
Susan C. Harvey, MD, Lutherville, MD (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Diagnosis of non-mammary metastatic disease to the breast can be very challenging. Hematogenous spread of disease to the breast may grow rapidly while lymphangitic spread can mimic inflammatory breast cancer. When lesions are bilateral, round and circumscribed, they can be misinterpreted as benign.In our exhibit we will:- Review non-mammary sources of metastatic disease to the breast- Discuss key imaging features and pitfalls of non-mammary metastatic disease- Highlight the importance of radiology - pathology correlation in the diagnostic workup through a series of cases

## TABLE OF CONTENTS/OUTLINE

1. Review non-mammary sources of metastatic disease to the breast2. Discuss hematogenous and lymphangitic dissemination of disease in regards to common imaging pitfalls3. Identify important imaging features and their histopathology correlates through a series of cases depicting:a. Metastatic small cell lung cancer next to intraductal carcinomab. Metastatic adenocarcinoma with associated benign calcifications acting as a red herring c. Metastatic ovarian cancerd. Metastatic renal cell carcinomae. Metastatic melanomaf. Metastatic leiomyosarcoma

BR159-ED-X

# Rare Mesenchymal Breast Tumors: A Radiology - Pathology Correlation

All Day Location: BR Community, Learning Center

**Participants**
Tali Amir, MD, Baltimore, MD (*Presenter*) Nothing to Disclose
Philip A. Di Carlo, MD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Ashley Cimino-Mathews, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Lisa A. Mullen, MD, Luthvle Timon, MD (*Abstract Co-Author*) Nothing to Disclose
Susan C. Harvey, MD, Lutherville, MD (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The recognition of typical imaging features of rare mesenchymal breast tumors can facilitate the correct workup, diagnosis and management of these lesions.In this exhibit we will:1. Identify types of rare mesenchymal tumors that occur in the breast2. Discuss key imaging features on mammography, ultrasound and MRI3. Appreciate the importance of histopathology correlation

## TABLE OF CONTENTS/OUTLINE

1. Identify rare types of mesenchymal breast tumors and their cellular origins. 2. Discuss the characteristics of mesenchymal breast tumors through a series of cases, with attention to presentation and epidemiology; important imaging features (including mammography, ultrasound and MRI); histopathology; and prognosis and management.Cases will includea. Benign adipose and smooth muscle derived tumors: angiomyolipoma and leiomyomab. Myofibroblast and fibroblast derived mesenchymal lesions: myofibroblastoma, nodular pseudoangiomatous stromal hyperplasia, fibromatosis and dermatofibromac. Neural derived tumors: granular cell tumor, and neurofibromad. Primary breast sarcomas: leiomyosarcoma

BR160-ED-X

# Idiopathic Granulomatous Mastitis: A Rare Disease That is Common at Our Practice! Review of Clinical Presentation, Imaging, and Management

All Day Location: BR Community, Learning Center

**Participants**
Shannon M. Navarro, MPH, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose
Linda Hovanessian-Larsen, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Mary W. Yamashita, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Oliver A. Press, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Sandy C. Lee, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Idiopathic Granulomatous Mastitis (IGM) is a rare benign disease of the breast with clinical and imaging findings that mimic advanced breast cancer and infections. At our institution, we have a unique experience of having a relatively high prevalence, with over 120 patients with biopsy proven disease. We will include clinical and radiologic findings, treatment and clinical course of these patients. We will show examples of multicentric, bilateral, and refractory disease.1. To describe imaging findings of IGM.2. To review clinical presentation and patient characteristics.3. To discuss treatment and describe detailed examples outlining clinical course and response.4. To correlate imaging findings with histopathology.5. Provide illustrative examples of biopsy proven IGM as well as mimickers: breast carcinoma and infectious processes including bacterial and tuberculous mastitis.

## TABLE OF CONTENTS/OUTLINE

1. Detailed literature search on: -Clinical presentation -Imaging findings -Treatment2. Illustrative case examples with discussion of the following: -Patient demographics -Clinical presentation -Epidemiology including past medical history and possible risk factors -Multi-modality imaging including mammogram, digital breast tomosynthesis, US, CT, and MRI -Histopathologic correlation -Treatment -Outcomes

BR161-ED-X

# No Cancer Left Behind: A Case-Based Review of the Utility of Pre-operative Breast MRI

All Day Location: BR Community, Learning Center

**Participants**
Esther E. Coronel, MD, Mineola, NY (*Presenter*) Nothing to Disclose
Samia Sayegh, DO, Mineola, NY (*Abstract Co-Author*) Nothing to Disclose
Jason C. Hoffmann, MD, Mineola, NY (*Abstract Co-Author*) Consultant, Merit Medical Systems, Inc; Speakers Bureau, Merit Medical Systems, Inc
Susana H. Fuchs, MD, Stony Brook, NY (*Abstract Co-Author*) Nothing to Disclose
Irina Rapoport, MD, Brooklyn, NY (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1. While there is some disagreement among breast radiologists and surgeons over the usefulness of pre-operative MRI in patients undergoing surgery for breast cancer, there are a number of ways that such imaging can impact patient care.2. Pre-operative MRI in breast cancer patients can locate additional occult malignancy (multifocal, multi centric, and/or contralateral disease) and better delineate the true size/extent of disease.3. In addition, MRI can identify hidden cancers in blind spots of other modalities, which, if left behind, would have resulted in under treatment and unexpected early recurrences.

## TABLE OF CONTENTS/OUTLINE

Detail the controversy over the utility of pre-operative breast MRI in the surgical management of breast cancer.Review relevant literature.Image-rich, case-based review to highlight the utility of MRI, as it can alter surgical planning for a variety of reasons.Cases include (but are not limited to):-Breast MRI of invasive lobular carcinoma demonstrating multicentric disease resulting in mastectomy-Mammo and sono demonstrating a primary mass found to have a few subcentimeter nodules in one quadrant on MRI consistent with multifocal disease.-Mammo demonstrating a cluster of micro calcifications consistent with DCIS, found to have multicentric invasive ductal carcinoma on MRI.

BR162-ED-X

# The Role of Breast MRI in the Diagnosis and Managment of Papillary Lesions of the Breast

All Day Location: BR Community, Learning Center

**Participants**
Vicente Martinez De Vega, MD, Madrid, Spain (*Presenter*) Nothing to Disclose
Susana Linares Gonzalez, MD, Pozuelo de Alarcon, Spain (*Abstract Co-Author*) Nothing to Disclose
Manuel Recio Rodriguez, Pozuelo de Alarcon, Spain (*Abstract Co-Author*) Nothing to Disclose
Leire Alvarez Perez, BMedSc, Pozuelo de Alarcon, Spain (*Abstract Co-Author*) Nothing to Disclose
Diana C. Mollinedo, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose
Cristina Saldarriaga, MD, Medellin, Colombia (*Abstract Co-Author*) Nothing to Disclose
Agustin Acevedo Barbera, MD, Pozuelo de Alarcon, Spain (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

To review MRI features of the different papillary lesions of the breastThe role of breast MRI for planning the surgeryVacuum biopsy MRI-guided for histological diagnosis and it's role for the treatment of solitary papillomas in selected cases

## TABLE OF CONTENTS/OUTLINE

Breast papillary lesions include a wide range of pathologies that have different morphological, radiological and pathological features. They can be divided in solitary or central papillomas, multiple or peripheral papillomas, juvenile papillomatosis, atypical ductal hyperplasia or DCIS inside a papilloma, micropapillary DCIS, and papillary carcinoma. Overlapping features makes difficult the differentiation of benign and malignant papillary lesions by imaging. Breast MRI has shown better accuracy than mammography and ultrasound for the diagnosis. To increase the diagnostic specificity is important to know their MRI features: morphology, enhancement, DWI. Breast MRI is an usefull tool to evaluate the extent of disease, essential for planning surgery. Besides in those lesions that are not seen with conventional techniques, vacuum biopsy MR-guided is the only way to get the histological diagnosis. In selected patients with bloody nipple discharge and the presence of solitary papilloma, vacuum biposy MRI-guided constitutes an alternative to surgery for the treatment.

BR163-ED-X

# Nipple Changes and More: The Varied Presentations and Imaging Findings of Paget's Disease of the Breast

All Day Location: BR Community, Learning Center

**Participants**
Elizabeth H. Dibble, MD, Providence, RI (*Presenter*) Nothing to Disclose
Jianhong Li, MD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Yihong Wang, MD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Ana P. Lourenco, MD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1. Review the epidemiology & clinical presentation of Paget's disease 2. Review the theories of pathogenesis of Paget's disease3. Review the imaging & pathologic features of Paget's disease

## TABLE OF CONTENTS/OUTLINE

I. Paget disease: Epidemiology, clinical presentationII. Pathogenesis: Epidermotropic & intraepidermal transformation theoriesIII. Imaging appearanceA. Mammography1. Nipple areolar complex (NAC): Skin thickening, calcifications, mass2. Parenchyma: Underlying carcinoma, multifocal diseaseB. Ultrasound 1. NAC: Skin thickening, NAC flattening 2. Parenchyma: Underlying mass, microcalcificationsC. MRI 1. NAC: Skin thickening, asymmetric enhancement, mass2. Parenchyma: Occult disease, multifocal/multicentric disease3. Triage for breast conservationD. CT and PET/CT: Incidental or known Paget's diseaseIV. Pathologic featuresA. Infiltration of the nipple epidermis with Paget cells1. Single, clusters, nests of cells2. Reactive dermal changes 3. ImmunohistochemistryB. Underlying intraductal carcinomaV. Differential diagnosis: malignant melanoma, Bowen's disease, clear keratinocytes, Toker cells, inflammatory changesVI. Management: Mastectomy +/- axillary dissection vs. breast conservation surgery, radiation +/- chemotherapy or hormonal therapy

BR165-ED-X

# Thinking Outside of the Breast: Secondary Findings on Diffusion Weighted MR Imaging

All Day Location: BR Community, Learning Center

**Participants**
Lena A. Omar, MD, Dallas, TX (*Presenter*) Nothing to Disclose
Kanwal A. Merchant, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Pooja Sharma, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Samir Kulkarni, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Lindsay Compton, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1. Review the role of diffusion weighted breast MRI and highlight it's utility in clinical practice2. Demonstrate that pathology can be seen in regions outside of the breast including the chest (lungs, heart), upper abdomen and lower neck on breast MRI. 3. Familiarize the general radiologist with incidental findings seen on breast MRI. This includes a special emphasis on secondary findings seen on diffusion weighted imaging along with multimodality correlation4. Illustrate the importance of evaluating all sequences and images on breast MRI for secondary findings.

## TABLE OF CONTENTS/OUTLINE

1. Discuss the physics and principles of diffusion weighted imaging on breast MRI2. Discuss the utility of diffusion weighted imaging for MR evaluation of the breast 3. Demonstrate the use of breast MRI in evaluation of secondary findings.4. Highlight the importance of T1/T2 weighted images, post-contrast sequences and diffusion weighted images in displaying ancillary findings on breast MRI5. Show sample cases with pointers to help identify important findings outside of the breast on MRI along with multimodality correlation including CT, nuclear medicine, ultrasound and radiographic studies.

BR166-ED-X

# Reading Between the Lines: Sonographic Evaluation for Breast Implant Rupture

All Day Location: BR Community, Learning Center

**Awards**
**Certificate of Merit**

**Participants**
Ramapriya Ganti, MD, Dallas, TX (*Presenter*) Nothing to Disclose
Pooja Sharma, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Jody C. Hayes, MD, Southlake, TX (*Abstract Co-Author*) Nothing to Disclose
Stephen J. Seiler, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Review the proper ultrasound technique for implant evaluation Describe the most common ultrasound features signifying implant rupture Highlight imaging findings that may mimic rupture

## TABLE OF CONTENTS/OUTLINE

• Ultrasound Techniques: Optimizing image quality Split screen imaging, with comparison to the contralateral implant• Implant Characteristics: Implant Type: saline, silicone, dual-lumen, expander-type Implant Location: prepectoral, retropectoral Capsule-Shell Complex Anatomy Contour Abnormalities: radial fold, bulge, herniation• Saline Implants: Injection Ports Saline Rupture• Silicone Implants: Intracapsular Rupture Signs: stepladder, subcapsular line, loss of trilaminar lining Intracapsular Rupture Mimics: reverberation artifact, radial folds, cohesive implants, fibrous capsular calcifications Extracapsular Rupture Signs: snowstorm/echogenic noise, silicone granulomas, extension along fascial planes, silicone-laden lymphadenopathy• Peri-Implant Effusions: Evaluation and management of peri-implant effusions by ultrasound• Diagnostic Uncertainty: Recommendations for inconclusive sonographic evaluations

BR167-ED-X

# Reading Between the Lines: Magnetic Resonance Evaluation for Breast Implant Rupture

All Day Location: BR Community, Learning Center

**Participants**
Ramapriya Ganti, MD, Dallas, TX (*Presenter*) Nothing to Disclose
Pooja Sharma, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Jody C. Hayes, MD, Southlake, TX (*Abstract Co-Author*) Nothing to Disclose
Stephen J. Seiler, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Review the typical magnetic resonance sequences obtained to evaluate implants Describe the most common MRI features signifying implant rupture Highlight imaging findings that may mimic rupture on breast MRI

## TABLE OF CONTENTS/OUTLINE

· Magnetic Resonance Imaging for Implant Interrogation: Review silicone-selective sequences Expander implant incompatibility Non-contrast evaluation and breast cancer detection limitations· Implant Characteristics: Implant Type: saline, silicone, dual-lumen, expander-type Implant Location: prepectoral, retropectoral Contour Abnormalities: radial fold, bulge, herniation· Saline Implants: Injection Ports Saline Rupture· Silicone Implants: Intracapsular Rupture: linguine sign, keyhole sign, subcapsular line sign Extracapsular Rupture: extracapsular silicone, silicone granulomas, silicone-laden lymphadenopathy Cohesive Implant Rupture· Peri-Implant Effusions: Benign Effusions Malignant Effusions· MRI biopsy considerations in patients with breast implants

BR168-ED-X

# The Spectrum of the Breast Skin Lesions. What Radiologists Need to Know?

All Day Location: BR Community, Learning Center

**Participants**
Karina Pesce, Vicente Lopez, Argentina (*Presenter*) Nothing to Disclose
Flavia B. Sarquis, MD, Vicente Lopez, Argentina (*Abstract Co-Author*) Nothing to Disclose
Bernardo O. Blejman, MD, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Maria Jose Chico, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1-To describe the radiological changes that occurs in the breast skin, nipple and areola.2-To define the spectrum of neoplastic and inflammatory diseases that affect female breast skin and the nipple-areola complex.3-To generate differential diagnosis on abnormalities of female breast skin, nipple and areola.4-To analyze the specific management of those lesions

## TABLE OF CONTENTS/OUTLINE

1-Introduction2-Normal Anatomy of skin: Radiological appearance (Mammography, Tomosynthesis, ultrasound and MRI)3- Spectrum of neoplastic and inflammatory diseases that affect female breast skin and the nipple-areola complex4- Assessment. Mass. Distinguishing Breast Skin Lesions from Superficial Breast Parenchymal Lesions: Role of Tomosynthesis, Role of Tangential View5-Differential Diagnosis Paget's Disease versus Ezcema. What Every Radiologist Should Know.6-Limitations7-Conclusion

BR169-ED-X

# Unilateral Breast Edema: What We Know and What We Need to Learn

All Day Location: BR Community, Learning Center

**Participants**
Karina Pesce, Vicente Lopez, Argentina (*Presenter*) Nothing to Disclose
Flavia B. Sarquis, MD, Vicente Lopez, Argentina (*Abstract Co-Author*) Nothing to Disclose
Bernardo O. Blejman, MD, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Maria Jose Chico, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Roxana A. Gerosa, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1. To review breast findings of unilateral breast edemas. 2. To describe the spectrum of edemas in various breast lesions providing pathologic findings. 3. To identify different edemas as clinical clues for differential diagnosis.

## TABLE OF CONTENTS/OUTLINE

1. Introduction2. Spectrum of etiologies: Bening and malignant lesion: inflammatory breast carcinoma,lymphatic obstruction (due to axillary, chest wall or intrathoracic lesions), mastitis, fat necrosis, trauma, postirradiation changes, granulomatous diseases, nephrotic syndrome, lymphoma, progressive systemic sclerosis, leukemia, pemphigus and other skin conditions, subclavian or innominate vein occlusion, or congestive heart failure3. Review of radiologic findings a. mammography b. ultrasound c. MRI4.Illustrative cases5.Discussion6.Conclusion

BR170-ED-X

# Uncommon But Not Forgotten: Unusual Tumors of the Breast

All Day Location: BR Community, Learning Center

**Participants**
Karina Pesce, Vicente Lopez, Argentina (*Presenter*) Nothing to Disclose
Flavia B. Sarquis, MD, Vicente Lopez, Argentina (*Abstract Co-Author*) Nothing to Disclose
Bernardo O. Blejman, MD, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Maria Jose Chico, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Vanina Kuznicki, Vicente Lopez, Argentina (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1-To identify clinical and imaging features of uncommon tumors of the breast2-To appreciate the role of pathology in diagnosis3-To describe the role of imaging in staging and follow-up

## TABLE OF CONTENTS/OUTLINE

1-Introduction2-The following categories of unusual breast neoplasms and tumor lesion are describe: A)Benign:Fibromatosis,Myofibroblastoma,Phyllodes,Granular cell tumor,Neurofibromatosis B)Malignant: Cystosarcoma phyllodes,Lymphoma,Leukemia,Angiosarcoma,Primary neuroendocrine tumors,Carcinoma in ectopic breast tissue3-Imaging characteristics are mostly nonspecific; however, imaging is useful for documenting extent of disease, describing associated findings and planning further diagnostic therapeutic approaches. Pathologic examination provides definitive diagnosis in most cases.4-Conclusion: There is a wide spectrum of uncommon benign and malignant tumors of the breast. Pathologic examination provides definitive diagnosis in most cases.

BR171-ED-X

# Reporting 'Breast tissue' in the 5th Edition of BI-RADS: Why, What, and How?

All Day Location: BR Community, Learning Center

**Awards**
**Cum Laude**

**Participants**
Ji Hyun Youk, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Eun Ju Son, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hye Mi Gweon, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jeong-Ah Kim, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1. To be aware of new breast BI-RADS descriptors for reporting breast tissue 2. To understand the clinical importance of reporting breast tissue 3. To illustrate clinical cases to help the practical application

## TABLE OF CONTENTS/OUTLINE

1. Breast anatomy - Overview - Anatomical interpretation and correlation of breast imaging: mammography, ultrasound, and MRI 2. Mammography - Clinical implication of breast density - Breast composition categories - Changes of the 5th ed from the 4th ed in reporting breast density with imaging correlation - Clinical application to example cases 3. Ultrasound - Tissue composition: interpretation, clinical implication, and application to example cases 4. MRI - Amount of fibroglandular tissue (FGT): interpretation, clinical implication, and application to example cases - Background parenchymal enhancement (BPE): interpretation, clinical implication, and application to example cases

BR172-ED-X

# Early Implementation of Synthesized 2D in Screening with Digital Breast Tomosynthesis : A Pictorial Essay of Early Outcomes

All Day Location: BR Community, Learning Center

**Awards**
**Magna Cum Laude**

**Participants**
Samantha P. Zuckerman, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Emily F. Conant, MD, Philadelphia, PA (*Abstract Co-Author*) Speaker, Hologic, Inc; Scientific Advisory Board, Hologic, Inc; Consultant, Siemens AG
Susan Weinstein, MD, Philadelphia, PA (*Abstract Co-Author*) Consultant, Siemens AG
Katrina Korhonen, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Marie Synnestvedt, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Elizabeth McDonald, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Synthesized 2D mammographic imaging (s2D), reconstructed from the digital breast tomosynthesis (DBT) acquisition, is being implemented as the 2D image in DBT screening as a dose-reduction measure. For the last 3 years at our institution, we have screened all of our patients with DBT (over 33,000); and as of January 2015, have replaced 2D dose digital mammographic (DM) imaging with s2D in screening. Current reconstruction algorithms lead to subtle differences in image quality which vary according to breast density and lesion type. Prior to complete implementation of s2D imaging, we underwent a 4 month period of acquiring both DM dose and s2D images. The purpose of this exhibit is to review the different appearances of common mammographic findings seen on s2D and DM. We present examples of calcifications, masses, and asymmetries in patients with different breast densities. Common artifacts seen on s2D will also be shown.

## TABLE OF CONTENTS/OUTLINE

Present case-based examples of findings seen on s2D and DM including the following:1. Variations in breast density2. Lesions: i. calcifications, ii. masses, iii. asymmetries, iv.architectural distortions3. Examples of s2D reconstruction artifacts 4. Examples of CAD markings in s2D versus DM

BR173-ED-X

# Real-time MRI Navigated Ultrasound for Preoperative Tumor Staging in Breast Cancer Patients: Technique and Clinical Implementation

All Day Location: BR Community, Learning Center

**Awards**
**Certificate of Merit**

**Participants**
Ah Young Park, MD, Ansan , Korea, Republic Of (*Presenter*) Nothing to Disclose
Bo Kyoung Seo, MD, PhD, Ansan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Kyu Ran Cho, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ok Hee Woo, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sang Hoon Cha, MD, Ansan City, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Real-time MRI navigated ultrasound is an image fusion technique to display the results of both MRI and ultrasound on the same monitor. This system is a promising technique to improve lesion detection and analysis, to maximize advantages of each imaging modality, and to compensate disadvantages of each US and MRI. The purpose of this educational exhibit is to illustrate technical principles of the real-time MRI navigated ultrasound and to demonstrate clinical implementation of the system in evaluation of tumor extent, nodal status, and multiplicity in breast cancer patients.

## TABLE OF CONTENTS/OUTLINE

1) Introduction 2) Significance of second-look ultrasound examination for breast lesions initially detected with MRI in breast cancer patients 3)Technical principles and equipment setting up of real-time MRI navigated ultrasound 4) Clinical implementation of real-time MRI navigated ultrasound: Tumor extent, lymph node status, and multiplicity 5) Prospect of real-time MRI navigated ultrasound in tumor staging 6) Discussion

BR174-ED-X

# The Many Faces of Pseudoangiomatous Stromal Hyperplasia (PASH)

All Day Location: BR Community, Learning Center

**Participants**
Fernanda C. Brito, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Fernanda Sachetto Pimenta, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Mariana L. Lemos, Rio De Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Marisa A. Domingues, MD, Rio De Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Giselle D. Mesquita, MD, Rio De Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Fernanda P. Pereira, MD,PhD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

## TEACHING POINTS

Pseudoangiomatous stromal hyperplasia (PASH) is a benign mesenchymal proliferative lesion that typically affects premenopausal women and with possible hormonal etiology. PASH is frequently an incidental histologic finding in breast biopsies performed for other benign or malignant lesions and, in those cases, does not require any additional specific treatment. However, less frequent but not unusual, it can present as a mass, also called as nodular or tumorous PASH, which from a histopathological point of view must be differentiated from malignant lesions. Tumorous PASH is treated by local surgical excision with clear margins and the prognosis is excellent, with minimal risk of recurrence after adequate surgical excision. PASH can also coexist with a malignant lesion and, in a case with more suspicious findings, should not be accepted as a final diagnosis on the basis of percutaneous biopsy findings alone.

## TABLE OF CONTENTS/OUTLINE

Etiology Clinical features Common and uncommon imaging findings Mammography Ultrasound MRI Differential diagnosis Pathology findings Management and prognosis to different presentations

BR175-ED-X

# Comprehensive Review of Accessory Breast in Axilla: From Normal to Pathologic Findings

All Day Location: BR Community, Learning Center

**Participants**
Hyo Soon Lim, MD, Jeollanam-Do, Korea, Republic Of (*Presenter*) Nothing to Disclose
Suk Hee Heo, MD, Hwasun-Gun, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jin Woong Kim, MD, Jeollanamdo, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sang Soo Shin, MD, Gwangju, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hyun Ju Seon, MD, Hwasun-Eup, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1. To know that accessory breast tissue derives from a failure of the primitive mammary tissue to regress and is most often located in the axilla. 2. To demonstrate the imaging findings of normal accessory breast and diseases in axilla with multimodality approach. 3. It is important to know that various lesions, both benign and malignant, that occur in normal breast can occur in accessory breast in axilla.

## TABLE OF CONTENTS/OUTLINE

A. Normal accessory breast 1. Development 2. Clinical manifestation 3. Imaging findings on various modalities (mammography, ultrasound, CT/MRI) B. Accessory breast-related disease 1. Benign breast disease arising in accessory breast (Fibroadenoma, benign phyllodes tumor, hamartoma, fibrocystic change, and mastitis) 2. Breast carcinoma in accessory breast C. Conclusion

BR176-ED-X

# How to Differentiate Large Enhancing Breast Masses in MRI

All Day Location: BR Community, Learning Center

**Participants**
Fernanda Sachetto Pimenta, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Mariana L. Lemos, Rio De Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Fernanda C. Brito, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Elisa P. Coutinho, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Gracy Carneiro, MD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Fernanda P. Pereira, MD,PhD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose

## TEACHING POINTS

A large breast mass can be frightening. A big size is one of the most common presenting features of breast carcinoma. However, the clinical features are frequently nonspecific. Imaging performed before biopsy is helpful in characterizing the nature of the mass. Magnetic resonance imaging (MRI) has been increasingly used for accurate diagnosis of breast cancers, particularly in cases in which mammography and breast ultrasound are inconclusive or yield discrepancies. MRI enable complete visualization of the tumor even in the region close to the chest wall, as well as clear delineation from healthy glandular tissue and may help to define the appropriate management. Large enhancing masses can present a confounding overlap between benign and malignant lesions. The knowledge of usual and unusual MRI presentations of large tumors, using conventional and advanced techniques, allows a more accurate differential diagnosis.

## TABLE OF CONTENTS/OUTLINE

Large enhancing masses (preview) Hamartoma Fibroadenoma Phyllodes tumor Pseudoangiomatous stromal hyperplasia (PASH) Invasive ductal carcinoma Angiosarcoma Clinical features Breast MRI Benign and malignant findings with predictive positive and negative values Appearances in conventional and advanced MRI Differential diagnosis Pathology findings Appropriate management

BR177-ED-X

# Comprehensive Pictorial Review of Breast Calcification: From the Benign to the Extraordinary

All Day Location: BR Community, Learning Center

**Participants**
Charlotte F. Longman, MBChB, MRCS, London, United Kingdom (*Presenter*) Nothing to Disclose
Rohit S. Malliwal, MBBS, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Sylvia O'Keeffe, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Tamara Suaris, MBBS, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Mammography forms the cornerstone of breast imaging and accurate interpretation allows patients to be appropriately managed. Calcification is present in up to 85% of mammograms and takes a wide range of morphological forms. Accurate differentiation of benign from malignant calcification patterns is therefore vital. Mammograms are graded on a scale from benign to malignant using BI-RADS score. A comprehensive pictorial review of a wide range of pathologies is presented: Benign breast calcification patterns including: vascular, coarse, popcorn calcification, tea-cupping and egg-shellIndeterminate calcification including crushed stone More concerning calcification types: microcalcification; fine branching seen in DCIS and malignant (segmental) distribution patternsExamples of more unusual mammographic calcification including manifestations of systemic diseaseOutline of BI-RADs classification with examples

## TABLE OF CONTENTS/OUTLINE

Introduction to standard mammographic views and interpretation including BI-RADS scoring Benign breast calcification patternsMalignant patterns including morphology and distributionCalcification mimicking breast pathologyMore unusual pathology including worm infection and manifestations of systemic diseaseWhere appropriate, mammographic findings will be correlated with multimodality/ cross sectional imaging

BR178-ED-X

# Guess...'What's the Answer to this Puzzle?' Causes of Breast Masses BI.RADS 5

All Day Location: BR Community, Learning Center

**Participants**
Karina Pesce, Vicente Lopez, Argentina (*Presenter*) Nothing to Disclose
Flavia B. Sarquis, MD, Vicente Lopez, Argentina (*Abstract Co-Author*) Nothing to Disclose
Bernardo O. Blejman, MD, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Maria Jose Chico, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Carlos M. Lamattina, MD, Vicente Lopez, Argentina (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Irregular breast masses are caused by many etiologies apart from breast cancer. The aim of the exhibit is to subject the readers to challenging cases in order to improve their understanding of various breast abnormalities causing mass. 1-To review both common and uncommon irregular breast masses using a case based approach

## TABLE OF CONTENTS/OUTLINE

Irregular breast masses cases from common and uncommon entities will be presented in a quiz format. Images with brief clinical history will be displayed along with multiple choice to pick the correct diagnosis from. Key points for the cases will be highlighted subsequently. Following cases will be included- breast cancer, Fibrotic Scar, Abscess, Idiopathic granulomatous lobular mastitis, Diabetic mastopathic, Sclerosing adenosis Cases will be present in a quiz format Images with a brief clinical history will be showed.

BR179-ED-X

# Digital Breast Tomosynthesis in the Evaluation of Advanced Breast Cancer Treated by Neoadjuvant Chemotherapy: Radiologic-pathologic Correlation in the Different Pathological Responses

All Day Location: BR Community, Learning Center

**Participants**
Giovanna Mariscotti, Turin, Italy (*Abstract Co-Author*) Nothing to Disclose
Manuela Durando, Turin, Italy (*Presenter*) Nothing to Disclose
Eleonora Sardo, Torino, Italy (*Abstract Co-Author*) Nothing to Disclose
Isabella Castellano, Turin, Italy (*Abstract Co-Author*) Nothing to Disclose
Pier Paolo Campanino, Turin, Italy (*Abstract Co-Author*) Nothing to Disclose
Elisa Regini, Torino, Italy (*Abstract Co-Author*) Nothing to Disclose
Enrica Caramia, Turin, Italy (*Abstract Co-Author*) Nothing to Disclose
Alessia Milan, Torino, Italy (*Abstract Co-Author*) Nothing to Disclose
Paolo Fonio, Vercelli, Italy (*Abstract Co-Author*) Nothing to Disclose
Giovanni Gandini, MD, Torino, Italy (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The major teaching points of this exhibit are:1.To discuss the role of Digital Breast Tomosynthesis (DBT) as an additional tool in the assessment of advanced breast cancer changes in response to neoadjuvant chemotherapy (NC).2.To evaluate the DBT ability to monitor the response to NC (responder versus non responder) and to assess the residual tumor extent.3.To understand how to correlate the DBT imaging with pathologic changes and response.4.To be aware of the limitations of DBT imaging, including false positives and false negatives cases.5.To support the importance of a multimodality approach in order to provide consistent information for enabling appropriate breast surgery after NC.

## TABLE OF CONTENTS/OUTLINE

1.Background2.Description of systems for categorization of pathologic response to NC:2.1.Complete response to therapy2.2.Partial response to therapy2.3.No evidence of response to therapy3.DBT imaging evaluation3.1.Parameters used in DBT to monitor response to NC:3.1.1.Changes in morphology and size 3.1.2.Residual Tumor analysis3.1.3.Evaluation of microcalcification3.1.4.Breast density influence4.DBT - pathology correlation5.DBT - pathology discordances6.Illustration with cases of main pitfalls (over- and under-estimation) in post-NC DBT evaluation7.Clinical implications and future directions8.References

BR180-ED-X

# Image Illustration of Ten Cases of Non-palpable Breast Cancer Detected by Contrast Enhanced Spectral Mammography (CESM)

All Day Location: BR Community, Learning Center

**Participants**
Nishi Talati, MD, New York, NY (*Presenter*) Nothing to Disclose
Luna Li, MD, PhD, Voorhees, NJ (*Abstract Co-Author*) Nothing to Disclose
Lydia Liao, MD, PhD, Voorhees, NJ (*Abstract Co-Author*) Consultant, General Electric Company; Consultant, Devicor Medical Products, Inc
Elizabeth Tinney, RRA, Cape May Court House, NJ (*Abstract Co-Author*) Nothing to Disclose
Pauline Germaine, DO, Camden, NJ (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

CESM is a new technology which combines benefits of digital mammography with contrast utilization in order to identify breast lesions. CESM highlights areas of cancer or high risk lesions associated with hyperemia, vessel recruitment and neovascularity. Adding CESM to workflow can increase early breast cancer detection, with particular improvement in detection of invasive cancers. The goal of the study is to illustrate the morphology and enhancement intensity of breast cancers initially detected by CESM, establishing this modality as an excellent tool in breast cancer detection.

## TABLE OF CONTENTS/OUTLINE

CESM can identify high risk lesions and cancers as small as 0.5 cm. CESM allows visualization of parenchymal masses as well as microcalcifications.CESM is utilized as a problem solving tool in patients with abnormal screening mammogram, inconclusive diagnostic mammogram and US findings, in high risk screen, and for staging of known malignancy.There are several advantages of CESM over breast MRI such as cost effectiveness and shorter duration of the study which combined with immediate availability of study results allow in significantly reduced patient anxiety.Adding CESM to diagnostic workflow prior to more expensive studies can increase sensitivity, decrease false positive results, and decrease the number of unnecessary tests.

BR182-ED-X

# Pictorial Review: Contrast Enhanced Ultrasound in Evaluating Breast Cancer Patients Receiving Neoadjuvant Chemotherapy

All Day Location: BR Community, Learning Center

FDA Discussions may include off-label uses.

**Participants**
Sandy C. Lee, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Brenna A. Chalmers, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose
Arman Danielian, MS, Glendale, CA (*Abstract Co-Author*) Nothing to Disclose
Edward G. Grant, MD, Los Angeles, CA (*Abstract Co-Author*) Research Grant, General Electric Company ; Medical Advisory Board, Nuance Communications, Inc
Bhushan Desai, MBBS, MS, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Mary W. Yamashita, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Linda Hovanessian-Larsen, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1. To understand the basics of contrast enhanced ultrasound (CEUS) and investigate its role in imaging breast cancer patients receiving neoadjuvant chemotherapy (NAC)2. To demonstrate the imaging findings, qualitative and quantitative parameters on CEUS for biopsy-proven invasive carcinoma at: (1) baseline before initiating NAC, (2) 3 weeks after starting NAC, and (3) after completion of NAC prior to surgical treatment3. Provide illustrative examples of CEUS and compare them to contrast enhanced breast MRI (CE-MRI)4. Discuss the future of CEUS and possible applications in patients undergoing NAC

## TABLE OF CONTENTS/OUTLINE

A. Background/significance of NAC and the current role of MRIB. Explain the technique/basics of CEUSC. Provide clinical presentation, imaging findings (tumor size, percent necrosis, enhancement characteristics and enhancement quantitative parameters), and histopathology for 15 patients that have biopsy proven invasive breast cancer who receive NAC with an emphasis on CEUS studies. CEUS is performed at baseline, after starting NAC, and after completion of NAC prior to surgeryD. Correlation of the CEUS and CE-MRI imaging findings with final histopathology after surgery will be presented. Examples of complete and partial pathologic response will be illustratedE. Discuss the future of CEUS and possible applications in patients undergoing NAC

BR185-ED-X

# The Utility of Ultrasound MicroPure Imaging in Breast Grouped Microcalcifications: Imaging Principle and Clinical Application

All Day Location: BR Community, Learning Center

**Participants**
Ah Young Park, MD, Ansan , Korea, Republic Of (*Presenter*) Nothing to Disclose
Bo Kyoung Seo, MD, PhD, Ansan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Kyu Ran Cho, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ok Hee Woo, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Young Sik Kim, Ansan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The MicroPure imaging is an innovative ultrasound technique to aid the detection of microcalcifications. This system has a special filter to enhance bright echoes with background suppression and to improve visualization of microcalcifications. Grouped microcalcifications, which is defined as five or more calcifications within 1cm of each other, is the smallest distribution subtype of calcifications on mammography. Grouped microcalcifications are not easily detectable on ultrasound, therefore, mammography-guided procedure is suggested for suspicious microcalcifications. The MicroPure imaging allows performing ultrasound-guided procedure of microcalcifications, that is beneficial to radiation exposure, time, and medical cost. The purpose of this educational exhibit is to demonstrate the imaging principle of the MicroPure imaging and clinical application in grouped microcalcifications with pathological correlation.

## TABLE OF CONTENTS/OUTLINE

1) Introduction 2) Definition and significance of grouped microcalcifications in the breast 3) Limitations of conventional ultrasound technique to detect breast microcalcifications 4) Imaging principle of MicroPure imaging 5) Clinical application of MicroPure imaging in grouped microcalcifications with pathological correlation: Benign vs. malignancy 6) Advantages and pitfalls of MicroPure imaging 7) Discussion

BR186-ED-X

# Imaging of Systemic Diseases Affecting the Breast: A Case-based Pictorial Review

All Day Location: BR Community, Learning Center

**Participants**
Alexandre Perez, MD, Valencia, Spain (*Presenter*) Nothing to Disclose
Guillermina Montoliu Fornas, MD, Valencia, Spain (*Abstract Co-Author*) Nothing to Disclose
Miguel A. Sanchez, MD, Valencia, Spain (*Abstract Co-Author*) Nothing to Disclose
Rosa Maria Viguer Benavent, MD, Valencia, Spain (*Abstract Co-Author*) Nothing to Disclose
Jesus Javier Collado Sanchez, MD, Valencia, Spain (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The purpose of this education exhibit is: To present systemic diseases that can manifest in the breast and review clinical features. To describe multimodality (mammography, US, MRI) imaging findings using a case-based approach. To provide a brief practical guide for describe the findings using BI-RADS 5th lexicon.

## TABLE OF CONTENTS/OUTLINE

The cases will be presented in a quiz format.1. Introduction2. Endrocrine disease - Diabetic mastopathy3. Metastatic disease4. Hematologic disease - Breast lymphoma - Leukemia - Myeloma5. Granulomatous disease - Sarcoidosis - Cutaneous vasculitis6. Amyloidosis7. Drug-induced gynecomastia8. Conclusions

BR187-ED-X

# Microcalcification in the Breast: 50 Shades of Grey?

All Day Location: BR Community, Learning Center

**Participants**
Ying Chen, MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose
Tran Seaton, FRCR, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Siham A. Sudderuddin, MRCP, FRCR, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Sami Shousha, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Hema N. Purushothaman, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Victoria Stewart, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Interpretation of microcalcification on mammography can be a difficult diagnostic challenge.The differential diagnosis can vary from completely benign to malignant disease. Some mammographic features of calcification allow the radiologist to make a confident benign diagnosis, equally there are features which are concerning for malignancy.It is important for the radiologist to be aware which calcification requires further assessment and extent can determine surgical management.Aims:To highlight how morphology and distribution of breast calcification relates to breast anatomy and pathology.To plan a radiological approach in assessment. To discuss current management.

## TABLE OF CONTENTS/OUTLINE

BackgroundCalcification morphology, distribution and their pathology correlate:Benign: Diffuse, layering, coarseIndeterminate: amorphous, clusteredMalignant: fine linear, branching, pleomorphic,segmental Work up and biopsy techniques:Further mammographic views14G core needle biopsy versus 10G vacuum assisted biopsySpecimen radiographs Management: Wide local excision vs mastectomySurgical Excision versus Vacuum Assisted ExcisionTest casesA selection of cases for self assessment.

BR188-ED-X

# MRI of Benign Breast Lesions: Key Imaging Findings for Making Correct Diagnosis

All Day Location: BR Community, Learning Center

**Awards**
**Certificate of Merit**

**Participants**
Mariko Goto, MD, Kyoto, Japan (*Presenter*) Research Grant, Bayer AG
Maki Kiba, Kyoto-Shi, Japan (*Abstract Co-Author*) Nothing to Disclose
Eiichi Konishi, Kyoto, Japan (*Abstract Co-Author*) Nothing to Disclose
Yusuke Tsuji, Kyoto, Japan (*Abstract Co-Author*) Nothing to Disclose
Yoko Masuda, Kyoto, Japan (*Abstract Co-Author*) Nothing to Disclose
Hajime Yokota, MD, Kyoto, Japan (*Abstract Co-Author*) Nothing to Disclose
Jun Tazoe, MD, Kyoto, Japan (*Abstract Co-Author*) Nothing to Disclose
Tadashi Tanaka, Kyoto, Japan (*Abstract Co-Author*) Nothing to Disclose
Kei Yamada, MD, Kyoto, Japan (*Abstract Co-Author*) Research funded, DAIICHI SANKYO Group Research funded, Eisai Co, Ltd Research funded, FUJIFILM Holdings Corporation Research funded, Nihon Medi-Physics Co, Ltd Research funded, Koninklijke Philips NV Consultant, H. Lundbeck A/S Consultant, Olea Medical Speaker, Bayer AG Speaker, DAIICHI SANKYO Group Speaker, Eisai Co, Ltd Speaker, Mitsubishi Corporation Speaker, Nihon Medi-Physics Co, Ltd Speaker, Otsuka Holdings Co, Ltd Speaker, Koninklijke Philips NV Speaker, Siemens AG Speaker, sanofi-aventis Group Speaker, Takeda Pharmaceutical Company Limited Speaker, Terumo Corporation

## TEACHING POINTS

The Breast Imaging Reporting and Data System (BI-RADS) lexicon is now used worldwide for assessing breast lesion on dynamic MRI, and demonstrates good correlation with the likelihood of malignancy. However, MRI features even using the BI-RADS still overlap between benign and malignant lesions, and the specificity of MRI remains to be only moderate. One of the causes of this low specificity may be lack of considerations about specific findings of common benign breast lesions. The aims of this exhibit are: To review the MRI findings of common benign breast lesions To learn about the malignant lesions that mimic benign lesions To learn the key MRI findings for making correct diagnosis of benign lesions

## TABLE OF CONTENTS/OUTLINE

1. MRI findings of common benign breast lesions and pathological background Typical benign finding: high SI on T2WI Edema: fibroadenoma, benign phyllodes tumor Dilated duct or microcysts: intraductal papilloma, mastopathy Specific findings Fluid: simple, complicated cyst Fat: hamartoma, galactocele Abscess: subareolar abscess, granulomatous mastitis Fibrosis: diabetic mastitis 2. Malignant mimickers in each benign lesion on MRI3. Key points for correct diagnosis of common benign lesions MRI findings that are specific or findings that require caution

BR189-ED-X

# Digital Breast Tomosynthesis: Where Does it Fail

All Day Location: BR Community, Learning Center

**Participants**
Paula Garcia Barquin, MD, Pamplona, Spain (*Presenter*) Nothing to Disclose
Maite Millor, MEd, Pamplona, Spain (*Abstract Co-Author*) Nothing to Disclose
Arlette Elizalde, Pamplona, Spain (*Abstract Co-Author*) Nothing to Disclose
Luis Pina, MD, PhD, San Sebastian, Spain (*Abstract Co-Author*) Nothing to Disclose
Paula Martinez Miravete, Zaragoza, Spain (*Abstract Co-Author*) Nothing to Disclose
Maria Paramo Alfaro, MD, Pamplona, Spain (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

To show that DBT cannot detect all breast cancers To show the reasons why some cancers are not visible on DBT To know in which cases US and MRI can be useful to detect cancers not seen on DBT

## TABLE OF CONTENTS/OUTLINE

Introduction: DBT does not detect all breast cancers Reasons for the non detectability: Lesions out of the field of view of the detector Lesions surrounded by fibroglandular tissue with no fat or a minimal ammount of fat Lesions with no distortion or spiculation, such as some invasive lobular cancers 3. US and MRI can detect cancers not visible on DBT, especially in very dense breasts (ACR pattern d) and if the lesion is surrounded with fibroglandular tissue 4. Conclusion: although DBT is an excellent technique, it can fail in some cases. US can be very useful to detect additional tumors not seen on DBT.

BR190-ED-X

# Man, Oh Man!: Clinical and Imaging Spectrum of Male Breast Cancer

All Day Location: BR Community, Learning Center

**Awards**
**Certificate of Merit**

**Participants**
Lena A. Omar, MD, Dallas, TX (*Presenter*) Nothing to Disclose
Emily Eads, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Stephen J. Seiler, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
W. Phil Evans III, MD, Dallas, TX (*Abstract Co-Author*) Scientific Advisory Board, VuCOMP, Inc

## TEACHING POINTS

1. Male breast cancer can present in a variety of forms, ranging from a spiculated mass to an intraductal mass to microcalcifications.2. Findings that may be considered benign or probably benign in females may warrant further evaluation and biopsy in men. 3. A variety of cases illustrating the imaging spectrum of male breast cancer will be presented.

## TABLE OF CONTENTS/OUTLINE

1. Clinical presentation of male breast cancer.2. Multimodality imaging features that discriminate benign from malignant lesions in men: Distinguishing male breast cancer from benign gynecomastia Review the imaging similarities between male and female breast cancers Highlight the imaging features in women that may be considered benign or probably benign that should be considered suspicious in men3. Presentation of interesting biopsy-proven cases, to include: Benign male gynecomastia Ductal Carcinoma in situ (DCIS) Intraductal Papilloma with DCIS Invasive Ductal Carcinoma Bilateral Invasive Ductal Carcinomas Breast Metastasis 4. Overview of management of male breast cancer.

BR191-ED-X

# Intraoperative Specimen Radiography- Going Beyond the Block

All Day Location: BR Community, Learning Center

**Participants**
Beatriz E. Adrada, MD, Houston, TX (*Presenter*) Nothing to Disclose
Monica L. Huang, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Rosalind P. Candelaria, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Lumarie Santiago, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Gaiane M. Rauch, MD, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Elsa M. Arribas, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Deborah J. Dawson, BS, RT, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Constance Albarracin, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Tanya W. Moseley, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Gary J. Whitman, MD, Houston, TX (*Abstract Co-Author*) Book contract, Cambridge University Press

## TEACHING POINTS

1. Positive surgical margins in breast conserving surgery (BCS) for ductal carcinoma in situ (DCIS) and invasive breast carcinomas are the strongest predictors for local recurrence.2. Optimally, clear margins should be obtained with the first surgical procedure. However, re-excision rates in BCS for DCIS have been reported to range from 21 to 50%.3. There are different techniques such as intraoperative specimen radiography, imprint cytology and frozen section analysis to ensure complete microscopic clearance of the surgical margins, leading to reduced re-excision rates. 4. Appropriate interpretation of specimen radiographs to confirm removal of targeted tumors, marker clips, needles, wires, and radioactive seeds and to ensure clear margins is extremely important.

## TABLE OF CONTENTS/OUTLINE

1. How to optimize the handling of the specimen by the pathologist. 2. En bloc and sliced specimen radiographs. 3. Electronic transmission of specimen radiography images. 4. Specimen radiography case presentations: the critical role of the radiologist in achieving negative surgical margins.

BR192-ED-X

# Axilla: Not Everything are Lymph Nodes

All Day Location: BR Community, Learning Center

**Participants**
Vicente Martinez De Vega, MD, Madrid, Spain (*Presenter*) Nothing to Disclose
Leire Alvarez Perez, BMedSc, Pozuelo de Alarcon, Spain (*Abstract Co-Author*) Nothing to Disclose
Susana Linares Gonzalez, MD, Pozuelo de Alarcon, Spain (*Abstract Co-Author*) Nothing to Disclose
Diana C. Mollinedo, MD, Madrid, Spain (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

To review and illustrate entities other than lymph nodes that can be found in the axilla.To evaluate the utility and limitations of mammography,ultrasound and MRI to study the axilla.To correlate imaging features with pathological anatomy.

## TABLE OF CONTENTS/OUTLINE

The axilla contains lymph nodes, fat, vascular and nervous structures. In 0,6-6% of the cases, ectopic breast tissue can be found.The most frequent axillary lesions derive from the lymph nodes. However, there are other entities to be aware of when evaluating the axilla.The purpose of this study is to revise and illustrate non lymphatic axillary lesions, to evaluate and to explain the utility and limitations of mammography, ultrasound and MRI for their characterization and to correlate imaging features with pathological anatomy.Masses associated with ectopic axillary breast tissue were benign (fibroadenomas, stromal fibrosis, fat necrosis, ductal ectasia, etc.) and malignant (ductal carcinoma, papilar carcinoma, etc).Lesions not associated with ectopic axillary breast tissue included lipomas, undifferentiated mesenchymal round cell tumor, schwanomas, granular cell tumor, etc.Ultrasound is the technique of choice to evaluate the axilla.Mammography and MRI are useful tools for an accurate diagnosis of axillary lesions.

BR193-ED-X

# The Leave-alone and Worrisome Lesions of Treated Breast: Post Breast Conservation Surgery/ Oncoplasty Imaging

All Day Location: BR Community, Learning Center

**Participants**
Subhash K. Ramani, MD, Mumbai, India (*Presenter*) Nothing to Disclose
Ashita Rastogi, MBBS, MD, Mumbai, India (*Abstract Co-Author*) Nothing to Disclose
Meenakshi H. Thakur, MD, Mumbai, India (*Abstract Co-Author*) Nothing to Disclose
Vani Parmar, MBBS, Mumbai, India (*Abstract Co-Author*) Nothing to Disclose
Tanuja Shet, Mumbai, India (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Common findings in patients treated for breast cancer - post breast conservative therapy and oncoplasty.To identify features of residual/ recurrent disease in post BCT/ oncoplasty state with emphasis on radiological-pathological concordance.Incremental value of Tomography and Volumetric breast density in this clinical setting.

## TABLE OF CONTENTS/OUTLINE

Normal post BCT appearance of breast on mammography: The 'leave-me-alone' lesions How to identify features suspicious for recurrence:'Worrisome' findings (Red flags) It is essential to identify common findings on mammography in patients with breast conservation surgery such as increasing skin thickening (which stabilises and decreases on sequential imaging), seromas, scar, fat necrosis, dystrophic calcifications, etc. The Breast Radiologist needs to be aware of these normal appearances and any change which is going retrograde to the normal temporal change is a red flag sign and should raise the suspicion for recurrence. A critical eye is required to identify such changes as well as to avoid unnecessary biopsies. Imaging findings of recurrence on Breast Ultrasound, CT, PET-CT and MRI are also discussed.

BR194-ED-X

# Imaging Evaluation of Nodal Involvement and Identification of N3 Disease in Primary Breast Cancer Patients

All Day Location: BR Community, Learning Center

**Participants**
Lyndsay D. Viers, MD, Rochester, MN (*Presenter*) Nothing to Disclose
Tara L. Anderson, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Katrina N. Glazebrook, MBChB, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Tina Hieken, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1. Pre-treatment imaging performed in breast cancer patients can identify level III axillary and extra axillary nodal involvement to include supraclavicular and internal mammary lymph nodes. These areas should be routinely evaluated by radiologists on breast MRI, CT, PET/CT, and ultrasound.2. Abnormal lymph node findings on US, MRI, CT, and PET/CT include cortical thickening, FDG-avidity, loss of the fatty hilum, and altered shape or size. 3. Extent of nodal disease on imaging is important for treatment decisions, especially radiation therapy planning.

## TABLE OF CONTENTS/OUTLINE

1. Introduction a. Clinical background of primary breast carcinoma b. Treatment options to include neo-adjuvant chemotherapy, surgery, and radiation2. Overview of lymph node levels from a surgical and radiologic perspective a. Level I axillary b. Level II axillary c. Level III axillary d. Supraclavicular and internal mammary3. Appearance of abnormal nodes in primary breast cancer utilizing patient examples a. MRI appearance and MRI sequences most useful for lymph node evaluation b. CT and PET/CT c. Ultrasound to include grayscale, Doppler, and elastography4. Radiologic N staging (rN) utilizing MRI, US, CT, and PET/CT a. rN1 b. rN2 c. rN3 d. Treatment implications5. Conclusions a. Radiologic N staging can inform treatment decisions and patient expectations

BR195-ED-X

# Spindle-Cell Lesions of the Breast: Multi-modality Imaging Differentiation of these Pathologically Similar Neoplasms

All Day Location: BR Community, Learning Center

**Awards**
**Certificate of Merit**

**Participants**
Sean D. Raj, MD, Houston, TX (*Presenter*) Nothing to Disclose
Anthony S. Hamame, MD, Royal Oak, MI (*Abstract Co-Author*) Nothing to Disclose
Sarfaraz Sadruddin, MD, Sugar Land, TX (*Abstract Co-Author*) Nothing to Disclose
Kevin Sweetwood, BS, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Karla A. Sepulveda, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Emily L. Sedgwick, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1) To review the spectrum of major spindle cell lesions of the breast and learn their multi-modality appearances including mammography, sonography and MRI. 2) To identify differentiating imaging features on multiple modalities for these pathologically challenging breast lesions that are almost predominantly composed of spindle cells. 3) To integrate clinical history and imaging findings in creating a differential that may help guide the physician establish a diagnosis.

## TABLE OF CONTENTS/OUTLINE

We will present a case-based review of our experience diagnosing spindle cell lesions, including clinical and imaging findings, along with pathologic correlation. 1) Definition, frequency, and epidemiology of spindle cell lesions 2) Challenges in diagnosis presented by overlapping histomorphology 3) Case-based review featuring multi-modality imaging characteristics and pathologic features of major spindle cell lesions of the breast, including: Spindle cell carcinoma, Scars, Mammary fibromatosis, Nodular fasciitis, PASH, Myofibroblastoma, Malignant phyllodes tumor, and Angiosarcoma 4) Lesion specific clinical management and prognosis 5) Imaging pitfalls and the do-not-miss lesions 6) Multi-disciplinary approach to accurate diagnosis

BR196-ED-X

# Young Women at High-Risk for Breast Cancer: Imaging characteristics (Magnetic Resonance, Mammography and Ultrasound)

All Day Location: BR Community, Learning Center

**Participants**
Ana P. Klautau Leite, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
Maria Cristina Chammas, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
Linda Moy, MD, New York, NY (*Presenter*) Nothing to Disclose

## TEACHING POINTS

Patients under 40 years of age comprise about 5% of the overall breast cancer population. These patients are generally considered to have at the time of diagnosis: more aggressive, advanced, large tumors, more positive lymph nodes, negative steroid hormone receptors and resultant poorer overall out-comes. It's not clear whether the poorer outcomes are a function of ineffective screening, pathologically "different" or more aggressive tumors a combination of two, or other unrelated factors. Also the young patient tends to be treated more "aggressively" surgically. Breast cancer in young group presents like higher histology grade, positive axillary nodes, hormone receptor negativity, and higher p 53 and Ki-67 expression.The aim of this study is to emphasize breast cancer characteristic features of magnetic resonance imaging, ultrasound and mammography in young women that have a challenging diagnosis.

## TABLE OF CONTENTS/OUTLINE

1-Pathophysiology2-Clinical findings3-Diagnistic imaging correlation: Magnetic Resonance, ultrasonography and mammography4-Pathology findings

BR197-ED-X

# Spectrum of Pregnancy and Lactation Related Benign Breast Pathology: Typical and Atypical Physiologic Changes Associated with Imaging Appearances and Management Considerations

All Day Location: BR Community, Learning Center

**Awards**
**Certificate of Merit**

**Participants**
Nicole S. Winkler, MD, Salt Lake City, UT (*Presenter*) Nothing to Disclose
Megan Saettele, MD, Kansas City, MO (*Abstract Co-Author*) Nothing to Disclose
Matthew B. Morgan, MD, Sandy, UT (*Abstract Co-Author*) Consultant, Reed Elsevier
Matthew Stein, MD, Salt Lake City, UT (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1. Understand typical appearances of benign breast pathology presenting during pregnancy and/or lactation including galactocele, lactating adenoma, fibroadenoma and abscess.2. Learn about atypical appearances of pregnancy and lactation related benign breast pathology through multiple illustrative examples.3. Understand management considerations for imaging findings presenting during lactation.

## TABLE OF CONTENTS/OUTLINE

- Physiologic breast changes during pregnancy and lactation- Galactocele: Typical and atypical imaging features and management considerations- Fibroadenoma: Typical and atypical imaging features and management considerations- Lactating adenoma: Typical and atypical imaging features and management considerations- Mastitis and abscess: Typical imaging features and management considerations

BR199-ED-X

# Minimizing the Misses: Breast Cancers Missed on Mammography

All Day Location: BR Community, Learning Center

**Participants**
Leah Rossett, MD, Rochester, NY (*Presenter*) Nothing to Disclose
Avice M. O'Connell, MD, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The purpose of the exhibit is: 1) To explain the common reasons for missed breast cancers on mammography 2) To suggest how to minimize the incidence of missed breast cancer on mammography, and therefore improve patient outcomes

## TABLE OF CONTENTS/OUTLINE

Minimizing the Misses and Accepting Limitations of Mammography for Detecting Breast Cancer Technical limitations, modality limitations, and personal limitations must be accepted and understood in order to increase our knowledge/skill and therefore improve patient outcomes.Common Reasons for Missed Breast Cancers Radiographic Technique - cannot see what is not imaged, but that does not mean it is not there Limitations of Mammography - field of view, dense breasts/overlapping breast tissue, radiographically occult carcinoma Personal Limitations Limited Patient Information Observer Error - the finding was there, but not seen Interpreter Error/Subtle and Nonspecific Findings - the finding was seen, but misinterpretedGiven the Limitations, How To Minimize the Misses Appropriate patient positioning Additional views and modalities Systematic search pattern Increase knowledge of the subtle/nonspecific findings Compare older studies to detect subtle change

BR200-ED-X

# Hemangioma of the Breast: A Multimodality Pictorial Essay

All Day Location: BR Community, Learning Center

**Participants**
Samuel O. Padua, MD, Bayamon, PR (*Presenter*) Nothing to Disclose
Lorraine B. Nadjafi, MD, Miami Beach, FL (*Abstract Co-Author*) Nothing to Disclose
Stuart Kaplan, MD, Miami Beach, FL (*Abstract Co-Author*) Consultant, Hologic, Inc; Consultant, Delphinus Medical Technologies, Inc

## TEACHING POINTS

The purpose of this exhibit is to: Review imaging characteristics of pathology-proven hemangiomas of the breast as seen on mammography, breast ultrasound and contrast enhanced breast MRI Discuss possible differential diagnoses based on imaging findings Describe appropriate management based on imaging findings including percutaneous core biopsy and recommendations after histo-pathologic diagnosis

## TABLE OF CONTENTS/OUTLINE

Epidemiology and statistics of breast hemangiomas Review of multimodality imaging findings Mammography, Ultrasound, MRI Differential diagnosis Management based on imaging findings Percutaneous core biopsy versus follow up Histo-pathologic correlation Exclusion of malignant angiosarcoma Management after histo-pathologic diagnosis

BR201-ED-X

# Beyond a Fibroadenoma: Rare Breast Lesions and Confounding Presentations of Common Breast Problems in Pediatric Population

All Day Location: BR Community, Learning Center

**Participants**
Evguenia J. Karimova, MD, Boston, MA (*Presenter*) Nothing to Disclose
Rashmi Jayadevan, MD, MBA, Brookline, MA (*Abstract Co-Author*) Nothing to Disclose
Geetika Khanna, MD, MS, Iowa City, IA (*Abstract Co-Author*) Nothing to Disclose
Catherine M. Appleton, MD, Saint Louis, MO (*Abstract Co-Author*) Scientific Advisory Board, Hologic, Inc; Royalties, Oxford University Press;

## TEACHING POINTS

Breast problems are relatively uncommon in children and adolescents; evaluation and correct triage can be challenging. The purpose of this exhibit is: 1. To review imaging findings, diagnosis and management of confusing presentations of common pediatric breast problems. 2. To discuss imaging findings, diagnosis and management of uncommon but important breast lesions encountered in pediatric population 3. To outline the need for special imaging process for childhood cancer survivors

## TABLE OF CONTENTS/OUTLINE

1. Review imaging of common and/or benign findings in pediatric patients i. Congenital/Developmental (breast bud, gynecomastia, Poland syndrome, accessory breast tissue, premature telarche) ii. Benign masses (phyllodes, hemangioma, granular cell tumor) iii. Infections (mastitis, abscess) 2. Imaging of malignant findings in pediatric patients i. Primary breast malignancies (invasive ductal carcinoma, sarcoma) ii. Breast metastases (rhabdomyosarcoma, lymphoma) 3. Special considerations in childhood cancer survivors 4. Correct triage of breast problems in pediatric patients

BR202-ED-X

# Where To Go From Here?: Interactive Radiologic - Pathologic Case Review and Step-by-Step Management of Breast MRs Given BI-RADs 3, 4, or 5

All Day Location: BR Community, Learning Center

**Awards**
**Certificate of Merit**

**Participants**
Robert C. Ward, MD, Providence, RI (*Presenter*) Nothing to Disclose
Lindsey M. Negrete, MD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Elizabeth Lazarus, MD, Barrington, RI (*Abstract Co-Author*) Nothing to Disclose
Ana P. Lourenco, MD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Michele Lomme, MD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

MRI use in the evaluation of breast disease has increased. Specifically, breast MRI extends beyond high-risk screening and is effective for dense breasts, implants, multifocal breast cancer, and patients with malignancy who may have occult, contralateral breast disease. MRI is sensitive at detecting malignancy, but may also detect benign enhancing lesions. Image-guided biopsy can distinguish benign vs. malignant, and avoid needless surgery. For probably benign lesions, short-interval follow-up MRI is reasonable. Experience with the range of malignant and benign appearances allows radiologists to decide which lesions require biopsy and which can be safely followed. Understanding the radiologic-pathologic correlations is key for integrating post-biopsy radiologic management and surgical interventions.

## TABLE OF CONTENTS/OUTLINE

We use a case-based approach to present the history, MRIs of BI-RAD lesions 3, 4, or 5, and pathology. Users have diagnostic scenarios and questions for: A. Breast-MRI detected mass and non-mass evaluated with MRI guided biopsiesB. Breast-MRI detected abnormality evaluated with US guided biopsyC. Short term follow up for BI-RADS 3 lesions detected on breast MRI, and following benign concordant MRI guided biopsyD. False positive breast-MRI detected lesions that resolved on follow up imaging at time of attempted biopsy

BR203-ED-X

# MR Only Detected Breast Masses Pictorial Review of Radiologic and Pathologic Findings: The Spectrum of BI-RADS 4 and 5 Lesions

All Day Location: BR Community, Learning Center

**Participants**
Robert C. Ward, MD, Providence, RI (*Presenter*) Nothing to Disclose
Lindsey M. Negrete, MD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Elizabeth Lazarus, MD, Barrington, RI (*Abstract Co-Author*) Nothing to Disclose
Ana P. Lourenco, MD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose
Michele Lomme, MD, Providence, RI (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

In the United States, approximately 1.6 million breast biopsies are performed each year. Of these, a significant number, 70-90%, are image-guided percutaneous procedures. Although US-guided remains the preferred method due to concerns such as cost, safety, and comfort, certain patients may not be best served by this method. In patients with MRI-detected abnormalities that remain occult on mammography and sonography, MRI guided biopsy is necessary and warranted. The radiologist performing the procedure is chiefly responsible for close follow up of the tissue diagnosis as well as assessment of the imaging-pathology correlation for concordance/discordance considerations.

## TABLE OF CONTENTS/OUTLINE

1.Overview of magnetic resonance (MR) imaging of the breast, MRI biopsy role, and utility as an adjunct to traditional modalities2.Brief review of breast MR standardized vocabulary, imaging lexicon3.Evaluate the morphologic criteria, enhancement patterns, and kinetic characteristics of MR detected BI-RADS 4 and 5 breast masses and malignancy potential4.Present the radiologic-pathologic findings of benign and malignant MR-detected masses: pseudoangiomatous stromal hyperplasia, apocrine metaplasia, flat epithelial atypia, ADH, radial scar, DCIS, and invasive carcinomas. 5.Discuss concordance, case management, and necessary imaging follow up, when appropriate

BR204-ED-X

# Multimodality Imaging of Elective and Reconstructive Breast Augmentation: Tough Calls, Complications, and New Techniques

All Day Location: BR Community, Learning Center

**Awards**
**Certificate of Merit**

**Participants**
Erica L. Martin-Macintosh, MD, Rochester, MN (*Presenter*) Nothing to Disclose
Robert T. Fazzio, MD, PhD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Katie N. Jones, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Katrina N. Glazebrook, MBChB, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The purpose of this educational exhibit is to illustrate the benefit of multimodality imaging in complicated breast augmentation cases. Major teaching points include: Surgical methods of breast augmentation vary and an understanding of different approaches is integral for radiographic interpretation. Complications of breast reconstruction are common and imaging is instrumental to identifying the source of patient's symptoms. MRI is the modality of choice for evaluation of implant dysfunction. However, new techniques, including dual energy CT, show promise as an alternative approach for implant evaluation in a single 20 second scan.

## TABLE OF CONTENTS/OUTLINE

Review the common and uncommon types of nonautologous breast reconstruction/augmentation. Demonstrate multimodality imaging features of augmentation related complications. Illustrate imaging methods for troubleshooting difficult cases with modalities including mammography, ultrasound, MR, dual energy CT, and PET/CT. Compare/contrast imaging features of postoperative complications, recurrent or de novo malignancy, and additional rare findings. Report outcomes of MR versus dual energy CT in assessing implant related complications.

BR205-ED-X

# American Joint Committee on Cancer (AJCC) Breast Cancer Staging - Multimodality Regional Nodal Basin Imaging

All Day Location: BR Community, Learning Center

**Participants**
Kyungmin Shin, MD, Houston, TX (*Presenter*) Nothing to Disclose
Beatriz E. Adrada, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Gaiane M. Rauch, MD, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Ana Paula Benveniste, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Wei T. Yang, MD, Houston, TX (*Abstract Co-Author*) Researcher, Hologic, Inc

## TEACHING POINTS

Learn how to stage breast cancer according to the AJCC breast cancer staging guideline. Understand what imaging modalities could be used for regional nodal basin staging and when to best select each modality. Discuss why accurate staging is important and how it impacts patient care. Learn the challenges and be able to problem solve the difficult cases.

## TABLE OF CONTENTS/OUTLINE

1. Overview of breast cancer staging by the AJCC guideline 2. Regional nodal basin staging using different imaging modalities Ultrasound PET-CT MRI 3. Utility of different imaging modalities for regional nodal basin staging in case review format 4. Case based review and discussion of how accurate regional nodal basin staging changes the patient management and the outcome 5. Pitfalls and challenges of each modality and how to problem solve 6. Summary

BR206-ED-X

# Skin-sparing Mastectomy and Immediate Reconstruction: Comprehensive Review of Diverse Surgical Methods and Spectrum of Imaging Features

All Day Location: BR Community, Learning Center

**Participants**
Gayoung Choi, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Ok Hee Woo, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hye Seon Shin, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Sang Dhong, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Kyu Ran Cho, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Bo Kyoung Seo, MD, PhD, Ansan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The purpose of this exhibit is: 1. To know the diverse surgical methods of autologous tissue flap for immediate breast reconstruction after skin-sparing mastectomy 2. To illustrate the imaging features of reconstructed breasts with autologous tissue flaps 3. To determine the role of the imaging studies in the diagnosis of various complications of breast reconstruction with autologous tissue flap

## TABLE OF CONTENTS/OUTLINE

Review of surgical methods of breast reconstruction with autologous tissue flap: Latissimus dorsi flap and TRAM Imaging features of reconstructed breasts with autologous tissue flaps by mammography, ultrasonography, CT, and MRI Benign complications of breast reconstruction with autologous tissue flap Malignant complications of breast reconstruction with autologous tissue flap Role of imaging modality in follow-up of reconstructed breasts with autologous tissue flap

BR207-ED-X

# Cancers Missed by Tomosynthesis: How to Avoid False Negative

All Day Location: BR Community, Learning Center

**Awards**
**Certificate of Merit**

**Participants**
Sadia Choudhery, MD, Dallas, TX (*Presenter*) Nothing to Disclose
Emily Eads, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Sally Goudreau, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose
Stephen J. Seiler, MD, Dallas, TX (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1) Review cases in which tomosynthesis failed to detect the presence of breast cancer.2) Demonstrate potential pitfalls in interpreting tomosynthesis.3) Emphasize the importance of utilizing a multimodality approach to evaluate breast imaging patients.

## TABLE OF CONTENTS/OUTLINE

1. Utility and advantages of tomosynthesis.2. Potential pitfalls in interpretation of tomosynthesis.a. Satisfaction of searchb. Dense breasts:i. Scattered and heterogeneously dense tissue may create a "busy" mammogram that translates into a "busy" tomosynthesis exam.ii. Extremely dense fibroglandular tissue may obscure masses due to lack of contrast.c. Location:i. Posterior, far lateral, or far medial position lesions may be excluded on one or both views.ii. Poorly compressed regions (subareolar region, implant-displaced) may be suboptimally visualized.d. One-view tomosynthesis findingse. Mass lacking suspicious secondary findings (calcifications, distortion, skin thickening, or nipple retraction)f. Developing asymmetriesg. Invasive Lobular Carcinoma3. Strategies to minimize errors in evaluating tomosynthesis images.a. Systematic search patternb. Awareness of areas in the breast not optimally evaluated with tomosynthesisc. Recognizing suspicious secondary characteristicsd. Multimodality approach including ultrasound and MRI

BR208-ED-X

# Imaging Breast Cancer during Pregnancy

All Day Location: BR Community, Learning Center

**Participants**
Kristina E. Hoque, MD, PhD, Los Angeles, CA (*Presenter*) Nothing to Disclose
Sandy C. Lee, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Nasim R. Khadem, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Kristi Van Winden, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Daphne K. Walker, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

This exhibit explores the complex multimodal approach to imaging breast cancer during pregnancy. Through a discussion of nonionizing and ionizing radiation imaging modalities, contrast, radiotracers, and fetal risk, we will review recommendations for breast cancer diagnosis, staging, monitoring, and surveillance throughout pregnancy and the peripartum period.

## TABLE OF CONTENTS/OUTLINE

I.Discussion of the hemodynamic and hormonal changes during pregnancy and the potential effect on breast cancer riskII. Diagnostic imaging of the gravid patientA. Imaging recommendations during each trimester of pregnancy and fetal riskB. Case presentationsC. Image guided biopsyIII. Breast cancer staging and fetal risk throughout pregnancyA. Surveillance and stagingB. Imaging recommendations and fetal risk: CT, (CE) CT, MRI, (CE) MRI, PET CTIV.Post-treatment imagingA. Recommendations and fetal riskV.Postpartum imaging and image guided proceduresA. Contrast agents and breast feedingB. Breast biopsy of the lactating breastVI.Ethical dilemmas in treating breast cancer during pregnancyA. Trimester based discussion and clinical decision makingVII. Multiple choice quiz, answers and explanations reviewing critical educational objectives

BR209-ED-X

# Comparative Effectiveness of Ultrasound and MR Imaging of Non-Calcified Ductal Carcinoma in Situ

All Day Location: BR Community, Learning Center

**Awards**
**Certificate of Merit**

**Participants**
Ok Hee Woo, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Hye Seon Shin, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Kyu Ran Cho, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Bo Kyoung Seo, MD, PhD, Ansan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Ductal carcinoma in situ (DCIS) is a heterogeneous disease comprising a spectrum of noninvasive malignant tumors of the breast. Typical mammographic finding of DCIS is micro-calcifications. However, approximately 6-23% of DCIS cases manifest as non-calcified lesions. Diagnosis of non-calcified DCIS by mammography is challenging. Thus, high resolution US and breast MRI can be useful.The purpose of this educations exhibit is:1. To illustrate the imaging features of non-calcified ductal carcinoma in situ (DCIS) on ultrasonography and breast MRI.2. To determine the role the imaging studies in the diagnosis and treatment decision of non-calcified DCIS.

## TABLE OF CONTENTS/OUTLINE

1. Clinical manifestation and significance of non-calcified DCIS.2. Ultrasonographic features of non-calcified DCIS. 1) Mass, 2) "Pseudomicrocystic" appearance3. Morphologic and kinetic characteristics of non-calcified DCIS at dynamic breast MRI4. Case review5. Role of imaging and Discussion

BR210-ED-X

# Pearls and Pitfalls in the MR Evaluation of Complete Response of Breast Cancer after Neoadjuvant Chemotherapy: Radiologic-pathologic Discordance

All Day Location: BR Community, Learning Center

**Participants**
Hye Sun Park, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Hak Hee Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Joo Hee Cha, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hee Jung Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Young Chae, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Woo Jung Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Assessment of residual breast cancer after neoadjuvant chemotherapy is important in optimal surgical planning. DCE-MR is considered to be the best modality to predict of the extent of residual tumor. However, several factors may influence the diagnostic accuracy of MR and cause false positive or negative results. Thus, it is important to have an improved knowledge about the imaging findings and factors that may cause the discordance between radiologic and pathologic complete response to decrease the inaccurate evaluation.

## TABLE OF CONTENTS/OUTLINE

1. Brief review of neoadjuvant chemotherapy of breast cancer and the role of DCE-MR in evaluating tumor response.2. Discordance between radiologic and pathologic CR(1) False negative:i. Presenting initially as nonmass enhancement- Hormone receptor positive-HER2 negative tumor- Pathologic correlation:ii. Lack of enhancement in breast cancer after chemotherapy- Decreased microvascularity after neoadjuvant chemotherapy- Pathologic correlationiii. Inflammatory breast cancer- Pathologic correlation(2) False positivei. Enhancement of fibrotic parenchymal change after chemotherapy- Enhancement pattern and kinetic curve analysis:- Pathologic correlationii. Intraductal lesioniii. Pseudo-enhancement due to artifact

BR211-ED-X

# Breast Cancer: What Does Your Subtype Mean? A Targeted Follow-up is Possible

All Day Location: BR Community, Learning Center

**Participants**
Maria Ares-Rego, MD, Santiago de Compostela, Spain (*Presenter*) Nothing to Disclose
Sandra Baleato Gonzalez, MD, PhD, Santiago, Spain (*Abstract Co-Author*) Nothing to Disclose
Roberto Garcia Figueiras, MD, Santiago de Compostela, Spain (*Abstract Co-Author*) Nothing to Disclose
Maria V. Trujillo Ariza, MD, Villagarcia de Arosa, Spain (*Abstract Co-Author*) Nothing to Disclose
Maria Elena Brozos Vazquez, Santiago de Compostela, Spain (*Abstract Co-Author*) Nothing to Disclose
Dolores Abal Arca, Santiago de Compostela, Spain (*Abstract Co-Author*) Nothing to Disclose
Pastora Rivas Pumar, Santiago de Compostela, Spain (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

From a radiologist´s perspective it´s important to understand the differences of breast cancer subtypes to predict metastatic behaviour that will allow us to individualize the follow-up. The aim of this exhibit is :To review the epidemiology and presentation of breast cancer.To describe the molecular subtypes and the differences that exit between them in terms of clinical features, metastatic behaviour, targeted therapies and prognosis.To review the metastatic behaviour of each molecular subtype: time interval of relapse and specific site of recurrence.To describe the utility of the imaging techniques (mammography, US, MRI, PET) used in diagnosis, staging and follow-up.To propose a targeted follow-up based on knowledge of the different metastatic behaviour

## TABLE OF CONTENTS/OUTLINE

Epidemiology and presentation of breast cancerClassification of molecular subtypes and evaluation the main differencesImaging findings in metastatic diseaseThe role of multi-technique imagingTargeted follow up

BR212-ED-X

# First Trial of Computer-aided Analysis of Unenhanced Breast MR Images: Does Structure Analysis of Mammary Gland Help to Find the Breast Cancer?

All Day Location: BR Community, Learning Center

**Participants**
Atsushi Teramoto, PhD, Toyoake, Japan (*Presenter*) Nothing to Disclose
Misato Shibasaki, RT, Kanawaza, Japan (*Abstract Co-Author*) Nothing to Disclose
Satomi Miyajo, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
Osamu Yamamuro, RT, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
Tsuneo Tamaki, MD, PhD, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
Hiroshi Fujita, PhD, Gifu City, Japan (*Abstract Co-Author*) Nothing to Disclose
Kumiko Ohmi, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
Masami Nishio, MD, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Recently, breast MR examination is introduced for high-risk group. The kinetic curve by dynamic scan is usually used in order to identify malignant tumor. Here, structure of mammary glands is also modified when there is the tumor in the breast; we can obtain the novel diagnostic information if we can accurately analyze the structure of mammary glands. The purpose of this exhibition is to show how much we can obtain the useful information from automated analysis of mammary structure in breast MR images. The major teaching points of this exhibit are:1. We can analyze the structure of mammary gland in three-dimensionally. 2. Mammary structure tells us the abnormality of the breast.3. Unenhanced MR images is useful for the detection of breast cancer.

## TABLE OF CONTENTS/OUTLINE

1.The advantage of the use of unenhanced breast MR images.2.Explanation of the structure analysis of mammary gland -Extraction of mammary gland ;Orientation analysis of mammary gland ;Estimation of abnormality3.Live demonstration of proposed system using tablet computer

BR213-ED-X

# All You need to Know About Accessory Breast Tissue - Embryology, Oncological Implications and Multi-modality Imaging Approach - Pictorial Essay

All Day Location: BR Community, Learning Center

**Participants**
Daniel C. Luz, MD, Brazil, Brazil (*Presenter*) Nothing to Disclose
Paula C. Moraes, MD, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
Layra R. Leao, Sao Paulo, Brazil (*Abstract Co-Author*) Nothing to Disclose
Marcelo B. Funari, MD, Ribeirao Pires, Brazil (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1 - Accessory Breast Tissue (ABT) is a normal embryological variant and can be found in up to 6% of general population. 2 - This panel will discuss embryology, general concepts, multi-modality imaging findings, cancer screening, oncological implications and management of ABT. 3 - With images from our data we will show ABT images by mammography,:ultrasound, tomography and magnetic resonance. We will also show cases of uncommon ABT locations, malignant transformation and the effect of hormone replacement therapy on ABT. 4 - Radiologists should promptly recognize ABT on multiple imaging modalities and have to keep in mind that any breast disease can also occur in the ABT.

## TABLE OF CONTENTS/OUTLINE

The basics of embryology to understand ABT like radiologist; Kajava classification review; Multi-modality imaging characterization of ABT: focus on mammography, ultrasound, computer tomography and magnetic resonance - illustrations with images from our data; ABT concepts in breast cancer screening, oncological implications and management.

BR214-ED-X

# Breast Cancers with Noncohesive Imaging Features: Equally Likely to be Classified as Ductal versus Lobular by Pathology

All Day Location: BR Community, Learning Center

**Participants**
Russell A. Trigonis, Roanoke, VA (*Presenter*) Nothing to Disclose
Erik S. Storm, DO, Roanoke, VA (*Abstract Co-Author*) Nothing to Disclose
James Mullet, MD, Roanoke, VA (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

Review pathologic naming conventions of lobular carcinomas and ductal carcinomas. Understand the classic appearance of noncohesive breast cancers using multimodality imaging, and large-format pathology. Learn how imaging findings suggestive of lobular carcinomas often differ from their pathologic classification. Understand that for invasive breast carcinomas with noncohesive features, the imaging morphology may hold more clinical significance than pathologic subtype alone.

## TABLE OF CONTENTS/OUTLINE

Invasive breast cancer classification -Invasive ductal carcinoma Invasive lobular carcinoma Imaging and pathology findings of non-cohesive breast cancers Mammography MRI Large format pathology E-cadherin staining3. Correlation between non-cohesive morphology and lobular classification Database review found no difference in proportion of non-cohesive cancers that are pathologically lobular versus pathologically ductal4. Possible pathophysiologic mechanisms explaining morphology5. Clinical significance of morphologic features versus pathological classification

BR215-ED-X

# Ultrasound Elastography in the Differential Diagnosis of Benign and Malignant Breast Lesions. Personal Experience and Update of the Literature on the Use of Strain-US Elastography (SUE) and Shear Wave.

All Day Location: BR Community, Learning Center

**Participants**
Vito Cantisani, MD, Roma, Italy (*Presenter*) Speaker, Toshiba Corporation; Speaker, Bracco Group; Speaker, Samsung Electronics Co, Ltd;
Nicola Di Leo, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Carlo De Felice, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Rossella Occhiato, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Laura Ballesio, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Carlo Catalano, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Ferdinando D'Ambrosio, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Valentina Cipolla, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Mattia Di Segni, MD, Roma, Italy (*Abstract Co-Author*) Nothing to Disclose
Francesco Flammia, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

1. Description of elastographic features of breast typical and atypical lesions, with pathology confirmation compared with BIRADS-US classification. 2. Explanation of technical issues of various US elastography methods and their application in the breast. 3. Review of epidemiology, clinical presentation, state of the art work up, differential diagnosis and treatment options.

## TABLE OF CONTENTS/OUTLINE

Diagnostic features of breast lesions. State of the art imaging and literature review, including BIRADS classification and EFSUMB and WFUMB guidelines. US techniques available for breast lesion evaluation and their use in the diagnosis and their limits: qualitative elastography with Ueno score, semi-quantitative strain ratio measurements and shear wave elasticity and velocity measurements. Tips and tricks for better results. Breast lesions features at US strain and shear wave elastography provided by image review of representative cases from our cohort of 88 patients in correlation with histopathology will be showed. Discussion on differential diagnosis and the role of the two imaging modalities. Conclusion: USE and Shear wave elastography are accurate and feasible ultrasound additional tool. Both of them may be used to increase accuracy of US in breast lesion differentiation, but necessary training is warranted for its prompt use.

BR216-ED-X

# Radioguided Surgery Applied to Breast Cancer, Reaches the State of the Art?

All Day Location: BR Community, Learning Center

**Participants**
Fernando Rogerio L. Ferreira, MD, Rio de Janeiro, Brazil (*Presenter*) Nothing to Disclose
Rebeca P. Barbosa, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Eduardo F. Junior, Rio De Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Giselle D. Mesquita, MD, Rio De Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Fernanda P. Pereira, MD,PhD, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Maria Julia Calas, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Rosana R. Santos, Rio de Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The Radioguided surgery was developed about 60 years, involves the use of a radiation detection probe system for intraoperative detection of radionuclides.The impact of radioguided surgery includes providing vital information in real time to the surgeon about the location, extent of disease , better evaluation of surgical and minimally invasive.The Sentinel linfondo technique in the breast, using technetium-labeled phytate (99mTc - phytate ), provided advance in Radioguided breast surgery.The correct and accurate positioning of subclinical disease nonpalpable is essential for correct identification and removal during surgery. The primary method used for preoperative localization of nonpalpable breast lesions is the labeling wire . The developed a labeling technique of occult lesions was called ROLL (Radioguided Occult Lesion Localization).The evolution of radioguided surgery continued with described the association of subclinical breast lesion location with sentinel node biopsy in the art titled SNOLL.Recently labeling of nonpalpable lesions began to be performed with seeds of Iodine -125.

## TABLE OF CONTENTS/OUTLINE

- A quick review about radioguided surgery, including ROLL, SNOLL, radioactive seed 125I; - Identify the most important diferencial methods;- Discuss about new metidos radioactive seed Localization 125I.

BR217-ED-X

# Dual Energy Contrast Enhanced Digital Mammography: A Review of How, Why and When Do We Use it?

All Day Location: BR Community, Learning Center

**Participants**
Rend Al-Khalili, MD, MBBCh, New York, NY (*Presenter*) Nothing to Disclose
Ralph T. Wynn, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Marc Brown, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Victoria Mango, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Elise Desperito, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Ellie S. Kwak, MD, Fort Lee, NJ (*Abstract Co-Author*) Nothing to Disclose
Mark A. Francescone, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Lauren C. Friedlander, MD, White Plains, NY (*Abstract Co-Author*) Nothing to Disclose
Richard S. Ha, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

## TEACHING POINTS

The use of Dual Energy Contrast-Enhanced (DECE) digital mammography to diagnose breast cancer has been studied for several decades. Similar to Breast MRI, Contrast Enhanced Mammography combines anatomic and physiologic imaging which primarily detects enhancing tumor vascularity after contrast enhancement. It is very essential for Breast Radiologists to be familiar with this modality as DECE digital mammography could be substituted for MR imaging in patients who are not candidates for MR imaging and it could potentially be used in staging breast cancer.

## TABLE OF CONTENTS/OUTLINE

1. How it is done: review of dual energy technique and contrast agents. 2. Review of published studies comparing DECE digital mammography sensitivity, specificity and PPV to digital mammography and MR imaging. 3. Potential indications, which include: -Staging of known breast cancers. -Additional evaluation of mammographic or clinical abnormalities. -Evaluation of the post lumpectomy breast for recurrent tumor. -Screening for cancer. 4. Advantages. 5. Limitations. 6. Case-based review of DECE digital mammography images demonstrating its use in: -Problem solving. -Ability to detect abnormalities compared to digital mammography and MRI. -Variations in benign enhancement pattern.

BR218-ED-X

# Atypical Ductal Hyperplasia: Controversies in Diagnosis and Management

All Day Location: BR Community, Learning Center

**Participants**
Lars J. Grimm, MD, Durham, NC (*Presenter*) Advisory Board, Medscape, LLC;
Karen S. Johnson, MD, Durham, NC (*Abstract Co-Author*) Research Consultant, Siemens AG
Rex Bentley, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Ruth Walsh, MD, Durham, NC (*Abstract Co-Author*) Research Consultant, Koning Corporation; Research Consultant, Siemens AG

## TEACHING POINTS

The purpose of this exhibit is: To present the variable imaging appearance of atypical ductal hyperlasia (ADH) on mammography, digital breast tomosynthesis, ultrasound, and MRI To demonstrate the difficulty in differentiating ADH from low grade ductal carcinoma in situ (DCIS) for pathologists. To review the evidence behind surgical excision and alternative management strategies for ADH

## TABLE OF CONTENTS/OUTLINE

Review of imaging findings in ADH - Mammography - Digital breast tomosynthesis - Ultrasound - MRIReview the pathologic diagnosis of ADH - ADH morphologies (micropapillary, solid, cribriform) - Discriminating histologic factors between ADH and DCISDiscuss evidence and controversies in ADH management - Reported upstaging rates in the literature - Surgical excision guidelines - Proposed active surveillance management strategies

SPSP01

# Diagnóstico Precoz por Imagen en la Población el CIR: Sesión del Colegio Interamericano de Radiología (CIR) en Español/Population based Preventive Imaging from CIR: Session of the Interamerican College of Radiology (CIR) in Spanish

Saturday, Nov. 28 1:00PM - 5:00PM Location: E451A

BR CH GI NR VA HP

*AMA PRA Category 1 Credits* ™: 3.75
ARRT Category A+ Credits: 4.00

**Participants**
Pablo R. Ros, MD, PhD, Cleveland, OH (*Moderator*) Medical Advisory Board, Koninklijke Philips NV; Medical Advisory Board, KLAS Enterprises LLC; Medical Advisory Committee, Oakstone Publishing; Departmental Research Grant, Siemens AG; Departmental Research Grant, Koninklijke Philips NV; Departmental Research Grant, Sectra AB; Departmental Research Grant, Toshiba Corporation
Miguel E. Stoopen, MD, Mexico City, Mexico (*Moderator*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) To review the state-of-the-art of population based preventive imaging 2) To discuss preventive imaging approaches in all major organ systems and key pathologies, ranging from dementia, cardiovascular disease, colon, liver, lung and breast cancer 3) To illustrate the use of different imaging technologies in preventive imaging such as CT, MRI and ultrasound

**Sub-Events**

## SPSP01A Introducción/Introduction

Participants
Dante R. Casale Menier, MD, Ciudad Juarez, Mexico (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

## SPSP01B Parte 1/Part 1

Participants

**LEARNING OBJECTIVES**

View learning objectives under main course title.

## SPSP01C Presentación de Ponentes/Panel Introduction

Participants
Pablo R. Ros, MD, PhD, Cleveland, OH (*Presenter*) Medical Advisory Board, Koninklijke Philips NV; Medical Advisory Board, KLAS Enterprises LLC; Medical Advisory Committee, Oakstone Publishing; Departmental Research Grant, Siemens AG; Departmental Research Grant, Koninklijke Philips NV; Departmental Research Grant, Sectra AB; Departmental Research Grant, Toshiba Corporation

**LEARNING OBJECTIVES**

View learning objectives under main course title.

## SPSP01D Colon: La Colonografía Virtual: ¿Un Método de Escrutinio en la Poblacion?/Colon: Virtual Colonography: A Population Screening Tool?

Participants
Jorge A. Soto, MD, Boston, MA (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Jorge A. Soto, MD - 2013 Honored Educator
Jorge A. Soto, MD - 2014 Honored Educator
Jorge A. Soto, MD - 2015 Honored Educator

## SPSP01E Cardiovascular: Cribaje de Enfermedad Cardiovascular por Imagen Medica/Cardiovascular: Diagnostic Imaging in Cardiovascular Screening

Participants

Carlos S. Restrepo, MD, San Antonio, TX (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Carlos S. Restrepo, MD - 2012 Honored Educator
Carlos S. Restrepo, MD - 2014 Honored Educator

### SPSP01F Neurología: Diagnóstico Temprano de Demencias: ¿Dónde Estamos?/Neurology: Dementia Early Diagnosis: Where Are We?

Participants
Carlos Zamora, MD,PhD, Chapel Hill, NC (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

Objetivos: 1) Comprender conceptos clínicos básicos para el diagnóstico de los síndromes principales de demencia. 2) Reconocer características anatómicas y metabólicas fundamentales de neuroimagen en los síndromes principales de demencia, con especial atención a enfermedad de Alzheimer. 3) Explorar direcciones futuras y desafíos para el diagnóstico temprano. Learning objectives: 1) Understand basic clinical concepts for the diagnosis of major dementia syndromes. 2) Recognize fundamental anatomic and metabolic neuroimaging features of major dementia syndromes, with special focus on Alzheimer's disease. 3) Explore future directions and challenges for early diagnosis.

### SPSP01G Parte II/Part II

Participants

**LEARNING OBJECTIVES**

View learning objectives under main course title.

### SPSP01H Presentación de Ponetes/Panel Introduction

Participants
Miguel E. Stoopen, MD, Mexico City, Mexico (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

### SPSP01I Mama: Rol de la RM en el Cáncer de Mama en Mujeres de Alto Riesgo/Breast: Role of MR in High Risk Breast Cancer Patients

Participants
Linei A. Urban, Curitiba, Brazil (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

### SPSP01J Pulmón: TC de Cribaje en Cancer de Pulmon: ¿Debe Hacerse en Fumadores y Exfumadores?/Lung: Lung Cancer CT Screening: Should It Be Performed in Smokers and Former Smokers?

Participants
Claudio S. Silva Fuente-Alba, MD, MSc, Santiago, Chile, (csilvafa@alemana.cl) (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

### SPSP01K Hígado: Cribaje del Hepatocarcinoma en Pacientes de Riesgo: ¿Cómo Hacerlo y a Quién Incluir?/Liver: Hepatocellular Carcinoma Screening in High Risk Patients: How and Whom?

Participants
Carmen Ayuso, MD,PhD, Barcelona, Spain, (cayuso@clinic.ub.es) (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Definir la población en riesgo de desarrollar un carcinoma hepatocelular que debe ser incluida en un programa de cribado. 2) Analizar la mejor estrategia para llevar a cabo el cribado del hepatocarcinoma en la población en riesgo de padecerlo. 3) Discutir la conducta a seguir una vez que se detecta un nódulo hepático en pacientes incluidos en un programa de cribado.1) To define the population at risk of hepatocellular carcinoma to be included in a surveillance program. 2) To analyze the best strategy for

surveillance in patients at risk of hepatocellular carcinoma. 3) To discuss how to proceed when a liver ndule is detected in patients on surveillance

## SPSP01L Comentarios Finales y Clausura/Closing Remarks

Participants
Dante R. Casale Menier, MD, Ciudad Juarez, Mexico (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

View learning objectives under main course title.

ED001-SU

## Breast Sunday Case of the Day

Sunday, Nov. 29 8:00AM - 11:59PM Location: Case of Day, Learning Center

**BR**

*AMA PRA Category 1 Credit ™*: .50

**Participants**
Susan O. Holley, MD, PhD, Saint Louis, MO (*Presenter*) Research Consultant, Biomedical Systems
Michelle V. Lee, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Eugene Y. Kim, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Michyla L. Bowerson, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Wendi A. Owen, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Catherine M. Appleton, MD, Saint Louis, MO (*Abstract Co-Author*) Scientific Advisory Board, Hologic, Inc; Royalties, Oxford University Press;
Whitney A. Manlove, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Jill A. Jones, MD, Kansas City, KS (*Abstract Co-Author*) Nothing to Disclose
Onalisa D. Winblad, MD, Kansas City, KS (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1) Identify, characterize, and analyze abnormal findings on multimodality breast imaging studies. 2) Develop differential diagnostic considerations based on the clinical information and imaging findings. 3) Recommend appropriate management for the patients based on imaging findings.

SSA01

## Breast Imaging (Contrast Mammo/CT)

Sunday, Nov. 29 10:45AM - 12:15PM Location: Arie Crown Theater

BR CT DM

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

FDA Discussions may include off-label uses.

**Participants**
Maxine S. Jochelson, MD, New York, NY (*Moderator*) Nothing to Disclose
John M. Lewin, MD, Denver, CO (*Moderator*) Consultant, Hologic, Inc; Research Grant, Hologic, Inc; Consultant, Novian Health Inc

**Sub-Events**

### SSA01-01 Contrast Enhanced Spectral Mammography: A University Educational Institute Experience in 3000 Patients

Sunday, Nov. 29 10:45AM - 10:55AM Location: Arie Crown Theater

Participants
Maha H. Helal IV, MD, Cairo, Egypt (*Presenter*) Nothing to Disclose
Marwa A. Haggag, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Omnia Mokhtar, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Mahmoud M. Rezk, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Nelly Aliden, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Sahar Mansour, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Iman Godda, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Rasha M. Kamal, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Noha Abdel Shafey, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Contrast-enhanced spectral mammography (CESM) is an advanced application of digital mammography that uses contrast agent. But little is known about its efficacy in Egyptian patients. In this work; we aimed to share our experience in evaluating large sector of female patients with different breast diseases using CESM.

#### METHOD AND MATERIALS

CESM was carried for 3000 patients during their daily visit to our institute from 2012-2014. Examinations were performed for staging of proved malignancy in 27% cases and to clarify nature of indeterminate lesions in another 30%. Post operative cases and follow up cases post neoadjuvant chemotherapy were 23% and 20% respectively. Medio-lateral oblique and cranio-caudal views were taken in low (22-33 kVp) and high (44-49 kVp) energy exposures after IV injection of non-ionic iodinated contrast agent. The diagnostic performance of the contrast enhanced mammography was evaluated and pathology from surgical specimen or ultrasound guided core biopsy were the gold standard of reference in all cases.

#### RESULTS

CESM presented sensitivity of 88% and specificity of 86% to differentiate benign andmalignant masses. For post operative cases;sensitivity was 85% andspecificity was 60%. In cases on chemotherapy;sensitivity was 87 % andspecificity was 77%. Contrast uptake was noted in 2040/3000 (68%) lesions. Intense uptake and heterogeneous enhancement were more frequent in malignant pathology (p value ≤ 0.001). Uniform ring enhancement noted in cavitory benign masses as abscess cavities and infected cysts noted in 664 cases (22.1%). Multicentric and multifocal carcinomas were detected in 42.2% (n=1266) of proved malignant masses. Statistical analysis yielded a sensitivity, specificity and accuracy of 71.4%, 37.5% and 53.3% for conventional mammograms compared to 87.5 %, 75% and 80% for contrast enhanced mammograms respectively

#### CONCLUSION

Contrast-enhanced spectral digital mammogram enhances the specificity of the standard mammogram. It presents an easy, simple and rapid contrast based method for discrimination between different breast pathologies and for follow up of chemotherapy and post operative cases

#### CLINICAL RELEVANCE/APPLICATION

CESM represents a new era of imaging. It provides better diagnostic performance than the standard mammogram, perform proper screening for high risk patients and follow up response to different lines of management

### SSA01-02 Comparison of Background Parenchymal Enhancement on Contrast-Enhanced Spectral Mammography and Breast Magnetic Resonance Imaging

Sunday, Nov. 29 10:55AM - 11:05AM Location: Arie Crown Theater

Participants
Julie Sogani, MD, New York, NY (*Presenter*) Nothing to Disclose
Elizabeth A. Morris, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Jennifer B. Kaplan, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Donna D. D'Alessio, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Debra A. Goldman, MS, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Chaya Moskowitz, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Maxine S. Jochelson, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

The purposes of this study were to examine the extent of background parenchymal enhancement (BPE) on contrast-enhanced spectral mammography (CESM) and to compare the level of BPE on CESM and breast magnetic resonance imaging (MRI).

**METHOD AND MATERIALS**

This is a retrospective, IRB-approved and HIPAA-compliant study performed on women with or at increased risk for breast cancer who underwent screening CESM and MRI at our institution between 2010 and 2014. Need for informed consent was waived. Three readers independently rated the BPE level on each imaging modality using a categorical scale: minimal, mild, moderate, or marked. To assess pairwise agreement between BPE levels on CESM and MRI as well as among readers, a weighted kappa (k) coefficient with quadratic weights was calculated. For overall agreement, the mean kappa and bootstrapped 95% confidence intervals (CI) were calculated with N=1000 bootstrap samples.

**RESULTS**

A total of 278 women underwent both CESM and MRI within a median time interval of 0 days (range: 0-28 days). Of these women, the BPE level determined by the three readers was minimal in 41-43%, mild in 24-34%, moderate in 17-20%, and marked in 4-16% on CESM compared to 36-46% minimal, 24-38% mild, 16-23% moderate, and 5-14% marked on MRI. The majority of women had minimal or mild BPE both on CESM (68-76%) and MRI (69-76%). Between CESM and MRI, the agreement ranged from moderate for reader 3 (k=0.55, 95% CI: 0.47-0.63) to substantial for reader 1(k=0.66, 95% CI: 0.57-0.75) and reader 2 (k=0.67, 95% CI: 0.60-0.75). Within CESM, the agreement for the readers was substantial at k=0.68 (95% CI: 0.62-0.73) with the pairwise agreement all being substantial (range: k=0.62-0.71). Within MRI, the agreement for the readers was substantial at k=0.75 (95% CI: 0.70-0.80) with the pairwise agreement all being substantial (range: k=0.72-0.79). Overall agreement on BPE levels between CESM and MRI and among the readers was substantial at k=0.66 (95% CI: 0.61-0.70).

**CONCLUSION**

The level of BPE detected on CESM is in substantial agreement with that on MRI. While increased BPE on MRI has been demonstrated to be associated with increased odds of breast cancer, additional studies will be needed to evaluate the role of BPE on CESM as a predictor of breast cancer risk.

**CLINICAL RELEVANCE/APPLICATION**

The level of BPE detected on CESM is in substantial agreement with that on MRI and may serve as an additional marker of breast cancer risk.

## SSA01-03 The Correlation between the Mammographic Breast Density and the Intensity of Background Parenchymal Enhancement in Contrast Enhanced Spectral Mammography

Sunday, Nov. 29 11:05AM - 11:15AM Location: Arie Crown Theater

Participants
Rasha M. Kamal, MD, Cairo, Egypt (*Presenter*) Nothing to Disclose
Sahar Mansour, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Maha H. Helal IV, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Marwa A. Haggag, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Omniya Mokhtar, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Mohammed M. Gomaa, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

The purpose of this study is to assess the correlation between the mammographic breast density and the intensity of background parenchymal enhancement (BPE) on Contrast Enhanced Spectral Mammography (CESM).

**METHOD AND MATERIALS**

The study is a retrospective study that included 410 patients who underwent CESM. The mammographic breast density was assessed on the low-energy images and was graded on the basis of the ACR BI-RADS breast density categories from a to d. These were further grouped into: group 1 which included the fatty (a) and the scattered fibroglandular tissue (b) breast densities and group 2 which included the heterogeneously dense (c) and the extremely dense (d) breast densities. The intensity of BPE was assessed on the subtraction high-energy images and was scored on a 4-point scale on the basis of the ACR MRI BI-RADS criteria, as minimal, mild, moderate, or marked. Statistical correlation was calculated using the Pearson correlation coefficient.

**RESULTS**

Group 1 (breast densities a and b) included 207/410 (50.5%) cases out of which 138/ 207 (66.6%) cases showed minimal and 66/207 (31.9%) cases showed mild BPE. Only 2/ 207 (1%) and 1/ 207 (0.5%) cases showed moderate and marked BPE respectively. Group 2 (breast densities c and d) included 203/410 (49.5%) cases out of which 91/ 203 (44.8%) cases showed minimal, 81/2013 (39.9%) cases showed mild, 24/203 (11.8%) cases showed moderate and only 7/ 203 (3.4%) cases showed marked BPE.The intensity of the BPE showed weak positive correlation with the corresponding breast density grade (r: 0.2824) were 376/410 (91.7%) of the cases showed minimal to mild BPE and only 34/410 (8.3%) showed moderate to marked BPE irrespective of the breast density group.

**CONCLUSION**

Mammographic breast density shows a weak positive correlation with the BPE in CESM, thus it does not hamper diagnosis even in the mammography dense breast parenchyma. Most of the cases show lower scores of BPE irrespective of the corresponding breast density grade.

**CONCLUSION**

Mammographic breast density shows weak positive correlation with the intensity of BPE in CESM.Most of the cases show lower scores of BPE, ranging from minimal to mild, irrespective of the corresponding breast density grade.

**CLINICAL RELEVANCE/APPLICATION**

Increased mammographic density and marked BPE can both decrease mammography and MRI sensitivity and specificity as they can obscure subtle and minimally enhancing malignant breast lesions. The weak positive correlation between mammographic breast density and BPE in CESM is a major advantage. CESM can thus be considered in the screening and diagnostic work-up of high risk patients and those with a heterogeneous dense breast parenchyma.

## SSA01-04 Enhancement Patterns of Benign and Malignant Breast Lesions on Contrast-enhanced Breast Tomosynthesis

Sunday, Nov. 29 11:15AM - 11:25AM Location: Arie Crown Theater

Participants
Chen-Pin Chou, MD, Kaohsiung, Taiwan (*Presenter*) Nothing to Disclose
Tsung-Lung Yang, MD,MD, Kaohsiung, Taiwan (*Abstract Co-Author*) Nothing to Disclose
Huay-Ben Pan, MD, Kaohsiung, Taiwan (*Abstract Co-Author*) Support, Hologic, Inc

### PURPOSE

To assess the enhancement patterns of benign and malignant lesions on contrast-enhanced breast tomosynthesis (CEBT)

### METHOD AND MATERIALS

Institutional review board approved the study. Written informed consent was obtained from all patients. A total of 140 consecutive women suspected of having architectural distortion on digital mammogram between March 2012 and April 2014 were reviewed. All women had both CEBT before biopsy. 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 iodine contrast agent. Post-contrast images were taken at 2 minutes (MLO view) and 4 minutes (CC view). The enhancement patterns were divided early enhancement in 2 minutes (type1), equal enhancement in 2 and 4 minutes (type2), late enhancement in 4 minutes (type3). The enhancement patterns were determinted by consensus of two radiologists.

### RESULTS

Total 151 histological results of breast lesions were available in 140 women (mean age 52 years, range 31-70 years). The pathology revealed 78 benign lesions and 73 breast malignancies (36 non-invasive and 37 invasive cacners). The enhancement patterns included 28 type 1, 65 type 2 and 58 type 3. Type 1 enhancement was found in 23 malignant lesions and 5 benign lesions, type 2 enhancement in 23 malignant lesions and 42 benign lesions, and type 3 enhancement in 27 malignant lesions and 31 benign lesions. Among 23 cancers with type 1 enhancement, 21 were invasive and 2 were non-invasive.Type 1 enhancement was highly associated with breast malignancy ($p<0.01$) and invasive breast cancer histology ( $p<0.01$).

### CONCLUSION

CEBT e nhancement pattens in 2 and 4 minutes may predict the nature of breast lesions.

### CLINICAL RELEVANCE/APPLICATION

Enhancement pattern of CEBT may paly a role for differentiating breast lesions..

## SSA01-05 Contrast-enhanced Spectral Mammography versus Breast Tomosynthesis in Further Evaluation of Recalled Cases after Screening Mammograms

Sunday, Nov. 29 11:25AM - 11:35AM Location: Arie Crown Theater

Participants
Norran H. Said, MD, FRCR, Cairo, Egypt (*Presenter*) Nothing to Disclose
Naglaa Abdel Razek, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Engy I. Ali, MSc, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Nivine A. Chalabi, MBBCh, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Ashraf Selim, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To compare the added value of Contrast Enhanced Spectral Mammography (CESM) and Breast Tomosynthesis (BT) in the confirmation or exclusion of breast cancer after their referral from the national screening program

### METHOD AND MATERIALS

After Ethics committee approval, and patients' consent, 75 women who underwent screening Digital Mammography, and were recalled by two independent breast radiologists were enrolled in the study. All patients underwent both BT and CESM, and an independent BIRADS score was given for each modality. Results were compared to pathology and follow up of negative/ typically benign findings.

### RESULTS

Out of the 75 patients; 39 were recalled due to detection of a mass, 19 due to focal asymmetry, 11 due to microcalcifications, and 6 due to architectural distortion. Sensitivity, Specificity, PPV, NPV , LR positive, LR negative of CESM were 91.1, 96.7, 97.6, 87.8, 27.3, 0.09 respectively, and in BT were 86.6, 76.6, 84.7, 79.3, 3.71, 0.17. Agreement by Kappa was 0.104. CESM and BT both agreed on TP in 36 cases out of 45 proved cancers. With CESM there were 4 FN cases , from which BT could detect 3 cancers (micro calcifications). With BT there were 6 FN cases from which CESM could detect 5 cancers. There was 1 FP by CESM, and 7 by BT. Biopsy was avoided by CESM in 29 cases, and by BT in 23 cases.

### CONCLUSION

CESM was able to avoid/ confirm biopsy with diagnostic certainty apart from cases with only microcalcifications as the dominant finding, where BT has shown better diagnostic capablities.

### CLINICAL RELEVANCE/APPLICATION

Both CESM and BT are now valuable tools in the recall unit of a national screening program and have proven good clinical

performance.

### SSA01-06 Automatic Classification of Breast Lesions in Contrast Enhanced Spectral Mammography

Sunday, Nov. 29 11:35AM - 11:45AM Location: Arie Crown Theater

Participants
Miriam Sklair-Levy, MD, Tel -Hashomer, Israel (*Presenter*) Nothing to Disclose
Yitzi Pfeffer, BS, Tel Aviv, Israel (*Abstract Co-Author*) Nothing to Disclose
Anat Shalmon, Ramat Gan, Israel (*Abstract Co-Author*) Nothing to Disclose
Yael Servadio, MD, Ramat Gan, Israel (*Abstract Co-Author*) Nothing to Disclose
Arie Rudnstein, MD, TelHashomer, Israel (*Abstract Co-Author*) Nothing to Disclose
Michael Gotlieb, MD, Ramat Gan, Israel (*Abstract Co-Author*) Nothing to Disclose
Arnaldo Mayer, PhD, Ramat Gan, Israel (*Abstract Co-Author*) Co-founder, RadLogics Inc; Officer, RadLogics Inc

#### PURPOSE

To assess feasibility of automatic breast lesion classification algorithm in dual-energy contrast enhanced spectral mammography and evaluate its potential for biopsy sparing in benign breast lesions.

#### METHOD AND MATERIALS

A retrospective study, a set of 93 breast lesions in dual-energy contrast mammography, 41 benign,52 malignant lesions. Each lesion was manually contoured using standard PACS viewer drawing tools.Based on the data set a supervised learning algorithm was developed to tell benign and malignant lesions . The algorithm automatically extracts numerical descriptors from the pixels located inside and outside the lesion. The descriptors characterizes visual patterns that appear in benign and malignant lesion. The set of numerical descriptors is appended into a feature vector characterizing the lesion. In a training phase, a linear support vector machine classifier is trained to tell apart benign and malignant lesions using a subset of the lesions represented by their feature vectors and the corresponding label (benign/malignant) provided by pathology.In a testing phase, the remaining subset of lesions is fed to the trained classifier that returns a classification score. The higher the score, the higher the probability that the considered lesion is malignant. Eventually, the score is thresholded to provide the final classification with the desired balance between sensitivity and specificity. In the performed experiments, 92 lesions were used for training and 1 for testing phases. In this leave-one-out approach training and testing were repeated 93 times, each one for a different test lesion, so that each lesion was classified exactly 1 time without contributing to the training of its classifier.

#### RESULTS

Setting the classification score threshold (TH) to 0.5:sensitivity=0.90, specificity=0.76, NPV=0.86. Reducing TH to 0: sensitivity=0.98, specificity=0.54, NPV=0.96. Only 1 malignant lesion was classified as benign.Reducing TH to -0.5: sensitivity=1, specificity=0.37, NPV=1. it provides a reduction on 37% in biopsies without affecting sensitivity

#### CONCLUSION

This research showed the feasibility of automatic lesion classification in dual-energy CESM with a significant potential to reduce the number of benign breast biopsies.

#### CLINICAL RELEVANCE/APPLICATION

Automatic lesion classification in dual-energy CESM has the potential to reduce the number of benign breast biopsies, therefore to reduce the anxiety of patients. And reduce the cost

### SSA01-07 Contrast-enhanced Breast Tomosynthesis and Dynamic Contrast-enhanced Breast MRI for Architectural Distortion Lesions on Mammograms

Sunday, Nov. 29 11:45AM - 11:55AM Location: Arie Crown Theater

Participants
Chen-Pin Chou, MD, Kaohsiung, Taiwan (*Presenter*) Nothing to Disclose
Tsung-Lung Yang, MD,MD, Kaohsiung, Taiwan (*Abstract Co-Author*) Nothing to Disclose
Huay-Ben Pan, MD, Kaohsiung, Taiwan (*Abstract Co-Author*) Support, Hologic, Inc

#### PURPOSE

To compare the diagnostic accuracy of contrast-enhanced breast tomosynthesis (CEBT) and dynamic contrast-enhanced breast MRI (DCE-MRI) for architectural distortion lesions detected on digital mammogram.

#### METHOD AND MATERIALS

Institutional review board approved the study. Written informed consent was obtained from all patients. A total of 32 consecutive women suspected of having architectural distortion on digital mammogram between March 2012 and April 2014 were reviewed. All women had both CEBT and DCE-MRI before biopsy. 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 iodine contrast agent and imaged between 2 and 4 minutes after injection. The BI-RADS classifications on CEBT were finally determined based on findings on combinations of 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. Receiver operating characteristic (ROC) analysis was used to evaluate the performance of CEBT and DCE-MRI. Different radiologists interpreted CEBT and DCE-MRI.

#### RESULTS

Total 32 histological results of architectural distortion were available in 32 women (mean age 54 years, range 45-63 years). The pathology revealed 24 benign lesions and 8 breast malignancies. The sensitivity/specificity/accuracy between CEBT and DCE-MRI for diagnosing breast cancers were 100%/38%/53% and 100%/58%/68%, respectively (all p>0.05). For all readers, the areas under the ROC curve (AUCs) for diagnosis of malignancy were not significantly different between CEBT and DCE-MRI (all p >0.05).

#### CONCLUSION

CEBT and DCE-MRI showed similar diagnostic performance for architectural distortion lesions on screening mammogram.

CEBT and DBT MLO showed similar diagnostic performance for architectural distortion lesions on screening mammogram.

**CLINICAL RELEVANCE/APPLICATION**

CEBT is a flexible imaging tool for differentiating architectural distortion lesions on screening mammogram.

## SSA01-08 The Comparative Role of Contrast Enhanced Spectral Mammography versus Sono-Mammography in the Assessment of Patients Following Breast Surgery

Sunday, Nov. 29 11:55AM - 12:05PM Location: Arie Crown Theater

Participants
Marwa M. El Sayad, MBBCh, Giza, Egypt (*Presenter*) Nothing to Disclose
Rasha M. Kamal, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Ayda A. Youssef, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

The purpose of this study is to evaluate the diagnostic accuracy of Contrast Enhanced Spectral Mammography as an adjunct to Sono-mammography versus Sono-mammography alone in the assessment of patients following breast surgery.

**METHOD AND MATERIALS**

The study is a prospective study that was approved by the research ethical committee of the Radiology Department. It included 38 patients (with 52 breast lesions) with history of breast surgery and indeterminate sono-mammographic findings. Patients with mastectomy bed lesions who could not perform mammography were excluded from the study. They were all scheduled for Contrast Enhanced Spectral Mammography (CESM). The identified lesions were classified into lesions at the site of the operative bed, lesions in the ipsilateral breast, yet, away from the operative bed and lesions in the contra-lateral breast. These lesions were further classified into benign or malignant by biopsy and histopathology. The sensitivity, specificity, positive and negative predictive values and likelihood ratios of sono-mammography and CESM were calculated and compared when using sono-mammography or CESM alone and when adding the three modalities together in diagnosis.

**RESULTS**

Out of the 52 identified breast lesions, 30/52, 57.7% were benign and 22/52, 42.3% were malignant. Eighteen out of 52 lesions, 34.6% were identified at the operative bed, 7/52, 13.5% in the ipsilateral breast, and 27/52, 51.9% in the contra-lateral breast. The calculated sensitivity, specificity, positive and negative predictive values and positive and negative likely-hood ratios of sono-mammography were 81.8%, 23.3%, 43.9%, 63.6%, 1.067 and 0.779 respectively as compared to 86.4%, 90%, 86.4%, 90%, 8.636 and 0.152 for CESM. When adding CESM to sono-mammogaphy the calculated diagnostic indices were raised to 95.5%, 96.7%, 95.5%, 96.7%, 28.636 and 0.047 respectively.

**CONCLUSION**

Adding CESM in the post-operative breast assessment improved the diagnostic performance of sono-mammography.

**CLINICAL RELEVANCE/APPLICATION**

The follow up of patients who had undergone breast surgery, especially the interpretation of findings of the postsurgical breast, represents a diagnostic dilemma. Many findings can be mistaken for cancer. CESM is a promising time saving and lower cost technique than Magnetic Resonance Imaging (MRI). It has the potential to replace MRI as an adjunct to sono-mammography in this field.

## SSA01-09 Clinical Performance of Dedicated Breast Computed Tomography in Comparison to Diagnostic Digital Mammography

Sunday, Nov. 29 12:05PM - 12:15PM Location: Arie Crown Theater

Participants
Elodia B. Cole, MS, Charleston, SC (*Presenter*) Consultant, FUJIFILM Holdings Corporation; Consultant, Koninklijke Philips NV; Consultant, Alan Penn & Associates, Inc
Amy S. Campbell, MD, Washington, DC (*Abstract Co-Author*) Nothing to Disclose
Srinivasan Vedantham, PhD, Worcester, MA (*Abstract Co-Author*) Research Grant, Koning Corporation
Etta D. Pisano, MD, Charleston, SC (*Abstract Co-Author*) Founder, NextRay, Inc CEO, NextRay, Inc Research Grant, Koning Corporation Research Grant, Koninklijke Philips NV Research Grant, Zumatek, Inc Research Grant, FUJIFILM Holdings Corporation Equipment support, Siemens AG Research Grant, Siemens AG Equipment support, Koninklijke Philips NV Research Grant, Koninklijke Philips NV
Andrew Karellas, PhD, Worcester, MA (*Abstract Co-Author*) Research collaboration, Koning Corporation

**PURPOSE**

To compare the clinical performance of a three-dimensional dedicated breast computed tomography system requiring no breast compression alone (dBCT), dBCT as adjunct to two-dimensional standard view screening mammography (SM), and two-dimensional diagnostic mammography (DxM).

**METHOD AND MATERIALS**

Eighteen radiologists interpreted 235 cases (52 negative, 104 benign, 79 cancer; 93/235 calcifications) that were randomly selected from 478 cases enrolled under 3 different clinical trial protocols, all in diagnostic population. Each case consisted of unilateral SM, DxM and dBCT images. Each case was randomized to 3 sessions and interpreted under 3 conditions: dBCT alone, dBCT plus SM, and DxM alone with at least a 4-week washout period. Each interpretation included an overall BIRADS score and continuous probability of malignancy (POM) score. For each case, any identified lesions assigned BIRADS category 3 or greater had its location, type, BIRADS and POM reported. Sensitivity, specificity and area under the ROC curve (AUC) were determined with either pathology or 1-year follow-up as truth.

**RESULTS**

All reported performance metrics were averaged across all readers. Results are reported from analysis using BIRADS score after

dichotomizing at BIRADS 4.The sensitivity for dBCT alone was 81.78%, 87.93% for dBCT plus SM, and 84.07% for DxM. dBCT plus SM had significantly higher sensitivity than DxM (p=0.0081), and dBCT alone (p<0.0001). DxM and dBCT alone did not differ in sensitivity (p=0.1753).The specificity for dBCT alone was 49.67%, 39.65% for dBCT plus SM, and 44.84% for DxM. Neither dBCT alone (p=0.1148) nor dBCT plus SM (p=0.0745) statistically differed from DxM. dBCT alone had a significantly higher specificity than dBCT plus SM (p<0.0001). The AUC based on BIRADS (POM) were 0.716 (0.770) for dBCT, 0.723 (0.791) for dBCT plus SM, and 0.724 (0.792) for DxM. There were no statistically significant differences between the modalities based on POM (p=0.3311) or BIRADS (p=0.8569) score analyses.

**CONCLUSION**

The most effective use of dBCT for diagnostic imaging is as adjunct to standard view mammography.

**CLINICAL RELEVANCE/APPLICATION**

Dedicated Breast Computed Tomography has potential for use as a diagnostic breast imaging tool.

SSA20

## Physics (Mammography/Ultrasound)

Sunday, Nov. 29 10:45AM - 12:15PM Location: S404AB

BR DM US PH

*AMA PRA Category 1 Credits* ™: 1.50
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

**Participants**
Andrew Karellas, PhD, Worcester, MA (*Moderator*) Research collaboration, Koning Corporation
Ernest J. Feleppa, PhD, New York, NY (*Moderator*) Research collaboration, General Electric Company; Research collaboration, SonaCare Medical, LLC

**Sub-Events**

### SSA20-01 Realistic Simulation of X-ray Phase-contrast Imaging at a Human Scale

Sunday, Nov. 29 10:45AM - 10:55AM Location: S404AB

Participants
Yongjin Sung, Boston, MA (*Presenter*) Nothing to Disclose
William P. Segars, PhD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Adam Pan, Cambridge, MA (*Abstract Co-Author*) Nothing to Disclose
Rajiv Gupta, PhD, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

X-ray phase-contrast imaging (XPCI) can dramatically improve soft tissue contrast in medical imaging. Despite worldwide efforts to develop novel XPCI systems, a numerical framework to rigorously predict the performance of a clinical XPCI system at a human scale is not yet available.

#### METHOD AND MATERIALS

We have developed a novel method of propagating the X-rays through a human-scale 3-D object [1]. Specifically, we have adopted the wave equation simplified with the first-order Rytov approximation, which allows us to quickly and accurately generate simulated amplitude and phase images that an XPCI detector would see. For our numerical phantom, we have adopted the XCAT model as defined with non-uniform rational B-splines (NURBS) [2]. Existing methods using the XCAT rely on ray tracing or Monte-Carlo simulation, which produce inaccurate XPCI simulations. Using our wave-based approach, we can accurately simulate the phase-contrast signal from the NURBS phantom.

#### RESULTS

Using the developed method, we have generated a projection image of a human chest for the grating-based method, the most popular XPCI method (Figure 1b). Compared to the attenuation image (Figure 1a), there is higher contrast between soft-tissue structures on the phase-contrast image. For example, all the structures obscured by the diaphragmatic silhouette are much better appreciated in the phase image. Similarly, the intra-vertebral disks are seen with greater clarity in phase-contrast than in attenuation. The phase-contrast image also demonstrates the bronchial tree (including the primary, secondary, and tertiary branches) better than the attenuation image.

#### CONCLUSION

Combining the NURBS-based XCAT phantom and our wave propagation simulator, we could simulate various XPCI methods at a full adult human scale, for the first time with the best of our knowledge.

#### CLINICAL RELEVANCE/APPLICATION

There is currently no XPCI system that can image a human torso. Our numerical tool can be used to predict and compare the performance of new XPCI systems on various disease entities in a clinical scenario.

### SSA20-03 Comparison of Detection Performance between 2D Digital Mammography and Breast Tomosynthesis Using a Structured Physical Phantom

Sunday, Nov. 29 11:05AM - 11:15AM Location: S404AB

Participants
Lesley Cockmartin, Leuven, Belgium (*Presenter*) Nothing to Disclose
Nicholas Marshall, Leuven, Belgium (*Abstract Co-Author*) Nothing to Disclose
Guozhi Zhang, Leuven, Belgium (*Abstract Co-Author*) Nothing to Disclose
Kim Lemmens, MSc, Leuven, Belgium (*Abstract Co-Author*) Nothing to Disclose
Eman Shaheen, Leuven, Belgium (*Abstract Co-Author*) Nothing to Disclose
Hilde Bosmans, PhD, Leuven, Belgium (*Abstract Co-Author*) Co-founder, Qaelum NV Research Grant, Siemens AG

#### PURPOSE

To propose and apply a phantom for performance comparison between digital mammography (DM) and breast tomosynthesis (BT).

#### METHOD AND MATERIALS

The phantom consists of a 48 mm thick breast-shaped acrylic container, filled with water and acrylic spheres of different diameters. Three-dimensionally printed spiculated (diameter range: 3.8-9.7 mm) and non-spiculated (1.6-6.2 mm) masses as well as

microcalcifications (90-250 µm) were inserted as targets. The phantom was imaged ten times in both DM and BT mode on four systems: Siemens Inspiration, Hologic Selenia Dimensions, GE SenoClaire 3D and Fuji Amulet Innovality under automatic exposure control. Five readers evaluated target detectability in a four-alternative forced-choice study. The percentage of correct responses (PC) was assessed based on 10 trials of each reader for each object type, size and imaging modality. Additionally, detection threshold diameters at 62.5% PC were assessed via fitting of the psychometric curve.

**RESULTS**

For microcalcifications, average PC was comparable for the four systems in DM and BT mode, ranging from 78% to 84% for DM and from 64% to 82% for BT. Threshold diameters for microcalcification detection for the four systems ranged between 111 and 118 µm in DM and between 113 and 158 µm in BT. For masses, PC values were higher in BT compared to DM. In DM, they ranged from 60% to 75% for spiculated and from 31% to 45% for non-spiculated masses. For BT, detection of spiculated masses was the highest (94% to 99%) and remained high for non-spiculated masses (65% to 85%). For spiculated masses threshold diameters were between 4.6 and 6.3 mm for DM and between 1.7 and 2.6 mm for BT. Threshold diameters for non-spiculated masses lay outside the range available in the phantom in DM mode while for BT threshold diameters were found between 1.8 and 3.1 mm.

**CONCLUSION**

The phantom was able to show detectability differences between DM and BT for four commercial systems. These results are comparable to published clinical findings: BT performed better for the detection of masses, while both modalities were equivalent for the detection of microcalcifications.

**CLINICAL RELEVANCE/APPLICATION**

The proposed phantom enables the detection performance evaluation of BT against DM during acceptance testing, routine quality control or image quality benchmarking of BT systems.

## SSA20-04 VHF-Induced Thermoacoustic Imaging Using a Clinical Ultrasound Transducer Array

Sunday, Nov. 29 11:15AM - 11:25AM Location: S404AB

Participants
Sarah K. Patch, PhD, Milwaukee, WI (*Presenter*) Nothing to Disclose
William See, MD, Milwaukee, WI (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To demonstrate that a clinical ultrasound transducer array can detect VHF-induced thermoacoustic pulses with sufficient bandwidth for quantitative whole organ imaging. This is an important step because thermoacoustic signal strength is directly proportional to SAR, which is lower in the VHF regime than in microwave or optical regimes.

**METHOD AND MATERIALS**

A 96-channel transducer array (P4-1) providing 3 cm coverage was incorporated into a benchtop thermoacoustic imaging system for imaging fresh surgical specimens. Thermoacoustic signal was generated by 700 ns irradiation pulses with 11 kV/m electric field strength. Data was acquired simultaneously in step-and-shoot mode by the array and a 2.25 MHz focused single-element transducer. In-plane resolution and contrast were measured by imaging an 80-micron wire and a homogeneous cylindrical phantom.Several fresh human prostates were imaged immediately after surgery. Two sets of sinograms were acquired, separated by a 2 cm translation along the tomographic axis. The P4-1 data was reconstructed over a 6 x 6 x 5 cm^3 volume. Rudimentary comparison to histology was performed.

**RESULTS**

As expected, the larger single element transducer was more sensitive and required 8-fold less signal averaging than the P4-1 array. Although nominal bandwidths of the P4-1 array and 2.25 MHz transducer are comparable, the single element transducer was more sensitive to low frequencies and provided better contrast, whereas the higher frequency P4-1 array provided better resolution. Full width at half maximum in the P4-1 and single element images of the 80-micron wire at isocenter were smaller and greater than 1 mm, respectively. CNR in the single element and P4-1 images of the cylindrical phantom were greater than 5 and less than 1/5, respectively. A weighted average of the two images provides better image quality than either individually.Volumetric reconstruction of the multi-channel P4-1 data visualizes anatomic features that are rarely seen in ultrasound, CT, or MRI.

**CONCLUSION**

VHF-induced thermoacoustic pulses can be detected by clinical ultrasound arrays. Quantitative imaging can be achieved using transducers and electronics with sensitivity to kHz frequencies.

**CLINICAL RELEVANCE/APPLICATION**

VHF-induced thermoacoustics requires propagating powerful EM pulses, similar to B1 excitation pulses used in MRI, but without the need for a costly superconducting magnet.

## SSA20-05 Intra-Operative Cerebral Angio-Sonography with Ultrasound Contrast Agents

Sunday, Nov. 29 11:25AM - 11:35AM Location: S404AB

Participants
Francesco Prada, MD, Milan, Italy (*Presenter*) Nothing to Disclose
Massimiliano Del Bene, Legnano, Italy (*Abstract Co-Author*) Nothing to Disclose
Luigi Solbiati, MD, Busto Arsizio, Italy (*Abstract Co-Author*) Nothing to Disclose
Giovanni Mauri, MD, San Donato Milanese, Italy (*Abstract Co-Author*) Consultant, Esaote SpA
Luca Maria Sconfienza, MD, PhD, San Donato Milanese, Italy (*Abstract Co-Author*) Nothing to Disclose
Francesco DiMeco, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose

**Background**

Intra-operative vessels visualization is highly desirable in neurosurgery, especially when the target is related or close to main

vessels, such as in skull base and vascular surgery. Contrast enhanced ultrasound (CEUS) is an imaging technique that allows visualization of tissue perfusion and vascularization, through the infusion of purely intravascular ultrasound contrast agents (UCA).

**Evaluation**

After cerebral scanning with B-mode ultrasound (US) CEUS is performed: UCA are injected and insonated with low mechanical index US. UCA specific harmonic signal is transduced using contrast specific algorithm, to obtain real-time angio-sonography (ASG).

**Discussion**

UCA depicts flow entity and direction in the target vessels, through the visual qualitative detection of movement, velocity and number of MB. Through the UCA dynamics it is possible to study all the vascular districts simultaneously, both arterial and venous, without the necessity to set gain or pulse repetition frequency as in Doppler imaging that however permits to quantify the flow; 3 phases of enhancement are notable: arterial, parenchymal and venous. ASG, being an echotomographic examination, provides a representation of the vessels within the surgical fields, not only on the surface, as showed by microscopic fluorescence, but also of those deeply seated and still embedded within the surgical field, allowing to visualize them in depth and follow their entire course simply tilting the probe.

**Conclusion**

Real time intra-operative ASG is a rapid, reliable, repeatable method for vessels visualization and evaluation of tissue perfusion.

## SSA20-06 A New AEC Set-up Achieves Constant Lesion Detectability for Different Breast Thicknesses in Digital Mammography

Sunday, Nov. 29 11:35AM - 11:45AM Location: S404AB

Participants
Elena Salvagnini, Leuven, Belgium (*Abstract Co-Author*) Nothing to Disclose
Chantal Van Ongeval, MD, Leuven, Belgium (*Abstract Co-Author*) Nothing to Disclose
Nicholas Marshall, Leuven, Belgium (*Abstract Co-Author*) Nothing to Disclose
Lesley Cockmartin, Leuven, Belgium (*Abstract Co-Author*) Nothing to Disclose
Koen Michielsen, MSc, Leuven, Belgium (*Abstract Co-Author*) Research Grant, Siemens AG
Andre Van Steen, MD, Leuven, Belgium (*Abstract Co-Author*) Nothing to Disclose
Lara Struelens, Mol, Belgium (*Abstract Co-Author*) Nothing to Disclose
Hilde Bosmans, PhD, Leuven, Belgium (*Presenter*) Co-founder, Qaelum NV Research Grant, Siemens AG

**PURPOSE**

To investigate detectability of simulated lesions in real mammograms for different breast thicknesses and 2 set-ups for automatic exposure control (AEC).

**METHOD AND MATERIALS**

520 screening mammograms, acquired under standard AEC mode, were selected and divided into 4 thickness groups(T-groups), T1≤29mm, T2=30-49mm, T3=50-69mm, T4≥70mm. Each group contained 130 cranio-caudal lesion-free images. BIRADS density scores and Volpara density maps were available for each image. Simulated lesions of microcalcification clusters and masses were inserted into half of the images. A specific lesion template was inserted into one image of each T-group having the same BIRADS score and local Volpara value in order to separate the influence of thickness from the background. A new AEC set-up, designed to give constant theoretical object detectability as a function of thickness rather than constant detector pixel value. Modified AEC was then implemented for breast thicknesses above 30 mm resulting in an average dose increase of 60%. New patient data were collected and lesion insertion was repeated for the new dataset. Four radiologists performed a free search study on both datasets. JAFROC analysis was then applied. The alternative free-response receiver operating characteristic (AFROC) areas were calculated for each T-group.

**RESULTS**

For standard AEC mode: AFROC area decreases from 0.802 to 0.553 with increasing thickness for groups T1 to T3 while the area for T4 (0.565) was found almost equal to T3 (0.553). All p-values were smaller than 0.05 except for the T3-T4 pair. Detection differences between T3 and T4 were not significantly different, while the decreasing trend from T1 to T3 is significant. For the modified AEC mode: the AFROC area for T1 was equal to 0.802, while for T2, T3 and T4 it was equal to respectively 0.650, 0.652 and 0.652. No significant differences were found for these T-groups (p-values>0.05) while T1 remained significantly different from all others T-groups.

**CONCLUSION**

A significant decrease in lesion detection for increasing breast thickness is seen when the standard AEC mode is used. The modified AEC mode instead provided constant lesion detection for breast thicknesses above 30mm.

**CLINICAL RELEVANCE/APPLICATION**

This study quantifies the influence of breast thickness on lesion detectability and proposes a new AEC set-up with improved detectability for digital mammographic systems.

## SSA20-07 X-ray Attenuation of Normal and Cancerous Breast Tissue Measured with Photon-counting Spectral Imaging

Sunday, Nov. 29 11:45AM - 11:55AM Location: S404AB

Participants
Erik Fredenberg, MSc, PhD, Stockholm, Sweden (*Presenter*) Employee, Koninklijke Philips NV
David R. Dance, PhD, Guildford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Kenneth C. Young, PhD, Guildford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Paula Willsher, Cambridge, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Fleur Kilburn-Toppin, MBBCHIR, MA, Cambridge, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Matthew G. Wallis, MD, Cambridge, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

Elin Moa, MS, Solna, Sweden (*Abstract Co-Author*) Employee, Koninklijke Philips NV

**PURPOSE**

Spectral imaging is emerging as a promising method to extract quantitative information from x-ray images, applied in mammography to improve lesion visibility, discriminate between lesion types, and measure breast density. Common for the development of these applications is that prior knowledge of tissue x-ray attenuation is required, but the sources of such information are sparse. Moreover, attenuation is often measured on formalin-fixed tissue specimens, but the effect of such fixation on the obtained attenuation values is largely unknown. The purpose of this study is to measure the attenuation of fresh and fixed samples of normal and cancerous breast tissue.

**METHOD AND MATERIALS**

7 samples of adipose breast tissue, 3 samples of glandular tissue and 8 samples of tumor tissue in the thickness range 3-12mm were imaged on a photon-counting spectral mammography system before and after formalin fixation. The energy dependent x-ray attenuation was measured in terms of equivalent thicknesses of aluminum (Al) and poly-methyl methacrylate (PMMA) for 10mm of tissue.

**RESULTS**

Figure 1 shows the equivalent Al and PMMA thicknesses (mean +-1 standard deviation of individual samples): -0.110+-0.022mm Al, 8.60+-0.13mm PMMA for fresh adipose tissue, 0.268+-0.040mm Al, 8.44+-0.26mm PMMA for glandular tissue, 0.312+-0.024mm Al, 8.55+-0.17mm PMMA for tumor tissue. The difference between fixed and fresh tissue were -0.007mm Al, 0.01mm PMMA for adipose tissue, -0.041mm Al, 0.22mm PMMA for glandular tissue, and -0.039mm Al, 0.07mm PMMA for tumor tissue.

**CONCLUSION**

There was a measurable difference in attenuation between fresh and fixed tissue that was consistent for all investigated tissue types. There was a relatively large difference between glandular and tumor tissue, but the number of samples is still too limited to show significance. The equivalent PMMA thicknesses were slightly higher than values derived from published data (Hammerstein 1979, Johns and Yaffe 1987), but the Al thicknesses agreed well values derived from Johns and Yaffe.

**CLINICAL RELEVANCE/APPLICATION**

Accurate data on tissue attenuation is crucial for the development and implementation of spectral imaging techniques, which can potentially improve sensitivity and specificity of mammography.

## SSA20-08 Dedicated High-Resolution Breast CT Allows Imaging Micro-Calcifications down to 130 µm at Screening Mammography Dose Levels

Sunday, Nov. 29 11:55AM - 12:05PM Location: S404AB

Participants
Willi A. Kalender, PhD, Erlangen, Germany (*Presenter*) Consultant, Siemens AG Consultant, Bayer AG Founder, CT Imaging GmbH Scientific Advisor, CT Imaging GmbH CEO, CT Imaging GmbH
Daniel Kolditz, PhD, Erlangen, Germany (*Abstract Co-Author*) Employee, CT Imaging GmbH
Ann-Christin Roessler, MSc, Erlangen, Germany (*Abstract Co-Author*) Nothing to Disclose
Evelyn Wenkel, MD, Erlangen, Germany (*Abstract Co-Author*) Nothing to Disclose
Ruediger Schultz-Wendtland, Erlangen, Germany (*Abstract Co-Author*) Nothing to Disclose
Peter Fasching, Erlangen, Germany (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Computed tomography of the breast (BCT) has been a topic of interest for about two decades. It was proposed and evaluated in different designs by a number of groups as a potential alternative method for breast imaging. So far efforts have shown success with respect to soft tissue imaging but suffer from limited spatial resolution. We designed and evaluated a BCT scanner aiming for three-dimensional (3D) spatial resolution of better that 100 µm to provide means for improved assessment of 3D micro-calcification clusters.

**METHOD AND MATERIALS**

The concept of the scanner is built on fast spiral CT using directly converting cadmium telluride detector technology with 100 µm pixel pitch; it was evaluated and confirmed previously by simulations. Here we assessed spatial resolution on a prototype setup by measuring the modulation transfer function (MTF) using a 10 µm diameter tungsten wire. High precision Ruby beads immersed in a plastic breast-mimicking setup and 10 surgically resected breast specimens were measured in direct comparison to full field digital mammography (FFDM). The same 60 kV scan protocol was used for all BCT measurements; standard clinical settings were used for FFDM imaging. Micro-CT at 30 µm resolution was employed as reference standard for judging the specimen results.

**RESULTS**

BCT exposures were kept at a level corresponding to below 6 mGy average glandular dose related to exposure of a tissue-equivalent cylinder of 14 cm diameter. Spatial resolution characterized by the MTF's 10% value was measured as 64 lp/cm. Ruby beads were clearly visible in BCT exams down to 130 µm, the smallest size available; FFDM revealed beads down to 160 µm. Specimen examinations confirmed these results qualitatively. For specimens, BCT showed micro-calcifications down to 100 µm; it was vastly superior in separating structures in different layers by virtue of its slice imaging nature.

**CONCLUSION**

High-resolution BCT allows improving the assessment of 3D micro-calcification clusters and avoids erroneous superimposition effects, which may pretend fictitious lesions in projection imaging.

**CLINICAL RELEVANCE/APPLICATION**

Breast CT offering high resolution in all three dimensions shall enable improved analysis and diagnostics of micro-calcifications.

## SSA20-09 Performance Evaluation of Microcalcification Detection in a Multi-contrast Breast X-ray Imaging System

Sunday, Nov. 29 12:05PM - 12:15PM Location: S404AB

Participants
John W. Garrett, MS, Madison, WI (*Presenter*) Nothing to Disclose
Yongshuai Ge, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Ke Li, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Ran Zhang, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Guang-Hong Chen, PhD, Madison, WI (*Abstract Co-Author*) Research funded, General Electric Company; Research funded, Siemens AG

## PURPOSE

The breast anatomical background noise power spectrum (NPS) and quantum NPS jointly impact the final detection performance of an x-ray breast imaging system. For a grating-based multi-contrast breast imaging system, it has recently been discovered that differential phase contrast (DPC) and dark-field (DF) contrast images have fundamentally different anatomical background NPS and quantum NPS. These dramatic differences should result in fundamentally different imaging performance, particularly in the context of microcalcification detection. The purpose of this study was to evaluate the diagnostic performance of the three-contrast mechanisms for the breast microcalcification detection task.

## METHOD AND MATERIALS

To evaluate imaging performance, a quantitative model observer performance analysis framework was used in this study. To model the microcalcification detection task for each contrast mechanism, a microcalcification signal was segmented from absorption, DPC, and DF images of a cadaver breast specimen. Two-component (quantum + anatomical) NPS were directly measured from multi-contrast images of cadaver breasts. A generalized model observer was used to combine the task functions and NPS to quantify the microcalcification detectability indices for a range of radiation exposure levels (5-100%) and calcification sizes (diameter = 0.25-2.5 mm).

## RESULTS

For the 1 mm calcification, the highest diagnostic performance corresponded to DPC imaging (7.4), with DF the next highest (3.8), and absorption the lowest (3.2). However, absorption imaging also showed the most relaxed dependence on radiation exposure level among the three modalities due to the larger portion of low frequency content in its anatomical noise. Among the calcifications with different sizes, DPC showed a peak in detectability at 1.25 mm and DF showed a peak at 0.75 mm, while absorption imaging had no such peak in the range explored.

## CONCLUSION

The microcalcification detection performance in multi-contrast breast imaging is strongly influenced by both anatomical noise and radiation dose level. The results presented here offer new insight into how each individual modality can be optimized to maximize the likelihood of detecting early breast cancers.

## CLINICAL RELEVANCE/APPLICATION

Understanding how additional information from DPC and DF imaging may aid in breast cancer is a crucial step in designing next generation multi-contrast breast imaging systems.

BRS-SUA

## Breast Sunday Poster Discussions

Sunday, Nov. 29 12:30PM - 1:00PM Location: BR Community, Learning Center

BR

*AMA PRA Category 1 Credit ™*: .50

**Participants**
Elizabeth McDonald, MD, PhD, Philadelphia, PA (*Moderator*) Nothing to Disclose

**Sub-Events**

### BR219-SD-SUA1 Correlation between Intra-voxel Incoherent Motion MRI and Dynamic Contrast Enhanced MRI in Breast Cancer at 3T

Station #1

Participants
Jing Yuan, PhD, Hong Kong, Hong Kong (*Abstract Co-Author*) Nothing to Disclose
Gladys G. Lo, MD, Happy Valley, Hong Kong (*Abstract Co-Author*) Nothing to Disclose
Oi Lei Wong, MSc, Happy Valley, Hong Kong (*Presenter*) Nothing to Disclose
Abby Y. Ding, PhD, Happy Valley, Hong Kong (*Abstract Co-Author*) Nothing to Disclose
Helen H. Chan, MBChB, Hong Kong, China (*Abstract Co-Author*) Nothing to Disclose
Ting Ting Wong, Happy Valley, Hong Kong (*Abstract Co-Author*) Nothing to Disclose
Polly Cheung, Hong Kong, Hong Kong (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Intravoxel incoherent motion (IVIM) has been proposed to reveal both perfusion and diffusion of breast tumor non-invasively, while its correlation with DCE-MRI has not been well understood. This study prompts to comprehensively study the correlation between quantitative IVIM parameters and semi-quantitative DCE-MRI parameters in malignant breast tumors at 3T.

#### METHOD AND MATERIALS

DCE and IVIM-MRI (pre-contrast) were conducted at 3T on 27 histology-confirmed breast tumors (23 IDC, 1 ILC, 3 DCIS) of 27 female patients (IVIM: voxel=1.82x1.82x3mm$^2$, TE/TR= 102/5800ms, b=0, 50, 100, 150, 200, 400, 600, 1000s/mm$^2$. DCE: voxel=0.74x0.74x2mm$^3$, flip angle=20°, TE/TR=3.2/7.3ms, acquired at 0, 60s, 150s, 210s, 270s and 330s). Voxel-wise IVIM parameters (segmented bi-exponential fitting) and ADC were calculated, then ROI-averaged values were correlated to DCE parameters of wash-in slope (at 90s), wash-in rate, wash-out (90s v.s. 330s) slope, wash-out rate, max enhancement, max enhancement rate, total time-intensity-curve (TIC) area, enhanced TIC area, and relative enhanced TIC area. Spearman correlation coefficients (r) and two-tailed p-values were reported.

#### RESULTS

2 tumors failed in IVIM-fitting were excluded. True diffusion coefficient D, pseudo-diffusion coefficient D* and ADC were negatively correlated with wash-in slope, max enhancement and rate, and all TIC areas, but were not significant. Pseudo-diffusion fraction f was positively correlated to many DCE parameters but weakly-correlated (-0.1

#### CONCLUSION

Significant negative correlation between D and maximum enhancement indicates that lower tumor diffusivity may be highly associated with peak contrast uptake amount. The correlation between D* and maximum enhancement rate may reveal the relationship between microvascular blood flow velocity and tumor perfusivity.

#### CLINICAL RELEVANCE/APPLICATION

Intravoxel incoherent motion (IVIM) MRI has potential to complement DCE-MRI to assess perfusion and diffusion of breast cancer non-invasively.

### BR220-SD-SUA2 Analysis of Factors Influencing the Detectability on Diffusion-weighted MRI and Diffusion Background Signals in Invasive Breast Cancer Patients

Station #2

Participants
Eun Sook Ko, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Boo-Kyung Han, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Young Ko, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To determine the factors influencing the detectability of diffusion-weighted (DW) magnetic resonance imaging (MRI) and diffusion background signals in invasive breast cancer.

#### METHOD AND MATERIALS

Institutional Review Board approval was obtained and patient consent was waived. 167 patients with newly diagnosed invasive ductal carcinoma, not otherwise specified (IDC NOS), who underwent preoperative breast MRI with diffusion-weighted imaging (DWI) were included in this study. Detectability on DWI and contrast-enhanced subtracted T1-weighted images, background parenchymal enhancement (BPE) and diffusion background signal were qualitatively rated. Detectability on DWI was compared with clinicopathologic findings including menopausal status, mammographic density, and molecular subtype. Multivariate ordinal logistic regression analysis was performed to determine variables independently associated with detectability on DWI and diffusion

background signals.

**RESULTS**

In multivariate analysis, the diffusion background signal (adjusted odds ratio = 0.23, P < 0.001), histologic grade (adjusted odds ratio = 1.91, P = 0.004), tumor size (adjusted odds ratio = 1.06, P = 0.004) and lymphovascular invasion (adjusted odds ratio = 2.30, P = 0.019) were independently correlated with the detectability on DWI in invasive breast cancer. Only BPE was independently correlated with the amount of diffusion background signals on DWI.

**CONCLUSION**

In invasive breast cancers, detectability on DWI was significantly affected by diffusion background signal.

**CLINICAL RELEVANCE/APPLICATION**

For robust use of breast DWI as a screening method without contrast material, detection of the lesion on DWI is essential. Little is known about the factors influencing the detectability on diffusion-weighted MRI and diffusion background signals in invasive breast cancer patients.

## BR221-SD-SUA3 2D Mammography, Digital Breast Tomosynthesis, and Whole Breast Sonography: Which Should be Used for the Different Breast Densities in Screening for Breast Cancer?

Station #3

Participants
Anna Starikov, BA, New York, NY (*Presenter*) Nothing to Disclose
Michele B. Drotman, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Keith D. Hentel, MD, MS, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Janine T. Katzen, MD, New York, NY (*Abstract Co-Author*) Research funded, Seno Medical Instruments, Inc.
Elizabeth K. Arleo, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To determine which breast imaging modality (2D mammography [2D], digital breast tomosynthesis [DBT], whole breast sonography [WBS]) or combination of modalities should be used for patients with different breast densities presenting for screening mammography.

**METHOD AND MATERIALS**

All women having presenting to our institution for screening mammography in 2013 were included and sorted by breast density into subgroups. Subgroups were then further subdivided by screening modalities received (2D, 2D + DBT, 2D + WBS, or 2D + DBT + WBS); recall and cancer detection rates were then calculated.

**RESULTS**

Of 16,789 screening mammograms performed, 2888 were recalled (overall recall rate =17.2%) and 67 cancers were screen-detected (cancer detection rate = 67/16,789=4 per 1000 screening mammograms). Overall, 2D + DBT had the lowest recall rate (10.2%, p<0.001), while 2D + DBT + WBS had the highest recall rate (23.6%, p<0.001); this trend was preserved in subjects with non-dense (p=0.03) and dense breasts (just shy of statistical significance, p=0.055). However, the addition of WBS to 2D mammography significantly increased the detection of all cancers (p = 0.02), including invasive cancers (from 2.3 to 5.1, p=0.06).

**CONCLUSION**

If a woman has dense breasts, then 2D+3D+WBS would optimize cancer detection, but at the expense of a significantly increased risk of being recalled for additional imaging. If a woman does not have dense breasts, then the addition of either DBT or WBS to 2D would almost equally improve cancer detection; however, given that the addition of WBS incurs a significantly increased risk of being recalled, 2D+DBT seems logically optimal.

**CLINICAL RELEVANCE/APPLICATION**

A recent ACR Statement on Breast Tomosynthesis states that it will be "important to learn which subgroups of women might benefit from these exams (…by breast density)," and our study addresses this, adding to the growing body of tomosynthesis literature by stratifying subjects by breast density and considering the effect of adding whole breast sonography.

## BR101-ED-SUA5 A Collective Review of the Imaging Characteristics of Various Common and Uncommon Skin Processes of the Breast.

Station #5

Participants
Rachelle C. Cruz-Centeno, DO, Hershey, PA (*Presenter*) Nothing to Disclose
Susann E. Schetter, DO, Hershey, PA (*Abstract Co-Author*) Consultant, Siemens AG
Claudia J. Kasales, MD, Lewisburg, PA (*Abstract Co-Author*) Nothing to Disclose
Alison L. Chetlen, DO, Hershey, PA (*Abstract Co-Author*) Research Consultant, Siemens AG

**TEACHING POINTS**

1. A review of the anatomy of the skin of the breast and its importance in evaluation during breast imaging exams2. Descriptions of the mammographic, sonographic, and MRI imaging characteristics of various common and uncommon skin processes and potential artifacts3. An understanding of the pathophysiology of each described skin process in correlation with its imaging appearance

**TABLE OF CONTENTS/OUTLINE**

A. Review of normal skin anatomy of the breastB. Review of imaging findings, example cases: 1. Normal Skin Findings: Skin calcifications, Kopans caves 2. Benign skin lesions: Epidermal Inclusion cyst, Post Surgical Changes. 3. Inflammatory/Infectious Processes: Cellulitis, Subareolar Mastitis, Post Radiation Changes, Ruptured Sebaceous Cyst. 4. Systemic Processes: Lymphedema, Scleroderma. 5. Malignant Processes: Inflammatory Carcinoma, Paget's disease of the Nipple, Superficial Invasive Ductal Carcinoma,

Superficial DCISC. Review of pathophysiology associated with each case presentationD. Conclusion/Summary 1. Recognition of the imaging appearance of various skin lesions 2. Understand potential pitfalls associated with superimposed artifacts related to skin lesions 3. Correlate the imaging appearance of each skin lesion with the corresponding pathophysiology

**BR183-ED-SUA6** **O Recurrent Breast Cancer, Where Art Thou? A Guide for Detecting Locally Recurrent Breast Cancer after Lumpectomy and Radiation.**

Station #6

**Awards**
**Certificate of Merit**

Participants
Stephanie A. Lee-Felker, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose
Kara-Lee Pool, MD , Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Mariam Thomas, MD, Sylmar, CA (*Abstract Co-Author*) Nothing to Disclose
Guita Rahbar, MD, Beverly Hills, CA (*Abstract Co-Author*) Nothing to Disclose
Denise M. Andrews-Tang, MD, Sylmar, CA (*Abstract Co-Author*) Nothing to Disclose
Esha A. Gupta, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Antoinette R. Roth, MD, Sylmar, CA (*Abstract Co-Author*) Nothing to Disclose

**TEACHING POINTS**

The purpose of this exhibit is: 1. To review the expected imaging findings following breast-conserving surgery and radiation therapy in women with early stage breast cancer 2. To illustrate examples of locally recurrent breast cancer 3. To show examples of recurrent breast cancer mimics and diagnostic pitfalls

**TABLE OF CONTENTS/OUTLINE**

1. Selection criteria for breast-conserving surgery and radiation therapy 2. Early (before six months) benign post-treatment findings on mammography and sonography: hematoma, seroma, fat necrosis 2. Late (at or after six months) benign post-treatment findings: skin thickening, skin retraction, increased parenchymal trabeculation, architectural distortion, evolved fat necrosis 3. Late malignant post-treatment findings in cases of biopsy-proven locally recurrent breast cancer: new or increasing mass or architectural distortion, new suspicious calcifications 4. Management of locally recurrent breast cancer 5. Mimics and potential pitfalls of locally recurrent breast cancer: Bovie cautery artifact, FloSeal hemostatic sealant artifact, fat necrosis

BRS-SUB

## Breast Sunday Poster Discussions

Sunday, Nov. 29 1:00PM - 1:30PM Location: BR Community, Learning Center

BR

*AMA PRA Category 1 Credit ™*: .50

**Participants**
Elizabeth McDonald, MD, PhD, Philadelphia, PA (*Moderator*) Nothing to Disclose

**Sub-Events**

### BR223-SD-SUB1 Upgrade Rate of Radial Scar on Core Needle Biopsies Performed for Calcifications

Station #1

Participants
Miriam Hulkower, MD, Bronx, NY (*Presenter*) Nothing to Disclose
Evan Himchak, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose
Beatriu Reig, MD, MPH, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose
Susan Fineberg, MD, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose
Tova C. Koenigsberg, MD, Bronx, NY (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Radial scars and radial/complex sclerosing lesions (RSL) of the breast are benign lesions of the breast that may present with mammographic findings or may be incidentally identified on core needle biopsy. Due to the concern for undersampling of an associated malignancy, patients with RSL on core biopsy usually undergo excisional biopsy. However, there is a wide range of upgrade rates (0 to 40%) reported in the literature. We seek to determine the upgrade rate after core biopsy performed for calcifications alone, in order to identify a possible group of patients with RSL who may not require excisional surgery.

#### METHOD AND MATERIALS

We searched the institutional clinical pathologic database for breast core biopsy results using the words "radial scar," "radial sclerosing lesion," or "complex sclerosing lesion" from 2003 through 2014. Radial scar was required to be the highest grade lesion diagnosed on the image-guided core needle biopsy specimen; the case was excluded if there was evidence of malignancy or atypia. Reports of the diagnostic mammograms indicating the need for biopsy were reviewed and only cases of calcifications were included. If a mass, nodule, asymmetry or architectural distortion were the cause for biopsy, the case was excluded. Method and length of follow-up were recorded for each patient.

#### RESULTS

40 lesions in 40 patients met criteria for inclusion. 26 patients underwent surgical excision and 14 patients had imaging or clinical follow up. All patients underwent stereotactic core needle biopsy for suspicious calcifications identified on mammography. There were no cases of upgrade to high grade lesions, no findings of carcinoma in situ or invasive ductal carcinoma on excision, and no cases of progression on follow up mammograms.

#### CONCLUSION

The cancer upgrade rate was 0% in this study of biopsies performed for calcifications. As calcifications are not typical imaging features of RSL, any RSL identified histologically were likely incidental and not related to the target imaging finding. Our results suggest that these incidental RSL may not require excision.

#### CLINICAL RELEVANCE/APPLICATION

Core needle biopsies performed for calcifications alone yielding radial scar as the highest grade lesion can be considered benign, without the need for surgical excision.

### BR224-SD-SUB2 Differentiation of Benign and Metastatic Axillary Lymph Nodes: Added Value of MR Computer-Aided Evaluation in Patients with Breast Cancer

Station #2

Participants
Seong Jong Yun, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Yu Mee Sohn, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Woo Jin Yang, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hee Young Choi, MD, Seoul, Korea, Democratic People's Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jehong Yoon, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To determine qualitative and quantitative threshold of the MR (magnetic resonance)-CAE (computer-aided evaluation) parameters to differentiate between benign and metastatic ALNs (axillary lymph nodes) and to investigate the added value of the MR-CAE.

#### METHOD AND MATERIALS

From July 2011 to June 2014, 124 patients (age range, 35-80 years; mean age, 59.8 ± 11.1 years) who underwent conventional MR and MR-CAE for preoperative assessment of tumor extent and ALNs were included. The MR-CAE were evaluated with regard to qualitative (visualization on color map, kinetic curve type) and quantitative parameters (initial enhancement ratio, delayed phase enhancement ratio, and peak enhancement). Two radiologists (board-certified radiologist dedicated to breast imaging with 7-years of experience and 4th grade senior resident) independently interpreted MR images for the presence of metastatic ALNs by using

conventional MR images alone and in combination with MR-CAE data. Diagnostic performance and threshold using receiver operating characteristic (ROC) curve were analyzed.

**RESULTS**

Among 124 patients, 34 (26.4%) had positive results of ALNM (axillary lymph node metastasis) and 90 (73.6%) showed negative results on final pathologic report. The frequencies of visualization on color map (p=0.007) and kinetic curve type (p<0.001) were significantly different between ALNM group and no ALNM group. Mean values (%) of persistent, plateau, and washout ratios differed significantly (all p<0.001) between positive ALNM and negative ALNM groups. Of these significant parameters, the washout ratio >49% showed the greatest diagnostic accuracy (area under the curve, 0.909). With conventional MR imaging alone, sensitivity, specificity, and accuracy were 70.6%, 70.0%, and 70.2%, respectively. With conventional MR imaging and washout ratio on MR-CAE combined, sensitivity, specificity, and accuracy were 84.9%, 92.8%, and 90.2%, respectively.

**CONCLUSION**

The addition of MR-CAE data to conventional MR imaging can be helpful to improve diagnostic accuracy in the differentiation of benign ALNs from metastatic ALNs by measuring washout ratio.

**CLINICAL RELEVANCE/APPLICATION**

The MR-CAE can predict ALN status in patients with breast cancer, for avoiding unnecessary treatment steps.

## BR225-SD-SUB3 Sonographic Features of Benign and Malignant Axillary Nodes Post Neoadjuvant Chemotherapy

Station #3

Participants
Kyungmin Shin, MD, Houston, TX (*Presenter*) Nothing to Disclose
Olena O. Weaver, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Abigail S. Caudle, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Henry M. Kuerer, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Wei Wei, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Wei T. Yang, MD, Houston, TX (*Abstract Co-Author*) Researcher, Hologic, Inc

**PURPOSE**

To determine the sonographic features of benign and malignant axillary nodes post neoadjuvant chemotherapy in patients with biopsy proven cN1 breast cancer.

**METHOD AND MATERIALS**

Patients with biopsy proven cN1 primary breast malignancy receiving neoadjuvant chemotherapy at a single institution between January 2011 and December 2014 were included in this study. Sonographic features of the biopsy proven clipped axillary lymph nodes were retrospectively reviewed and documented pre and post neoadjuvant treatment. Changes in the sonographic features of the clipped axillary lymph nodes were correlated with the final histopathology. Statistical analyses of the shape, cortical thickness, presence or absence of the fatty hilum, and cortical echogenicity of the lymph nodes prior to and after neoadjuvant treatment (consistent with methods) were performed using the univariate logistic regression model.

**RESULTS**

A total of 165 patients with a median age of 49 years (range, 23-84 years) were included in the study. Of these, 75 patients (45%) showed complete pathologic response and 90 (55%) persistent metastatic disease on histopathology at the time of final surgery. The analysis demonstrated that irregular shape of the lymph node post neoadjuvant therapy was associated with lower probability of having complete response compared to the lymph nodes with oval shape (odds ratio=0.17, p=0.004). Also, resolution/normalization of cortical thickening was associated with higher likelihood of having complete response compared to the lymph nodes with persistent cortical thickening (OR=4.95, p=0.0001). In addition, increase in lymph node volume or cortical thickness was associated with less change of having complete pathologic response (OR=0.99, p=0.007). Other sonographic findings such as the presence of absence of the fatty hilum did not show statistically significant correlation with having complete pathologic response.

**CONCLUSION**

Sonographic factors that may help predict axillary nodal response to therapy include shape, normalization of cortical thickness and lymph node volume, while hilar status was not helpful in the evaluation of response.

**CLINICAL RELEVANCE/APPLICATION**

The ability to distinguish benign from malignant nodes post neoadjuvant treatment with sonography may help to develop more individualized and less invasive surgical approaches to the axillae.

## BR226-SD-SUB4 Accuracy of Index Tumor Measurement on CESM When Compared to Pathologic Tumor Size and Its Implications on Breast Cancer Staging

Station #4

Participants
Chandni Bhimani, DO, Camden, NJ (*Presenter*) Nothing to Disclose
Pauline Germaine, DO, Camden, NJ (*Abstract Co-Author*) Nothing to Disclose
Allison S. Gittens, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Robyn G. Roth, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Lydia Liao, MD, PhD, Voorhees, NJ (*Abstract Co-Author*) Consultant, General Electric Company; Consultant, Devicor Medical Products, Inc
Luna Li, MD, PhD, Voorhees, NJ (*Abstract Co-Author*) Nothing to Disclose
Elizabeth Tinney, RRA, Cape May Court House, NJ (*Abstract Co-Author*) Nothing to Disclose
Kristin Brill, MD, Camden, NJ (*Abstract Co-Author*) Nothing to Disclose
Todd L. Siegal, MD, Camden, NJ (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Correlate accuracy of index breast cancer measurements on contrast-enhanced spectral mammography (CESM) based on abnormal area of enhancement to final assessment of size at the time of pathologic evaluation following tumor excision (i.e. lumpectomy or mastectomy).

**METHOD AND MATERIALS**

A retrospective database search of 1568 CESM cases performed at our institution between December of 2013 and April of 2015 revealed 220 cases of biopsy proven malignancy. Electronic medical records of these patients were accessed to obtain the final pathology including tumor size at the time of excision. Reported measurements in radiology and pathology databases were recorded and compared.

**RESULTS**

Out of 220 CESM diagnosed malignancies, 202 patients underwent surgery at our institution. Fifty patients underwent preoperative chemotherapy, resulting in exclusion from final analysis. Additional 53 patients with biopsy-proven DCIS were also excluded from the final analysis, as diagnosis of malignancy was based on microcalcification assessment on digital mammography, rather than abnormal enhancement on CESM. Final cohort of 99 patients consisted of single site and multifocal involvement with ductal and lobular carcinoma of various sizes and tumor grades.A strong correlation exists between the size of enhancement on CESM and final tumor measurement at the time of pathology evaluation, particularly for a single mass. This correlation improves with increase in tumor size and grade. Correlation decreased in cases of multifocal involvement and infiltrative morphology, particularly infiltrative lobular carcinoma.

**CONCLUSION**

CESM combines benefits of digital mammography with assessment of lesion vascularity following intravenous contrast administration. Based on prior research, CESM has an excellent correlation with MRI, the current gold standard, in tumor visualization and characterization, providing important information of tumor assessment, staging and preoperative planning. This study further supports the important role CESM plays in breast cancer evaluation and serves as a reliable indicator of tumor size.

**CLINICAL RELEVANCE/APPLICATION**

Index tumor measurement on CESM is a reliable indicator of final tumor assessment at the time of pathology evaluation, providing extremely valuable information in tumor staging and preoperative planning.

## BR111-ED-SUB5 Strengths and Shortcomings of Digital Breast Tomosynthesis: Review of Cancers Detected as well as those "Missed" in a Population-based Screening Program

Station #5

**Awards**
**Magna Cum Laude**
**Identified for RadioGraphics**

Participants
Katrina Korhonen, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Susan Weinstein, MD, Philadelphia, PA (*Abstract Co-Author*) Consultant, Siemens AG
Elizabeth McDonald, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Samantha P. Zuckerman, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Emily F. Conant, MD, Philadelphia, PA (*Abstract Co-Author*) Speaker, Hologic, Inc; Scientific Advisory Board, Hologic, Inc; Consultant, Siemens AG

**TEACHING POINTS**

This exhibit will: Review cases of screen detected cancers seen only or better with digital breast tomosynthesis (DBT) compared to digital mammography alone (DM) in a population based screening program. Define false negative and interval cancers and demonstrate examples from 3 years of screening an entire population with combination DBT (over 33,000 patients). Explore reasons why cancers were missed or not detected at DBT screening and suggest opportunities for improvement.

**TABLE OF CONTENTS/OUTLINE**

1. Review of DBT versus DM cancer conspicuity from 3 years and over 33,000 cases of DBT screening Case-based review of subtle or DBT-only detected cancers2. Review rates and trends of false negative and interval cancers using follow-up data from network and state-wide cancer registries Case-based review of false negative and interval cancer cases with review of possible reasons for lack of detection, including asymptomatic patients whose cancers were detected by other modalities such as US or MRI3. Review of possible causes for false negatives or diagnostic error in DBT screening Failure to detect Satisfaction of search Breast complexity or obscuration Excluded from view Not visible on modality (detected by MR or US) Failure to characterize Call-back mis-categorized as benign Stable lesion

## BR184-ED-SUB6 Don't Quit Too Soon! Troubleshooting to Overcome Technical Challenges in Image-guided Breast Biopsy

Station #6

**Awards**
**Identified for RadioGraphics**

Participants
Allyson L. Chesebro, MD, Boston, MA (*Presenter*) Nothing to Disclose
Sona A. Chikarmane, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Julie A. Ritner, MD, West Roxbury, MA (*Abstract Co-Author*) Nothing to Disclose
Robyn L. Birdwell, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Catherine S. Giess, MD, Wellesley, MA (*Abstract Co-Author*) Nothing to Disclose

**TEACHING POINTS**

1. Discuss patient and lesion factors which pose technical challenges to successful stereotactic-, US-, and MRI-guided breast biopsy2. Present strategies and procedural modifications used to perform successful stereotactic-, US-, or MRI-guided breast biopsy and wire localization for challenging breast lesions or challenging clinical scenarios3. Discuss techniques for ensuring correlation between mammographic and US, mammographic and MRI, and US and MRI findings

**TABLE OF CONTENTS/OUTLINE**

1. Discuss patient factors (psychosocial, physical, co-morbidity) that pose technical challenges to image-guide core needle biopsy 2. Discuss lesion factors (type, multiplicity, conspicuity, location within the breast or axilla) that pose technical challenges to image-guided core needle biopsy and wire localization3. Present potential solutions and strategies to overcome patient and lesion challenges using a multi-modality case-based approach4. Present some of the challenges of multi-modality image correlation (mammography-US, mammography-MRI, US-MRI) and possible solutions to ensure successful and accurate image-guided core needle biopsy

**Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Catherine S. Giess, MD - 2015 Honored Educator
Robyn L. Birdwell, MD - 2015 Honored Educator

RC115

## Breast Imaging: Fundamentals of Interpretation

Sunday, Nov. 29 2:00PM - 3:30PM Location: S406A

BR DM US

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

**Participants**

**Sub-Events**

### RC115A ACR Accreditation

Participants
Brett T. Parkinson, MD, Salt Lake Cty, UT (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) Understand the history and current relevance of Breast Imaging Accreditation. 2) Be familiar with the scoring standards for breast imaging accreditation, including reasons for failure. 3) Learn about electronic submission of mammography images for accreditation. 4) Appreciate the importance of attaining Breast Imaging Centers of Excellence status.

### RC115B Mammography: A Practical Approach to Breast Lesions

Participants
Gilda Cardenosa, MD, Richmond, VA (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) The participants should be able to develop a practical common sense approach to the detection and subsequent evaluation of breast lesions. The participant should be able develop an approach focused on the use of prior films, additional spot compression views and ultrasound in establishing the significance of screen detected lesions and the evaluation of patients presenting with clinical signs and symptoms.

#### ABSTRACT

A basic, practical and common sense approach in the detection and evaluation of potential breast lessons is presented. As a starting point the need to sit back and review the images globally for potential technical issues that may limit or preclude interpretation, breast size asymmetry, parenchymal asymmetry (focal, global or developing) and the presence of diffuse changes will be discussed. After the images are accessed globally, the active search for the presence of potential masses, calcifications and distortion will be discussed. The importance of using prior films, additional spot compression views, physical examination and ultrasound before making management decisions will be emphasized all towards the goal of minimizing potential delays in the diagnosis of early breast cancers.

### RC115C Breast Ultrasound

Participants
Paula B. Gordon, MD, Vancouver, BC (*Presenter*) Stockholder, OncoGenex Pharmaceuticals, Inc ; Scientific Advisory Board, Hologic, Inc; Scientific Advisory Board, RealImaging

#### LEARNING OBJECTIVES

1) Participants should have greater confidence in performing and interpreting breast ultrasound exams, with an understanding of knobology and post-processing to produce optimal images, and to make use of Doppler to assess breast masses. A brief explanation of elastography will be included. 2) Participants will also gain understanding of the challenges of mammographic-sonographic correlation, and an approach for when correlation is uncertain.

#### ABSTRACT

Breast ultrasound is an indispensable adjunct to mammography. Using BIRADS criteria, ultrasound can provide critical information that can lead to the earlier diagnosis of cancer, but also allow a definitive benign diagnosis and eliminate the need for invasive procedures. This requires optimal imaging.This course will cover the fundamentals of breast ultrasound including:Equipment selection, set-up and optimization, including the proper use of focal zones, compounding and harmonics, Doppler and elastography.Lesion characterization using BIRADS descriptors will be discussed for simple and complicated cysts, and criteria for distinguishing benign from malignant solid masses.Mamographic/sonographic correlation is key, when the indication for the examination is investigation of a mass seen at screening mammography. This is fairly straightforward when the mass is large and solitary, but more challenging when it is small and/or there are multiple masses. The ultrasound finding has to correspond to the location of the mammographic mass as well as the character of the mass.

RC150

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

Sunday, Nov. 29 2:00PM - 3:30PM Location: E260

BR MR

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

**Participants**
Amy D. Argus, MD, Cincinnati, OH (*Presenter*) Advisory Board, Devicor Medical Products, Inc
Christopher P. Ho, MD, Atlanta, GA, (christopher.ho@emory.edu) (*Presenter*) Nothing to Disclose
Su-Ju Lee, MD, Cincinnati, OH, (su-ju.lee@uchealth.com) (*Presenter*) Spouse, Stockholder, General Electric Company.
Michelle V. Lee, MD, Saint Louis, MO, (leem@mir.wustl.edu) (*Presenter*) Nothing to Disclose
Mitva J. Patel, MD, Columbus, OH (*Presenter*) Nothing to Disclose
Stamatia V. Destounis, MD, Scottsville, NY (*Presenter*) Research Grant, FUJIFILM Holdings Corporation; Research Grant, Hologic, Inc; Research Grant, QT Ultrasound LLC
Wade C. Hedegard, MD, Rochester, NY (*Presenter*) Nothing to Disclose
Carol H. Lee, MD, New York, NY (*Presenter*) Nothing to Disclose
Colleen H. Neal, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Carol M. Dell, MD, Lexington, KY (*Presenter*) Nothing to Disclose
Roberta A. Jong, MD, Toronto, ON (*Presenter*) Nothing to Disclose
Gary J. Whitman, MD, Houston, TX (*Presenter*) Book contract, Cambridge University Press
Christiane K. Kuhl, MD, Bonn, Germany (*Presenter*) Nothing to Disclose
Hiroyuki Abe, MD, Chicago, IL, (habe@radiology.bsd.uchicago.edu) (*Presenter*) Consultant, Seno Medical Instruments, Inc
Karla A. Sepulveda, MD, Houston, TX (*Presenter*) Nothing to Disclose
Amy L. Kerger, DO, Columbus , OH, (amy.kerger@osumc.edu) (*Presenter*) Nothing to Disclose
Jill J. Schieda, MD, Cleveland, OH, (jschieda@metrohealth.org) (*Presenter*) Nothing to Disclose
Mai A. Elezaby, MD, Madison, WI (*Presenter*) Nothing to Disclose
Amado B. del Rosario, DO, Chicago, IL (*Presenter*) Nothing to Disclose
Andrew Bowman, MD, PhD, Jacksonville, FL (*Presenter*) Nothing to Disclose
Elizabeth R. Deperi, MD, Jacksonville, FL (*Presenter*) Nothing to Disclose
Candice W. Bolan, MD, Jacksonville, FL, (bolan.candice@mayo.edu) (*Presenter*) Nothing to Disclose
Jiyon Lee, MD, New York, NY, (jiyon.lee@nyumc.org ) (*Presenter*) Nothing to Disclose
Kirti M. Kulkarni, MD, Chicago, IL (*Presenter*) Nothing to Disclose

## 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) Discuss pearls and pitfalls associated with successful MR Image-guided biopsy.

## ABSTRACT

This course is intended to provide both basic didactic instruction and hands-on experience in the application of MRI guided breast biopsy. MRI provides greater sensitivity for detecting breast cancer compared with mammography and ultrasound, although with imperfect specificity. MRI guided biopsy is required to confirm or exclude maligancy for MRI only findings. This course will be devoted to the understanding and identification of the following pertaining to MRI guided biopsy: 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.

ED001-MO

## Breast Monday Case of the Day

Monday, Nov. 30 7:00AM - 11:59PM Location: Case of Day, Learning Center

**BR**

*AMA PRA Category 1 Credit ™*: .50

**Participants**
Susan O. Holley, MD, PhD, Saint Louis, MO (*Presenter*) Research Consultant, Biomedical Systems
Michelle V. Lee, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Eugene Y. Kim, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Michyla L. Bowerson, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Wendi A. Owen, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Catherine M. Appleton, MD, Saint Louis, MO (*Abstract Co-Author*) Scientific Advisory Board, Hologic, Inc; Royalties, Oxford University Press;
Whitney A. Manlove, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Onalisa D. Winblad, MD, Kansas City, KS (*Abstract Co-Author*) Nothing to Disclose
Jill A. Jones, MD, Kansas City, KS (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1) Identify, characterize, and analyze abnormal findings on multimodality breast imaging studies. 2) Develop differential diagnostic considerations based on the clinical information and imaging findings. 3) Recommend appropriate management for the patients based on imaging findings.

RC215

## Breast Series: Hot Topics in Breast Imaging

Monday, Nov. 30 8:30AM - 12:00PM Location: Arie Crown Theater

BR DM MR US

ARRT Category A+ Credits: 4.00
*AMA PRA Category 1 Credits* ™: 3.25

**Participants**
Wendie A. Berg, MD, PhD, Pittsburgh, PA, (wendieberg@gmail.com) (*Moderator*) Consultant, SuperSonic Imagine; Departmental Research Grant, General Electric Company ; Departmental Research Grant, Hologic, Inc; Equipment support, Gamma Medica, Inc; Equipment support, General Electric Company; Equipment support, Hologic Inc; ;
Sarah M. Friedewald, MD, Chicago, IL (*Moderator*) Consultant, Hologic, Inc; Research Grant, Hologic, Inc
Elizabeth A. Morris, MD, New York, NY (*Moderator*) Nothing to Disclose

**Sub-Events**

### RC215-01 Tomosynthesis

Monday, Nov. 30 8:30AM - 8:50AM Location: Arie Crown Theater

Participants
Liane E. Philpotts, MD, New Haven, CT (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) Assess the increasing body of literature concerning digital breast tomosynthesis. 2) Describe its use in both the screening and diagnostic mammography environments. 3) Evaluate the benefits of tomosynthesis and understand how it is dramatically changing the whole practice of breast imaging.

#### ABSTRACT

Tomosynthesis is revolutionizing breast imaging. The evidence to date reveals consistent reductions in false positives and increases in invasive cancer detection in screening mammography. This should have a profound effect on shifting the balance of benefits and harms of screening mammography. In addition, tomosynthesis has a dramatic effect on diagnostic mammography, resulting in expedited imaging, fewer patients requiring follow up, and increases in the positive predictive value of biopsy recommendations. Interpretation time and learning curve are considerations in utilizing tomosynthesis. Correct utilization requires careful interpretation of images and careful correlation with multi-modality imaging, particularly ultrasound. Downstream effects of tomosynthesis lead to dramatic changes in workflow. Cost analyses point to cost savings with tomosynthesis.

### RC215-02 Three Consecutive Years of Screening with Digital Breast Tomosynthesis: Are the Outcomes Sustainable?

Monday, Nov. 30 8:50AM - 9:00AM Location: Arie Crown Theater

Participants
Emily F. Conant, MD, Philadelphia, PA (*Presenter*) Speaker, Hologic, Inc; Scientific Advisory Board, Hologic, Inc; Consultant, Siemens AG
Andrew Oustimov, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Lauren Pantalone, BS, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Susan Weinstein, MD, Philadelphia, PA (*Abstract Co-Author*) Consultant, Siemens AG
Elizabeth McDonald, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Marie Synnestvedt, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Mitchell D. Schnall, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Studies have shown improved screening outcomes when digital breast tomosynthesis (DBT) is combined with digital mammography (DM) compared to screening with DM alone. However, questions exist regarding the sustainability of outcomes over consecutive years. Are the improved DBT outcomes due to prevalence rather than incidence screening? What impact is there on interval cancer rates? We investigate these issues by comparing outcomes from 3 years of consecutive DBT screening of our entire clinic population. Cancer registry data is used to determine interval cancer rates.

#### METHOD AND MATERIALS

We have screened over 33,000 patients with DBT after complete conversion in 9/2011. Recall rates, cancer detection rates, PPVs, biopsy rates and interval cancer rates within 1 year will be compared over the 3 year period with prior DM rates. A positive screen is defined as recall prompting a biopsy recommendation (cat. 4, 5). Patients assigned to short-term follow-up (cat. 3) are considered negative screens. Network cancer registry data through 12/2014 is used to determine interval cancer rate (defined as symptomatic cancers presenting at <1 year).

#### RESULTS

The reduction in recall from the baseline DM rate of 10.4% remained statistically significant over 3 DBT years ($p<0.001$, <0.001 and 0.003, respectively) however, showed a non-significant trend upward from DBT yr 1 to 3 (8.8, 9.0 and 9.2%). Cancer detection rates/1000 screened continued to increase from baseline DM rate of 4.6 to 5.5, 5.8 and 6.1 for DBT yr 1 to 3, but the trend was non-significant ($p=0.108$). The biopsy rate remained relatively stable, however, PPV1, 2 and 3 showed continued increases over time, with the trend in PPV1 statistically significant ($p=0.025$). The interval cancer rate decreased from 0.9/1000 screened for DM to 0.5 for DBT yr 1 and 0.1 for DBT yr 2. There is not adequate follow-up to calculate interval cancer rate for DBT yr 3.

#### CONCLUSION

Our data shows that not only are DBT screening outcomes sustainable, there are continued trends of increased cancer detection and PPVs over time. There was also a decrease in interval cancer rate with DBT within 1 year of screening suggesting that DBT detects more, clinically significant interval cancers.

**CLINICAL RELEVANCE/APPLICATION**

Consecutive years of screening with DBT demonstrate sustainable and even continually improving outcomes as measured by increased cancer detection and a trend of decreasing interval cancers.

**Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Mitchell D. Schnall, MD, PhD - 2013 Honored Educator

## RC215-03 Screen-detected and Interval Cancers before, During, and after Implementation of Digital Breast Tomosynthesis in a Population-based Mammography Screening Program

Monday, Nov. 30 9:00AM - 9:10AM Location: Arie Crown Theater

Participants
Per Skaane, MD, PhD, Oslo, Norway (*Presenter*) Equipment support, Hologic, Inc; Consultant, Hologic, Inc; Support, Hologic, Inc
Sofie Sebuodegard, Oslo, Norway (*Abstract Co-Author*) Nothing to Disclose
David Gur, PhD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Randi Gullien, RT, Oslo, Norway (*Abstract Co-Author*) Support, Hologic Inc; Travel support, Hologic, Inc
Solveig S. Hofvind, Oslo, Norway (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To analyze cancer detection and interval cancer rates before, during, and after implementation of digital breast tomosynthesis (DBT) in organized breast cancer screening.

**METHOD AND MATERIALS**

The prospective screening trial including DBT was approved by the Ethical Committee. All participating women signed a written consent. The screening program includes women 50-69 years invited biannually to two-view full-field digital mammography (FFDM) screening. Image interpretation is carried out in batch reading mode with independent double reading using a 5-point rating scale for probability of cancer, with consensus/arbitration decision for all positive scores before final decision to recall. Incident screening exams (prior exams performed 2 years earlier) of the first years of four subsequent screening rounds in 2007 (FFDM), 2009 (FFDM), 2011 (FFDM plus DBT), and 2013 (FFDM only) were analyzed. Prevalent screen exams were excluded from analysis. Interval cancers of incident screened women in 2007, 2009, and 2011 were recorded based on a two-year follow-up period. Attendance as well as cancer detection rates (invasive cancers and DCIS), and interval cancer rates were compared using t-test with 95% confidence intervals (CI).

**RESULTS**

The number of women in the study population was 10.755, 11.069, 8.269, and 8.580 in 2007, 2009, 2011, and 2013, respectively. The numbers and rates (per 1.000 screen exams) of screen-detected cancers were 67 and 6.2 (95% CI 4.7-7.7), 52 and 4.7 (95% CI 3.4-6.0), 81 and 9.7 (95 CI 7.6-11.8), and 41 and 4.8 (95% CI 3.3-6.2) in 2007, 2009, 2011, and 2013. The numbers and rates (per 1.000 screen exams) of interval cancers were 22 and 2.1 (95% CI 1.2-2.9), 32 and 2.9 (95% CI 1.9-3.9), 17 and 2.1 (95% CI 1.1-3.0) for women screened in 2007, 2009, and 2011, respectively.

**CONCLUSION**

Implementation of digital breast tomosynthesis increases the cancer detection rate in mammographic screening. The interval cancer rate remained stable.

**CLINICAL RELEVANCE/APPLICATION**

Tomosynthesis increases cancer detection rate in organized mammographic screening. Further studies are needed for evaluating the interval cancer rates.

## RC215-04 Missed Breast Cancer by Digital Mammography and Tomosynthesis

Monday, Nov. 30 9:10AM - 9:20AM Location: Arie Crown Theater

Participants
Miguel A. Pinochet, MD, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose
Eleonora Horvath, MD, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose
Monica P. Rochels, MD, Santiago , Chile (*Presenter*) Nothing to Disclose
Claudio S. Silva Fuente-Alba, MD, MSc, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose
Marcela Uchida, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose
Maria Paz Duran Caro, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose
Heriberto Wenzel, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose
Eduardo Soto, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose
Maria Cecilia P. Galleguillos, MD, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose
Maria E. Droguett, MD, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Full-field digital mammography (FFDM) plus digital breast tomosynthesis (DBT) have shown to improve the sensitivity of breast cancer detection in screening programs. The purpose of this study was to analyze the imaging and histopathological characteristics of the breast cancers missed by FFDM and DBT.

**METHOD AND MATERIALS**

IRB approved, retrospective review of 223 consecutive breast cancers evaluated by FFDM plus DBT and Ultrasound (US) examination between 2013 and 2014. Variables assessed were: age, breast density (ACR 1-4), tumor size, location in the parenchyma, presence of microcalcifications, detailed morphological features in different imaging methods, histopathological tumor type and molecular subtype. Qualitative variables were described by percentage distribution, median and range.

**RESULTS**

Detection-rate of FFDM and DBT were: 83.0% and 90.5% respectively, with a substantial interreader agreement (k=0.67±0.06). In total we found 38 cancers (17%) undetectable in FFDM. Of these, 17 (7.5%) were recognized by DBT as a focal distortion or spiculated mass; 14 of them in dense breast (ACR 3-4). Finally 21 cancers (9.5%) among 20 women (median age: 53 years; range 41-64 years) were occult also in DBT, all identified by US. Breast density according to ACR 2, 3 and 4 was 10%, 65%, and 25% respectively. Median tumor size was 8.5 mm (range 4-35 mm). All cancers had an intraparenchymatous location, were microlobulated, without microcalcifications nor distortion. Two cases were DCIS and 19 infiltrating (14 ductal and 5 lobular). Thirteen were luminal A, 4 luminal B and 2 HER2 positive subtypes.

**CONCLUSION**

DBT improved the detection-rate of the FFDM, depicting more cancers that appeared as distortions or spiculated masses in dense breast tissue.However, the DBT also has limitations: it is not able to recognize 9.5 % of all breast cancers, mainly those small, infiltrating, non-calcified, non-spiculated, within dense parenchyma. Complementary breast US allows their earlier detection.

**CLINICAL RELEVANCE/APPLICATION**

We describe the imaging characteristics of those cancers that remain occult in FFDM and in DBT.

**Active Handout:Monica Patricia Rochels**

http://abstract.rsna.org/uploads/2015/15008044/RC215-04.pdf

## RC215-05 Performance Measures When Interpreting FFDM Examinations with Increasing Experience with DBT Based Screening in a Mixed FFDM/DBT Practice

Monday, Nov. 30 9:20AM - 9:30AM Location: Arie Crown Theater

Participants
David Gur, PhD, Pittsburgh, PA (*Presenter*) Nothing to Disclose
Margarita L. Zuley, MD, Pittsburgh, PA (*Abstract Co-Author*) Research Grant, Hologic, Inc;
Jules H. Sumkin, DO, Pittsburgh, PA (*Abstract Co-Author*) Scientific Advisory Board, Hologic, Inc

**PURPOSE**

To assess radiologists' recall and cancer detection rates when interpreting full field digital mammography (FFDM) examinations as experience with digital breast tomosynthesis (DBT) increased in a mixed FFDM and DBT practice.

**METHOD AND MATERIALS**

Using MQSA and pathology reporting data, we reviewed FFDM recall and cancer detection rates for 12 radiologists in a mixed FFDM and DBT practice before they interpreted DBT and then after they each interpreted 500 DBT screening examinations, and for 5 radiologists after interpreting 1000 DBT examinations. All diagnostic recommendations were obtained from our radiology databases and outcome measures were verified by pathology. Individual and pooled data were assessed at a two sided significance level of $p<0.05$.

**RESULTS**

A total of 41,871 FFDM examinations were reviewed and analyzed pre DBT and 38,664 and 18,395 FFDM examinations were reviewed and analyzed post 500 and 1000 interpretations of DBT examinations, respectively. We observed no significant changes ($p>0.05$) in recall rates for FFDM as experience with DBT increased from virtually none to 500 DBT interpretations and later to over 1000 DBT interpretations. Average recall rates for FFDM were 11.4%, 11.6% and 11.3%, respectively, with no individual demonstrating a significant change or a relative rank order change on a relative scale ($p>0.05$). We observed no significant changes in cancer detection rates (CDRs) with increased experience with DBT from virtually none to 500 DBT interpretations and later to over 1000 DBT interpretations. Group CDRs were 4.7, 5.0, and 4.7 per 1000 FFDM screening examinations during the three periods, respectively ($p>0.05$). Pooled data group changes in recall rates had concordant trend changes in CDRs, albeit the trends were not statistically significant ($p>0.05$).

**CONCLUSION**

Despite expectations for improved performance, in particular in terms of recall rates, when interpreting FFDM examinations as experience with DBT increases in a mixed FFDM/DBT practice, radiologists reporting patterns and cancer detection rates did not change significantly.

**CLINICAL RELEVANCE/APPLICATION**

In a mixed FFDM/DBT practice, radiologists reporting patterns and cancer detection rates when interpreting FFDM examinations did not change significantly as experience with DBT increased.

## RC215-06 Integrated Interpretation of Digital Breast Tomosynthesis and Ultrasound in Asymptomatic Women with Dense Breasts

Monday, Nov. 30 9:30AM - 9:40AM Location: Arie Crown Theater

Participants
Jung Min Chang, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Won Hwa Kim, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Woo Kyung Moon, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To compare the diagnostic performances of combined digital mammography (DM) and digital breast tomosynthesis (DBT) versus combined DM and breast ultrasound (US) in asymptomatic women with dense breasts, and to evaluate the performance of an integrated interpretation of DBT and US.

**METHOD AND MATERIALS**

This study was approved by our Institutional Review Board and all patients provided informed consent. 196 pairs of DBT and US images from asymptomatic women with dense breasts (median age, 51 years; range, 21-77), who underwent screening examinations comprised our study population. Two independent prospective reading sessions of DBT and US with information of DM were performed in parallel by 12 radiologists blinded to the other examinations, and the integration of the results from both examination was performed by 2 expert breast radiologists in consensus, downgrading BI-RADS 3 lesions on US to BI-RADS 2 if DBT showed benign findings (BI-RADS categories 1 to 3). Sensitivity, specificity, negative predictive value (NPV), and positive predictive value (PPV) for recall of DBT, US, and their integrated results were compared using McNemar test, and Fisher's exact test.

**RESULTS**

Among 196 women, 27 lesions were assessed as showing suspicious findings on DBT, and 60 on US. Five cancers (mean invasive tumor size, 1.9cm; range 0-2.8cm) were detected on both DBT and US. Sensitivities and NPVs were 100% for both DBT and US. Specificity and PPVs for recall were 96.9% and 18.5% for DBT and 90.6% and 8.3% for US. The specificity for DBT was significantly higher than that of US (P=0.008). Integrated results downgrading BI-RADS 3 lesions on US to BI-RADS 2 if DBT showed benign findings yielded a significant reduction in the recall rate (30.6% vs. 12.2%, P=0.0004) without sensitivity loss.

**CONCLUSION**

For asymptomatic women with dense breasts, DBT combined with DM showed higher specificity than US combined with DM, and the integration of DBT information to US, resulted in decreased recall rates without loss in sensitivity.

**CLINICAL RELEVANCE/APPLICATION**

DBT is a beneficial method in evaluating dense breasts on DM, and integrated reading of DBT and US may induce reduction of short-term follow-up without change in sensitivity.

## RC215-07 Whole Breast Ultrasound

Monday, Nov. 30 9:40AM - 10:00AM Location: Arie Crown Theater

Participants
Regina J. Hooley, MD, New Haven, CT (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Review the indications for whole breast ultrasound. 2) Be familiar with the advantages and disadvantages of automated and handheld whole breast ultrasound. 3) Review optimal technique and strategies to improve specificity of whole breast ultrasound.

**ABSTRACT**

Technological advances and improvements in scan resolution have led to increased utility of whole breast ultrasound. Whole breast ultrasound is more widely accepted as a supplemental screening tool in women with dense breasts and a negative mammogram, but may also be used to evaluate disease extent in women with a new diagnosis of breast cancer. Whole breast ultrasound may be performed using a traditional handheld technique or using an automated scanner, which is less operator dependent. Careful attention to scanning technique is essential to produce high quality images, as well as to improve overall sensitivity and specificity.

**ActiveHandout:Regina J. Hooley**

http://abstract.rsna.org/uploads/2015/15002285/ActiveRC21.pdf

## RC215-08 Update on Technologist-performed, Screening Breast Ultrasound in Women with Dense Tissue 5 Years after CT Public Act No. 09-41: How Are We Doing Now?

Monday, Nov. 30 10:00AM - 10:10AM Location: Arie Crown Theater

Participants
Liane E. Philpotts, MD, New Haven, CT (*Presenter*) Nothing to Disclose
Madhavi Raghu, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Melissa A. Durand, MD, New Haven, CT (*Abstract Co-Author*) Research Grant, Hologic, Inc
Laura J. Horvath, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Reni S. Butler, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Paul H. Levesque, MD, Madison, CT (*Abstract Co-Author*) Nothing to Disclose
Regina J. Hooley, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Much experience has been gained during 5 years of performing screening whole breast ultrasound (US) on women with dense tissue. The purpose of this study was to assess current outcomes of these exams and compare to results obtained in our first year.

**METHOD AND MATERIALS**

A HIPAA-compliant, retrospective review of the breast imaging database (PenRad, MN) was performed to identify all screening ultrasound exams performed at a satellite office of a tertiary academic cancer hospital, during a 5 month period (10/1/14-2/28/15). All screening US exams were performed by dedicated breast technologists using hand-held scanning and with on-site dedicated breast radiologists available. Only cases reported as normal and dense on recent screening mammogram were included. Patients undergoing diagnostic mammography or follow up ultrasounds were not included. The BIRADS final assessment, positive predictive value (PPV3) and cancer detection rate (CRD) was determined and compared to results obtained in our practice in the first year of performing screening ultrasound (10/1/09 - 9/30/10).

**RESULTS**

756 supplemental screening US were performed during the time period, of which 708 (94%) were reported as normal (BIRADS 1,2). 40 cases (5%) were reported as BIRADS 3. Only eight biopsies were recommended (BIRADS 4,5 1%) of which 2 were malignant (both invasive ductal carcinoma), PPV3=25%. This yield a cancer detection rate of 2.6 per 1000 (2/756). In comparison to our first year results, there has been significant changes with and increase in the rate of BIRADS 1,2 (75% vs 94%, p<0.0001), a decrease in the rate of BIRADS 3 (20% vs 5%, p<0.0001), fewer biopsies recommended BIRADS 4,5 (5% vs 1%, p<0.0001), and an improvement in the PPV3( 6.5% vs 25%, p<0.0001) with maintained CDR (3.2 vs 2.6 per 1000).

**CONCLUSION**

There has been a large shift in the outcome of supplemental screening ultrasound performed during 5 years with significantly fewer false positives and a higher PPV with maintained CDR, resulting in greatly improved performance of this exam.

**CLINICAL RELEVANCE/APPLICATION**

With experience, the performance and outcome of supplemental screening ultrasound is greatly improved.

## RC215-09 Radiologists' Specificity in Reading Automated Breast Ultrasound (ABUS) Can Be Improved by Computer Aided Arbitration

Monday, Nov. 30 10:10AM - 10:20AM Location: Arie Crown Theater

Participants
Jan Van Zelst, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Tao Tan, Nijmegen, Netherlands (*Abstract Co-Author*) Research Grant, QView Medical, Inc
Andre R. Grivegnee, MD, Linkebeek, Belgium (*Abstract Co-Author*) Nothing to Disclose
Mathijn D. De Jong, MD, 's-Hertogenbosch, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Nico Karssemeijer, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Shareholder, Matakina Technology Limited; Consultant, QView Medical, Inc; Shareholder, QView Medical, Inc; Director, ScreenPoint Medical BV; Shareholder, ScreenPoint Medical BV;
Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Speakers Bureau, Bayer AG

**PURPOSE**

Screening for breast cancer with supplemental Automated Breast Ultrasound (ABUS) increases the amount of unnecessary recalls for benign lesions that otherwise would not have been observed. We investigated the effect of using Computer Aided Detection (CADe) software as independent arbiter on radiologists' findings on the sensitivity and specificity of ABUS for breast screening.

**METHOD AND MATERIALS**

The IRB waived the need for informed consent for this study. Randomly selected views from ABUS scans (Siemens, ABVS) of 89 women were included. 19 women had malignancies, 30 had benign lesions and 40 women had no abnormalities. Three dedicated breast radiologists and a 4th year resident with experience in reading ABUS participated in this multi-reader-multi-case (MRMC) study. They read all 89 cases without aid from CADe and were instructed to mark and report their findings using a 0-100 likelihood-of-malignancy scale. The CADe program (Qview Medical Inc, Los Altos, Ca.) also analyzed the 89 cases independent from the radiologists, providing suspicious region candidates for each case.The locations of the findings of the radiologists were compared to the locations of the CADe software findings. Radiologist's findings were considered suspicious only when the marked lesions matched to the candidates of CADe. Radiologists' findings that were not marked by CADe were regarded as benign.MRMC ROC analysis was used to compare the area under the ROC curve (AUC) of the normal unaided readings to the AUC of the readings after computer aided arbitration.

**RESULTS**

The AUC improved significantly from 0.77 to 0.88 after arbitration, using the CADe software ($p = 0.01$). Furthermore, the partial AUC in the range of 90-100% specificity also improves significantly from 0.05 to 0.065 ($p=0.04$). The radiologists' findings that were subsequently overruled by the CADe program were mostly true benign lesions or artefacts. None were malignant.

**CONCLUSION**

Using CADe software for computer aided arbitration has the potential to improve the specificity of breast radiologists screening with ABUS.

**CLINICAL RELEVANCE/APPLICATION**

CADe arbitration may help to identify unnecessary referrals for non-malignant lesions that can be reevaluated by second readers and potentially increase specificity without losing sensitivity.

## RC215-10 Supplemental Automated Breast Ultrasound Screening in BRCA Gene Mutation Carriers; Is There Any Value?

Monday, Nov. 30 10:20AM - 10:30AM Location: Arie Crown Theater

Participants
Jan Van Zelst, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Gwendolyn Woldringh, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Roel D. Mus, MD, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Peter Bult, MD, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Matthieu Rutten, MD, Hertogenbosch, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Speakers Bureau, Bayer AG
Nicoline Hoogerbrugge, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Nico Karssemeijer, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Shareholder, Matakina Technology Limited; Consultant, QView Medical, Inc; Shareholder, QView Medical, Inc; Director, ScreenPoint Medical BV; Shareholder, ScreenPoint Medical BV;

**PURPOSE**

Intensive yearly breast cancer screening programs for BRCA carriers with MRI and mammography (XM) detect many cancers at an

early stage. However, BRCA carriers still present with interval cancers. In this prospective study we investigated whether automated breast ultrasound (ABUS) leads to earlier or additional detection of breast cancer.

**METHOD AND MATERIALS**

This study was approved by a local IRB and is HIPAA compliant. 295 female BRCA gene mutation carriers signed informed consent for this study. They were offered 5 round of screening in two years. A team of 4 dedicated breast radiologists read all examinations. We analyzed sensitivity, specificity and positive predictive value (PPV) of all three modalities. Furthermore, we retrospectively reevaluated prior ABUS scans of cancer patients and the ABUS scans of ultrasound negative cases in this cohort.

**RESULTS**

Out of 295 BRCA gene mutation carriers, 16 women were diagnosed with a screening-detected breast cancer. In six women, pure DCIS with no invasive component was found. None of the DCIS, not prospectively or in retrospect, was found on ABUS. In ten women, invasive breast cancer (IBC) was detected. Seven of these IBCs were found on ABUS. No additional cancers were found with ABUS. For six out of ten IBCs a prior ABUS scan was available. In retrospect, two IBCs (33,3%) were retrospectively visible on the ABUS scan six months earlier and one of these was detected but classified as BI-RADS 2. Also two interval IBCs (12.5%) occurred in between screening rounds and one of these cancer was also detected six months earlier but classified as BI-RADS 2. For XM, MRI, and ABUS sensitivity was 0.50, 0.88 and 0.44, specificity 0.97, 0.95 and 0.95 and PPV 0.32, 0.28 and 0.09, respectively

**CONCLUSION**

In our BRCA screening program, MRI and XM together detect most of the cancers. In this study, adding ABUS did not increase cancer detection. In retrospect, some cancers were seen earlier, but regarded benign due to a benign appearance, which is common in the BRCA population.

**CLINICAL RELEVANCE/APPLICATION**

High interval cancer rates in the BRCA carrier population justifies intensifying the yearly screening regimen of MRI and XM, however at this point adding ABUS does not seem to offer a solution.

## RC215-11 Supplemental Screening US in Combination with Elastography and Color Doppler US: Interim Results of a Prospective Multicenter Study

Monday, Nov. 30 10:30AM - 10:40AM Location: Arie Crown Theater

Participants
Su Hyun Lee, MD,PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Sung Ui Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
A Jung Chu, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Min Sun Bae, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Woo Kyung Moon, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To validate the added value of elastography and color Doppler ultrasonography (US) for supplemental screening US in a multicenter study.

**METHOD AND MATERIALS**

This study was conducted with institutional review board approval, and written informed consent was obtained. From November 2013 to December 2014, 1,241 women (mean age, 46 yrs) with breast masses (mean size, 1.0cm) detected on supplemental screening US and assessed as BI-RADS category 3 or higher were prospectively recruited from 10 tertiary care centers. After identifying the mass of interest on B-mode US, elastography (strain elastography in 4 sites; shear-wave elastography in 6 sites) and color Doppler US were performed. Investigators assessed the likelihood of malignancy as a percentage at the time of enrollment using the four data sets: B-mode US alone, B-mode US with elastography, B-mode US with color Doppler US, and B-mode US with elastography and color Doppler US. Reference standard of biopsy or at least 1 year of follow-up was completed in 1,050 women (84.6%) and included in the interim analysis.

**RESULTS**

71 of 1,050 breast masses (6.8%) were malignant. The areas under the receiver operating characteristics curve (AUC) of B-mode US increased from 0.878 to 0.922 (P=.039) and 0.911 (P=.157) when elastography or color Doppler US was added, respectively. When both elastography and color Doppler US were added to B-mode US, the highest AUC (0.957) was achieved (P<.001). The majority of breast masses in our cohort (91.5%, [961/1050]) was assessed as BI-RADS category 3 or 4A on B-mode US and included 25 malignancies (9 DCIS, 16 invasive carcinoma). None of invasive cancers but only one DCIS showed negative findings on both elastography and color Doppler US. If the BI-RADS category 3 or 4A masses with negative findings on both elastography and color Doppler US were managed with 1-year follow-up, a considerable number of benign biopsies (84.0%, [539/642]) and unnecessary short-term follow-up (85.7%, [252/294]) can be reduced yielding higher PPV (27%, [70/258]) compared to that of B-mode US alone (6.8%, [71/1050]).

**CONCLUSION**

Combined use of elastography and color Doppler US can increase the PPV of supplemental screening US for breast cancer detection.

**CLINICAL RELEVANCE/APPLICATION**

Combined use of elastography and color Doppler US can reduce a considerable number of unnecessary biopsies or short-term follow-up induced by supplemental screening breast US.

## RC215-12 Breast MRI: Screening and Diagnostic Use

Monday, Nov. 30 10:50AM - 11:10AM Location: Arie Crown Theater

Participants
Christiane K. Kuhl, MD, Bonn, Germany (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) To list shortcomings of mammographic screening for breast cancer. 2) To define the term 'overdiagnosis' and distinguish it from 'false positive diagnoses'. 3) To list the current indications for screening with Breast MRI. 4) To describe pathophysiological processes that determine diagnosis of breast cancer in MRI vs. in mammography. 5) To list the advantages and limitations of non-mammographic screening.

## RC215-13 Prospective Abbreviated MRI (AB-MR) Exam in a Screening Cohort Compared with Conventional Breast MRI

Monday, Nov. 30 11:10AM - 11:20AM Location: Arie Crown Theater

Participants
Claudia R. Seuss, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Yiming Gao, MD, New York, NY (*Presenter*) Nothing to Disclose
Amy N. Melsaether, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Hildegard B. Toth, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Linda Moy, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To evaluate an AB-MR in women at intermediate and high-risk (HR) for breast cancer.

### METHOD AND MATERIALS

An IRB approved study was performed on 86 asymptomatic women who underwent 114 breast MRI exams from 12/2011 - 12/2013. All women were at risk for breast cancer, had dense breasts, had surgery and/or follow up imaging. The breast MRI was performed on a 3T magnet with an acquisition time of 10 minutes. A single reader prospectively interpreted the AB-MR by reviewing the first post-contrast scan, T2 scan and prior studies. Comparison was made to the original diagnostic interpretation. Also, two additional readers retrospectively review the AB-MR exams. Final BIRADS assessment and confidence score was assessed for each lesion.

### RESULTS

Of 86 women, 17 (19.8%) at HR, of which 11 (12.8%) were BRCA carriers, and 58 (67.4%) were at intermediate risk. Mean age was 46 years, range 29-76 years. Mean lesion size was 0.7cm (range 0.3 - 4cm). Sensitivity was 100%; 8 cancers (3 DCIS and five invasive cancer) were identified by the readers. All four cancers in BRCA carriers were identified by all readers. Using the abridged protocol, the specificity was 71% and an additional 14 findings were identified prospectively. The specificity for the retrospective review was 59 - 76%. Kappa score showed good interobserver agreement among the 3 readers. Mild to moderate BPE (p=0.02) small lesion size (< 0.6cm) (p=0.03) and absence of high signal T2 correlate (p=0.01) were significantly correlated with decreased confidence by all 3 readers. Of the 114 exams, 78 (68.4%) were originally assessed as BIRADS 1 or 2, 9 (7.9%) as BIRADS 3, 27 (23.7%) as BIRADS 4 or 5. Among the 3 readers, there was a statistically increase rate of BIRADS 3 assessments - 9.1 -17.6% (p=0.04) but not for BIRADS 4 assessments 19.2 -26.3% (p=.76).

### CONCLUSION

An abridged breast MRI in a screening population had a high sensitivity but moderate specificity.

### CLINICAL RELEVANCE/APPLICATION

An AB-MR screening exam can detected all the breast cancers but at the expense of a higher rate of follow up imaging.

## RC215-14 Efficacy of Annual MRI for High-risk Breast Cancer Screening

Monday, Nov. 30 11:20AM - 11:30AM Location: Arie Crown Theater

Participants
Sarah Stamler, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Janice S. Sung, MD, New York, NY (*Presenter*) Nothing to Disclose
Jennifer B. Kaplan, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Tammy Huang, MD, Short Hills, NJ (*Abstract Co-Author*) Nothing to Disclose
Carol H. Lee, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
D. David Dershaw, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Elizabeth A. Morris, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Christopher E. Comstock, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To assess the need for annual MRI in high-risk screening.

### METHOD AND MATERIALS

IRB approved retrospective review was performed to identify breast cancers detected on screening breast MRI between January 2005-December 2010. Medical records were reviewed for risk factors (family history, personal history, BRCA status, prior high risk lesion) and tumor histopathology. The time intervals between the MRI on which the cancer was detected and the patient's baseline and most recent prior screening MRI were determined.

### RESULTS

18,065 screening MRIs in 7,517 women were performed during the study period. 170 cancers were detected in 167 women (2.2%).

63/170 (37%) cancers were detected on baseline MRI. Of 107 (63%) cancers detected on a subsequent MRI, 81 (75%) were invasive, mean size= 0.7 cm, 9/107 (8%) node positive. 82/107 (77%) had a negative screening MRI within 1.3 years prior to the MRI on which the cancer was detected. Cancers were found at 1 year follow up (<1.5 years) in 17 (16%), at 2 years (1.5-2.5) in 25 (23%), and 65 (61%) on additional years of follow up. Results were independent of risk factors.

**CONCLUSION**

Annual MRI effective detects node negative, subcentimeter invasive cancers in a high-risk population. These cancers were not seen on MRI 1 year earlier suggesting the need for annual screening in this population.

**CLINICAL RELEVANCE/APPLICATION**

Annual MRI is the most appropriate screening interval for high-risk women, detecting node negative subcentimeter invasive cancers.

## RC215-15 Longitudinal Results of a Breast MRI Screening Program for Patients at High and Intermediate Risk: Does BRCA Status Matter?

Monday, Nov. 30 11:30AM - 11:40AM Location: Arie Crown Theater

Participants
Suzan Vreemann, MSc, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Albert Gubern-Merida, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Susanne Lardenoije, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Bram Platel, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Nico Karssemeijer, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Shareholder, Matakina Technology Limited; Consultant, QView Medical, Inc; Shareholder, QView Medical, Inc; Director, ScreenPoint Medical BV; Shareholder, ScreenPoint Medical BV;
Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Speakers Bureau, Bayer AG

**PURPOSE**

Breast cancer screening in women at elevated risk is performed with yearly MRI and mammography. This includes women with BRCA mutations and women at elevated risk for other causes (mainly family history). The purpose of this study was to assess differences between BRCA mutation carriers and non-BRCA patients in a longitudinal MRI screening program in terms of recall rate, positive predictive value, and detection.

**METHOD AND MATERIALS**

An IRB approved, retrospective review of patient files from women screened with breast MRI between 2003 and 2013 was performed at our academic center. We analysed 9.504 screening MR examinations in 2843 women (age: 45 ± 12.09 years), including 761 BRCA patients, and 2082 non-BRCA patients. Recall rate (RR), positive predictive value (PPV), and cancer detection rate (CDR) were evaluated for first round examinations and follow-up examinations separately. BRCA patients were compared with non-BRCA patients. Chi-square tests were used to determine statistical significance.

**RESULTS**

The RR for BRCA patients in the first round of screening was 86.07 per 1000 examinations and 52.58 per 1000 examinations in non-BRCA patients ($p<0.001$). The PPV for BRCA patients in the first round of screening was found to be 0.44, compared to 0.50 in non-BRCA patients ($p=0.013$). The CDR was 38.25 per 1000 examinations for BRCA patients and 26.53 per 1000 examinations for non-BRCA patients ($p<0.001$). In follow up, the RR was found to be 24.92 per 1000 examinations for BRCA patients and 22.81 per 1000 examinations for non-BRCA patients ($p<0.001$). The PPV was 0.46 for BRCA patients and 0.21 for non-BRCA patients ($p<0.001$). CDR was 11.42 per 1000 examinations for BRCA patients and 4.86 per 1000 examinations for non-BRCA patients ($p<0.001$).

**CONCLUSION**

RR and CDR are high for all patients in the first round. RR and CDR significantly decreased in follow-up rounds ($p<0.001$). PPV remained at an acceptable level for both patient groups, and remains particularly high in BRCA carriers. RR, PPV, and CDR differed significantly between BRCA and non-BRCA patients in both first and follow up rounds.

**CLINICAL RELEVANCE/APPLICATION**

These results underline that MRI is an excellent tool for screening high risk patients. Cancer detection is very high in the first round in all patients, but remains high only in BRCA carriers in follow up rounds.

## RC215-16 Ultrafast Dynamic Contrast Enhanced (DCE) MRI of the Whole Breasts: A Novel Imaging Technique for Breast Cancer Detection with Super High Temporal Resolution- Comparison of MIP Images between Ultrafast MRI and Regular DCE MRI

Monday, Nov. 30 11:40AM - 11:50AM Location: Arie Crown Theater

Participants
Hiroyuki Abe, MD, Chicago, IL (*Presenter*) Consultant, Seno Medical Instruments, Inc
Naoko Mori, MD, PhD, Sendai, Japan (*Abstract Co-Author*) Nothing to Disclose
Keiko Tsuchiya, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Kirti M. Kulkarni, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Deepa Sheth, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
David V. Schacht, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Federico Pineda, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Gregory S. Karczmar, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Milica Medved, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To evaluate whether DCE ultrafast MRI (UFMRI) is equal or superior to regular DCE MRI in terms of cancer detection using maximum intensity projection (MIP) images.

**METHOD AND MATERIALS**

The acquisition protocol of UFMRI consisted of 5 pre and 8 post-contrast bilateral, fat-suppressed ultrafast acquisitions of whole breasts, with temporal resolution of 7 sec for 3T (spatial resolution: 1.5 x 1.5 x 3 mm), or 9 sec for 1.5T (spatial resolution: 1.5 x 1.5 x 3.75 mm); followed by four high spatial resolution acquisitions (spatial resolution: 0.8 x 0.8 x 0.8 mm) with temporal resolution of 75 sec for 3T or followed by five acquisitions (spatial resolution: 1.0 x 1.0 x 1.0 mm) with temporal resolution of 65 sec for 1.5T. Two radiologists compared MIP images of regular MRI (first phase) and UFMRI (first to eighth phase) of 16 patients with breast cancer, to see if tumors are detectable with MIP images of each acquisition method. In total 30 known cancers were evaluated.

**RESULTS**

All 30 masses (100%) were detected on MIP images of the UFMRI, while 22 masses (73%) were detected on the MIP image of the regular MRI. Among the 22 masses detected on both, 3 masses were subtle on the regular MIP, but clearly seen on the UFMRI MIP. Eight masses were not visible on regular MRI due to strong parenchymal enhancement (6 masses), misregistration artifacts (1 mass), and overwrap with large vessels (1 mass).

**CONCLUSION**

UFMRI could represent a better method than regular MRI for the detection of breast cancer with MIP images.

**CLINICAL RELEVANCE/APPLICATION**

Enhancing lesions are clearly visualized with UFMRI due to the lack of interference from background parenchymal enhancement. MIP images of UFMRI may be useful as a new screening MRI protocol which would shorten the performance and interpretation time without lowering the sensitivity and therefore decrease costs.

## RC215-17 Abbreviated MRI (AB-MR) of the Breast - Do We Need a Second Post-Contrast Scan?

Monday, Nov. 30 11:50AM - 12:00PM Location: Arie Crown Theater

Participants
Amy N. Melsaether, MD, New York, NY (*Presenter*) Nothing to Disclose
Yiming Gao, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Claudia R. Seuss, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Laura Heacock, MS, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Linda Moy, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

AB-MR exam has a high sensitivity for the detection of breast cancers. However, for AB-MR to be an effective screening tool, it should maintain a high sensitivity and specificity. The purpose of this study was to assess the diagnostic accuracy of an AB-MR using one and two post-contrast scans in a screening cohort.

**METHOD AND MATERIALS**

An IRB approved retrospective review of 145 women with 205 findings who underwent a breast MRI at 3T was performed by two readers. Women with dense breasts who were at risk for breast cancer were included. 61 (42%) women were newly diagnosed with breast cancer and 84 (58%) were asymptomatic high-risk women. The scan time for the 3 T1-scans was 4 minutes; the scan time for the T2-sequence was 4 minutes. Prior to this study, each reader interpreted 400 AB-MR exams. Final BIRADS assessment and confidence score was assessed for each lesion. Comparison was made to the original diagnostic interpretation.

**RESULTS**

73 (97%) of 76 invasive cancers and all 61 known cancers, especially those presenting as masses were detected on the first post-contrast scan. However, the second post-contrast scans allowed improved characterization of foci and NME but not for masses ($p<0.03$). Of interest, about 10 (50%) of 20 DCIS were better seen on the second post contrast scan. Seven of 10 lesions were low or intermediate grade DCIS. With a single post contrast data set, 15 (10.3%) incidental NME not reported on the full breast MRI protocol was noted and recommended for additional imaging, follow-up or biopsy. The second post-contrast scan was as such able to downgrade a BIRADS 3 assessment in 9 (60%) lesions to a BIRADS 2 diagnosis assessment, none of which were malignant at follow-up. One interval cancer, low grade DCIS, was missed by both readers on the abbreviated two post-contrast data set protocol.

**CONCLUSION**

In an intermediate risk population with dense breasts, a second post-contrast scan both increased cancer detection and improved characterization of benign lesions, which led to a decrease in BI-RADS 3 assessments.

**CLINICAL RELEVANCE/APPLICATION**

Two post-contrast scans may be sufficient for an AB-MR exam to have a high sensitivity and specificity.

RC252

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

Monday, Nov. 30 8:30AM - 10:00AM Location: E264

BR IR US

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

**Participants**
Jocelyn A. Rapelyea, MD, Washington, DC (*Moderator*) Consultant, General Electric Company
Margaret M. Szabunio, MD, Lexington, KY (*Presenter*) Nothing to Disclose
Shambhavi Venkataraman, MD, Boston, MA (*Presenter*) Nothing to Disclose
Angelique C. Floerke, MD, Washington, DC (*Presenter*) Consultant, CareFusion Corporation
Rachel F. Brem, MD, Washington, DC (*Presenter*) Board of Directors, iCAD, Inc Board of Directors, Dilon Technologies LLC Stock options, iCAD, Inc Stockholder, Dilon Technologies LLC Consultant, U-Systems, Inc Consultant, Dilon Technologies LLC Consultant, Dune Medical Devices Ltd
Karen S. Johnson, MD, Durham, NC, (karen.johnson2@dm.duke.edu) (*Presenter*) Research Consultant, Siemens AG
Nicole S. Lewis, MD, Washington, DC (*Presenter*) Nothing to Disclose
Kathleen R. Gundry, MD, Atlanta, GA (*Presenter*) Nothing to Disclose
Michael N. Linver, MD, Albuquerque, NM (*Presenter*) Scientific Advisory Board, Hologic, Inc; Scientific Advisory Board, Real Imaging Ltd

### 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

MSCM22

## Case-based Review of Magnetic Resonance (An Interactive Session)

Monday, Nov. 30 10:30AM - 12:00PM Location: S100AB

BR CH HN NR MR

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

**Participants**
John R. Leyendecker, MD, Dallas, TX (*Director*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Understand the role of MRI in diagnosing abnormalities of the breast. 2) Be familiar with the MRI appearance of select cardiothoracic abnormalities. 3) Effectively use MRI to diagnose disorders of the head and neck. 4) Distinguish between a variety of brain lesions based on MRI appearance.

### ABSTRACT

This session will help attendees recognize and manage select, commonly encountered breast, cardiothoracic, head and neck, and brain abnormalities based on their MRI appearances using a case-based, interactive format.

**Sub-Events**

### MSCM22A Breast MRI

Participants
Fiona J. Gilbert, MD, Cambridge, United Kingdom (*Presenter*) Medical Advisory Board, General Electric Company; Research Grant, GlaxoSmithKline plc; Research Grant, General Electric Company

### LEARNING OBJECTIVES

View learning objectives under main course title.

### MSCM22B Cardiothoracic MRI

Participants
Suhny Abbara, MD, Dallas, TX (*Presenter*) Author, Reed Elsevier; Editor, Reed Elsevier; Institutional research agreement, Koninklijke Philips NV; Institutional research agreement, Siemens AG

### LEARNING OBJECTIVES

View learning objectives under main course title.

### ABSTRACT

#### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Suhny Abbara, MD - 2014 Honored Educator

### MSCM22C Head and Neck MRI

Participants
Daniel W. Williams III, MD, Winston Salem, NC (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

View learning objectives under main course title.

### MSCM22D Brain MRI

Participants
Mauricio Castillo, MD, Chapel Hill, NC (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Review the differential diagnosis and imaging features of intraventricular massses in children and adults. 2) Review the cerebral complications of treatment vascular malformations. 3) Review the differential diagnosis and imaging features of masses arising in the cerebello-pontine angle region. 4) Review the differential diagnosis of cerebral microbleeds.

BRS-MOA

## Breast Monday Poster Discussions

Monday, Nov. 30 12:15PM - 12:45PM Location: BR Community, Learning Center

BR

*AMA PRA Category 1 Credit ™*: .50

**Participants**
Dipti Gupta, MD, Chicago, IL (*Moderator*) Nothing to Disclose

**Sub-Events**

### BR228-SD-MOA2 Differential Upgrade Rates for Non-Definitive Image-Guided Core Needle Breast Biopsies Based on BI-RADS Features

Station #2

Participants
Alison R. Gegios, Madison, WI (*Presenter*) Nothing to Disclose
Mai A. Elezaby, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Wendy B. Demartini, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Jennifer R. Cox, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Celina Montemayor, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Elizabeth S. Burnside, MD, MPH, Madison, WI (*Abstract Co-Author*) Stockholder, NeuWave Medical Inc
Heather Neuman, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Finn Kuusisto, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
John Hampton, Madison, WI (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Non-definitive image-guided breast biopsies typically require repeat sampling by surgical excision for potential upgrade to malignancy. The American College of Radiology (ACR) defines and requires tracking of repeat sampling categories of atypia/radial scar (ARS), discordant (D), and insufficient (I). Identifying lesions with low likelihoods of upgrade to safely avoid surgery is a priority, but there are little data about lesions and outcomes according to ACR non-definitive categories. We assessed the frequency of mammographic features and associated rates of upgrade by category.

#### METHOD AND MATERIALS

From our database of 2808 consecutive image-guided core needle breast biopsies performed from 1/1/2006-12/31/2011, classified prospectively by a multidisciplinary team as concordant/definitive or non-definitive (ARS, D or I), we identified all non-definitive biopsies with mammographic correlates. BI-RADS imaging features of non-definitive cases were categorized retrospectively by one of three fellowship trained breast imaging radiologists blinded to core biopsy and surgical outcome. Surgical results or tumor registry match served as reference standard for upgrade to malignancy. We calculated frequencies of imaging features and pathology outcomes stratified by ARS, D, and I categories. We compared upgrade rates based on mammographic features, using exact chi-square tests.

#### RESULTS

A total of 130 biopsies meeting study criteria were classified as non-definitive (ARS, D or I). Overall, the upgrade rate was 16.2%. The majority of ARS biopsies had imaging feature calcifications (71.4%), while masses were most common for discordant (50.0%) and insufficient (88.2%) biopsies. The upgrade rate was significantly higher for masses (26.0%) than for calcifications (10.5%; p-value = 0.04).

#### CONCLUSION

Among ACR categories for non-definitive breast biopsies, upgrade rates differ based on mammographic features. The upgrade rate is higher for masses than for calcifications, which should be considered as shared decision-making to avoid surgical excision increases in practice.

#### CLINICAL RELEVANCE/APPLICATION

Upgrade rates for ACR non-definitive biopsies differ based on mammographic features, which should be considered as shared decision-making to avoid surgical excision increases in practice.

### BR229-SD-MOA3 Dual-energy Contrast Enhanced Spectral Mammography. One Step beyond BI-RADS Score, by Adding the Power of Iodinated Contrast Media

Station #3

Participants
Athanasios N. Chalazonitis, MD, MPH, Athens, Greece (*Presenter*) Nothing to Disclose
Alexandra Tsigginou, Athens, Greece (*Abstract Co-Author*) Nothing to Disclose
Christina Gkali, MD, Athens, Greece (*Abstract Co-Author*) Nothing to Disclose
Eleni Feida, Athens, Greece (*Abstract Co-Author*) Nothing to Disclose
Aris Giannos, Athens, Greece (*Abstract Co-Author*) Nothing to Disclose
Constantine Dimitrakakis, MD, Athens, Greece (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To assess how Dual-energy Contrast Enhanced Spectral Mammography (CESM) can add value to BI-RADS (ACR) probability of malignancy classification.

### METHOD AND MATERIALS

216 women, aged from 26 to 85 years, with mammographic findings primarily assessed as BIRADS II to V, underwent CESM examination. Ten of these had bilateral findings, so we examined 226 lesions in total. Lesion evaluation was based on contrast enhancement intensity strength, categorized as -1, 0, 1 or 2. We examined the presumption that the sum of the numerical value of BIRADS and CESM enhancement score as a value, can be predictive of malignancy. Thus, a sum of ≤ 4 was assumed to predict benign lesions and a sum of >4 considered to favor a malignant diagnosis. All lesions were biopsied and pathology reports were compared to imaging assessment.

### RESULTS

Pathology reports confirmed 98 malignant and 128 benign lesions. There was an excellent correlation between proven breast malignancy and moderate or intense lesion contrast enhancement (92/98 lesions). The sum of BIRADS and CESM enhancement score conferred an accuracy in breast cancer diagnosis of 85.4% and a specificity rate of 80.47%, much higher than the corresponding values of diagnostic mammography (73.89% and 59.37%) and of the CESM enhancement mode alone (80.97% and 71.31%). Sensitivity rates of mammography, CESM and their sum were similar, namely 92.85%, 93.87% and 91.83%, respectively.

### CONCLUSION

A new "malignancy potential predictive" score empowering the credibility of digital mammography BIRADS score and the value of lesion's strength enhancement in Dual-energy CEDM, increases the accuracy of digital mammography.

### CLINICAL RELEVANCE/APPLICATION

Our proposed score may improve clinical decision making in breast cancer diagnosis. Furthermore breast biopsies in lesions with no enhancement or very low enhancement (type 0 or -1, according to our recommendation) can be avoided.

## BR230-SD-MOA4 Decreasing Rates of Atypia with Digital Breast Tomosynthesis

Station #4

Participants
Madhavi Raghu, MD, New Haven, CT (*Presenter*) Nothing to Disclose
Melissa A. Durand, MD, New Haven, CT (*Abstract Co-Author*) Research Grant, Hologic, Inc
Liva Andrejeva-Wright, MD, Wallingford, CT (*Abstract Co-Author*) Nothing to Disclose
Jaime L. Geisel, MD, New Haven, CT (*Abstract Co-Author*) Consultant, QView Medical, Inc; Consultant, Siemens AG
Regina J. Hooley, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Brigid Killelea, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Liane E. Philpotts, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Atypical Ductal Hyperplasia (ADH) is a lesion which often generates additional procedures and treatments for the patient, contributing to the "overdiagnosis" phenomenon associated with mammography. The purpose of this study was to assess the prevalence and upgrade rates of ADH before and after the implementation of tomosynthesis.

### METHOD AND MATERIALS

A retrospective review of the breast imaging database at a tertiary academic cancer hospital was performed to identify all cases of ADH on biopsy 12 months prior to (2D: 6/1/2010-6/1/2011) and three consecutive years following the implementation of tomosynthesis (3D1:1/1/2012-12/31/2012; 3D2:1/1/2013-12/31/2013 and 3D3:1/1/2014-12/31/2014). The pathology obtained at core needle biopsy was compared with the pathology obtained at surgical excision. Those cases upgraded to cancer were identified.

### RESULTS

In the 2D group, 287 total biopsies were performed of which 18 (6.2%; 18/287) cases were diagnosed as ADH. None of the 18 cases were upgraded to malignancy at surgery. In the tomosynthesis group a total of 257, 358 and 321 biopsies (3D1, 3D2, 3D3, respectively), were performed resulting in 20 (6.2%), 20 (5.6%) and 15 (4.7%) cases of ADH, representing a nonsignificant (p=0.4) but 24% decrease in the prevalence of ADH from 2D to 3D3. A majority of the lesions (2D:16/18 (89%), 3D1:16/20 (80%), 3D2:16/20 (80%), 3D3:11/15 (73%)) were described as calcifications. Only one lesion in period 3D1 was upgraded to DCIS. This occurred in a patient with fine calcifications extending over a 4 cm area of the breast. None of the lesions in groups 3D2 and 3D3 were upgraded to malignancy at surgery.

### CONCLUSION

Following the implementation of tomosynthesis, there was a trend to a decline in the percentage of atypias diagnosed, with a low upgrade rate of 1.8% (1/55). If the trend continues, it will result in fewer patients receiving a diagnosis of ADH and thereby avoiding surgical excisions.

### CLINICAL RELEVANCE/APPLICATION

Diagnostic work-up with tomosynthesis has resulted in a trend of decreasing rate of atypias, reducing the number of additional procedures for patients.

## BR231-SD-MOA5 Prediction of Pathologic Response Following Neoadjuvant Breast Cancer Chemotherapy: A Model Based on Diffusion-weighted Imaging, Contrast-enhanced MR Imaging and Tumour Phenotype

Station #5

Participants
Gorane Santamaria, MD, PhD, Barcelona, Spain (*Presenter*) Nothing to Disclose
Xavier Bargallo, MD, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose
Blanca Farrus, MD, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose
Xavier Caparros, MD, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose
Pedro Luis Fernandez, MD, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose

Jose Rios, MSc, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose
Martin Velasco, MD, Barcelona, Spain (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To investigate the relevance of diffusion imaging, contrast-enhanced MRI and cancer subtype to predict pathologic response to neoadjuvant chemotherapy in patients with breast cancer.

**METHOD AND MATERIALS**

From November 2009 to December 2014, all consecutive patients with histopathologically confirmed breast cancer undergoing neoadjuvant chemotherapy were enrolled. One hundred and eleven patients (mean age, 54.6; range, 27-84) underwent breast MRI, including diffusion sequence and contrast-enhanced MRI before and after neoadjuvant treatment. MRI interpretation included presence of enhancement in the last post-contrast sequence. The apparent diffusion coefficient (ADC) values were obtained using two different methods of region of interest (ROI) placement. The ADC ratio (mean post-treatment ADC/mean pretreatment ADC) was calculated in all cases. Tumours were characterised by immunohistochemical phenotype into three subtypes: human epidermal growth factor receptor 2 (HER2) positive (n=51), estrogen receptor positive/HER2 negative (n=40) and triple negative (n=20). Pathologic complete response (pCR) was defined as the absence of any residual type of invasive cancer or ductal carcinoma in situ (DCIS). Multivariate regression analysis and receiver operating characteristic analysis were performed.

**RESULTS**

For the total group, the pCR was 19% (21/111). The highest pCR was observed in the triple-negative (6/20 patients, 30%) and the HER2 positive (12/51 patients, 23.5%) subtypes. The ADC ratio increased significantly when pCR was achieved (1.440, 1.743 and 1.788 in presence of residual invasive cancer, residual DCIS and pCR, respectively; p<0.001). No significant differences in the ADC values obtained by single or multiple ROI placement were observed. Presence of late enhancement on the post-treatment MRI was significantly associated with residual tumour (area under the curve [AUC] 0.84; CI 95% 0.75-0.94). When the tumour subtype, ADC ratio and late enhancement were included in the model to predict the pathologic response, the AUC amounted to 0.92 (CI 95% 0.86-0.97).

**CONCLUSION**

Triple-negative or HER2 positive breast tumours showing high ADC ratios and absence of late enhancement after neoadjuvant chemotherapy are more likely to show pCR.

**CLINICAL RELEVANCE/APPLICATION**

Breast MRI including contrast-enhanced and diffusion imaging help predict pCR after neoadjuvant chemotherapy and is highly recommended in certain tumour phenotypes.

## BR232-SD-MOA6 No Significant Difference in Time-To-Treatment of Newly Diagnosed Breast Cancer Patients Regardless of Whether Pre-Treatment MRI Performed or Whether a New Lesion was Found on MRI

Station #6

Participants
Brian Pogatchnik, MD, Minneapolis, MN (*Presenter*) Nothing to Disclose
Jessica E. Kuehn-Hajder, MD, Crystal, MN (*Abstract Co-Author*) Nothing to Disclose
Tim H. Emory, MD, Saint Paul, MN (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

The use of pre-treatment breast MRI in newly diagnosed breast cancer has been criticized because it has been reported to delay treatment. The purpose of our study was to measure the period between the diagnosis of breast cancer and the time of surgery in newly diagnosed patients, and look for differences between those that underwent pre-treatment MRI versus those that did not, all at a single institution.

**METHOD AND MATERIALS**

A retrospective analysis was performed using the medical records of all women with newly diagnosed breast cancer from 2009-12 at our institution. Included patients had their tissue diagnosis, surgery, and possible pre-treatment MRI performed entirely at our institution. We excluded non-surgical candidates and those that recieved neoadjuvant therapy. We recorded timing of initial tissue biopsy to surgery, type of surgery, pre-treatment MRI results, resultant biopsy data, and patient age.

**RESULTS**

Of the 189 qualifying patients,109 (58%) had pre-treatment MRI. Time-to-treatment was not significantly different (34.7 days with MRI vs 35.2 days without MRI, p=0.832), nor was it different if additional findings suspicious for malignancy were detected by MRI (37.2 days with new findings vs 33.0 days without new findings, p=0.169). In the MRI patient group, 45 of 109 (41%) had a new lesion found, 32 were biopsied, and 14 of 32 were cancerous for a 13% new cancer detection rate, and a PPV3 of 44%.There was an increased rate of mastectomy among those with a second lesion that was malignant vs benign (60% vs 19%, p=0.008). There was no difference in overall mastectomy rates (29% with MRI vs 24% without MRI, p=0.391). Women who received preoperative breast MRI were an average of 10 years younger than those who did not (p<0.0001).

**CONCLUSION**

Pre-treatment MRI did not delay surgery in patients with newly diagnosed breast cancer. No significant difference in mastectomy rate was seen overall in the MRI group, but it was greater in the 13% of patients with additional cancer found by MRI. Patients receiving pre-treatment MRI at our institution were 10 years younger than those who did not.

**CLINICAL RELEVANCE/APPLICATION**

Individualized treatment for newly diagnosed breast cancer often involves consultation with various specialists and additional testing. In our setting, when additional testing utilized preoperative breast MRI, it didn't delay surgery, yet it found additional cancer important for treatment planning.

## BR117-ED- Metastatic Disease to the Breast: Common Findings in an Uncommon Clinical Entity

**MOA7**

Station #7

Participants
Rachel L. Delfanti, MD, San Diego, CA (*Presenter*) Nothing to Disclose
Haydee Ojeda-Fournier, MD, La Jolla, CA (*Abstract Co-Author*) Nothing to Disclose

**TEACHING POINTS**

Metastatic cancer to the breast is uncommon. Given recent Center for Disease Control reports of more patients living with metastatic disease for longer than 5 years, it is possible that the incidence of metastasis to the breast could increase. We searched a single institution reporting system and identified 11 metastasis to the breast between 2008 to 2014. The imaging modalities, morphologic features of the lesions and the patient clinical history were reviewed. At the end of this educational exhibit the learner will: 1. Understand the importance of metastatic disease to the breast, 2. Be able to identify the imaging features of metastatic cancer to the breast. 3. Be able to explain to both the clinician and the patient the significance of such findings.

**TABLE OF CONTENTS/OUTLINE**

Introduction; Historical perspective; Definitions: primary breast cancer v. metastatic breast cancer to the breast v. regional breast cancer metastasis; Review the incidence, evaluation, and diagnosis of metastasis to the breast; Significance of metastatic disease to the breast; Literature review of metastatic disease to the breast significance; Imaging work up; Illustrate the imaging finding of metastasis to the breast with multimodatily breast imaging; Algorithm for the management of metastatic disease to the breast; Test yourself with image and multiple choice questions.

## BR198-ED-MOA8 BRCA Positive Patients Undergoing Annual MRI Screening: Is there an Added Benefit to Continuing Annual Mammography?

Station #8

Participants
Brenna A. Chalmers, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose
Mary W. Yamashita, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Lingyun Ji, MS, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Duveen Sturgeon, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Sandy C. Lee, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Susan Groshen, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Lauren Alonzo, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Linda Hovanessian-Larsen, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose

**TEACHING POINTS**

1. To review current screening recommendations for patients considered to be at high risk for developing breast cancer.2. To be familiar with the genetic mutations that incur an increased breast cancer risk, including more recently discovered mutations such as ATM gene, which causes radiosensitivity leading to increased cancer susceptibility.3. To assess the benefit, if any, of continued annual mammography in addition to MRI in BRCA patients through illustrative case examples and retrospective analysis of data collected from our institution.

**TABLE OF CONTENTS/OUTLINE**

A. Summarize data from prior multicenter studies which showed MRI has a higher sensitivity than mammography in high risk patients.B. Review the current recommendations for breast cancer screening in high risk patients.C. Describe the genetic mutations that incur an increased risk of breast cancer.D. Present data from our institution of 38 BRCA 1/2 patients diagnosed with breast cancer from 2012 to 2013, including age at diagnosis, clinical presentation, type and size of cancer, and imaging modality(s) that showed cancer.E. Provide illustrative case examples with comparison of mammogram and MRI findings in BRCA 1/2 patients, specifically focusing on any added diagnostic information gained from mammogram over MRI.

BRS-MOB

## Breast Monday Poster Discussions

Monday, Nov. 30 12:45PM - 1:15PM Location: BR Community, Learning Center

BR

*AMA PRA Category 1 Credit ™*: .50

**Participants**
Dipti Gupta, MD, Chicago, IL (*Moderator*) Nothing to Disclose

**Sub-Events**

### BR234-SD-MOB2 BI-RADS 5th Edition Breast Density Classification: Comparison of Radiologist and Automated System

Station #2

Participants
Delia M. Keating, MD, New York, NY (*Presenter*) Nothing to Disclose
Donna D. D'Alessio, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Kimberly N. Feigin, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

BI-RADS 5th edition includes a revised approach to breast density categorization that considers not only estimation of percentage volume of fibroglandular tissue but also subjective assessment of tissue distribution to better reflect potential to obscure a lesion. Our study compares radiologists' scores of breast density to those of an automated breast density system that considers percent volume density combined with texture and dispersion pattern of breast tissue, in a clinical setting

#### METHOD AND MATERIALS

Following IRB approval, we performed a HIPAA-compliant retrospective review of imaging reports of 401 bilateral and unilateral digital screening mammograms performed from January 2015 to March 2015 and compared BI-RADS mammographic density scores assigned by one of 13 radiologists who specialize in breast imaging to those assigned by a fully automated breast density system ( VuCOMP, M-Vu Breast Density 2.1). Statistical analysis was performed with kappa statistic and Pearson chi- square test.

#### RESULTS

Of 401 asymptomatic patients who presented for bilateral or unilateral mammography, there was agreement of breast density scores in 241 (60%) yielding a kappa of 0.43, $p < .001$. The automated system underreported breast density: radiologists scored a, b, c, d in 13 ,31 ,45, 11% and automated system 20, 40, 30 , 9%, respectively. Pearson chi- square ($9, N = 401$) = 357.57, $p < .001$.

#### CONCLUSION

An automated breast density system that considers percent volume density as well as distribution of tissue, and that uses an algorithm that incorporates experts' scores to create category thresholds to align with BI-RADS 5th edition modifications may underreport breast density. Biases between radiologist scoring in a nonclinical, investigative setting and scoring in a clinical setting may contribute to these differences.

#### CLINICAL RELEVANCE/APPLICATION

Automated breast density software intends to lower subjectivity of density scores; however,compared to radiologists' scores the evaluated system underreports breast density in a clinical setting.

### BR235-SD-MOB3 Screen Detected Breast Cancer Conspicuity on Digital Breast Tomosynthesis versus Digital Mammography

Station #3

Participants
Katrina Korhonen, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Susan Weinstein, MD, Philadelphia, PA (*Abstract Co-Author*) Consultant, Siemens AG
Emily F. Conant, MD, Philadelphia, PA (*Abstract Co-Author*) Speaker, Hologic, Inc; Scientific Advisory Board, Hologic, Inc; Consultant, Siemens AG
Samantha P. Zuckerman, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Marie Synnestvedt, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Elizabeth McDonald, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To evaluate breast cancer conspicuity on the digital mammography (DM) versus digital breast tomosynthesis (DBT) acquisitions of combination DBT/DM screening to determine whether detected cancers are better seen on DM or DBT.

#### METHOD AND MATERIALS

After IRB approval, 201 cases of screen detected cancers from over 3 years of DBT/DM screening were reviewed by two fellowship-trained breast imagers. Cancer conspicuity was assessed using a numerical scale ranging from not seen (0) to clearly seen (5). 4 cases were excluded due to incomplete images/reader omission leaving 197 for analysis. Conspicuity grades were averaged between readers and differences between DBT and DM were assessed by Wilcoxon signed rank test. Associations of conspicuity score were also compared with patient age and breast density. For single variable analysis, density was grouped into "high" and "low" (BIRADs 1 and 2 vs 3 and 4). Multivariable linear regression was performed to identify independent predictors of conspicuity. Analyses were conducted using JMP software, v12 (SAS Institute Inc., Cary, NC).

**RESULTS**

Cancers were significantly better seen on DBT (mean 4.2) than DM (mean 3.7) (p=<0.0001). Cancers were also significantly better seen on CC vs MLO view of both DBT (mean CC 4.2, mean MLO 3.9, p=0.012) and DM (mean CC 3.6, mean MLO 3.3, p=0.0459), noting that 9 cancers were not included on the CC field of view. On DM, increased density was associated with decreased conspicuity (mean 3.3 high and 4.0 low density, p=0.0013), even when controlling for age (p=0.0001). Conspicuity on DBT also decreased with increasing density (4.1 high and 4.3 low density), but this was not significant (p=0.08).

**CONCLUSION**

Cancers were more conspicuous on DBT than DM and seen better on the CC view of both studies. Additionally, increased density is significantly associated with decreased cancer conspicuity in DM but not in DBT.

**CLINICAL RELEVANCE/APPLICATION**

Screen detected cancers on DBT and DM may be better seen on the CC view with overall conspicuity decreasing as breast density increases.

### BR236-SD-MOB4 Impact of 2D Reconstructed Mammograms on Patient Dose in the Clinical Practice of Tomosynthesis

Station #4

Participants
Bruno Barufaldi, BSC, MSc, Sao Carlos, Brazil (*Abstract Co-Author*) Nothing to Disclose
Samantha P. Zuckerman, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Marie Synnestvedt, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Emily F. Conant, MD, Philadelphia, PA (*Abstract Co-Author*) Speaker, Hologic, Inc; Scientific Advisory Board, Hologic, Inc; Consultant, Siemens AG
Homero Schiabel, PhD, Sao Carlos, Brazil (*Abstract Co-Author*) Nothing to Disclose
Andrew D. Maidment, PhD, Philadelphia, PA (*Presenter*) Research support, Hologic, Inc; Research support, Barco nv; Spouse, Employee, Real-Time Radiography, Inc; Spouse, Stockholder, Real-Time Radiography, Inc
Mitchell D. Schnall, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To investigate the impact on radiation dose of 2D reconstructed mammograms (C-View; Hologic Inc., Bedford, MA) in combination with digital breast tomosynthesis (DBT) in clinical practice.

**METHOD AND MATERIALS**

In 2014-15 our clinical practice, consisting of four Selenia Dimensions (Hologic Inc.), transitioned from "Combo" imaging to "TomoHD". In Combo mode, both 2D and 3D x-ray images are taken during the same breast compression. In TomoHD mode, no 2D image is acquired; rather, synthesized 2D mammograms are generated from the 3D images. We studied the impact of this change on radiation dose. The study includes 3936 images of 991 women from two 13-day periods in 2014 and 2015. The average glandular dose (AGD) was extracted by automated custom software. The software tracks radiation dose in terms of approximately 60 data elements including patient age, breast thickness, x-ray spectrum, room, procedure identifier, and view position.

**RESULTS**

Various factors affect the radiation dose, including compressed breast thickness, breast density, and radiographic technique. Over the considered time period in 2014, 485 Combo studies were performed (average age 55.3y), with an average AGD per view of 4.28 mGy (1.95 mGy 2D; 2.33 mGy 3D). In the matching period in 2015, 506 TomoHD studies were conducted (average age 54.6y), with an average AGD of 2.42 mGy. This represents a 43% dose reduction. These data also suggest that a practice changing from 2D digital mammography to TomoHD DBT imaging would see approximately a 24% increase in patient dose.

**CONCLUSION**

The implementation of TomoHD DBT, in which synthetic mammograms replace radiographically acquired mammograms, resulted in a 43% reduction in radiation dose in our patient population.

**CLINICAL RELEVANCE/APPLICATION**

Institutions transitioning from Combo to TomoHD should expect about a 40% reduction in dose, while those changing from digital mammography to TomoHD DBT should expect about a 25% increase in dose.

**Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Mitchell D. Schnall, MD, PhD - 2013 Honored Educator

### BR238-SD-MOB6 Breast Cancer Recurrence in Patients With and Without Adjuvant Radiation Therapy

Station #6

Participants
Wade C. Hedegard, MD, Rochester, NY (*Presenter*) Nothing to Disclose
Andrea L. Arieno, BS, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose
Renee Morgan, RT, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To review time between original cancer diagnosis and recurrent breast cancer diagnosis in patients treated with breast conserving surgery with and without adjuvant radiation therapy.

### METHOD AND MATERIALS

A retrospective, single-institution medical record review was performed of 9,005 breast cancers diagnosed at a community breast center from 2000-2013. We specifically evaluated 4,796 patients with 4,822 cancers treated with breast conserving surgery who developed an ipsilateral breast cancer recurrence. Charts were reviewed for patient demographics, clinical presentation for both primary and recurrent tumor, histopathology for both primary and recurrent tumor, time interval between the two diagnoses, tumor size for primary tumor, margin status for primary tumor, receptor status for primary tumor, and surgical treatment for recurrent tumor.

### RESULTS

Of 4,796 patients with 4,822 cancers treated with breast conserving surgery, 171 (3.5%) had recurrent tumor diagnosed. 29% (50/171) of the recurrences were not originally treated with adjuvant radiation therapy. Average time interval between original diagnosis and recurrence was 3.86 years. 14 presented with calcifications, 34 mass, 1 mass with calcification and 1 palpable thickening, of which 16 were of non-invasive pathology and 34 were of invasive pathology. 71% (121/171) of the recurrences were treated with adjuvant radiation therapy. Average time interval between original diagnosis and recurrence was 5.75 years. 38 presented with calcifications, 72 mass, 2 MRI, 1 nipple change, 1 palpable thickening and 1 complicated seroma, of which 31 were non-invasive and 90 were invasive.

### CONCLUSION

Recurrence in patients treated without radiation was on an average of 2 years earlier than those treated with radiation (3.86 v. 5.75 years, respectively).

### CLINICAL RELEVANCE/APPLICATION

Adherence to a more stringent imaging surveillance protocol is essential in patients treated without adjuvant radiation.

## BR136-ED-MOB7 Benign to Malignant Spectrum of Architectural Distortions on Digital Breast Tomosynthesis

Station #7

**Awards**

**Certificate of Merit**

Participants
Jennifer Young, MD, MPH, Los Angeles, CA (*Presenter*) Nothing to Disclose
Melissa M. Joines, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

With the advent of digital breast tomosynthesis (DBT), architectural distortions appear to be encountered more frequently as they are more easily visualized without overlying breast parenchyma obscuring features. After reviewing this presentation, participants will be able to:-Understand the role of DBT and reconstructed 2D images in identifying occult architectural distortions.-Identify architectural distortions on DBT and reconstructed 2D images.-Describe the histopathologic characteristics of various types of lesions that can present as architectural distortions.-Understand the management of the various types of lesions presenting as architectural distortions.

### TABLE OF CONTENTS/OUTLINE

-Review and benefits of DBT-Review and benefits of synthetically reconstructed 2D images-Synthetically reconstructed 2D images vs conventional 2D images and pitfalls-Detection of architectural distortion on DBT-Review of lesions presenting as architectural distortions-including imaging (mammograms, DBT, reconstructed 2D images, and ultrasound), management, histopathology, and teaching points Post-procedural change Reduction mammoplasty Fat necrosis Radial scar Non-calcified ductal carcinoma in situ Invasive ductal carcinoma Invasive lobular carcinoma

SSE01

## Breast Imaging (MR Response to Tx)

Monday, Nov. 30 3:00PM - 4:00PM Location: Arie Crown Theater

BR MR

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

**Participants**
Nola M. Hylton, PhD, San Francisco, CA (*Moderator*) Nothing to Disclose
Constance D. Lehman, MD, PhD, Seattle, WA (*Moderator*) Research Consultant, General Electric Company;

**Sub-Events**

### SSE01-01 DCE-MRI Early Predict Pathological Complete Response to Neoadjuvant Chemotherapy in Resectable Primary Breast Cancer

Monday, Nov. 30 3:00PM - 3:10PM Location: Arie Crown Theater

Participants
Ying-Shi Sun, MD, PhD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Yanling Li, MD, Beijing, China (*Presenter*) Nothing to Disclose
Xiaoting Li, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Kun Cao, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To establish a predictive model using dynamic enhanced MRI multi-parameters for early predicting pathological complete response (pCR) to neoadjuvant chemotherapy (NAC) in breast cancer.

#### METHOD AND MATERIALS

In this prospective cohort study, 170 breast cancer patients treated with NAC were enrolled and were randomly grouped into training sample (136 patients) and revalidation sample (34 patients). DCE-MRI parameters achieved before the start of the NAC and at the end of the first cycle of NAC were screened to establish the predictive model by using multivariate logistic regression model according to pCR status. Receiver operating characteristic curves were conducted to assess the predictive capability. The association between MRI-predicted pCR status and survival outcomes was estimated by using the Kaplan-Meier method.

#### RESULTS

Multivariate analysis showed ΔAreamax, ΔI and ΔSlopemax were independent predictors for pCR, OR were 0.939(95%CI, 0.915 to 0.964), and 0.966(95%CI, 0.947 to 0.986), respectively. A predictive model was established "Y=-0.089*ΔAreamax - 0.022*ΔSlopemax", a cut-off point of 2.8 was determined. The AUC for training and revalidation sample were 0.908 (95%CI, 0.844 to 0.972) and 0.884 (95%CI, 0.772 to 0.998), respectively. MRI-predicted pCR status showed significant association with DFS (P=0.045), nearly significant association with RFS (P=0.086) and no significant association with OS (P=0.23).

#### CONCLUSION

The multi-parameter MRI model can be potentially used for early predicting pCR status and especially be used for accurately finding out patients not achieving pCR. MRI-predicted pCR status achieved at an early stage of NAC allows regimen refinement before definitive surgical treatment.

#### CLINICAL RELEVANCE/APPLICATION

This is the first time that a prospective study has constructed a multi-parameter MRI model for early predicting pCR to neoadjuvant chemotherapy in breast cancer patients. The pCR status achieved at an early stage of NAC before surgical resection allows in time regimen alteration and give an opportunity to refine treatment plans before definitive surgical treatment. This might also serve as an early indicator for predicting comparative effectiveness in clinical trials.

### SSE01-02 Multiparametric Breast Magnetic Resonance Imaging (MRI) in Patients Eligible for Neoadjuvant Chemotherapy (NAC): Can We Predict Tumor Response According to Baseline Features?

Monday, Nov. 30 3:10PM - 3:20PM Location: Arie Crown Theater

Participants
Marta Maria Panzeri, Milan, Italy (*Presenter*) Nothing to Disclose
Francesco Ballati, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose
Claudio Losio, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Francesco A. De Cobelli, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose
Alessandro Del Maschio, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

NAC is the standard treatment of locally advanced breast cancer, but only a minority of the patients obtain a complete pathologic complete response (pCR), which correlates with prognosis. Identification of potential responders could avoid ineffective toxic treatment and delay in surgery. Breast MRI is considered the best technique for monitoring NAC, but there is no consensus on its predictive role. We evaluated the potential role of morphological, dynamic and functional tumor features, assessed with baseline MRI, as markers of tumor response to NAC.

#### METHOD AND MATERIALS

Seventy-two patients with histopathologically proven locally advanced breast cancer underwent baseline MRI (1.5T) before starting

NAC. T2 TSE sequences, diffusion-weighted imaging (DWI) and dynamic gadolinium-enhanced studies were performed. Morphological parameters included tumor size, morphology, presence or absence of pseudocapsule, oedema, rim enhancement, necrosis and vascular map. T2 signal intensity and Apparent Diffusion Coefficient (ADC) obtained from DWI were assessed. Dynamic parameters included kinetic curve patterns and contrast enhancement data (Maximum relative enhancement, Wash-in and wash-out rates, brevity of enhancement [BOE]). Final response to NAC was histopathologically defined. Univariate and multivariate analysis using logistic binary regression were performed.

**RESULTS**

All women completed NAC and 40% achieved a pCR. At univariate analysis, presence of peritumoral oedema was significantly associated with pCR [OR 3.33 (IC95%: 1.13-9.82), p=0.029]. Chemosensitive tumors showed higher mean ADC values [OR 1.03 (IC95%: 1.01-1.07), p=0.032]. BOE was higher in patients who achieved pCR [OR 1.08 (IC95%: 1.01-1.14), p=0.015]. At multivariate analysis, BOE [OR 1.08 (IC95%: 1.01-1.16), p=0.025] and mean ADC values [OR 1.03 (IC95%: 1.01-1.07), p=0.049] were significantly associated with pCR.

**CONCLUSION**

Some tumor features at baseline MRI are reflective of growth patterns and aggressiveness, influencing the response to NAC in different ways. BOE and ADC seem the strongest predictors of responsiveness.

**CLINICAL RELEVANCE/APPLICATION**

Quantitative DWI and Brevity of enhancement assessed with baseline Breast MRI can potentially predict chemosensitivity to NAC.

## SSE01-03 Tumor Heterogeneity Patterns on DCE-MRI Parametric Response Maps May Augment Early Assessment of Neoadjuvant Chemotherapy in Locally Advanced Breast Cancer: A Pilot Study of ACRIN 6657/I-SPY 1

Monday, Nov. 30 3:20PM - 3:30PM Location: Arie Crown Theater

Participants
Jia Wu, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Susan Weinstein, MD, Philadelphia, PA (*Abstract Co-Author*) Consultant, Siemens AG
Andrew Oustimov, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Lauren Pantalone, BS, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Ning Yu, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Yangming Ou, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Mark A. Rosen, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Angela DeMichele, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Christos Davatzikos, Philadelphia, PA (*Abstract Co-Author*) Shareholder, Gliomics LLC
Despina Kontos, PhD, Philadelphia, PA (*Presenter*) Nothing to Disclose

**PURPOSE**

To investigate the performance of tumor heterogeneity metrics derived from parametric response mapping (PRM), in their capacity to predict early pathologic complete response (pCR) to neoadjuvant chemotherapy (NAC) in women with locally advanced breast cancer, based on longitudinal assessment of dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI).

**METHOD AND MATERIALS**

A subset 27 patients from ACRIN 6657/I-SPY 1 TRIAL were retrospectively analyzed. Four kinetic features (i.e., signal enhancement ratio, peak enhancement, wash-in and wash-out slope) were computed separately from DCE-MRI acquired before chemotherapy and at the first post treatment visit. For each feature, voxel-wise measures of variation during chemotherapy were assessed via PRM, and the degree of spatial heterogeneity for these voxel-level variations were quantified by selected statistical texture-based indices. The resulting heterogeneity-based PRM-index was compared with current standard measures in predicting pCR using logistic regression, where each model was also adjusted for age and tumor subtype. Performance was assessed via receiver operating characteristic (ROC) analysis.

**RESULTS**

After adjusting for patient's age and tumor subtype (ER/PR+, Her2+, TN), the heterogeneity-based PRM-index outperformed all current standard measures (AUC = 0.93 (95% CI: 0.83 - 1.00), PRM-index p-value = 0.08), including the "hot spot" signal enhancement ratio (SER) (AUC = 0.87 (95% CI: 0.71 - 1.00), SER p-value = 0.76), tumor longest diameter (LD) (AUC = 0.89 (95% CI: 0.67 - 1.00), LD p-value = 0.13), and tumor volume (AUC = 0.87 (95% CI: 0.71 - 1.00), volume p-value = 0.34). A similar trend was observed for unadjusted models, although classification performance was generally lower across all models.

**CONCLUSION**

Our study provides preliminary evidence that metrics of spatial tumor heterogeneity are valuable in revealing patterns of early tumor response to breast NAC, and could augment pCR prediction based on standard MRI measures, age and tumor subtype.

**CLINICAL RELEVANCE/APPLICATION**

Patterns of quantitative tumor heterogeneity analysis based on voxel-level DCE-MRI kinetic feature changes may augment early prediction of tumor pathologic response to breast neoadjuvant chemotherapy.

## SSE01-04 Texture Analysis of Magnetic Resonance Images Predicts Ultimate Residual Cancer Burden (RCB) Scores in Patients Undergoing Neoadjuvant Chemotherapy for Breast Cancer

Monday, Nov. 30 3:30PM - 3:40PM Location: Arie Crown Theater

Participants
Shelley Waugh, PhD, Dundee, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Sarah J. Vinnicombe, MRCP, FRCR, Dundee, United Kingdom (*Presenter*) Nothing to Disclose
Colin Purdie, MBChB,PhD, Dundee, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Richard A. Lerski, PhD, Dundee, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

Marilyn Johnston, Dundee, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Andrew Evans, MRCP, FRCR, Dundee, United Kingdom (*Abstract Co-Author*) Research Grant, SuperSonic Imagine Speakers Bureau, SuperSonic imagine
Alastair Thompson, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To evaluate whether lesion heterogeneity, as measured using texture analysis on Magnetic Resonance Imaging (MRI), is associated with residual cancer burden in patients receiving neoadjuvant chemotherapy (NAC) for primary breast cancer.

**METHOD AND MATERIALS**

IRB approval was waived for this retrospective study of anonymised data. T2-weighted images (voxel size: 1.1 mm3) from 61 consecutive patients undergoing a total of 6 cycles of anthracycline based NAC. All patients underwent baseline (pre-NAC) and interim (post 3-cycles of NAC) MRI examinations on a 32-channel 3.0T MRI scanner (Trio; Siemens, Erlangen) using a 7 element open breast biopsy coil. Texture analysis was performed using MaZda (University of Lodz, Poland) with manually placed regions of interest within the lesion on one slice matched between each imaging time-point. Lesion heterogeneity was assessed using the entropy feature as derived from the co-occurrence matrix.Final pathological response on the resected cancer was assessed using the Residual Cancer Burden (RCB), (calculated from tumour bed dimensions, cellularity and axillary node burden.

**RESULTS**

Patients who ultimately achieved a pathological complete response (pCR; RCB-0) or who had minimal residual disease (RCB-I) demonstrated a greater reduction in lesion heterogeneity between baseline and interim examinations compared with those who ultimately went on to have moderate (RCB-II) or extensive (RCB-III) disease at surgical resection (Figure 1). Average reduction in entropy values between baseline and interim examinations were as follows: pCR:20.0%, RCB-I:10.6%, RCB-II:6.8% and RCB-III: 3.4%.Differences in entropy change were highly significant ($p<0.001$; Mann-Whitney U) between the good responders (pCR and RCB-I) and the poor responders (RCB-II and RCB-III).

**CONCLUSION**

Changes in lesion T2 heterogeneity between baseline and interim MR examinations, as measured using texture analysis of T2-weighted images, can predict residual cancer burden after NAC for breast cancer.

**CLINICAL RELEVANCE/APPLICATION**

Changes in lesion T2 heterogeneity on MR imaging between baseline and 3 cycles of NAC are strongly associated with ultimate pathologic response and could therefore facilitate timely surgical planning.

## SSE01-05 Higher Background Parenchymal Enhancement at Preoperative MRI: Association with Poor Prognosis in Breast Cancer Patients Treated with Neoadjuvant Chemotherapy

Monday, Nov. 30 3:40PM - 3:50PM Location: Arie Crown Theater

Participants
Ji Soo Choi, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Sook Ko, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Boo-Kyung Han, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Young Ko, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ga Ram Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To retrospectively investigate whether background parenchymal enhancement(BPE) of the contralateral breast at preoperative dynamic contrast material-enhanced magnetic resonance imaging(DCE-MRI) are associated with therapy outcome in patients with unilateral invasive breast cancer after neoadjuvant chemotherapy(NAC).

**METHOD AND MATERIALS**

The institutional review board approved this retrospective study. Between 2009 and 2011, 170 women with unilateral invasive breast cancers had undergone NAC, and pre- and post-treatment DCE-MRI before curative breast surgery. Among these, 93 women (43 premenopausal women who performed pretreatment MRI between day 7 and 20 of the menstrual cycle, 50 postmenopausal women) were finally included in this study. MRI features (BPE grade [minimal, mild, moderate, severe] of contralateral breast, size and number of lesions, lesion kinetics, and the percent change of lesion size between pre- and post-treatment MRI) and clinicopathologic features (age, menopausal status, clinical tumor and nodal stages, pathologic response to NAC, tumor size, nuclear grade, immunohistochemical subtype, presence of lymphovascular invasion, and adjuvant therapy) were analyzed. Patients were grouped according to BPE grade (high [moderate or severe], low [minimal or mild]) of contralateral breast. A Cox regression model was used to determine the association between MRI features and disease-free survival after controlling for clinicopathologic variables.

**RESULTS**

Median follow-up was 46 months. There were 23 recurrent cases(2 ipsilateral breast, 6 regional, 15 distant). Multivariate analysis showed that high BPE of contralateral breast at pretreatment DCE-MRI(hazard ratio [HR]=4.242, P=0.005), lower change of lesion size between pre- and post-treatment MRI(HR=1.024, P=0.002), presence of lymphovascular invasion(HR=10.194, P<0.001), and triple negative cancer(HR=4.820, P=0.006),were independent factors associated with poor disease-free survival.

**CONCLUSION**

BPE of contralateral breast is significantly associated with long-term outcome of patients with unilateral invasive breast cancer who had undergone NAC. This study suggests that higher BPE at pretreatment DCE-MRI may have potential as a predictor for relatively poor outcome in breast cancer patients who undergo NAC.

**CLINICAL RELEVANCE/APPLICATION**

Higher BPE at pretreatment DCE-MRI may have potential as a predictor for relatively poor outcome in breast cancer patients who undergo NAC

## SSE01-06 Baseline DCE-MRI and PET-CT as a Predictor of Pathologic Response in Patients Treated with Neodjuvant Chemotherapy (NAC) for Locally Advanced Breast Cancer

Monday, Nov. 30 3:50PM - 4:00PM Location: Arie Crown Theater

Participants
Loic Colleter, MD, Paris, France (*Presenter*) Nothing to Disclose
Emmanuelle Cauderlier, Caen, France (*Abstract Co-Author*) Nothing to Disclose
Marine Bricout, MD, Angers, France (*Abstract Co-Author*) Nothing to Disclose
Constance de Margerie-Mellon, Paris, France (*Abstract Co-Author*) Travel support, Guerbet SA
Marion Chapellier, Paris, France (*Abstract Co-Author*) Nothing to Disclose
Marcela Albiter, MD, Paris, France (*Abstract Co-Author*) Nothing to Disclose
Eric De Kerviler, MD, Paris, France (*Abstract Co-Author*) Research Consultant, Galil Medical Ltd; Speaker, Guerbet SA
Cedric M. De Bazelaire, MD, PhD, Paris, France (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To evaluate DCE-MRI analysis and PET-CT at baseline for prediction of pathological response to neoadjuvant chemotherapy (NAC) in patients with locally advanced breast cancer.

### METHOD AND MATERIALS

88 patients with locally advanced breast cancer treated with NAC followed in DCE-MRI at 1.5T and PET-CT were included in this retrospectively study. Perfusion parameters (Ktrans, Kep, Ve) and SUVmax were measured at baseline of the NAC. Imaging datas were compared with tumoral and nodal pathologic response and histopathological tumor characteristics (SBR, Ki67, Hormonal Receptors (HR), HER2, and p53).

### RESULTS

Response were observed in 54 patients (61%) and non-response in 34 patients. Low Ve and high SUVmax were significatively associated with tumoral response to NAC (Ve, t-test, p = 0,0035 ; SUVmax, t-test, p = 0,0265). Other perfusion parameters were not significatively associated to pathological response. Low Ve and high SUVmax were significantly associated with histopathological agressivity markers (SBR III, Ki67 > 15%, negative HR, p53 muted). Only low Ve was associated with nodal response (t-test, p = 0,048).

### CONCLUSION

Ve and SUVmax before NAC were associated with tumoral response and histopathological aggressivity markers.

### CLINICAL RELEVANCE/APPLICATION

Ve and SUVmax before NAC can predict tumoral response and histopathological aggressivity markers.

SSE02

## Breast Imaging (Screening Issues)

Monday, Nov. 30 3:00PM - 4:00PM Location: E450A

BR DM SQ

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

**Participants**
Paula B. Gordon, MD, Vancouver, BC (*Moderator*) Stockholder, OncoGenex Pharmaceuticals, Inc ; Scientific Advisory Board, Hologic, Inc; Scientific Advisory Board, RealImaging
Etta D. Pisano, MD, Charleston, SC (*Moderator*) Founder, NextRay, Inc CEO, NextRay, Inc Research Grant, Koning Corporation Research Grant, Koninklijke Philips NV Research Grant, Zumatek, Inc Research Grant, FUJIFILM Holdings Corporation Equipment support, Siemens AG Research Grant, Siemens AG Equipment support, Koninklijke Philips NV Research Grant, Koninklijke Philips NV

**Sub-Events**

### SSE02-01 Evolution of a Breast Screening Program: Indicators of Efficacy

Monday, Nov. 30 3:00PM - 3:10PM Location: E450A

Participants
Samantha L. Heller, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Sam Dumonteil, MBBS, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Sue Hudson, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Louise S. Wilkinson, MBBCh, FRCR, London, United Kingdom (*Presenter*) Nothing to Disclose

#### PURPOSE

The purpose of this study is to evaluate how changes in practice and technology have impacted upon indicators of program efficacy in a regional breast screening program, including cancer detection rates (CDR), invasive versus in situ disease detection rates, repeat operation rates, and age adjusted mortality.

#### METHOD AND MATERIALS

This retrospective audit adheres to local policy on confidentiality.: Breast screening database was interrogated from March 1995 to April 2014. :Number of women screened, recall rates, short term follow-up rates, overall CDR, invasive cancers, in situ cancers, interval cancers, and repeat operation rates were identified and compared for early versus later years of the screening program.

#### RESULTS

834,201 women were invited for routine screening over the study period, and 587,648 (70%) attended with 5021 cancers detected.: Over study period, national screening age range has broadened (50-70 vs. 50-64) and:many more women are screened per year (39,506 vs. 23,934).: There has been an increase in CDR (0.97% vs. 0.83) with an increase in detection of in situ :disease (0.267% versus 0.167%) and a decrease in interval cancer rate (0.15% versus 0.20%).: There has also been a decrease in repeat operation rate:(15.7% versus 21.7%).:: Finally, there has been a decrease in regional age adjusted mortality (16.81/100,0000 vs. 26.95/100,000) (see Table 1).::

#### CONCLUSION

Over the time period of the screening program, multiple improved performance indicators are noted, including increased CDR, decreased interval cancer rate, and decreased repeat operation rate.: This is thought to be multifactorial, secondary to technological and quality assurance factors, including core biopsy versus fine needle aspiration (FNA), adoption of bilateral whole breast ultrasound/bilateral axillary ultrasound in the context of newly diagnosed cancer, use of digital mammography, and vacuum assisted excision versus surgical excision.: We also find an age-adjusted decrease in regional mortality from breast cancer, but it is difficult to prove that this is related to screening alone.:

#### CLINICAL RELEVANCE/APPLICATION

This study evaluates changing factors contributing to improvements in our breast screening program.: :Results put into question negative evaluations of breast screening's efficacy based only on studies from early days of practice.

### SSE02-02 The Inevitable Proportion of Overdiagnosis in the Norwegian Breast Cancer Screening Program

Monday, Nov. 30 3:10PM - 3:20PM Location: E450A

Participants
Solveig S. Hofvind, Oslo, Norway (*Presenter*) Nothing to Disclose
Marta Roman, Oslo, Norway (*Abstract Co-Author*) Nothing to Disclose
Ragnhild Falk, Oslo, Norway (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To estimate the number of overdiagnosed women, defined as those diagnosed with breast cancer and who die within the lead-time period.

#### METHOD AND MATERIALS

In this modeling cohort study, we used incidence- and death statistics available online and published estimates of lead-time. Postulated cohorts of screened and not screened women aged 50-51 were followed for a period corresponding to ten biennial screening exams during 20 years, and further ten years, to age 78-79. The increase in breast cancer incidence due to screening was estimated based on lead-time. The proportion of women diagnosed with breast cancer who died within the lead-time period

was assessed based on the differences in the cumulative number of breast cancer diagnosed in the non-screened and screened cohort.

**RESULTS**

The proportion of overdiagnosed women in screened compared to non-screened cohort was 1.8%. Sensitivity analyses using various assumptions increased the estimates up to a maximum of 4%

**CONCLUSION**

The proportion of women with breast cancer diagnosed after participation in a screening program and who died within the estimated lead-time period was less than 4%. This inevitable proportion of overdiagnosis, should be emphasized in the definition and communication of the issue.

**CLINICAL RELEVANCE/APPLICATION**

Approximately 2% of women with breast cancer diagnosed in a screening program are estimated to die within the lead-time period.

## SSE02-03 The False Negative Rate of Annual Screening Mammography at an American Academic Institution Using Digital Technology

Monday, Nov. 30 3:20PM - 3:30PM Location: E450A

Participants
Hannah Perry, MD,MS, Boston, MA (*Presenter*) Nothing to Disclose
Jordana Phillips, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Shambhavi Venkataraman, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Vandana M. Dialani, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Valerie J. Fein-Zachary, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Alexander Brook, PhD, Boston, MA (*Abstract Co-Author*) Spouse, Research Grant, Guerbet SA
Tejas S. Mehta, MD, MPH, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

The majority of published data on the Breast Imaging medical audit is not based on current American practice and includes programs that screen biennially or used film-screen mammography (MG). Current practice data is needed as performance metrics become more transparent. We determine the false negative rate at an American academic institution that screens annually using digital MG, and evaluate the MG features of these cases.

**METHOD AND MATERIALS**

Patients diagnosed with breast cancer (BC) between 1/1/12 and 9/30/12 with a negative MG within 15 months prior to diagnosis (index MG) were included. Those with index MGs from outside institutions were excluded.Index MGs were reviewed by three breast imagers in two phases (initially blinded followed by non-blinded) according to the European Guidelines for Quality Assurance in BC Screening and Diagnosis. MGs were classified as true negative (TN) if initially correctly interpreted as negative and included true interval cancers, MG occult cancer, or minimal signs. MGs were classified as false negative (FN) if initially incorrectly interpreted due to reader or technical error and represented missed BC. Abnormalities were recorded as calcifications, mass/focal asymmetry, asymmetry, or distortion.

**RESULTS**

71 of 220 BC cases met inclusion criteria. Average age was 60.5 years (range 38.5 - 87.6, SD 10.4). 33/71 (46%) had fatty or scattered fibroglandular tissue and 38/71 (54%) were heterogeneous or extremely dense. There were 13/71 (18%) in situ and 58/71 (82%) invasive cancers.57/71 (80%) were TN and 14/71 (20%) were FN (95% CI: 12-31%). Of the 57 TN, there were 33 (58%) interval cancers, 3 (5%) MG occult cancers and 21 (37%) minimal signs. Of 21 minimal signs, 6 were calcifications, 9 asymmetries, and 6 mass/focal asymmetry. Of the FN, all cases were due to reader error, with 5 calcifications, 2 asymmetries and 7 mass/focal asymmetry. Imaging presentation of the index MG was not different between the TN and FN groups.

**CONCLUSION**

Our American academic institution annual digital screening mammogram (MG) program had a false negative (FN) rate of 20%, compared to 20-30% reported for film-screen or biennial MG. FN cases had no distinguishing MG features.

**CLINICAL RELEVANCE/APPLICATION**

Our annual digital screening mammogram (MG) program had a false negative (FN) rate of 20%, compared to 20-30% reported for film-screen or biennial MG. FN cases had no distinguishing MG features.

## SSE02-04 Balancing the Benefits and Harms Among Women Targeted by the Norwegian Breast Cancer Screening Program

Monday, Nov. 30 3:30PM - 3:40PM Location: E450A

Participants
Solveig S. Hofvind, Oslo, Norway (*Presenter*) Nothing to Disclose
Marta Roman, Oslo, Norway (*Abstract Co-Author*) Nothing to Disclose
Sofie Sebuodegard, Oslo, Norway (*Abstract Co-Author*) Nothing to Disclose
Ragnhild Falk, Oslo, Norway (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

The balance between benefits and harms of mammographic screening is debated. Our purpose was to estimate a balance sheet of benefits and harms for the NBCSP.

**METHOD AND MATERIALS**

Data from published studies using individual level data from the NBCSP were used to assess the reduction in breast cancer mortality

versus over-diagnosis. The program invites all Norwegian women aged 50-69 years to biennial mammographic screening. The mortality reduction in the studies varied from 36.8% to 43.0% among screened women, with an average estimate of 39.9%. Estimates of over-diagnosis ranged from 1.8% to 19.6%, with an estimated average of 10.7%. The cumulative risk of a false positive result was 15.9% for additional imaging and 4.1% for an invasive assessment. The benefit-detriment ratio was computed for different scenarios of mortality reduction and over-diagnosis.

**RESULTS**

For every 10,000 women screened according to the invitations and followed until age 79 we estimated that 54-63 women are saved from breast cancer death, 11-126 are over-diagnosed, 1590 have a false positive result with non-invasive assessment and 410 have a false positive result with invasive procedures. The benefit-harm ratio between mortality reduction and over-diagnosis was 0.4, 0.8, and 5.7 under the less favorable, average and most favorable estimates, respectively.

**CONCLUSION**

Using average estimates showed that about one woman is saved from breast cancer death for each woman over-diagnosed. The ratio estimates varied substantially and should be interpreted with care before it is communicated to women targeted by the screening program

**CLINICAL RELEVANCE/APPLICATION**

Approximately one woman is estimated to be saved from breast cancer death for each woman over-diagnosed in the Norwegian Breast Cancer Screening Program, although estimates varied substantially.

## SSE02-05 Is One Prior Enough: Does Comparing with Multiple Prior Examinations Impact Recall Rates at Screening Mammography?

Monday, Nov. 30 3:40PM - 3:50PM Location: E450A

Participants
Jessica H. Hayward, MD, San Francisco, CA (*Presenter*) Nothing to Disclose
Kimberly M. Ray, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Dorota J. Wisner, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Edward A. Sickles, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Bonnie N. Joe, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To evaluate the impact of comparison with multiple prior mammograms on the screening mammography recall rate (RR) relative to comparison with a single prior mammogram.

**METHOD AND MATERIALS**

We performed a retrospective search of our institutional mammography database for screening mammograms performed at our facility between 6/14/2010 and 3/3/2015. This yielded a dataset of 46,317 consecutive screening mammograms performed in 22,792 women. We collected data on patient age, dates of mammograms recorded as comparisons in the clinical report and recommendations for recall. Generalized estimating equation logistic model was used to determine the relative odds of recall as a function of the number of comparison exams without and with adjustment for age as a confounding variable.

**RESULTS**

A total of 3,845 screening mammograms were interpreted with no prior comparison mammograms, 5,749 exams were interpreted with a single prior and 36,723 exams were interpreted with two or more priors. Screening recall rates for mammograms interpreted with no priors, one prior and two or more priors were 16.6%, 7.8%, and 6.3%, respectively. The unadjusted odds ratio (OR) of recall for mammograms compared with multiple priors versus one prior was 0.789 (95% CI: 0.711, 0.877; p<0.0001). After adjusting for patient age, the OR of recall for the multiple prior group relative to the single prior group was 0.864 (95% CI: 0.776, 0.962; p=0.0074).

**CONCLUSION**

Comparison with two or more prior mammograms resulted in a statistically significant 14% reduction in the screening mammography recall rate relative to comparison with a single prior.

**CLINICAL RELEVANCE/APPLICATION**

Comparison with multiple prior mammograms is a more effective strategy for reducing the screening mammography recall rate than comparison with a single prior.

## SSE02-06 Is it Necessary to Perform Standard (Implant-full) Views in Screening Mammography for Women with Breast Implants?

Monday, Nov. 30 3:50PM - 4:00PM Location: E450A

Participants
Gun Ha Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Hak Hee Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Joo Hee Cha, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hee Jung Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Young Chae, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Woo Jung Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To investigate the necessity of standard (implant-full) views in screening mammography for women with breast implants.

**METHOD AND MATERIALS**

1441 mammograms with 838 silicone and 603 saline breast implants performed between January 2009 and September 2014 were evaluated by two radiologists in consensus. Of the 1441 mammograms, 1328 were screening mammograms. Implant ruptures and breast cancer with regard to the incidence, detection rate by implant-displaced (ID) and implant-full (IF) views, mean age of ruptured implants, mean average glandular dose were assessed. Implant ruptures were confirmed by US, MRI or surgery and breast cancer were proven by pathology.

**RESULTS**

In 1328 screening mammograms, implant ruptures were found in 14 (14/1328, 1%); 12 were intracapsular and the remaining two were extracapsular ruptures. Intracapsular ruptures were detected with indirect sign in 7 (7/12, 58.3%) on IF views and 1 (1/12, 8.3%) on ID views. All extracapsular ruptures (2/2, 100%) were demonstrable on both views. Incidental detection of implant ruptures on mammograms which could not be demonstrable on US or MRI was absent. The mean age of the ruptured implants was 16 years (range, 6 - 30 years). Breast cancer were found in 3 (3/1328, 0.2%); two cases were found only on ID views and the other one was demonstrable on both views. The mean average glandular dose per breast was 3.42 mGy for IF views and 1.88 mGy for ID views.

**CONCLUSION**

The diagnostic gain of IF views in screening of implant ruptures and breast cancer was low. The mean average glandular dose for IF views was 1.8 times higher than for ID views. Considering clinical low impact and cumulative radiation, routine performance of IF views for screening mammography need to be reconsidered.

**CLINICAL RELEVANCE/APPLICATION**

The number of women with breast augmentation is increasing, but there are no widely accepted imaging guidelines. Routine performance of IF views for screening mammography need to be reconsidered.

ED001-TU

## Breast Tuesday Case of the Day

Tuesday, Dec. 1 7:00AM - 11:59PM Location: Case of Day, Learning Center

**BR**

*AMA PRA Category 1 Credit ™*: .50

**Participants**
Susan O. Holley, MD, PhD, Saint Louis, MO (*Presenter*) Research Consultant, Biomedical Systems
Michelle V. Lee, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Eugene Y. Kim, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Michyla L. Bowerson, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Wendi A. Owen, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Catherine M. Appleton, MD, Saint Louis, MO (*Abstract Co-Author*) Scientific Advisory Board, Hologic, Inc; Royalties, Oxford University Press;
Whitney A. Manlove, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Onalisa D. Winblad, MD, Kansas City, KS (*Abstract Co-Author*) Nothing to Disclose
Jill A. Jones, MD, Kansas City, KS (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1) Identify, characterize, and analyze abnormal findings on multimodality breast imaging studies. 2) Develop differential diagnostic considerations based on the clinical information and imaging findings. 3) Recommend appropriate management for the patients based on imaging findings.

MSRO31

## BOOST: Breast-Oncology Anatomy (An Interactive Session)

Tuesday, Dec. 1 8:30AM - 10:00AM Location: S103AB

BR RO

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

**Participants**
Cristina Fuss, MD, Portland, OR, (fussc@ohsu.edu) (*Presenter*) Nothing to Disclose
Jean L. Wright, MD, New York, NY (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Understand breast and regional lymph node anatomy. 2) Be familiar with how the basic anatomic images appear on a variety of imaging modalities. 3) Be familiar with breast and regional lymph node contouring techniques used in radiation treatment planning for breast cancer. 4) Apply principles of critical thinking to ideas from experts and peers in the radiologic sciences.

RC315

## Breast Series: Emerging Technologies in Breast Imaging

Tuesday, Dec. 1 8:30AM - 12:00PM Location: Arie Crown Theater

BR MR

*AMA PRA Category 1 Credits* ™: 3.25
ARRT Category A+ Credits: 4.00

FDA Discussions may include off-label uses.

**Participants**
Emily F. Conant, MD, Philadelphia, PA (*Moderator*) Speaker, Hologic, Inc; Scientific Advisory Board, Hologic, Inc; Consultant, Siemens AG
Margarita L. Zuley, MD, Pittsburgh, PA (*Moderator*) Research Grant, Hologic, Inc;
Bonnie N. Joe, MD, PhD, San Francisco, CA (*Moderator*) Nothing to Disclose

**Sub-Events**

### RC315-01 MRI Acquisition and DWI

Tuesday, Dec. 1 8:30AM - 8:50AM Location: Arie Crown Theater

Participants
Savannah C. Partridge, PhD, Seattle, WA (*Presenter*) Nothing to Disclose

#### LEARNING OBJECTIVES

1) Review the basics of clinical breast MRI acquisition. 2) Identify factors that may impact image quality and interpretation. 3) Describe advanced MRI approaches with potential value for breast imaging.

#### ABSTRACT

### RC315-02 Correlation of R2* Value Using Iterative Decomposition of Water and Fat with Echo Asymmetry and Least-squares Emission (IDEAL) with Histologic Prognostic Factor and Hypoxic Biomarker

Tuesday, Dec. 1 8:50AM - 9:00AM Location: Arie Crown Theater

Participants
Mari Miyata, MD, Kitakyushu, Japan (*Presenter*) Nothing to Disclose
Takatoshi Aoki, MD, PhD, Kitakyushu, Japan (*Abstract Co-Author*) Nothing to Disclose
Atsuji Matsuyama, MD, Kitakyushu, Japan (*Abstract Co-Author*) Nothing to Disclose
Shohei Shimajiri, MD, Kitakyushu, Japan (*Abstract Co-Author*) Nothing to Disclose
Shunsuke Kinoshita, Kitakyushu, Japan (*Abstract Co-Author*) Nothing to Disclose
Yukunori Korogi, MD, PhD, Kitakyushu, Japan (*Abstract Co-Author*) Nothing to Disclose
Yoshiko Hayashida, MD, Fukuoka, Japan (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Hypoxic breast cancers are difficult to treat by radiation and chemotherapy, and a fibrotic focus (FF) induced by hypoxia is an important predictor of early tumor recurrence. The purpose of this study is to correlate R2* value using iterative decomposition of water and fat with echo asymmetry and least-squares emission (IDEAL) with FF and hypoxic biomarker (HIF-1α) in breast carcinoma.

#### METHOD AND MATERIALS

This study consisted of 30 patients who were diagnosed with invasive carcinoma of breast and underwent breast MRI including IDEAL before surgery. The scan time of IDEAL R2* map imaging was 23 sec. Entire region of interest (ROI) was delineated on the R2* map carefully, and average tumor R2* value was calculated for each ROI. Histological specimens were evaluated for the presence of FF (a scar-like lesion near the center of a carcinoma) and the grading of HIF-1α (0, no staining; 1, weakly positive and/or positive cells in less than 10 %; 2, moderately positive and/or positive cells in 10-50 %; 3, strongly positive and/or positive cells in more than 50 %) by 2 pathologists and final decision was reached by consensus.

#### RESULTS

Fibrotic focus was identified in 43.3% (13/30) breast carcinomas. Average R2* value for breast carcinoma with FF (45.1±18.9) was significantly higher than that without FF (29.8±13.9) ($p<0.05$). Spearman rank correlation suggested that average R2* value correlated with the grade of HIF-1α ($p<0.05$), and the grade of HIF-1α with FF was significantly higher than that without FF ($p < 0.01$).

#### CONCLUSION

Quantification of tumor R2* using IDEAL is associated with the presence of FF and the overexpression of HIF-1α, and may therefore be a useful prognostic and hypoxic biomarker for breast carcinoma.

#### CLINICAL RELEVANCE/APPLICATION

In vivo IDEAL-R2*imaging is simple to perform without extrinsic contrast agent and the R2* value may be useful for therapeutic strategy for breast carcinoma.

### RC315-03 Apparent Diffusion Coefficient Values of Breast Cancer and Normal Breast Tissue in Diffusion-weighted Imaging: Effects of the Menstrual Cycle and Menopausal Status

Tuesday, Dec. 1 9:00AM - 9:10AM Location: Arie Crown Theater

Participants
Jin You Kim, MD, Busan, Korea, Republic Of (*Presenter*) Nothing to Disclose
Shinyoung Park, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jin Il Moon, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ji Won Lee, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Suk Kim, MD, Pusan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To investigate whether the apparent diffusion coefficient (ADC) values of breast tumor and normal fibroglandular tissue vary with the menstrual cycle and menopausal status.

**METHOD AND MATERIALS**

The institutional review board approved this prospective study, and informed consent was obtained from each participant. Forty-six patients (20 premenopausal and 26 postmenopausal) with newly diagnosed breast cancer underwent diffusion-weighted (DW) imaging with b values of 0 and 1,000 s/mm2 twice (interval 12-21 days) before surgery. Two radiologists independently measured the ADC values of the breast tumor and normal fibroglandular breast tissue of the contralateral breast and the differences according to the phases of the menstrual cycle and postmenopausal breast were evaluated. The reproducibility of the ADC measurement was analyzed using the intraclass correlation coefficient (ICC).

**RESULTS**

The ADC values of normal fibroglandular tissue were significantly higher in premenopausal women than in postmenopausal women (1.77±0.25×10-3 vs. 1.53±0.12×10-3 mm2/s; P = 0.007). In premenopausal women, the ADC values of the breast tumor did not differ significantly between the proliferative and secretory phases of the menstrual cycle (0.92±0.128×10-3 vs. 0.93±0.150×10-3 mm2/s; P = 0.421). No significant differences were observed in the ADC values of normal breast tissue in relation to the menstrual cycle phase (1.74±0.22×10-3 vs. 1.77±0.25×10-3 mm2/s; P = 0.202). In postmenopausal women, there were no significant differences in the ADC values of either breast tumors or normal fibroglandular tissue between the two time intervals (P = 0.983 and P = 0.363, respectively); the magnitude of the ADC differences was similar in women who were taking estrogen-replacement therapy and those who were not (P = 0.368 and P = 0.418, respectively). The intra- and interobserver agreement was excellent for all of the ADC measurements, with ICCs ranging from 0.84 to 0.94.

**CONCLUSION**

The ADC values of breast cancer and normal fibroglandular tissue are not affected by the change in the menstrual cycle and the ADC measurements are highly reproducible within and across observers.

**CLINICAL RELEVANCE/APPLICATION**

Since ADC values are not influenced by the change in the menstrual cycle, it is not necessary to restrict the timing of performing diffusion-weighted imaging of the breast to a certain phase of the menstrual cycle.

## RC315-04 Unenhanced Breast MRI (STIR, T2-weighted TSE, DWIBS): An Accurate and Alternative Strategy for Detecting and Differentiating Breast Lesions

Tuesday, Dec. 1 9:10AM - 9:20AM Location: Arie Crown Theater

Participants
Marco Moschetta, MD, Bari, Italy (*Presenter*) Nothing to Disclose
Michele Telegrafo, MD, Bari, Italy (*Abstract Co-Author*) Nothing to Disclose
Leonarda Rella, Bari, Italy (*Abstract Co-Author*) Nothing to Disclose
Amato Antonio Stabile Ianora, Bari, Italy (*Abstract Co-Author*) Nothing to Disclose
Giuseppe Angelelli, Bari, Italy (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To assess the role of STIR, T2-weighted TSE and DWIBS sequences for detecting and characterizing breast lesions and to compare unenhanced (UE)-MRI results with contrast enhanced (CE)-MRI and histological findings, having the latter as the reference standard.

**METHOD AND MATERIALS**

280 consecutive patients (age range, 27-73 years; mean age ± standard deviation (SD), 48.8 ± 9.8 years) underwent MR examination with a diagnostic protocol including STIR, T2-weighted TSE, THRIVE and DWIBS sequences. Two radiologists blinded to both dynamic sequences and histological findings evaluated in consensus STIR, T2-weighted TSE and DWIBS sequences and after two weeks CE-MRI images searching for breast lesions. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy for UE-MRI and CE-MRI were calculated. UE-MRI results were also compared with CE- MRI.

**RESULTS**

UE-MRI sequences obtained sensitivity, specificity, diagnostic accuracy, PPV and NPV values of 94%, 79%, 86%, 79% and 94 %, respectively. CE-MRI sequences obtained sensitivity, specificity, diagnostic accuracy, PPV and NPV values of 98%, 83%, 90%, 84% and 98%, respectively. No statistically significant difference between UE-MRI and CE-MRI was found.

**CONCLUSION**

Breast UE-MRI could represent an accurate diagnostic tool and a valid alternative to CE-MRI for evaluating breast lesions. STIR and DWIBS sequences allow to detect breast lesions while T2-weighted TSE sequences and ADC values could be useful for lesion characterization.

**CLINICAL RELEVANCE/APPLICATION**

Unenhanced MR imaging of the breast including STIR, T2-weighted TSE and DWIBS sequences could characterize breast lesions, although not yet able to avoid histological characterization.

## RC315-05 Breast Cancer: Feasibility and Preliminary Experience of Diffusion Kurtosis Imaging for Detection and Assessment of Invasive Ductal Carcinoma Comparing with Intravoxel Incoherent Motion and Conventional Diffusion-weighted Imaging

Tuesday, Dec. 1 9:20AM - 9:30AM Location: Arie Crown Theater

Participants
Kun Sun, Shanghai, China (*Presenter*) Nothing to Disclose
Fuhua Yan, MS, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To assess the feasibility of diffusion-kurtosis imaging (DKI) for distinguishing benign from malignant breast lesions in comparison with IVIM and conventional DWI

### METHOD AND MATERIALS

The institutional review board approved this retrospective HIPAA-compliant study and waived informed consent. Twenty-five breast disease patients who underwent surgery from January 2014 and April 2014 were retrospectively analyzed. Multi-b-value diffusion images with five b values (range:0-2800s/mm²) were acquired and processed using the DKI model, yielded kurtosis (K),and corrected diffusion(D) coefficient, similarly, IVIM model was also acquired with 5 b values(range:0-200s/mm²), yielded D*,D,f,ADC, The apparent diffusion coefficient (ADC) was also calculated using the conventional mono-exponential diffusion weighted imaging (DWI) model with 2 b values(50,1000) .Two radiologists reviewed these maps and measured the all these parameters. Two independent sample t test was employed and receiver operating characteristic curves were plotted for data analysis.

### RESULTS

Among the 25 patients, 15(60%) were invasive ductal carcinoma and 10 (40%) were fibroadenoma. The area under the curve for all these parameters as following: DKI model: 0.973 for K, 0.967 for D;IVIM model::0.74 for D*,:0.793 for D, 0.673 for f, 0.947 for ADC; Conventional DWI: 0.90 for ADC. Then we chosen K represent DWI model, IVIM-ADC represent IVIM model, ADC represent Conventional DWI model to compare the diagnostic accuracy. Although the area under the curve of K was relatively higher than IVIM-ADC and Conventional ADC, there's no significant difference (P>0.05).K was significantly higher in the malignant lesions than in the benign lesions (0.91±0.13vs.0.68±0.10,P<0.0001). IVIM- ADC and Conventional ADC were significantly lower in the malignant lesions than in the benign lesions (0.93±0.14 vs.1.05±0.20 and 1.53±0.35 vs.1.60±0.43, respectively, P<0.0001).

### CONCLUSION

DKI model had a similar diagnostic ability with IVIM and DWI model in assessing benign and malignant breast lesions. Performing DKI model with quantification K values reduces the overlap between benign and malignant lesion than ADC values from IVIM and DWI model.

### CLINICAL RELEVANCE/APPLICATION

DKI model had a similar diagnostic ability with IVIM and DWI model in assessing benign and malignant breast lesions.

## RC315-06 DBT Technology

Tuesday, Dec. 1 9:30AM - 9:50AM Location: Arie Crown Theater

Participants
Martin J. Yaffe, PhD, Toronto, ON (*Presenter*) Research collaboration, General Electric Company Founder, Matakina International Ltd Shareholder, Matakina International Ltd Co-founder, Mammographic Physics Inc

### LEARNING OBJECTIVES

1) To review the basic principles of digital breast tomosynthesis (DBT). 2) Identify factors that may impact image quality and interpretation.

## RC315-07 Detection and Classification of Calcifications on Two-dimensional Mammography: Comparison of Synthetic Mammography Reconstructed from Digital Breast Tomosynthesis and Full-field Digital Mammography

Tuesday, Dec. 1 9:50AM - 10:00AM Location: Arie Crown Theater

Participants
Ji Soo Choi, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Young Ko, MD, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Ga Ram Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Boo-Kyung Han, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Sook Ko, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Soo Yeon Hahn, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To evaluate the interpretative performance of two-dimensional (2D) synthetic mammography (SM) reconstructed from digital breast tomosynthesis (DBT) in the detection and classification of calcifications, compared to 2D full-field digital mammography (FFDM).

### METHOD AND MATERIALS

The institutional review board approved this study, and the patients' informed consent was waived. Between January and October 2013, 73 patients with 81 calcifications (40 biopsy proven malignant calcifications, 24 biopsy-proven benign calcifications, 17 typical benign calcifications) were consecutively enrolled. For each patient, FFDM and DBT were performed, and SM was reconstructed from each set of DBT slices. Three breast radiologists, blinded to the histology, interpreted SM and FFDM images and recorded the conspicuity (three-point scale; 1 low conspicuity, 2 medium conspicuity, 3 high conspicuity) and the presence of calcifications, and corresponding BI-RADS categories. Diagnostic performance of SM was compared with that of FFDM in terms of percentage of detected calcifications (detection sensitivity) and the percentage of times each detected calcifications was

correctly classified as benign or malignant. BI-RADS category 2 was assigned as negative and BI-RADS category greater than or equal to 3 was assigned as positive.

**RESULTS**

There was no significant difference in detection sensitivity of calcifications between SM (range 91.4-95.1%) and FFDM (range 85.2-90.1%) for all readers (P>0.05). The conspicuity scores of SM and FFDM were also not significantly different for each observer (range of mean scores 1.9-2.8 for SM, 1.9-2.8 for FFDM; P > 0.05). For correct classification of calcifications, there was no significant difference between SM (68.9-74.0%) and FFDM (62.1-69.6%) for all readers (P>0.05). Of discordant cases between SM and FFDM, correct classifications were more frequent with SM, compared to FFDM for all readers.

**CONCLUSION**

Diagnostic performance of SM and FFDM are comparable for detection and classification of calcifications. Therefore, our results indicate that SM may overcome the limitation that DBT may underestimate the calcifications during DBT-based screening.

**CLINICAL RELEVANCE/APPLICATION**

SM may overcome the limitation that DBT may underestimate the calcifications. DBT with SM may be sufficient in the detection and classification of calcifications during DBT-based screening, without addition of FFDM

## RC315-08 Comparison of Low Dose Tomosynthesis Plus Synthesized Mammography and Digital Mammography Alone for Breast Cancer Screening

Tuesday, Dec. 1 10:00AM - 10:10AM Location: Arie Crown Theater

Participants
Tokiko Endo, MD, Nagoya, Japan (*Presenter*) Institutional research support, FUJIFILM Holdings Corporation
Takako Morita, MD, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
Mikinao Ooiwa, Nagaya, Japan (*Abstract Co-Author*) Nothing to Disclose
Namiko Suda, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
Misaki Shiraiwa, MD, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
Kazuaki Yoshikawa, MD, Hamada, Japan (*Abstract Co-Author*) Nothing to Disclose
Yukie Hayashi, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
Hirotoshi Ogawa, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
Takao Horiba, Kagamihara, Japan (*Abstract Co-Author*) Nothing to Disclose
Yasuyuki Satoh, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
Shu Ichihara, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
Naokazu Kamiya, Ashigarakami-gun, Japan (*Abstract Co-Author*) Employee, FUJIFILM Holdings Corporation
Takahisa Arai, Ashigarakami-gun, Japan (*Abstract Co-Author*) Employee, FUJIFILM Holdings Corporation
Tomonari Sendai, Ashigarakami-Gun, Japan (*Abstract Co-Author*) Employee, FUJIFILM Holdings Corporation

**PURPOSE**

To compare the diagnostic performance (sensitivity, specificity and AUC) of breast tomosynthesis (DBT) plus synthesized mammography (S2D) with several-levels of dose reduction versus conventional digital mammography (FFDM) alone in breast cancer screening.

**METHOD AND MATERIALS**

An institutional review board approved this study and informed consent was provided by all patients. Images of 200 breasts were acquired from 100 subjects aged 27-86 years (mean, 53 years) who underwent FFDM and DBT with the same positioning and included both mediolateral oblique and craniocaudal views. All FFDM images were acquired at normal dose (AGD 0.65 ~ 4.16mGy). For DBT, half the patients were imaged at the same dose level (AGD 0.95 ~ 3.19mGy) of FFDM and the remainder at about 75% (AGD 0.87 ~ 2.7mGy). In addition, DBT + S2D images with 60% dose were generated virtually using approximately half the normal 15 projection images. The DBT + S2D images with dose reduction were processed by improved reconstruction algorithms. Eight radiologists specialized in breast imaging were divided equally into two groups and each group reviewed images of 100 breasts retrospectively. The FFDM and DBT + S2D images were interpreted independently with an interval of minimum 4 weeks for memory washout. Diagnostic performance was assessed by comparing sensitivity, specificity and area under the receiver operating characteristic (ROC) curve.

**RESULTS**

We found no significance difference in sensitivity and specificity between FFDM and DBT + S2D acquired with normal dose. Furthermore, FFDM and DBT + S2D acquired with 75% dose showed a significant difference in sensitivity (P = .043) keeping specificity and AUC because spiculated or lobulated masses were more precisely identified by the improved DBT images.

**CONCLUSION**

Dose reduction is possible with DBT + S2D in screening with the same sensitivity and specificity as FFDM. In addition, the improvement of reconstruction algorithm has the potential to provide higher sensitivity, even when the dose is reduced more than 25% compared to FFDM.

**CLINICAL RELEVANCE/APPLICATION**

Screening by DBT + S2D with the improved reconstruction algorithm contributes to not only dose reduction, but also improved sensitivity keeping specificity.

## RC315-09 Impact on Recall Rates Following Implementation of Synthesized 2D Mammography in Digital Breast Tomosynthesis Screening

Tuesday, Dec. 1 10:10AM - 10:20AM Location: Arie Crown Theater

**Awards**
**Trainee Research Prize - Resident**

Participants
Samantha P. Zuckerman, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Emily F. Conant, MD, Philadelphia, PA (*Abstract Co-Author*) Speaker, Hologic, Inc; Scientific Advisory Board, Hologic, Inc; Consultant, Siemens AG
Susan Weinstein, MD, Philadelphia, PA (*Abstract Co-Author*) Consultant, Siemens AG
Marie Synnestvedt, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Katrina Korhonen, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Elizabeth McDonald, MD, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

The combination of digital breast tomosynthesis (DBT) with full field digital mammography (DM) decreases recall rates and improves cancer detection in breast cancer screening compared to using DM alone. Synthesized 2D images (s2D) are being used to replace conventional DM as a method to reduce dose. However, the reconstructed s2D images frequently have a different appearance varying by breast density and lesion type, particularly "calcification-only" lesions. We have evaluated the early implementation of s2D in a population screened entirely with s2D/DBT and compared recall rates and recall finding types to similar historic outcomes from DM/DBT screening. Comparison of cancer detection rate is on-going.

**METHOD AND MATERIALS**

Recall rates and lesion type were compared for 15,571 women screened with DM/DBT from October 1, 2011-February 28, 2013 and 2,090 women screened with s2D/DBT from January 7th, 2015 to March 20th, 2015. Data collection is on-going. Differences between groups were compared using Wilcoxon rank sum test.

**RESULTS**

Overall recall rate for s2D/DBT was 8.3% compared to 8.8% for DM/DBT (p=0.45). In addition, s2D/DBT screening was not associated with a significant change in the distribution of recalled lesion type. The percentage of screened patients recalled for calcifications, masses, asymmetries, architectural distortion and technical reasons was 1.6, 2.4, 3.8, 1.1 and 0.05 for s2D/DBT compared to 1.6, 2.7, 4.5, 1.0 and 0.2 for DM/DBT (p=ns). Specifically, there was no change in the rate of recall for calcific lesions.

**CONCLUSION**

Preliminary data demonstrates stable recall rates and lesion types with the replacement of DM with s2D in combination with DBT. Ongoing data collection will allow comparison of cancer detection rates and PPVs.

**CLINICAL RELEVANCE/APPLICATION**

The replacement of DM with s2D in combination with DBT will lead to decreased radiation dose in screening with DBT with maintenance of recall reduction.

## RC315-10 Synthesized 2D Mammography+Tomosynthesis: Can We See Clearly?

Tuesday, Dec. 1 10:20AM - 10:30AM Location: Arie Crown Theater

Participants
Melissa A. Durand, MD, New Haven, CT (*Presenter*) Research Grant, Hologic, Inc
Madhavi Raghu, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Jaime L. Geisel, MD, New Haven, CT (*Abstract Co-Author*) Consultant, QView Medical, Inc; Consultant, Siemens AG
Regina J. Hooley, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Xiaopan Yao, PhD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Liane E. Philpotts, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Compare synthesized 2D mammography+tomosynthesis (C-view+Tomo) to 2D mammography+tomosynthesis (2D+Tomo) in a clinical setting.

**METHOD AND MATERIALS**

Screening mammograms were performed with C-view+Tomo and 2D+Tomo from 8/1/2014-1/9/2015. A hanging protocol showed C-view+Tomo first, followed by 2D+Tomo. Findings (calcifications, asymmetries, masses, architectural distortions) on C-view+Tomo were prospectively assessed as better, equally, or less well seen compared to 2D+Tomo. Separate BIRADS final assessments were recorded and Kappa statistics assessed agreement. Recall and cancer detection rates were compared with Fisher's exact test. Multivariate logistic regression analysis determined effect of breast density or age on visualization of C-view+Tomo findings.

**RESULTS**

201 C-view+Tomo and 2D+Tomo mammograms were performed. 4 types of findings were recorded (calcifications 50.8%,102/201;asymmetries 28.9%,58/201;masses 14.4%,29/201;architectural distortions 6.0%,12/201). 53.7% (108/201) were not dense and 46.3% (93/201) were dense; average age 56 years. 82.1% (165/201) of findings were equally/better seen with C-view+Tomo, 17.9% (36/201) less well seen. This was most evident for architectural distortions and calcifications (architectural distortions 100%,12/12); calcifications 96.1%,98/102;asymmetries 63.8%,37/58;masses 62.1%,18/29). Logistic regression models showed neither density nor age had a significant effect on visibility of findings (p 0.8358 density;p 0.3336 age). Kappa statistics showed perfect agreement in BIRADS assessment for architectural distortions (K 1.0000), strong agreement for asymmetries (K 0.9695) and masses (K 0.9247), moderate agreement for calcifications (K 0.7850). Recall rates were not significantly different (C view: 10.9%,22/201; 2D: 9.45%,19/201); p 0.7421). All recalled patients returned for diagnostic imaging. 6 biopsies were performed and 2 malignancies found (PPV1:10.5%;PPV3:33.3%). Cancer detection rate was the same as both cancers were identified on both modalities.

**CONCLUSION**

C-view+Tomo shows the majority of mammographic findings equally well/better than 2D+Tomo, regardless of breast density or age, with equitable recall rates and cancer detection.

**CLINICAL RELEVANCE/APPLICATION**

Visibility of findings on C-view+Tomosynthesis is at least equal to 2D, with no significant difference in recall rates or cancer detection, and suggests potential as a screening modality.

## RC315-11 Synthetized Digital Mammography Compared to Conventional Digital Mammography in a Diagnostic Setting

Tuesday, Dec. 1 10:30AM - 10:40AM Location: Arie Crown Theater

Participants
Giovanna Mariscotti, Turin, Italy (*Abstract Co-Author*) Nothing to Disclose
Manuela Durando, Turin, Italy (*Presenter*) Nothing to Disclose
Camilla Bogetti, MD, Torino, Italy (*Abstract Co-Author*) Nothing to Disclose
Pier Paolo Campanino, Turin, Italy (*Abstract Co-Author*) Nothing to Disclose
Elisa Regini, Torino, Italy (*Abstract Co-Author*) Nothing to Disclose
Mirella Fasciano, Turin, Italy (*Abstract Co-Author*) Nothing to Disclose
Giulia Schivazappa, Turin, Italy (*Abstract Co-Author*) Nothing to Disclose
Enrica Caramia, Turin, Italy (*Abstract Co-Author*) Nothing to Disclose
Alessia Milan, Torino, Italy (*Abstract Co-Author*) Nothing to Disclose
Paolo Fonio, Vercelli, Italy (*Abstract Co-Author*) Nothing to Disclose
Giovanni Gandini, MD, Torino, Italy (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To compare the diagnostic performances of conventional Digital Mammography (DM) versus Synthetized Digital Mammography (SDM) used alone (without combination with Digital Breast Tomosynthesis (DBT) images) in the identification and characterization of breast malignant and benign lesions in a diagnostic setting.

**METHOD AND MATERIALS**

A retrospective observer performance study was performed using anonymized images acquired between August 2014 and January 2015 (compliant to protocols approved by the Institutional Ethic Committee). The sample included 120 consecutive patients with 73 biopsy-proven cancer (confirmed histologically) and 64 biopsy-proven benign lesions. All patients (after signing an informed consent) had undergone DM combined to DBT; SDM images were obtained in both standard views. Two dedicated breast radiologists, blinded to the clinical information and histological diagnosis, retrospectively reviewed all the studies. The readers reviewed separately DM images and then SDM studies, in a different order. BIRADS category was used for the classification of the findings in both techniques. Mammographic features (mass, architectural distortion, microcalcification, asymmetry) were also indicated. A statistical analysis was performed on the data, by evaluating the differences in sensitivity (SE), specificity (SP), negative and positive predictive value (NPV and PPV) between DM and SDM. Accuracy was calculated by using areas under the receiver operating characteristic curve (AUC) for both techniques.

**RESULTS**

The SE and SP were respectively 78.6% and 67.9% for DM and 87.1% and 63.5% for SDM. No significant differences were found regarding SE and SP between DM and SDM (p=0.14 and 0.63). The AUC was 0.75 for DM and 0.81 for SDM. There were not significant differences between both AUC´s (p=0.27). By stratifying the results according to mammographic features, SDM better identified and classified (according to BIRADS category) architectural distortions than DM.

**CONCLUSION**

In our study, SDM alone is comparable in performance to DM, demonstrating a similar SE, SP and AUC values; SDM could be used instead of DM in addition to DBT images as part of routine clinical study.

**CLINICAL RELEVANCE/APPLICATION**

Preliminary studies suggest that SDM alone is comparable in performance to DM, so it could be used instead of DM in addition to DBT images as part of routine clinical study.

## RC315-12 Clinical Evidence of DBT Utility

Tuesday, Dec. 1 10:50AM - 11:10AM Location: Arie Crown Theater

Participants
Sarah M. Friedewald, MD, Chicago, IL (*Presenter*) Consultant, Hologic, Inc; Research Grant, Hologic, Inc

**LEARNING OBJECTIVES**

1) Acquire brief knowledge of the basics of tomosynthesis aquisition, interpretation and implementation. 2) Learn the clinical evidence that supported FDA approval for tomosynthesis. 3) Describe the European Clinical Evidence. 4) Describe the American Clinical Evidence. 5) Be aware of the additional studies needed for further research.

## RC315-13 Tomosynthesis in Diagnostic Mammography - Continued Change after Three Years of Experience

Tuesday, Dec. 1 11:10AM - 11:20AM Location: Arie Crown Theater

Participants
Reni S. Butler, MD, New Haven, CT (*Presenter*) Nothing to Disclose
Vivek B. Kalra, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Jaime L. Geisel, MD, New Haven, CT (*Abstract Co-Author*) Consultant, QView Medical, Inc; Consultant, Siemens AG
Jacquelyn Crenshaw, RT, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Liane E. Philpotts, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To assess how the initial impact of tomosynthesis on the diagnostic work-up changes with increasing experience over a 3 ½ year

time interval.

**METHOD AND MATERIALS**

After IRB approval, a HIPAA-compliant retrospective review of diagnostic mammography examinations was performed before and at three time points over a 3 ½ year period after tomosynthesis implementation. Diagnostic exams were performed on 2D digital mammography units (Selenia, Hologic, Bedford, MA) prior to tomosynthesis implementation and on both 2D and 3D digital breast tomosynthesis units (Dimensions, Hologic, Bedford, MA) in the 3 ½ years after implementation. Total number of additional views (AV), spot compression views (SCV) and magnification views (MV), were recorded during a one month period immediately prior to tomosynthesis (2D) and compared to one month periods during the second (3D1), third (3D2), and fourth year (3D3) after tomosynthesis utilization. The number of "routine" diagnostic studies, consisting only of MLO and CC views, was recorded for each time point. Statistical analysis was performed using the two-tailed student t-test with unequal variance.

**RESULTS**

The study population consisted of 497 2D diagnostic mammograms (2D) and 350 (3D1), 410 (3D2), and 314 (3D3) tomosynthesis diagnostic exams. AV, SCV and MV per exam decreased each year from 2.07, 0.84 and 0.85 (2D) to 1.42, 0.59 and 0.73 (3D1), 1.11, 0.33 and 0.41 (3D2), and 0.53, 0.23 and 0.20 (3D3), respectively. Significant differences were observed in all categories between 2D and 3D1, 3D1 and 3D2, and 3D2 and 3D3 ($p < 0.01$). Concordantly, the number of routine diagnostic exams increased from 29.9% (2D) to 41.4% (3D1), 44.9% (3D2), and 73.3% (3D3), ($p < 0.01$).

**CONCLUSION**

In the first 3½ years after tomosynthesis implementation, there has been a continual shortening of the diagnostic work-up from year to year. This data suggests a learning curve exists in developing comfort with utilizing tomosynthesis in the diagnostic setting and that, with time, fewer additional views are seen to be necessary. The majority of diagnostic cases require only the routine views, making the difference between screening and diagnostic mammography start to blend.

**CLINICAL RELEVANCE/APPLICATION**

Reported experience from a diagnostic center where tomosynthesis was adopted early may aid in shortening the learning curve at centers implementing tomosynthesis presently or in the future.

## RC315-14 Biopsy Outcomes Following Diagnostic Work-up with Digital Breast Tomosynthesis

Tuesday, Dec. 1 11:20AM - 11:30AM Location: Arie Crown Theater

Participants
Madhavi Raghu, MD, New Haven, CT (*Presenter*) Nothing to Disclose
Melissa A. Durand, MD, New Haven, CT (*Abstract Co-Author*) Research Grant, Hologic, Inc
Liva Andrejeva-Wright, MD, Wallingford, CT (*Abstract Co-Author*) Nothing to Disclose
Regina J. Hooley, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Jaime L. Geisel, MD, New Haven, CT (*Abstract Co-Author*) Consultant, QView Medical, Inc; Consultant, Siemens AG
Liane E. Philpotts, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To compare the positive predictive value of biopsies performed (PPV3) before and after the implementation of tomosynthesis.

**METHOD AND MATERIALS**

A retrospective review of all biopsies performed following diagnostic work-up with mammography before (2D: June 2010-June 2011) and three consecutive years (3D1:1/1/2012-12/31/2012; 3D2:1/1/2013-12/31/2014; 3D3:1/1/2014-12/31/2014) following the implementation of tomosynthesis was conducted. The recorded mammographic features of lesions recommended for biopsy (masses, architectural distortions (AD), calcifications (Ca++) and asymmetries) and subsequent pathology were evaluated. The PPV3 was compared and trends from year to year were evaluated.

**RESULTS**

A total of 3567(2D), 3385(3D1), 4542(3D2) and 4507 (3D3) diagnostic mammograms were performed. There was a nonsignificant slight decrease in the proportion of BI-RADS 4,5 studies: 2D 8.5% (304/3567), 3D1 7.9% (269/3385), 3D2 8.4% (384/4542), 3D3 7.7% (345/4507)) as well as biopsies performed over time: 2D 94% (287/304); 3D1 96% (257/269); 3D2 93% (358/384); 3D3 93% (321/345)). With tomosynthesis, there was a 40% increase in the PPV3 over time, from 29% in 2D (85/287) to 41.2% (3D1;106/257;p=.005), 45% (3D2;162/358;p<.0001) and 51.1% (3D3;164/321;p<.0001). Of the total malignancies in the 2D group, 69% were masses, 2.3% AD, 28% Ca++ and 0% asymmetries. With tomosynthesis there was an increase in the proportion of malignancies manifesting as noncalcified lesions, particularly masses (66%(3D1), 78%(3D2), 80%(3D3)) and AD (4.7%(3D1), 3.0% (3D2), 5.5%(3D3)), with a small proportion of cancers manifesting as asymmetries (3.8% (3D1), 1.9% (3D2) and 0%(3D3)). Over time, calcifications made up a smaller proportion of the malignancies (24.5%(3D1), 16.7%(3D2), 15.2%(3D3)).

**CONCLUSION**

Utilization of tomosynthesis resulted in a significant increase of 40% in the PPV3 for BIRADS 4, 5 lesions, demonstrating increased diagnostic acumen in characterizing lesions requiring biopsy.

**CLINICAL RELEVANCE/APPLICATION**

Diagnostic work up with tomosynthesis resulted in a significant and steady increase in the PPV.

## RC315-15 Clinical and Imaging Features of Tomosynthesis Occult Breast Cancer and Reasons for Non-Detection

Tuesday, Dec. 1 11:30AM - 11:40AM Location: Arie Crown Theater

Participants
Liva Andrejeva-Wright, MD, Wallingford, CT (*Abstract Co-Author*) Nothing to Disclose
Regina J. Hooley, MD, New Haven, CT (*Presenter*) Nothing to Disclose
Kaitlin Eng, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose

Jonathan R. Weisiger, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Madhavi Raghu, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Reni S. Butler, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Liane E. Philpotts, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Laura S. Sheiman, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To investigate the clinical and imaging features of tomosynthesis (DBT) occult cancers and determine reasons for non-detection of these cancers.

**METHOD AND MATERIALS**

This is a HIPPA compliant study with IRB approval. Between August 2011 and December 2014, a retrospective database review identified 32 cancers in 32 women diagnosed by breast ultrasound (US) or MR within one year of a normal combined DBT + 2D mammogram. Patient breast cancer risk, mammographic density, and tumor histology were assessed. Three radiologists blinded to clinical outcomes and study purpose reviewed each mammogram to determine if the cancers were truly mammographically occult. Two radiologists unblinded to clinical outcomes also reviewed each case in order to determine reasons why cancers were undetected.

**RESULTS**

The average patient age was 57 years (range 41-82). Breast cancer risk was average in 44% (14/32), intermediate in 22% (7/32), and increased in 34% (11/32). Breast density was scattered fibroglandular in 13% (4/32), heterogeneously dense in 69% (22/32), and extremely dense in 19% (6/32). Cancer detection was made by US in 75% (24/32) and by MR in 25% (8/32), with 4/9 MR detected cancers also identified on MR-directed US. Four cancers were DCIS and 28 were invasive, including 20 ductal and 8 lobular tumors. Of the invasive cancers 12 were grade1, 13 were grade 2, and 3 were grade 3. 63% (20/32) of the cancers were diagnosed more than two years since implementation of DBT. Upon case review, 72% (23/32) cases were truly occult on DBT and 28% (9/32) were seen retrospectively, including subtle findings in 16% (5/32) and interpretative errors in 13% (4/32). Of 4 cancers missed due to interpretive error, three were spiculated masses and one was a subtle architectural distortion (avg. tumor size 30 mm, range 13 - 66 mm).

**CONCLUSION**

The majority of DBT occult cancers were invasive, detected in women with dense breast tissue, and identified on US. These cancers may be seen in women across all risk groups and may occur despite more than two years of reader experience. Subtle masses and architectural distortions were the common findings in tumors identified retrospectively. Cancers missed due to interpretive error tended to be large.

**CLINICAL RELEVANCE/APPLICATION**

Despite the increased sensitivity of tomosynthesis combined with 2D mammography, some cancers may still be occult and radiologists should be aware of the limitations of tomosynthesis.

## RC315-16 Comparing the Performance of Full-Field Digital Mammography (FFDM), Digital Breast Tomosynthesis (DBT) and Whole Breast Ultrasound (WBUS) in the Initial Staging Evaluation of Breast Cancer: Interim Results of a Prospective Study

Tuesday, Dec. 1 11:40AM - 11:50AM Location: Arie Crown Theater

Participants
Rosalind P. Candelaria, MD, Houston, TX (*Presenter*) Nothing to Disclose
Monica L. Huang, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Beatriz E. Adrada, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Elsa M. Arribas, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Marion E. Scoggins, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Wei T. Yang, MD, Houston, TX (*Abstract Co-Author*) Researcher, Hologic, Inc
Jennifer G. Schopp, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Mark J. Dryden, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
H. Carisa Le-Petross, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Tanya W. Moseley, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Gary J. Whitman, MD, Houston, TX (*Abstract Co-Author*) Book contract, Cambridge University Press
Gaiane M. Rauch, MD, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Lumarie Santiago, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To determine the incremental cancer detection rate (ICDR) of FFDM+DBT and FFDM+DBT+WBUS when compared to FFDM alone in the local staging of patients with recently diagnosed invasive breast cancer (BI-RADS 6) and patients with mammograms and/or ultrasound highly suspicious for invasive breast carcinoma (BI-RADS 5).

**METHOD AND MATERIALS**

This IRB-approved, prospective study was performed in a single, large tertiary cancer center. Informed written consent was obtained. We enrolled the first 100 women who were referred to our center from 12/2014-3/2015, met inclusion criteria and agreed to participate. All women had FFDM with DBT followed by WBUS; FFDM interpretation occurred blinded to DBT images. WBUS was performed with knowledge of FFDM/DBT results. Suspicious lesions on FFDM, DBT or WBUS farthest apart in the breast were biopsied to determine disease extent and to establish multifocality and/or multicentricity. Gold standard for diagnosis of malignancy was histopathology from needle biopsy and/or surgery. A separate surgical plan was recorded for each patient based on findings from FFDM alone, FFDM+DBT and FFDM+DBT+WBUS. In patients who did not have mastectomy, true negatives were defined by negative clinical and imaging assessment at 12-month follow-up (pending).

**RESULTS**

Median patient age was 54 years, range 26-82. Mean index tumor size was 2.1 cm, range 0.4-15. Mean satellite tumor size was 1.2

cm, range 0.4-4.2. Breast tissue density among the study group was predominantly fatty (1%), scattered fibroglandular (26%), heterogeneously dense (70%) and extremely dense (3%). ICDR of FFDM+DBT when compared to FFDM alone was 1% (exact 95% CI:0.02%-5.4%) in the ipsilateral and 0% (exact 95% CI:0%-5.7%) in the contralateral breast. ICDR of FFDM+DBT+WBUS when compared to FFDM alone was 20% (exact 95% CI:12.7%-29.2%) in the ipsilateral and 1.6% (exact 95% CI:0.04%-8.7%) in the contralateral breast. FFDM+DBT findings changed the surgical plan in 1% while FFDM+DBT+US findings changed the surgical plan in 20%.

**CONCLUSION**

Our interim analysis indicates that there is a greater increase in cancer detection in the ipsilateral and contralateral breasts when adding WBUS to FFDM, compared to adding DBT to FFDM.

**CLINICAL RELEVANCE/APPLICATION**

In large tertiary cancer centers, use of FFDM+DBT provides no significant advantage over FFDM when staging breast cancer; more studies are needed to establish proper indications for DBT in the diagnostic setting.

## RC315-17 Analysis of False Negative Exams in 2D and Tomosynthesis Screening Mammography: Comparison by Breast Density

Tuesday, Dec. 1 11:50AM - 12:00PM Location: Arie Crown Theater

Participants
Liane E. Philpotts, MD, New Haven, CT (*Presenter*) Nothing to Disclose
Cameron Thomson, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose
Melissa A. Durand, MD, New Haven, CT (*Abstract Co-Author*) Research Grant, Hologic, Inc
Madhavi Raghu, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Regina J. Hooley, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

While digital breast tomosynthesis (DBT) has been shown to increase specificity in screening mammography, the sensitivity of this new modality has not yet been determined. The purpose of this study was to assess the false negative cases in patients undergoing screening with different technologies - 2D FFDM, DBT, +/- supplemental screening ultrasound.

**METHOD AND MATERIALS**

An IRB-approved, retrospective search of the breast imaging database (PenRad, MN) was performed to identify all screening mammograms over a two year period (8/1/11 - 7/31/13) when both DBT and 2D machines were utilized (Hologic Dimensions or Selenia) yielding 14, 295 DBT (8,291 not dense, 6,004 dense) and 10,132 2D (6,943 not dense, 3,189 dense) exams. Thirty percent of women with dense tissue underwent supplemental screening ultrasound (US). All false negative exams were identified through PenRad and reviewed for method of diagnosis, breast density, and cancer type and size.

**RESULTS**

The 2D cancer detection rate (per 1000) was significantly different for dense and non dense (7.3 versus 3.4, p=0.02) however, it was similar in the DBT group (not dense 5.3, dense 5.4). Eleven cancers were identified as false negatives (10 Invasive, 1 DCIS): 6 in the 2D group (6/10,132, 0.6 per 1000) and 5 in the DBT group (5/14,295, 0.3 per 1000)(p=0.56, NS). Five were palpable interval cancers (4 in the 2D group and 1 in the DBT group). Missed cancers in the DBT group were smaller (mean 10mm, range 5-15mm) and more likely to be diagnosed by MRI (3/5, 60%) compared to those in the 2D group, which were larger (mean 20mm, range 10-45mm) and palpable (4/6, 67%). The missed cancer rate in the dense patients (6/9,193, 0.7 per 1000) was not significantly different to not dense patients (5/15,234, 0.3 per 1000)(p=0.39, NS). Of 3000 patients undergoing screening US, only two interval cancers were identified; one as a palpable mass 8 months after screening US, and the other as a new 8mm mass found on 6 months follow up of a different BIRADS 3 lesion.

**CONCLUSION**

In our current practice, missed cancers were infrequent and occurred at a similar rate in dense as in non dense women. Cancers in false negative DBT exams were smaller and more likely to be found by MRI.

**CLINICAL RELEVANCE/APPLICATION**

Current screening modalities including DBT and screening US are proving to result in a very low rate of missed and interval cancers.

MSRO32

## BOOST: Breast-Integrated Science and Practice (ISP) Session

Tuesday, Dec. 1 10:30AM - 12:00PM Location: S103AB

BR OI RO

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

**Participants**
Anna Shapiro, MD, Syracuse, NY (*Moderator*) Nothing to Disclose
Katherine L. Griem, MD, Chicago, IL (*Moderator*) Nothing to Disclose

**Sub-Events**

### MSRO32-01 Invited Speaker:

Tuesday, Dec. 1 10:30AM - 10:40AM Location: S103AB

Participants
William Small JR, MD, Maywood, IL (*Presenter*) Speakers Bureau, Carl Zeiss AG

### MSRO32-02 Potencial Benefits of Neoadjuvant Radiation Therapy in Overall Survival of Advanced Breast Cancer Patients

Tuesday, Dec. 1 10:40AM - 10:50AM Location: S103AB

Participants
Lilian Faroni, Rio De Janeiro, Brazil (*Abstract Co-Author*) Nothing to Disclose
Daniel Przybysz, MD, RIO DE JANEIRO, Brazil (*Presenter*) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): To analyze 66 patients with inoperable breast cancer who failed to neoadjuvant chemotherapy and were rescued with radiotherapy prior to surgery.Materials/Methods: From a total of 10.199 registered breast cancer patients, 3.365 new cases of advanced disease were treated and their charts revised. 1.641 patients received neoadjuvant chemotherapy (NeoCh) and 229 failed it. In 66 cases, they received neoadjuvant radiotherapy (NeoRT). Endpoints were resectability and response rate. Chi-square test was used for comparison among groups. NeoRT was delivered in a conventional course of 50 Gy @ 25 fractions or 40 Gy @ 16 fractions to breast, supraclavicular fossae and axila, with tangential and non-pair irregular opposed fields, and 6 MV photons energy. If inoperable, they received a 10 Gy boost on the breast area. Surgery was intended to be done four weeks after RT.Results: From a total of 66 patients analyzed, the median age was 55 years, and 97% of patients were staged as IIIB. Invasive ductal carcinoma was the most frequent hystopathological diagnose. Regarding NeoCh, 43 (65.15%) received FAC; 16 (24.2%) FAC plus Docetaxel and 6 (10%) CMF. Tamoxifen was used in 8 (12%) cases. After NeoCh, 34 (52%) showed stable disease (SD); 24 (36%), progression disease (PD) and 8 (12%), partial response (PR). After NeoRT, 33 (50%) showed SD; 24 (36%), PR and 4 (6%) had clinical complete response (CR). 5 cases (8%) showed PD. 32 patients (48.5%) were eligible to mastectomy. In pathological study, 4 (12,5%) had pathological CR and 20 (61%) showed PR, with a response rate of 73,5% and median volume of surgical specimen of 2,68 cm3. Axillary dissection was performed in all patients, and the mean number excised and positive nodes were respectively 11 (5-22) and 2 (0-18). In the hypofractionated group (13 cases), 4 (31%) patients were considered operable. In the conventional group (49 cases), 28 (57%) had their tumor respected. 4 patients received an additional whole breast boost of 10 Gy @ 5 fractions . Median time of RT was, respectively, 26 and 37 days in the hypofractionated and in the conventional group (including boosted patients). Patients who remained inoperable after RT, showed 91% of distant metastasis. With a median follow up of 84 months, 7 operated patients (21.8%) are alive without evidence of disease and no patients at the inoperable group; last follow-up: Dec/2014. Regarding operated and non-operated patients, 3 years OS, were respectively 75% and 50% (p Conclusion: NeoRT in patients with poor response to NeoCh, who remained inoperable, is a feasible treatment approach. It has allowed almost half of them to become eligible to surgery, with significant benefit on OS when compared to those that remained inoperable. Although, further studies should be done before this protocol becomes standard of are for advanced breast cancer patients.

### MSRO32-03 Intraoperative Radiation Therapy as a Boost After Neoadjuvant Chemotherapy: DFS after a Median Follow-up of 4 Years

Tuesday, Dec. 1 10:50AM - 11:00AM Location: S103AB

Participants
Hans-Christian Kolberg, Bottrop, Germany (*Presenter*) Advisory Boards, Novartis AG; Advisory Boards, GlaxoSmithKline plc; Advisory Boards, Carl Zeiss AG; Advisory Boards, Genomic Health, Inc; Advisory Boards, LIV Pharma GmbH; Speaker, Novartis AG; Speaker, GlaxoSmithKline plc; Speaker, Carl Zeiss AG; Speaker, F. Hoffmann-La Roche Ltd; Speaker, Teva Pharmaceutical Industries Ltd; Speaker, Theraclion; Speaker, Genomic Health, Inc; Speaker, Amgen Inc;
Gyorgy Lovey, Bottrop, Germany (*Abstract Co-Author*) Nothing to Disclose
Leyla Akpolat-Basci, Bottrop, Germany (*Abstract Co-Author*) Nothing to Disclose
Miltiades Stephanou, Bottrop, Germany (*Abstract Co-Author*) Nothing to Disclose
Michael Untch, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): The expected local recurrence rate in 5 year follow-up after breast conserving therapy and whole breast irradiation is 7,6%. Adding a boost of the index region results in a reduced recurrence rate of 4,3%. The boost irradiation as an intraoperative procedure showed a further decrease of local recurrence rates down to 1,75% . We adapted this approach to patients after neoadjuvant chemotherapy (NACT) and are reporting the DFS after a median of 4 years of follow up. To our knowledge this is the first time that data concerning intraoperative radiotherapy with a 50 kV X-ray source after neoadjuvant chemotherapy are presented.Materials/Methods: Between April 2010 and November 2011 we treated 61 patients after NACT (+/-

Trastuzumab according to HER2-status) with an intraoperative boost of 20 Gy with a 50 kV X-ray source followed by an external radiation with 50 Gy. The patient characteristics were as follows and represent the high risk cohort typical for a cohort of patients treated with NACT: median age 54,9 years, 24 pts premenopausal / 37 pts postmenopausal, 31 pts G2 / 30 pts G3, 39 pts ER positive / 22 pts ER negative, 29 pts PR positive / 32 pts PR negative, 24 pts HER2 positive / 37 pts HER2 negative, 36 pts T1 / 24 pts T2 / 1 pt T3, 28 pts node negative / 33 pts node positive. 19 patients reached a pCR. 17 patients needed more than one operation. No patient was lost to follow up and at the time of data closure the median follow up was 49,56 months.Results: At a median follow up of 49,55 months the DFS was 86,89%, the DDFS 93,44%. 18 of the 19 patients were disease free in the group of patients who reached a pCR (DFS 94,74%). In the group of 42 patients who had residual tumor after NACT, 35 were disease free (DFS 83,33%).Conclusion: A DFS of 86,89% compares favorably to the DFS expected for patients after NACT. The higher DFS in the pCR-group was expected due to the fact that a pCR after NACT +/- Trastuzumab is predictive for DFS. Still the DFS in the non pCR-group compares favorably to the known data for patients not reaching a pCR. Our data are the first on IORT as a boost after neoadjuvant chemotherapy and show a favorable outcome of the patients in this high risk group. They strongly encourage the design of prospective trials in this indication.

## MSRO32-04 Preliminary Results of a Phase I Trial Evaluating Nipple Sparing Mastectomy with Immediate Reconstruction Followed by Prophylactic Nipple Areola Complex Irradiation in Early-Stage Breast Cancer: Patient Reported Satisfaction and Cosmesis Outcomes

Tuesday, Dec. 1 11:00AM - 11:10AM Location: S103AB

Participants
Cristiane Takita, MD, Miami, FL (*Presenter*) Nothing to Disclose

### ABSTRACT

Purpose/Objective(s): Breast conserving therapy has become the standard option for patients with early stage breast cancer. Still, there are some patients in need for mastectomy due to multicentric disease or diffuse microcalcifications. If mastectomy is to be performed, keeping the nipple areola complex (NAC) is still controversial. Studies have shown that preservation of the NAC provided higher patient's satisfaction and less psychological impact after mastectomy. Previous studies have used nipple sparing approach using intraoperative radiation (RT) to the NAC. This study is to report preliminary data of a prospective phase I trial using nipple sparing mastectomy with immediate reconstruction, followed by prophylactic NAC RT at weeks 5 to 8 postoperative.Materials/Methods: From 2009 to 2014, 10 patients with 11 breast cancers primary (one patient had bilateral disease) were enrolled in the study. The first 6 patients were treated to the NAC using 25 Gy in 10 fractions, BID, 6 hours apart, over 5 consecutive days, using electrons (dose level II; dose escalation/de-escalation design). The next 3 patients received dose level III, 30 Gy in 10 fractions, using same regimen. Radiation was delivered 5 to 8 weeks postoperative. Patient's cosmesis was assessed by the patient and physicians during 1, 3, 6, and 12 months after completion of protocol therapy. Patient's satisfaction was also evaluated at same interval.Results: Nine out of ten patients were able to complete treatment per protocol. At the last follow up, patient's evaluation of cosmesis was excellent in 78% (7/9), good in 11% (1/9), and poor in 11% (1/9). Overall patient satisfaction with nipple sparing protocol was Good/Excellent in all patients during the time interval of evaluations. Physician's evaluation of NAC cosmesis was excellent in 34% (3/9), good 66% (6/9). In regard toxicity, only one patient developed grade 3 infection and loss of NAC postoperative; this patient did not receive NAC RT. Of the 9 evaluable patients in the protocol, there was no NAC loss or need for treatment interruption. There was no grade 4, 5 toxicity in patients treated with NAC RT. The most common toxicity was acute radiation dermatitis and NAC pain, mostly grade 2, which completely resolved in subsequent follow up.Conclusion: The preliminary results of this nipple sparing protocol for early stage breast cancer showed a high level of patient's satisfaction and self-reported good/excellent cosmesis in the majority of patients treated. Toxicity appeared to be acceptable so far, mostly related to acute radiation dermatitis, grade 2. There was no NAC loss with the use of prophylactic NAC RT. Final results will be presented at completion of the trial.

## MSRO32-06 Dose to Organs in the Supraclavicular Region When Covering the Internal Mammary Nodes (IMN) in Breast Cancer Patients: A Comparison of VMAT Versus 3-D and VMAT

Tuesday, Dec. 1 11:20AM - 11:30AM Location: S103AB

Participants
Vishruta A. Dumane, PhD, Chicago, IL (*Presenter*) Nothing to Disclose
Richard L. Bakst, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Sheryl Green, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

### ABSTRACT

Purpose/Objective(s): VMAT has been reported to offer improved dosimetric sparing of the ipsilateral lung, total lung and heart compared to 3D conformal planning while covering IMNs. However OARs in the supraclavicular region often receive higher doses compared to 3D conformal planning. We aim to compare VMAT versus a combination of 3D and VMAT to improve sparing of OARs in this region without compromising target coverage or the dosimetric advantage that is already offered on using VMAT alone.Materials/Methods: 10 patients previously treated with VMAT at our institution were re-planned with 3D conformal planning in the supraclavicular region and VMAT inferiorly to the chestwall. VMAT planning consisted of 2 complementary arcs within a 230° arc range with 6 MV. The supraclavicular region was planned either with a single off-cord AP field or with off-cord AP/PA and field in field employing 6 MV and/or 16 MV depending on the depth of nodal coverage. Coverage criteria were PTV D95 = 50 Gy, V95 = 98% and PTV D05 = 115%. Doses to the esophagus, trachea, larynx, brachial plexus, thyroid and cord were noted in addition to the heart, lungs and contralateral breast.Results: Combining 3D with VMAT significantly reduced the maximum dose to the esophagus, trachea and spinal cord by 15 Gy, 11 Gy and 12 Gy and also significantly reduced mean dose to the thyroid, larynx and trachea by 15 Gy, 12 Gy and 18 Gy respectively (Table 1). No significant differences were seen in the mean dose to the heart, ipsilateral lung, total lung and contralateral breast or in the maximum dose to the brachial plexus. A statistically significant increase in the V20 Gy to the ipsilateral lung and total lung was observed but was = 2%.Conclusion: 3D conformal planning in the supraclavicular region while restricting VMAT to the chestwall helps reduce dose to additional OARs without compromising doses to the heart, lungs and contralateral breast when VMAT alone is used. OARVMAT3D + VMAT Esophagus Max (Gy)45.65* (SE 2.32)30.8* (SE 4.54) Esophagus Mean (Gy) 9.16* (SE 0.64) 6.54* (SE 0.54)Trachea Max (Gy)43.97* (SE 1.51)33.24* (SE 5.44) Trachea Mean (Gy)26.53* (SE 1.65)8.52* (SE 1.38)Cord Max (Gy)28.25* (SE 1.64)15.93* (SE 3.46) Thyroid Mean (Gy)29.61* (SE 2.91)14.36* (SE 3.25)Larynx Mean (Gy)14.24* (SE 2.15)2.26* (SE 0.64) Brachial Plexus Max (Gy)56.03 (SE 1.2)55.95 (SE 1.83)Heart Mean (Gy)5.54 (SE 0.71)5.49 (SE 0.7) Ipsilateral Lung Mean (Gy)15.31 (SE 0.27)16.01 (SE 0.24)Ipsilateral Lung V20Gy (%)24.69* (SE 0.72)26.85* (SE 0.62) Total Lung Mean (Gy)9.78 (SE 0.24)9.97 (SE 0.23)Total Lung V20Gy (%)13.04* (SE 0.61)14.06* (SE 0.49) Contralateral Lung Mean (Gy)3.6* (SE 0.37)3.23* (SE 0.32)Contralateral Breast Mean (Gy)4.13 (SE 0.2)4.05 (SE 0.23)SE= standard error*p <0.05

## MSRO32-07 SBRT for Secondary Lung and Liver Lesions in 35 Breast Cancer Oligometastatic Patients

Tuesday, Dec. 1 11:30AM - 11:40AM Location: S103AB

Participants
Slavisa Tubin, Empoli, Italy (*Presenter*) Nothing to Disclose
Franco Casamassima, Empoli, Italy (*Abstract Co-Author*) Nothing to Disclose
Claudia Menichelli, Empoli, Italy (*Abstract Co-Author*) Nothing to Disclose
Silvia Grespi, Empoli, Italy (*Abstract Co-Author*) Nothing to Disclose
Alessandro Fanelli, Empoli, Italy (*Abstract Co-Author*) Nothing to Disclose
Gabriella Pastore, Empoli, Italy (*Abstract Co-Author*) Nothing to Disclose
Cecilia Arrichiello, Empoli, Italy (*Abstract Co-Author*) Nothing to Disclose

### ABSTRACT

Purpose/Objective(s): This retrospective study explores the impact of SBRT as an aggressive local treatment on the disease evolution and survival of patients with oligometastatic breast cancer treated for lung and liver metastases.Materials/Methods: 24 lung lesions in 11 patients and 39 liver lesions in 24 patients (total of 63 lesions) were irradiated using SBRT between Feb.'07-Nov.'14. All 35 patients treated (KPS =70) were oligometastatic which according to our criteria implied the presence of = 5 in lung- or in liver-only metastases, or = 3 if presented in > 1 site. 7 patients (20%) were with single metastases while 28 (80%) with multiple. 11 patients were irradiated for lung lesions while 24 for liver lesions. Histology was ductal ADK in 81% of patients, lobular in 10%, mixed in 2% and other histologies or no data in 7%. The median diameter of the lung lesions was 1 cm (range 0.5-5) and of the liver metastases 3.5 cm (range 1-9.1). Planning Target Volume was created by adding a 3 mm margin to the Gross Tumor Volume. SBRT was delivered with VMAT by 6 MV LINAC and planned by TPS with Montecarlo algorithm. All lesions were treated in Breath-hold with different dose levels depending on tumor site and size. Almost all lung lesions (83.3%) were irradiated with 26 Gy in a single fraction prescribed to the 70% isodose (BED10 to isocenter = 175). Liver lesions were treated mainly (72%) with 37.5 Gy in 3 fractions prescribed to the 67% isodose (BED10 to isocenter = 161). Set-up and isocenter were assessed by CBCT. All patients treated for liver lesions underwent Gold fiducials insertion 1 week before CT simulation. The response was evaluated after 60 days by CT and PET, and every 3 months subsequently. Toxicity was assessed by CTCAE score.Results: Considering all treated lesions, both lung and liver, only 5 (7.9%) "in field" recurrences were observed, all occurred in liver during the first year from SBRT so the local control rate at 1 year was 92.1%; Dividing irradiated lesions by anatomic site 1 year local control rate for lung lesions was 100% while for liver-group 87.2%. At 1 and 2 years Overall Survival (OS) rates were 86% and 69% (91% and 70% in lung-group vs. 83% and 50% in liver-group), and Progression Free Survival rates were 37% and 20%, respectively (median F.U. 19.9 months, range 2,2-60). No predictive factors of local failure were found. No toxicity > G2 (4 patients) was recorded.Conclusion: SBRT for Lung and Liver metastases in Breast oligometastatic patients is a safe and well tolerated treatment. High local control rate (only 5 recurrences in field) confirms the ablative role of SBRT using high BED doses (> 100). The low number of relapses does not allow statistical analysis on predictive factors of local failure but high local control rate in the subset of patients with primary breast cancer indicates an trend for better local control respect to other primitive tumors (92.1% at 1 year that appears stable over the time).

## MSRO32-08 Salvage Radiation Therapy for 2nd Oligo-Recurrence in Patients With Breast Cancer

Tuesday, Dec. 1 11:40AM - 11:50AM Location: S103AB

Participants
Mari Miyata, MD, Kitakyushu, Japan (*Abstract Co-Author*) Nothing to Disclose
Takayuki Ohguri, Kitakyushu, Japan (*Presenter*) Nothing to Disclose
Katsuya Yahara, Kitakyushu, Japan (*Abstract Co-Author*) Nothing to Disclose
Yukunori Korogi, MD, PhD, Kitakyushu, Japan (*Abstract Co-Author*) Nothing to Disclose

### ABSTRACT

Purpose/Objective(s): A new concept of "oligo-recurrence (OR)" indicates one to several distant metastases/recurrences in one or several organs which can be treated with local therapy, while the primary site of the cancer was once controlled. A previous study demonstrated that first failure detected as the state of OR (e.g. isolated loco-regional recurrence (LRR) or isolated pulmonary metastasis) could be salvaged by local therapy. However, a subset of once salvaged patients with OR could have a second failure which is also detected as the state of OR. We have often experienced this situation in patients with breast cancer and have defined that as "2nd OR." The purpose of this study was to assess the efficacy and toxicity of salvage radiotherapy (RT) for the 2nd OR of breast cancer.Materials/Methods: All the 23 patients satisfied the following requirements of our definition for 2nd OR: (i) disease-free status after initial therapy for clinically localized breast cancer had been once confirmed; (ii) first failure was detected as OR (1st OR), and disease control of the 1st OR after salvage local therapy was confirmed, while simultaneously there were no other distant metastases/recurrences; (iii) second failure was also detected as OR (2nd OR) which was treated with salvage RT. The sites of the 2nd OR were LRR in 9 patients and distant metastasis in 14 patients. The total radiation dose of the salvage RT ranged from 40–76 Gy (median, 60 Gy), the daily dose was 2.0–3.0 Gy (median, 2.0 Gy). Efficacy and toxicity of the salvage RT for the 2nd OR were retrospectively evaluated, and the predictors of a long-term survival were analyzed.Results: Twenty-one (91%) patients had an objective response. The median overall survival and progression-free survival times were 40 and 20 months after salvage RT for the 2nd OR, respectively. The three-year local (in-field) control rates were 84%. The toxicities were mild; acute toxicities = Grade 3 were seen in one patient with Grade 3 dermatitis, and no late toxicity = Grade 2 was observed, except for one patient who had a Grade 3 lymphatic edema of the arm. The first sites of disease progression after the salvage RT for the 2nd OR were out-field alone in 11 patients (48%) and both in-field and out-field in 4 patients (17%); none of the patients had first sites in local (in-field) alone. The univariate analyses indicated that age (Conclusion: Salvage RT for the 2nd OR was able to achieve a better local control rate and longer progression-free survival time without inducing severe toxicity, and therefore may be a potentially effective modality for inducing long-term survival in select patients.

## MSRO32-09 Cost-Effectiveness of Pertuzumab in HER2-positive Metastatic Breast Cancer

Tuesday, Dec. 1 11:50AM - 12:00PM Location: S103AB

Participants
Yushen Qian, MD, Stanford, CA (*Presenter*) Nothing to Disclose

### ABSTRACT

Purpose/Objective(s): The Clinical Evaluation of Pertuzumab and Trastuzumab (CLEOPATRA) study showed a benefit in overall

survival with the addition of pertuzumab (P) to docetaxel (T) and trastuzumab (H) (THP) compared to TH as first-line treatment for patients with HER2-positive metastatic breast cancer. With median follow-up of 50 months, median overall survival for the THP and TH groups were 56.5 and 40.8 months, respectively [Swain, NEJM 2015]. Based on these results, we performed a cost-effectiveness analysis to determine the impact of pertuzumab on the treatment of HER2-positive metastatic breast cancer.Materials/Methods: Cost-effectiveness was evaluated from a societal perspective. A four-state Markov model was constructed to evaluate the cost-effectiveness of TH with or without P. Health states included: stable disease, progression of disease, hospice, and death. The model was run over 10 years with cycle length of 1 week. Transition probabilities were based on the results of the CLEOPATRA study. Costs were based upon 2014 Medicare reimbursement rates and manufacturers' Average Sales Price. Interventions were evaluated with a willingness-to-pay threshold (WTP) of $100,000 per quality-adjusted life years (QALY) gained. One-way and multi-way sensitivity analyses were performed to explore the effects of specific assumptions.Results: Our modeled overall survival and progression-free survival intervals compared well with the results of the CLEOPATRA study. Modeled median survival was 171 weeks (39.5 months) and 253 weeks (58.3 months) for TH and THP group, respectively. The addition of P resulted in an additional 0.73 QALY at an increased cost of $426,039 compared with TH, resulting in an incremental cost-effectiveness ratio (ICER) of $582,141 per QALY. Two-way sensitivity analysis showed that in the scenario where baseline costs (including cost of trastuzumab) were half of predicted, THP would not become cost-effective until discounted by 96% of the current Medicare Average Sales Price.Conclusion: The addition of pertuzumab to docetaxel and trastuzumab in metastatic HER2(+) breast is unlikely to be cost-effective at a WTP threshold of $100,000 per QALY gained. This finding is attributed to 1) the expense of pertuzumab, and 2) that patients treated with pertuzumab have prolonged progression-free survival, and, therefore, accrue higher costs for prolonged treatment with both pertuzumab and trastuzumab. Additional results from the adjuvant trials of pertuzumab will be important to characterize the overall cost-benefit of this agent in both metastatic and early stage HER2-positive breast cancer.

SSG01

## ISP: Breast Imaging (Intervention Path Correlation)

Tuesday, Dec. 1 10:30AM - 12:00PM Location: E451A

BR DM

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

**Participants**
Thomas J. Lawton, MD, Chapel Hill, NC (*Moderator*) Nothing to Disclose
Dianne Georgian-Smith, MD, Boston, MA (*Moderator*) Nothing to Disclose
Michael A. Cohen, MD, Atlanta, GA (*Moderator*) Nothing to Disclose

**Sub-Events**

### SSG01-01 Breast Imaging Keynote Speaker: Radiology-Pathology Challenges to Lobular Neoplasia and Radial Scars

Tuesday, Dec. 1 10:30AM - 10:40AM Location: E451A

Participants
Dianne Georgian-Smith, MD, Boston, MA (*Presenter*) Nothing to Disclose

### SSG01-02 Breast Imaging Keynote Speaker: Radiology-Pathology Challenges to Lobular Neoplasia and Radial Scars

Tuesday, Dec. 1 10:40AM - 10:50AM Location: E451A

Participants
Thomas J. Lawton, MD, Chapel Hill, NC (*Presenter*) Nothing to Disclose

### SSG01-03 ACR BI-RADS Assessment Category 4 Subdivisions in Diagnostic Mammography: Utilization and Outcomes in the National Mammography Database

Tuesday, Dec. 1 10:50AM - 11:00AM Location: E451A

Participants
Mai A. Elezaby, MD, Madison, WI (*Presenter*) Nothing to Disclose
Mythreyi Bhargavan-Chatfield, PhD, Reston, VA (*Abstract Co-Author*) Nothing to Disclose
Elizabeth S. Burnside, MD, MPH, Madison, WI (*Abstract Co-Author*) Stockholder, NeuWave Medical Inc
Wendy B. Demartini, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Since 2003, the ACR Breast Imaging Reporting and Data System (BI-RADS) Atlas has suggested that mammography category 4 assessments be subdivided by likelihood of malignancy into 4A (> 2% to ≤ 10%), 4B (> 10% to ≤ 50%) and 4C (> 50% to ≤ 95%). This allows a more meaningful practice audit and aids patients, clinicians and pathologists. However, little is known about use and outcomes of category 4 subdivisions in clinical practice. We evaluated utilization of these subdivisions in the National Mammography Database (NMD), a large national registry with approximately 160 participating facilities.

#### METHOD AND MATERIALS

This study was NMD Registry Committee approved and HIPAA compliant. We included data for all diagnostic mammograms submitted to the NMD performed from January 2008 to December 2013. We calculated the utilization rate of BI-RADS assessment category 4 subdivisions overall and by year, and determined the positive predictive values of biopsy performed (PPV3) overall and by category 4 subdivision.

#### RESULTS

Data from 968,670 diagnostic mammograms were included. Overall, 90,988 (9%) were given BI-RADS assessment category 4, with subdivisions used in 30,163 (33%) and not used in 60,825 (67%) of category 4 exams. Subdivision use by year was 54% (2008), 46% (2009), 35% (2010), 31 % (2011), 30% (2012) and 32 % (2013). Among the 30,163 diagnostic mammograms given category 4 subdivisions, frequencies were 4A in 1, 6900 (56%), 4B in 9,555 (32%) and 4C in 3,708 (12%). PPV3s were: overall category 4 20% (13.925/69,537), category 4A 8% (941/12,460), category 4B 22% (1683/7636) and category 4C 69% (1990/2892).

#### CONCLUSION

Despite the ACR BI-RADS Atlas suggestion for use of assessment category 4 subdivisions since 2003, the minority (33%) of NMD category 4 diagnostic mammograms utilized these subdivisions. When category 4 subdivisions were used, positive predictive values for biopsy performed reproduced appropriate BI-RADS specified malignancy ranges. This analysis supports the use of subdivisions in broad practice and should motivate increased utilization given benefits for patient care.

#### CLINICAL RELEVANCE/APPLICATION

In the NMD, subdivisions were used in the minority of category 4 diagnostic mammograms, but PPV3s were in BI-RADS-specified malignancy ranges. Increased utilization should be encouraged given benefits for patient care.

## SSG01-04 Identifying Criteria to Follow Rather than Excise Radial Scar/Complex Sclerosing Lesion: A 10-year Single Institution Study and Literature Review

Tuesday, Dec. 1 11:00AM - 11:10AM Location: E451A

Participants
Bart B. Singer, Chapel Hill, NC (*Presenter*) Nothing to Disclose
Sheryl G. Jordan, MD, Chapel Hill, NC (*Abstract Co-Author*) Nothing to Disclose
Thomas J. Lawton, MD, Chapel Hill, NC (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Radial scars/complex sclerosing lesions (RS/CSL) are not considered premalignant, yet are routinely excised because of a reported risk of coexistent malignancy. This study´s purpose was to determine if pathologic and imaging criteria can identify patients who may not require surgery.

### METHOD AND MATERIALS

A literature review identified 21 published studies since 1999, reporting upgrade rates for RS from 0% to 40%. In addition to significant selection bias, each of these retrospective studies had at least one major confounding factor: 1) Admixing upgrade rates of RS plus atypia with benign RS; 2) Not reporting CNB RadPath concordance and/or including discordant cases; 3) Not providing histologic review; 4) Not reporting distance from the biopsy site to upgrade lesion on excision, thereby not confirming association. With IRB approval, we identified all breast biopsies from 2004 to 2014 with RS/CSL, with and without atypia, followed by excision. All above confounding factors were addressed, and pathologic and radiologic features were catalogued for each case. Statistical significance was evaluated using the chi-square test.

### RESULTS

The literature review identified 352 cases that met our inclusion criteria, with 1.1% upgrading to DCIS or invasive malignancy at excision. Our study identified 50 concordant RS/CSL without atypia, 11 concordant RS/CSL with atypia, and 2 discordant RS/CSL without atypia; all were excised. Imaging features and CNB techniques used are detailed in Figure 1. Of the 50 cases of RS/CSL without atypia that were concordant, 0% were upgraded to DCIS or invasive malignancy at excision. 16% of these cases had an excisional diagnosis of atypia that was not present on CNB. This occurred more frequently when CNB technique was automated load device (23.5%) vs vacuum assisted device (13.2%). 2/2 discordant cases upgraded to DCIS or invasive carcinoma on excision, and 3/11 cases of RS/CSL with atypia upgraded (27.2%).

### CONCLUSION

Our review suggests that concordant RS/CSL without atypia do not warrant excision. The data also suggests CNB for suspected RS should be performed with larger gauge VAD for improved accuracy of risk assessment based on the presence of atypia.

### CLINICAL RELEVANCE/APPLICATION

Entering the era of increased detection of RS/CSL by digital breast tomosynthesis, it is relevant to have identified strict pathologic and biopsy technique criteria that may permit patients to forgo unnecessary surgery

## SSG01-05 Suspicious Breast Calcifications in Women Over Age 70: Are Some Safe to Follow?

Tuesday, Dec. 1 11:10AM - 11:20AM Location: E451A

Participants
Lars J. Grimm, MD, Durham, NC (*Presenter*) Advisory Board, Medscape, LLC;
David Y. Johnson, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Karen S. Johnson, MD, Durham, NC (*Abstract Co-Author*) Research Consultant, Siemens AG
Jay A. Baker, MD, Durham, NC (*Abstract Co-Author*) Research Consultant, Siemens AG
Mary S. Soo, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Sujata V. Ghate, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

While the incidence of breast cancer increases with age, tumor prognosis in the elderly is often favorable. Our study evaluated the histologic outcomes of stereotactically biopsied breast calcifications in women ≥70 years of age to determine if specific BI-RADS morphology descriptors may be candidates for active surveillance rather than biopsy.

### METHOD AND MATERIALS

In this HIPAA compliant, IRB approved study, digital mammograms from 236 consecutive patients ≥70 years who underwent stereotactic biopsy of calcifications without associated findings were independently reviewed by three breast radiologist who provided BI-RADS morphology descriptors for each case. The majority opinion was recorded. Stereotactic and surgical excision pathology reports were reviewed and final tumor type, hormone receptor status, and lymph node status were recorded. Surrogate molecular subtypes based on ER, PR and HER2 data were tabulated. The proportion of benign, atypical, in situ, and invasive disease were calculated in total and by morphology.

### RESULTS

The 236 biopsies resulted in 131 (56%) benign, 20 (9%) atypical, 57 (24%) in situ, and 28 (12%) invasive diagnoses. There were 30 (53%) low risk (low/intermediate grade) and 27 (47%) high risk (high grade) in situ cases. Of the 28 invasive cases, 24 (86%) were luminal type (ER and/or PR+), 1 (4%) HER2 (ER/PR-, HER2+), and 3 (11%) triple negative cancers; 5 (18%) were node positive. Invasive disease was found in 25% (7/28) of fine linear, 18% (3/17) of round, 15% (16/105) of fine pleomorphic, and 5% (2/40) of amorphous calcifications, with no invasive disease in the coarse heterogeneous calcifications. In situ disease was found in 35% (37/105) of fine pleomorphic, 29% (8/28) of fine linear, 20% (8/40) of amorphous, 12% (2/17) of round, and 5% (2/37) of coarse heterogeneous. There was no malignancy detected in 9 cases of calcifications described as dystrophic.

### CONCLUSION

Biopsies of calcifications in women ≥ 70 years yielded a greater than 5% likelihood of malignancy, including triple negative and

lymph node positive tumors, for all suspicious calcification morphologies. Active surveillance in this age group is not appropriate.

**CLINICAL RELEVANCE/APPLICATION**

Active surveillance is not appropriate for women ≥ 70 years with suspicious calcification morphologies.

## SSG01-06 Amorphous Calcifications Rarely Represent Aggressive Malignancy

Tuesday, Dec. 1 11:20AM - 11:30AM Location: E451A

Participants
Wendie A. Berg, MD, PhD, Pittsburgh, PA (*Presenter*) Consultant, SuperSonic Imagine; Departmental Research Grant, General Electric Company ; Departmental Research Grant, Hologic, Inc; Equipment support, Gamma Medica, Inc; Equipment support, General Electric Company; Equipment support, Hologic Inc; ;
Sue S. Chen, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Hayley Oligane, DO, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Sahand Sohrabi, MD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Margarita L. Zuley, MD, Pittsburgh, PA (*Abstract Co-Author*) Research Grant, Hologic, Inc;
Maria L. Anello, DO, Jacksonville, FL (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To determine rate and molecular subtypes of malignancy on stereotactic biopsy of amorphous calcifications and to consider implications for overdiagnosis.

**METHOD AND MATERIALS**

From 6727 stereotactic 9-g vacuum-assisted biopsies performed from 1/1/2009 through 9/30/2013 at a single institution, consecutive cases were reviewed under an IRB-approved protocol. Calcification morphology and distribution were recorded. For cases with primarily amorphous calcifications but no more suspicious morphologies, demographic information was recorded together with imaging findings and histopathologic outcomes including excision for any high-risk result or malignancy.

**RESULTS**

Interim analysis of 804 biopsies revealed 233 (29.0%) were for amorphous calcifications in 203 women (median age 53 years, range 30-78). Of 233 biopsies, 25 (10.8%) were ultimately malignant in 24 women (median age 51, range 39-75), including nine invasive ductal carcinomas (IDC) with median size 0.3 cm (range 0.1 to 1.2 cm), all node negative, seven Nottingham grade 2 and two grade 1; seven were luminal A [ER/PR(+) HER2(-), low Ki-67] and two were luminal B [ER(+),HER2(-), Ki-67 20%; one PR(+) and one PR(-)]. Among 16 DCIS lesions, two were nuclear grade 3, 11 grade 2 (two of which were upgraded from ADH on core), and 3 grade 1; three of the DCIS were PR(-). Distribution influenced malignancy rate: 4/11(36%) linear distribution were malignant as were 3/9(33%) segmental, 17/194(8.8%) grouped, and 1/18(5.6%) regional ($p<0.001$). Of 24 women diagnosed with cancer, 18 (75%) had risk factors other than age or breast density. Another 67/233 (28.8%) biopsies yielded a final result of atypical/high risk results: 45 ADH; 8 LCIS; 7 FEA; 6 ALH; 1 atypical apocrine adenosis.

**CONCLUSION**

Malignancy rate of 10.8% was observed on stereotactic biopsy of amorphous calcifications. All malignancies were DCIS or ER-positive IDC; 4/203 (2.0%) women were diagnosed with luminal B IDC or high nuclear grade DCIS. Among 69 lesions atypical/high risk on core biopsy only 2 (2.9%) (95%CI 0.9 to 4.9%) were upgraded at excision (grade 2 DCIS), both of whom had ipsilateral cancer (one current, one prior).

**CLINICAL RELEVANCE/APPLICATION**

Stereotactic biopsy remains necessary for amorphous calcifications, but an atypical result on vacuum biopsy of amorphous calcifications has a very low (2.9%) rate of upgrade to malignancy at excision. Further study is warranted to determine if excision is necessary in this context.

## SSG01-07 Pilot Evaluation of Minimally Invasive Needle-biopsy of Sentinel Nodes as Compared to Surgical Removal

Tuesday, Dec. 1 11:30AM - 11:40AM Location: E451A

Participants
Stefan Paepke, MD, Munich, Germany (*Abstract Co-Author*) Advisor, SurgicEye GmbH; Advisor, NeoDynamics AB
Christian H. Pfob, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Ralf Ohlinger, MD, Greifswald, Germany (*Abstract Co-Author*) Nothing to Disclose
Ines Gruber, MD, Tubingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Marc Thill, MD, Frankfurt, Germany (*Abstract Co-Author*) Nothing to Disclose
Jens-Uwe Blohmer, MD, Berlin, Germany (*Abstract Co-Author*) Nothing to Disclose
Thorsten Kuhn, MD, Esslingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Markus Hahn, MD, Tuebingen, Germany (*Abstract Co-Author*) Nothing to Disclose
Marion Kiechle, MD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Klemens Scheidhauer, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Thomas Wendler, Munich, Germany (*Abstract Co-Author*) Former Employee, SurgicEye GmbH
Joerg Traub, PhD, Garching bei Munchen, Germany (*Presenter*) Shareholder and Managing Director of SurgicEye GmbH

**PURPOSE**

Evaluate within a pilot setup feasibility and safety of minimally invasive needle-biopsy of sentinel nodes guided by SPECT/US as compared to surgical removal while defining optimal needle for follow-up trial.

**METHOD AND MATERIALS**

As pre-trial test phase of the MinimalSNB study, 38 breast cancer patients (6 centers) were taken a needle-biopsy of their sentinel lymph nodes (SLNs) under guidance of SPECT/US (SentiGuide by SurgicEye). All patients were indicated for a surgical SLN biopsy which was performed immediately after the needle-biopsy. For the test phase, 4 different biopsy systems were tested: HistoCore

14G (BIP), elite 10G and 13G (Mammotome) and CASSI II 10G (Scion Medical Technologies). Histopathological examination (HandE, step-sectioning) of needle-biopsies and surgically removed SLNs were compared.

**RESULTS**

No single complication was reported. Occasionally, small hematomas could be found close to the SLN during surgery. The needle-biopsies showed lymphatic tissue in 29/38 cases. Within the 29 successful cases both methods matched in 26 cases (24 true negative, 2 true positive). The needle biopsy failed to detect metastases in 2 pN1 SLNs. In 1 case, the surgically resected tissue did not contain lymph nodes and the needle biopsy remained the only information on nodal status (pN0). The success of the biopsies was strongly dependent on training and experience of user making axillary needle biopsies. 5 of the failed needle biopsies were the first attempt of the user. In both false negative cases, the retrieved lymph tissue was minimal (1x 14G sample, 1x 10G sample tangential to node).

**CONCLUSION**

SPECT/US showed to be a valid method for percutaneous detection of SLNs and needle-guidance. Sampling SLNs with a needle seems safe and feasible. However it requires proper training and user experienced with axillary needle-biopsies. Retrieving more tissue (more cores and larger lumen needles) improves diagnostic power of needle-biopsy. These considerations will be taken within the upcoming MinimalSNB trial.

**CLINICAL RELEVANCE/APPLICATION**

Sentinel lymph biopsy today is a surgical diagnostic procedure with an non-zero morbidity. Moving it out of the operating theatre to a needle-based intervention has a huge impact on the burden of this procedure for the patient as well as relevant improvements in logistics, workflow and radiation burden.

## SSG01-08 Detection of Different Nuclear Grades of Ductal Carcinoma in Situ in Digital Mammography Screening

Tuesday, Dec. 1 11:40AM - 11:50AM Location: E451A

Participants
Stefanie B. Weigel, Muenster, Germany (*Presenter*) Nothing to Disclose
Jan Heidrich, Muenster, Germany (*Abstract Co-Author*) Nothing to Disclose
Oliver Heidinger, Muenster, Germany (*Abstract Co-Author*) Nothing to Disclose
Shoma Berkemeyer, Muenster, Germany (*Abstract Co-Author*) Nothing to Disclose
Walter L. Heindel, MD, Muenster, Germany (*Abstract Co-Author*) Nothing to Disclose
Hans Werner Hense, Muenster, Germany (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To investigate detection rates of ductal carcinoma in situ (DCIS), separately for different nuclear grades of the first subsequent round in relation to the initial round of a population-based digital mammography screening program.

**METHOD AND MATERIALS**

We included data from 516,286 subsequent round (SR) examinations (52-69 years, 2007-2010) and 720,778 initial round (IR) examinations (50-69 years, 2005-2008) from 16 screening areas provided by the population-based cancer registry. The total detection rate per 100 women screened (DetR%) for DCIS was dissected into low (SR n= 64, IR n= 181), intermediate (SR n= 220, IR n= 387) and high grades (SR n= 285, IR n= 425). Spearman rank correlations and Wilcoxon test were used. P values less than .05 were considered significant.

**RESULTS**

The SR-DetR% of total DCIS correlated significantly with high grade DCIS ($r = 0.75$; $P < .001$) and intermediate grade DCIS ($r = 0.55$; $P = .028$), the association with low grade DCIS was lower ($r = 0.48$; $P = .057$). SR-DetR% of DCIS low grade was lower than for intermediate ($P < .001$) and high grade ($P < .001$).The median SR-DetR% of total DCIS (0.12%) was lower than the median IR-DetR% (0.14%; $P = .039$). In particular, the median SR-DetR% of low grade was significantly lower than in the initial round (0.01% vs. 0.02%; $P = .01$) while the median DetR% of intermediate grade were 0.04% and 0.05%, respectively ($P = 0.19$), and for high grade 0.05% and 0.06%, respectively ($P = .67$).

**CONCLUSION**

Only DCIS of low grade decreased significantly from the initial to the first subsequent screening round, it was less common than intermediate and high grade DCIS and it showed only a weak association with total DCIS detection.

**CLINICAL RELEVANCE/APPLICATION**

Biennial digital mammography screening of women aged 50 to 69 years showed constantly higher DCIS detection rates of the more progressive grades than of the DCIS low grade.

## SSG01-09 Following Imaging-concordant Benign MRI-guided Vacuum-assisted Breast Biopsy: Is MRI Follow Up Needed?

Tuesday, Dec. 1 11:50AM - 12:00PM Location: E451A

Participants
Monica L. Huang, MD, Houston, TX (*Presenter*) Nothing to Disclose
Megan E. Speer, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Basak E. Dogan, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Gaiane M. Rauch, MD, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Rosalind P. Candelaria, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Wei T. Yang, MD, Houston, TX (*Abstract Co-Author*) Researcher, Hologic, Inc
Kenneth Hess, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Beatriz E. Adrada, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Follow up of lesions with imaging-concordant benign MRI-guided vacuum-assisted biopsy result is not currently standardized. We aim to investigate the false omission rate of benign breast MRI-guided vacuum-assisted biopsy (MVAB) to assess whether MRI follow up is needed.

## METHOD AND MATERIALS

Medical records of patients with 9-gauge breast MRVAB from January 1, 2007 to July 1, 2012 were reviewed retrospectively. Only patients/lesions with imaging-concordant MRVAB benign result and 1) surgical histopathology or 2) minimum of 2-year imaging follow up were included in this study. The false omission rate (1-NPV= # false negative result/ # negative calls) of the MRVAB with imaging-concordant benign result was calculated.

## RESULTS

A total of 161 patients (170 lesions) with MRVAB imaging-concordant benign result met the inclusion criteria. The majority, 127/161 (79%) patients [134/170 (79%) lesions] had only imaging follow up; 58/161 (36%) patients [61/170 (36%) lesions] had mammography and > 24 months MRI follow up; and 26/161 (16%) patients [29/170 (17%) lesions] had mammography with < 24 months follow up (MRI follow up range 2 to 20 months, median 11 months). Of the 34/161 (21%) patients [36/170 (21%) lesions] with surgical correlation, none had surgical discordance. Malignancy was later diagnosed in the same breast in 3/161 patients (1.9%): 1 invasive ductal carcinoma (IDC) (0.6%), 1 IDC with ductal carcinoma in situ (DCIS) (0.6%), and 1 DCIS (0.6%). Only 1 of these 3 patients (1/127 = 0.8%) had subsequent malignancy (IDC) near (1 cm from) the site of previous MRVAB, with malignancy discovered on follow up mammography (calcifications) >23 months after MRVAB. The other 2 patients developed cancer in a different site in the same breast: 1(DCIS) found on mammography (calcifications) >11 months post MRVAB and 1(DCIS) found on MRI (mass) >22 months post MRVAB.

## CONCLUSION

Our study shows a false omission rate for benign MRVAB of 0.6%, with cancer near the MRVAB site detected by mammography at 24 months post MRVAB in 1/170 lesions (1 false negative result/170 negative calls).

## CLINICAL RELEVANCE/APPLICATION

Imaging-concordant benign MRVAB has extremely low false omission rate and may not warrant MRI follow up.

SSG09

## Molecular Imaging (Gynecologic Oncology)

Tuesday, Dec. 1 10:30AM - 12:00PM Location: S504CD

BR GU MI MR RO

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

FDA Discussions may include off-label uses.

**Participants**
Kathryn A. Morton, MD, Salt Lake City, UT (*Moderator*) Nothing to Disclose
Zaver M. Bhujwalla, PhD, Baltimore, MD (*Moderator*) Nothing to Disclose

**Sub-Events**

### SSG09-01 First Clinical Trial on Ultrasound Molecular Imaging Using KDR-Targeted Microbubbles in Patients with Breast and Ovarian Lesions

Tuesday, Dec. 1 10:30AM - 10:40AM Location: S504CD

Participants
Juergen K. Willmann, MD, Stanford, CA (*Presenter*) Research Consultant, Bracco Group; Research Consultant, Triple Ring Technologies, Inc; Research Grant, Siemens AG; Research Grant, Bracco Group; Research Grant, Koninklijke Philips NV; Research Grant, General Electric Company
Lorenzo Bonomo, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Antonia Testa, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Pierluigi Rinaldi, MD, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Guido Rindi, Rome, Italy (*Abstract Co-Author*) Nothing to Disclose
Sanjiv S. Gambhir, MD, PhD, Stanford, CA (*Abstract Co-Author*) Board Member, Enlight Biosciences; Board Member, ImaginAb, Inc; Board Member, FUJIFILM Holdings Corporation; Board Member, ClickDiagnostics, Inc; Consultant, FUJIFILM Holdings Corporation; Consultant, Gamma Medica, Inc; Speaker, ImaginAb, Inc; Stock, Enlight Biosciences; Stock options, Enlight Biosciences; Travel support, Gamma Medica, Inc

#### PURPOSE

To assess if clinical ultrasound molecular imaging (USMI) using a novel clinical grade human kinase domain receptor (KDR)-targeted microbubble (BR55, Bracco) is safe and allows assessment of KDR expression in patients with breast and ovarian lesions, using immunohistochemistry (IHC) as gold standard.

#### METHOD AND MATERIALS

21 women (34-66 yrs) with focal breast lesions and 24 women (48-79 yrs) with focal ovarian lesions were injected IV with BR55 (0.03-0.08 mL/kg bw) and 2D USMI of the target lesions was performed dynamically every 2 min starting 5 min after injection up to 29 min, using the linear 15L8 probe (Siemens) or the endocavitary 1123 probe (Esaote). Normal breast tissues surrounding the lesion or the contralateral presumed normal ovary served as intra-patient controls. Blood pressure, EKG, oxygen levels, heart rate, CBC, and metabolic panel were obtained before, and 30 min, 1h, 24h after BR55 administration. Persistent focal BR55 binding on USMI was visually assessed in consensus by 2 blinded offsite radiologists as none, possibly or definitely. Patients underwent surgical resection of the target lesions and tissues were stained for CD31 and KDR. A pathologist assessed vascular KDR expression using a 4-point scale (none, weak, intermediate, high). Adjudication was performed in consensus (offsite radiologists and pathologist) to match clinically.

#### RESULTS

USMI with BR55 was well tolerated by all patients at all doses, without safety concerns. Among the 40 patients included in the analysis, KDR expression was higher in malignant breast and ovarian lesions (score 2.40±0.63 and 2.08±0.64, respectively) compared to benign breast and ovarian lesions (2.08±0.64 and 1.33±0.50). KDR expression matched well with presence of focal BR55 binding on USMI in malignant breast (13/15; 86.7%) and ovarian (11/13; 84.6%) lesions, as well as benign breast (2/3; 66.7%) and ovarian (8/9; 88.9%) lesions. Focal USMI signal could be detected up to 29 min after injection.

#### CONCLUSION

Use of BR55 in USMI of breast and ovarian lesions is safe and effective and preliminary data indicate that KDR-targeted USMI signal matches well with vascular KDR expression on IHC.

#### CLINICAL RELEVANCE/APPLICATION

This study provides proof of principle on feasibility and safety of KDR-targeted USMI in patients with breast and ovarian lesions and lays the foundation for further clinical trials.

### SSG09-02 Imaged EGFR Expression Level Reflects Inhibited Growth-Pathway Node in Model of Triple-Negative Breast Cancer

Tuesday, Dec. 1 10:40AM - 10:50AM Location: S504CD

Participants
Eric Wehrenberg-Klee, MD, Boston, MA (*Presenter*) Nothing to Disclose
Nafize S. Turker, PhD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Pedram Heidari, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Mauri Scaltriti, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Umar Mahmood, MD, PhD, Charlestown, MA (*Abstract Co-Author*) Research Grant, Sabik Medical Inc; Advisory Board, Blue Earth

Diagnostics Limited;

**PURPOSE**

Triple-negative breast cancer (TNBC) is an aggressive breast cancer subtype for which targeted inhibitors of the RTK/PI3K/AKT/mTOR growth pathway have demonstrated early treatment success. The surface receptor EGFR is one of the dominant RTKs mediating downstream growth signals along this pathway and changes in EGFR expression may be predictive of therapeutic inhibition. We sought to demonstrate that the changes in EGFR expression predictive of treatment response could be non-invasively assessed.

**METHOD AND MATERIALS**

64Cu-DOTA-cetuximab F(ab´)2 was prepared from cetuximab monoclonal antibody and probe affinity for EGFR assessed. A panel of TNBC cell lines (MDMBA468, MDMBA231, HCC70) was treated with the AKT inhibitor GDC-0068 or the PI3K inhibitor GDC-0941 for one day at a range of concentrations. Following treatment, we assessed in vitro EGFR probe uptake. In vitro uptake study results were compared to protein quantification as assessed by Western blot. After treatment of HCC70 mouse xenografts with control, GDC-0068, or GDC-0941 for two days, PET-CT imaging of HCC-70 tumors with 64Cu-DOTA-EGFR F(ab´)2 was performed.

**RESULTS**

In vitro treatment with GDC-0068 resulted in increased EGFR Probe uptake of 25%, 139%, and 16% for MDAMB468, MDMBA231, and HCC70, respectively. In vitro treatment with GDC-0941 resulted in increased EGFR uptake of 6%, 87%, and 88%, for the same panel of cell lines. In vitro uptake studies demonstrate close correlation with changes in EGFR expression as assessed by Western blot. In vivo imaging of HCC70 mouse xenografts with EGFR PET Probe after treatment with control, GDC-0068, or GDC-0941 demonstrate SUVmean of 0.32 (±0.03), 0.50 (±0.01), 0.62 (±0.01), with all comparisons significant ($p<0.01$).

**CONCLUSION**

We demonstrate in a murine model of triple-negative breast cancer that changes in EGFR expression induced by targeted therapeutics can be non-invasively assessed using a 64Cu-DOTA-EGFR F(ab´)2 PET imaging probe. We demonstrate that changes in the level of EGFR expression, potentially indicative of therapeutic response, differ depending on the growth-pathway inhibited.

**CLINICAL RELEVANCE/APPLICATION**

Noninvasive assessment of changes in EGFR expression could be a valuable clinical tool for rapid assessment of therapeutic efficacy of targeted growth pathway inhibitors in TNBC, allowing for dynamic clinical decision making in response to imaged resistance profiles.

## SSG09-03 FACBC PET/CT Before and After Neoadjuvant Therapy in Locally Advanced Breast Cancer: A Prospective Pilot Clinical Trial

Tuesday, Dec. 1 10:50AM - 11:00AM Location: S504CD

Participants
Gary A. Ulaner, MD, PhD, New York, NY (*Presenter*) Research support, General Electric Company; Research support, F. Hoffmann-La Roche Ltd
Serge Lyashchenko, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Hanh Pham, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Jason S. Lewis, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Genes for amino acid transport proteins are highly upregulated in both invasive ductal carcinoma (IDC) and ILC, as compared to normal breast epithelium. This molecular phenotype may allow for the development of imaging agents based on amino acid metabolism. We evaluated whether Fluorine-18 labeled 1-amino-3-fluorocyclobutane-1-carboxylic acid (FACBC), an amino acid analog labelled with fluorine-18, could be used as an imaging agent for local staging of locally advanced breast cancer before and after neoadjuvant therapy.

**METHOD AND MATERIALS**

This prospective clinical trial is being performed under IRB approval. In this trial, newly diagnosed breast cancer patients that are planned for neoadjuvant systemic therapy followed by surgical resection undergo FACBC PET/CT prior to systemic therapy and then again following completion of systemic therapy. Maximum Standardized Uptake Values (SUVmax) and other quantitative measures of FACBC-avidity are measured for the primary breast tumor and nodal metastases before and after systemic therapy. Following surgery, FACBC results are correlated with postoperative histopathologic results.

**RESULTS**

Of 28 planned patients, we have currently accrued 23. All 23 accrued patients have undergone the pre-neoadjuvant therapy FACBC PET/CT. All 23 primary breast lesions were FACBC avid with SUVmax values of 2.3 to 17.5. 18 of 23 patients (78%) had FACBC avid axillary nodes with SUVmax values of 1.2 to 14.6. In 2 of 23 patients (9%), an unsuspected extra-axillary local nodal metastasis was detected on the pre neoadjuvant therapy FACBC PET/CT. SUVmax of these nodes was 2.1 and 2.2, and both were pathologically proven to be metastases. 15 of 23 patients (65%) have completed both pre- and post-neoadjuvant PET/CT scans and histological analysis following surgical resection. In 13 of these 15 patients (87%), a reduction of SUVmax in the primary breast cancer of greater than 90% could accurately identify the presence or absence of complete response/near complete response as defined by post surgical histologic analysis.

**CONCLUSION**

This pilot trial of FACBC PET/CT in locally advanced breast cancer demonstrates potential uses of FACBC PET/CT before and after neoadjuvant therapy.

**CLINICAL RELEVANCE/APPLICATION**

Further work on FACBC as a radiotracer in locally advanced breast cancer is warranted.

## SSG09-04 Operation-naive Invasive Ductal Carcinoma of the Breast. Comparison of Staging Performed with

## Whole Body DWI, PET, PET-CT, and PET-MR

Tuesday, Dec. 1 11:00AM - 11:10AM Location: S504CD

Participants
Onofrio A. Catalano, MD, Napoli, Italy (*Presenter*) Nothing to Disclose
Bruce R. Rosen, MD, PhD, Charlestown, MA (*Abstract Co-Author*) Research Consultant, Siemens AG
Angelo Luongo, Napoli, Italy (*Abstract Co-Author*) Nothing to Disclose
Mark Vangel, PhD, Charlestown, MA (*Abstract Co-Author*) Nothing to Disclose
Marco Catalano, Napoli, Italy (*Abstract Co-Author*) Nothing to Disclose
Umar Mahmood, MD, PhD, Charlestown, MA (*Abstract Co-Author*) Research Grant, Sabik Medical Inc; Advisory Board, Blue Earth Diagnostics Limited;
Emanuele Nicolai, Napoli, Italy (*Abstract Co-Author*) Nothing to Disclose
Andrea Soricelli, MD, Napoli, Italy (*Abstract Co-Author*) Nothing to Disclose
Marco Salvatore, MD, Napoli, Italy (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To compare the performance of whole body (WB) DW, WB-PET, WB-PETCT, and WB-PETMR in patients with newly diagnosed invasive ductal breast cancer, before undergoing treatment.

### METHOD AND MATERIALS

49 consecutive women with newly diagnosed invasive ductal carcinoma of the breast underwent WB-DWI, WB-PET, WB-contrast enhanced (CE) PETCT and WB-CE-PETMR before treatment. A radiologist and a nuclear medicine physician evaluated in consensus the studies and searched for occurrence, number, and location of metastases. Final staging and number of lesions, according to each technique, were compared. Pathology and imaging follow up were used as the ground truth reference.

### RESULTS

All the techniques correctly staged 32/49 patients: stage2b in 8, 2c in 7, 3c in 4, 4 in 13. They provided discordant stages in 17/49 patients: 1 (stage 2a): staged-4 by WB-PET; 4 (stage 2b): 3/4 staged-2a by WB-PET and WB-PETCT, 1/4 staged-4 by WB-DWI;3 (stage 3a): 2/3 staged-2b by WB-PET and WB-PETCT, 1/3 staged-4 by WB-DWI;3(stage 3c): 2/3 staged-2a by WB-PET and WB-PETCT, 1/3 staged-4 by WB-PET and WB-PETCT;6 (stage 4): 1/6 staged-3a by WB-PET, WB-DWI, and WB-PETCT, 1/6 staged-2b by WB-PET and WB-PETCT, 1/6 staged-2b by WB-PET, WB-DWI, and WB-PETCT, 1/6 staged-3a by WB-DWI, 1/6 staged-3c by WB-DWI, and 1/6 staged-3a by WB-PET, WB-PETCT and 3c by WB-DWI. Staging performance of WB-PETMR (49 correctly staged) was significantly better than WB-PETCT (38 correctly staged) (P=0.001, chi square-test).The best performing modality for malignant lymph-node detection was WB-PETMR (47 of 49 patients), followed by WB-DWI (37/49), followed by WB-PET and WB-PETCT (15 patients each). Significantly more malignant nodes were detected by WB-PETMR (P<0.0001, paired t-tests). At least as many true-positive lesions were detected by WB-PETMR than by any of the other three modalities for 46 patients. The corresponding number of patients for WB-PET, WB-PETCT, and WB-DWI were 40, 39 and 34, respectively.

### CONCLUSION

PETMR allows a better accuracy in initial staging of surgical-naive ductal invasive breast cancer. The higher performance is likely related to the additive information of PET, DWI, as well as of the other sequences (STIR, T1-weighted Dixon, HASTE, ADC maps, and CE-T1-weighed images) of WB-PETMR

### CLINICAL RELEVANCE/APPLICATION

When available WB-PETMR should be considered for proper staging of naive ductal invasive breast cancer.

## SSG09-05 Multiparametric 18F-FMISO PET/MRI for Assessment of Treatment Response to Chemo-radiation and Hypoxia Monitoring in Cervix Cancer Patients: A Feasibility Study

Tuesday, Dec. 1 11:10AM - 11:20AM Location: S504CD

Participants
Petra Georg, MD,PhD, Wiener Neustadt, Austria (*Abstract Co-Author*) Nothing to Disclose
Piotr Andrzejewski, MA, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Pascal A. Baltzer, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Stephan H. Polanec, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Wolfgang Wadsak, Vienna, Austria (*Abstract Co-Author*) Speaker, General Electric Company; Consultant, THP Medical; Research Grant, ABX GmbH; Research Grant, Rotem GmbH
Alina Sturdza, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Georgios Karanikas, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Stephan Polterauer, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Richard Poetter, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Thomas H. Helbich, MD, Vienna, Austria (*Abstract Co-Author*) Research Grant, Medicor, Inc; Research Grant, Siemens AG; Research Grant, C. R. Bard, Inc
Dietmar Georg, PhD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Katja Pinker, MD, New York, NY (*Presenter*) Nothing to Disclose

### PURPOSE

To demonstrate feasibility of combined multiparametric positron emission tomography/magnetic resonance imaging at 3T (3T MP PET/MRI) and to assess treatment response and hypoxia monitoring in cervix cancer patients undergoing chemo-radiation therapy.

### METHOD AND MATERIALS

In this IRB-approved prospective study 7 patients underwent sequential 3T MP 18F-FMISO PET/MRI at baseline; 2 and 5 weeks (w) after start and 3 months (FU) after treatment. MRI protocol consisted of a high-resolution isotropic T2-w SPACE, a DWI EPI ($b=50/850$ sec/mm$^2$) and a high-resolution contrast-enhanced (CE) T1-w VIBE sequence. Patients were injected with 330 MBq 18F-FMISO and scanning was started 240 min after injection. CT data was used for attenuation correction. PET and MR image registrations were performed using Mirada RTx (Mirada Medical, Oxford, UK , ver. 1.4.0.23) software. Gross tumour volume (GTV)

was contoured by an experienced radiation oncologist on PET/MRI data sets. The volume of GTV was assessed for tumor size, CE-kinetics, restricted diffusivity and 18F-FMISO-avidity using SUVmax and SUV (SUVnorm ) normalized to gluteal muscle uptake. At follow up, cervix was contoured, since all patients showed clinically complete remission.

**RESULTS**

3T MP 18F-FMISO PET/MRI was successfully performed in all patients at every time-point. Median GTV volume was 43.9cc at baseline, 22.4cc after 2w (20-25Gy) and 7.7cc after 5w (40-45Gy). Mean ADC values were 1.02x10-3mm2/sec increasing to 1.18x10-3mm2/sec after 2w and to 1.27x10-3mm2/sec after 5w and to 1.37x10-3mm2/sec at FU. All GTVs showed mean initial-enhancement (IE) followed by a plateau with an increasing IE at 2w and 5w and wash-out at 5w. At FU, there was a persistent enhancement. The mean 18F-FMISO SUVnorm was 3.1 at baseline and decreased to 2.3 at 2w and 2.0 at 5w and follow-up. In all patients there was never the whole tumor 18F-FMISO-avid, but 18F-FMISO-avid spots within the tumor indicative of hypoxia could be identified before and during the course of therapy.

**CONCLUSION**

MP 18F-FMISO PET/MRI in cervix cancer patients at 3T is feasible and enables non-invasive monitoring of morphological and functional changes during treatment.

**CLINICAL RELEVANCE/APPLICATION**

3T MP 18F-FMISO PET/MRI can depict areas of tumor hypoxia during therapy and thus identify patients at risk who need an aggressive treatment approach.

## SSG09-06 Correlation of PET-MR Biomarkers with Breast Cancer Molecular Subtypes, Grading and Presence of Distant Metastases at Time of Presentation

Tuesday, Dec. 1 11:20AM - 11:30AM Location: S504CD

Participants
Onofrio A. Catalano, MD, Napoli, Italy (*Presenter*) Nothing to Disclose
Bruce R. Rosen, MD, PhD, Charlestown, MA (*Abstract Co-Author*) Research Consultant, Siemens AG
Carlo Iannace, MD, San Leucio del Sannio, Italy (*Abstract Co-Author*) Nothing to Disclose
Angelo Luongo, Napoli, Italy (*Abstract Co-Author*) Nothing to Disclose
Marco Catalano, Napoli, Italy (*Abstract Co-Author*) Nothing to Disclose
Mark Vangel, PhD, Charlestown, MA (*Abstract Co-Author*) Nothing to Disclose
Umar Mahmood, MD, PhD, Charlestown, MA (*Abstract Co-Author*) Research Grant, Sabik Medical Inc; Advisory Board, Blue Earth Diagnostics Limited;
Maria Lepore, MD, Avellino, Italy (*Abstract Co-Author*) Nothing to Disclose
Bethany L. Niell, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Emanuele Nicolai, Napoli, Italy (*Abstract Co-Author*) Nothing to Disclose
Andrea Soricelli, MD, Napoli, Italy (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To evaluate if PET-MR biomarkers correlate with molecular genetic subtypes, grading, and presence of distant metastases at time of presentation in naïve ductal invasive breast cancers.

**METHOD AND MATERIALS**

21 consecutive patients with naïve ductal invasive breast cancer and genetic molecular subtype profiling underwent whole-body contrast enhanced FDG-PET-MR (Biograph mMR, Siemens). Two readers, using commercially available software, measured the following PET-MR biomarkers: ADC, Ktrans, Ve, Kep, IAUC, SUVmax, SUVmean, and MTV. They were correlated with genetic molecular subtypes, grading and occurrence of distant metastases.

**RESULTS**

Genetic molecular subtypes were as follows: ER-7, ER+14; PR-8, PR+13; HER2-11, HER2+10; Ki67-low (<=35%), Ki67 medium/high (>35%). Grading was G2 in 14 and G3 in 7. Six patients had distant metastases. The following biomarkers were higher in the ER- and PR- compared to ER+ and PR+ patients: Kep (9234±1320 versus 6492 ±2358, p0.01), SUVmax (14.19±7.17 versus 6.17±4.24, p0.004), and SUVmean (8.44±4.01, p0.004). ADC directly correlated with the degree of Ki67 expression (1019±256 for Ki67<=35%, 1338±105 forKi67>35%, p0.002). The following biomarkers were lower in HER2- patients compared to HER2+ cases: ADC (1050±280 versus 1306±122, p0.009), Kep (6726±2240 versus 8599±2122, p0.028), SUVmax (6.29±4 versus 11.8±7.65, p0.046), and SUVmean (3.72±2.28 versus 7.03±4.43, p0.04).G2 patients experienced lower Kep (6638±2391 versus 8944±1764, p0.04) and lower SUVmax (6.83±4.73 versus 12.89±8.07, p 0.04) than G3 patients.No biomarkers correlated with presence of distant metastases.

**CONCLUSION**

In naïve ductal invasive breast cancers, PET-MR biomarkers correlate with molecular genetic subtypes and with grading, but not with the presence of distant metastases.

**CLINICAL RELEVANCE/APPLICATION**

PET-MR biomarkers might have prognostic and therapeutic implications on patients' management.

## SSG09-07 Impact of Estrogen Receptor Gene Mutations on [18F]-Fluoroestradiol Uptake in Breast Cancer

Tuesday, Dec. 1 11:30AM - 11:40AM Location: S504CD

Participants
Manoj Kumar, MS, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Ginny L. Powers, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Justin Jeffery, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Yongjun Yan, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Amy M. Fowler, MD, PhD, Saint Louis, MO (*Presenter*) Nothing to Disclose

**PURPOSE**

Accurately predicting therapeutic responsiveness in women with breast cancer remains challenging. Positron emission tomography (PET) imaging using [18F]-16alpha-17beta-fluoroestradiol (FES) provides a way to non-invasively and longitudinally examine the subset of tumors expressing estrogen receptor alpha (ERα) which comprise approximately 70% of all breast cancers. However, the effect of mutations in the gene encoding ERα, recently identified in patients with endocrine-resistant, metastatic breast cancer, on FES uptake is unknown. We developed a model system to test how mutations in ERα influence the uptake of FES.

**METHOD AND MATERIALS**

Stable cell lines expressing either wild-type ERα (231-ER) or a point mutation in the ligand-binding pocket, G521R (231-G521R), were created in the ERα-negative human breast cancer cell line MDA-MB-231. ERα-positive MCF7 human breast cancer cells were used as a positive control and parental MDA-MB-231 cells were used as a negative control. Cell uptake of FES was measured in vitro with microPET/CT imaging and gamma counting. In addition, in vivo FES uptake was measured in MCF7 and 231-ER tumors grown as xenografts in athymic nude mice.

**RESULTS**

FES uptake was observed both in vitro and in vivo in the MCF7 and 231-ER cells/tumors. However, there was no significant FES uptake in the 231-G521R cells or parental MDA-MB-231 cells. The 231-ER cells had a similar dose response curve to MCF7 in competition assays using increasing doses of cold estradiol, and as consistent with the uptake data, 231-G521R binding was not altered by cold competition.

**CONCLUSION**

These data support the use of stable cell lines expressing variant forms of ERα as models for demonstrating the effects of ERα gene mutations on FES uptake. Ongoing studies are focusing on the effects of recently identified clinically-relevant ERα mutations on FES uptake and on the prediction of response to ER-targeted therapies.

**CLINICAL RELEVANCE/APPLICATION**

FES-PET imaging provides a non-invasive way to probe ERα function and may prove useful in identifying the development of ERα gene mutations and thus predicting endocrine resistance in ERα-positive breast cancer patients.

## SSG09-08 Imaging Patients with Breast and Prostate Cancers Using Combined 18F NaF/18F FDG and TOF simultaneous PET/ MRI

Tuesday, Dec. 1 11:40AM - 11:50AM Location: S504CD

Participants
Ryogo Minamimoto, MD, PhD, Stanford, CA (*Presenter*) Nothing to Disclose
Andreas M. Loening, MD, PhD, San Francisco, CA (*Abstract Co-Author*) Nothing to Disclose
Valentina Taviani, PhD, Stanford, CA (*Abstract Co-Author*) Nothing to Disclose
Sanjiv S. Gambhir, MD, PhD, Stanford, CA (*Abstract Co-Author*) Board Member, Enlight Biosciences; Board Member, ImaginAb, Inc; Board Member, FUJIFILM Holdings Corporation; Board Member, ClickDiagnostics, Inc; Consultant, FUJIFILM Holdings Corporation; Consultant, Gamma Medica, Inc; Speaker, ImaginAb, Inc; Stock, Enlight Biosciences; Stock options, Enlight Biosciences; Travel support, Gamma Medica, Inc
Shreyas S. Vasanawala, MD, PhD, Palo Alto, CA (*Abstract Co-Author*) Research collaboration, General Electric Company; Consultant, Arterys; Research Grant, Bayer AG;
Andrei Iagaru, MD, Stanford, CA (*Abstract Co-Author*) Research Grant, General Electric Company; Research Grant, Bayer AG

**PURPOSE**

We previously reported the pilot evaluation of a simultaneous PET/MRI scanner with TOF capability, as well as the use of combined 18F NaF/18F FDG PET/CT in cancer patients. Here we prospectively compared the combined 18F NaF/18F FDG PET/ MRI against 99mTc-MDP in patients with breast and prostate cancers for the detection of metastatic disease.

**METHOD AND MATERIALS**

Fifteen patients referred for 99mTc-MDP bone scans were prospectively enrolled from Oct 14 - Mar 15. The cohort included 7 men with prostate cancer and 8 women with breast cancer, 41 - 85 year-old (average 61 ± 13). 18F NaF (0.7-2.2 mCi, mean: 1.2 mCi) and 18F FDG (3.8-5.2 mCi, mean: 4.2 mCi) were subsequently injected from separate syringes. The PET/MRI was done 6-30 days (average 9.3 ± 3.2) after bone scan. The whole body MRI protocol consisted of T2-weighted, DWI, and contrast-enhanced T1-weighted imaging. Lesions detected with each test were tabulated and the results were compared.

**RESULTS**

All patients tolerated the PET/MRI exam, and PET image quality was diagnostic despite the marked reduction in the administered dosage of radiopharmaceuticals (80% less for 18F NaF and 67% less for 18F FDG compared to standard protocols). Five patients had no bone metastases identified on either scans. Bone scintigraphy and PET/MRI showed osseous metastases in 9 patients, but more numerous bone findings were noted on PET/MRI than on bone scintigraphy in 3 patients. One patient had negative bone scan, but bone metastases were seen on PET/MRI. Lesions outside the skeleton were identified by PET/MRI in 3 patients.

**CONCLUSION**

The combined 18F NaF/18F FDG PET/MRI is superior to 99mTc-MDP scintigraphy for evaluation of skeletal disease extent. Further, it detected extra-skeletal disease that may change the management of these patients, while allowing a significant reduction in radiation exposure from lower dosages of PET radiopharmaceuticals administered. A combination of 18F NaF/18F FDG PET/MRI may provide the most accurate staging of patients with breast and prostate cancers prior to the start of treatment.

**CLINICAL RELEVANCE/APPLICATION**

The combined 18F NaF/18F FDG PET/MRI is superior to 99mTc-MDP scintigraphy for evaluation of skeletal disease extent.

## SSG09-09 In Vivo Assessment of Ovarian Tumor Response to Tyrosine Kinase Inhibitor Pazopanib using Hyperpolarized 13C-Pyruvate MRS and 18F-FDG PET/CT Imaging in a Mouse Model

Tuesday, Dec. 1 11:50AM - 12:00PM Location: S504CD

Participants
Murali Ravoori, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Sheela Singh, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Jaehyuk Lee, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
James Bankson, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Vikas Kundra, MD, PhD, Houston, TX (*Presenter*) License agreement, Introgen Therapeutics, Inc

## PURPOSE

Early response measures for ovarian cancer are needed to common targets such as tyrosine kinases. Via effects on signaling within tumor cells or via effects on angiogenesis, such inhibitory drugs have the potential to alter tumor metabolism. 18Fluorodeoxyglucose (18F-FDG) mimics glucose and can be used to evaluate early glycolysis. Hyperpolarization magnetic resonance spectroscopy (MRS) imaging can be used to study pyruvate, which can be produced by glycolysis and other pathways and sits at a decision point for aerobic versus anaerobic metabolism. Our purpose was to assess whether either early or late components of metabolism can serve as indicators of response of ovarian cancer to tyrosine kinase inhibitor (including angiogenesis inhibitor via VEGF receptor inhibition) Pazopanib.

## METHOD AND MATERIALS

Seventeen days after injection of 2 x 106 human ovarian SKOV3 tumors cells into female nude mice, treatment with vehicle or Pazopanib (2.5 mg/mouse po) was initiated. Longitudinal T2-weighted MR, hyperpolarized pyruvate MRS, and 18F-FDG PET/CT imaging were performed pre-treatment as well as 2 days and 2 weeks after treatment.

## RESULTS

Pazopanib was effective in inhibiting ovarian tumor growth compared to control ($p<0.05$). Significantly higher pyruvate to lactate conversion (lactate/pyruvate+lactate ratio) was found 2 days after treatment with pazopanib compared to pre-therapy ($p<0.005$, $n=8$). This was not seen with control or with 18F-FDG PET/CT imaging.

## CONCLUSION

Findings suggest that later metabolic events (pyruvate to lactate conversion) may serve as as an early indicator of response of ovarian cancer to tyrosine kinase (angiogenesis) inhibitor pazopanib in mouse models, even when early glycolytic events do not.

## CLINICAL RELEVANCE/APPLICATION

Hyperpolarized 13C-Pyruvate MRS may serve as an early indicator of response to tyrosine kinase (angiogenesis) inhibitors such as pazopanib in ovarian cancer even when 18F-FDG PET/CT does not.

BRS-TUA

## Breast Tuesday Poster Discussions

Tuesday, Dec. 1 12:15PM - 12:45PM Location: BR Community, Learning Center

BR

*AMA PRA Category 1 Credit ™*: .50

**Participants**
Emily F. Conant, MD, Philadelphia, PA (*Moderator*) Speaker, Hologic, Inc; Scientific Advisory Board, Hologic, Inc; Consultant, Siemens AG

**Sub-Events**

### BR239-SD-TUA1 Contrast-Enhanced Spectral Mammography and Breast-MRI in Neo-Adjuvant Chemotherapy Treatment Monitoring: Comparison in Detection of Complete Responders and Influence of Different Shrinkage Patterns

Station #1

Participants
Valentina Iotti, MD, Reggio Emilia, Italy (*Presenter*) Nothing to Disclose
Rita Vacondio, Reggio Emilia, Italy (*Abstract Co-Author*) Nothing to Disclose
Sara Ravaioli, Reggio Emilia, Italy (*Abstract Co-Author*) Nothing to Disclose
Chiara Coriani, Reggio Emilia, Italy (*Abstract Co-Author*) Nothing to Disclose
Roberto Sghedoni, PhD, Reggio Emilia, Italy (*Abstract Co-Author*) Nothing to Disclose
Andrea Nitrosi, PhD, Reggio Emilia, Italy (*Abstract Co-Author*) Nothing to Disclose
Giulio Tondelli, Correggio, Italy (*Abstract Co-Author*) Nothing to Disclose
Vladimiro Ginocchi, Reggio Emilia, Italy (*Abstract Co-Author*) Nothing to Disclose
Carlo Alberto Mori, Reggio Emilia, Italy (*Abstract Co-Author*) Nothing to Disclose
Pierpaolo Pattacini, Reggio Emilia, Italy (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To compare Contrast-Enhanced Spectral Mammography (CESM) and Contrast-Enhanced MRI in breast cancer response to Neo-Adjuvant Chemotherapy (NAC), especially in detection of Complete Responders (CR), that has important consequences on prognosis and surgical treatment. To evaluate if shrinkage patterns may influence the assessment of response.

#### METHOD AND MATERIALS

51 consenting woman with breast cancer and indication of NAC were enrolled into this prospective study between October 2012 and December 2014. Patients underwent CESM and MRI before, during and after the end of NAC. 34 patients completed NAC up to April 2015. Response to NAC was evaluated according to RECIST 1.1 criteria, considering as responders lesions those with size reduction (shrinkage) of at least 30% and CR those with disappearance on imaging. Results were compared to pathological response on surgical specimens, considered as gold standard. Shrinkage patterns were classified into: concentric (C), spotty (S), disappearance (D).

#### RESULTS

31/34 patients were considered responders both on CESM and MRI vs 29/34 on histopathology. In assessing CR accuracy, sensitivity, specificity, PPV and NPV were respectively 79%, 100%, 74%, 50% and 100% for CESM and 62%, 86%, 56%, 33% and 94% for MRI. Imaging shrinkage patterns overall were: 13 C, 10 S and 8 D. CESM and MRI had 7 (1 C, 2 S, 4 D) and 12 (4 C, 4 S, 4 D) false positive assessments, respectively. MRI shown 1 false negative (S pattern). Errors on CESM were correlated more to disappearance of lesions (50%, 4/8) rather than C (7%, 1/13) or S (20% 2/10) patterns, while errors on MRI were more correlated to disappearance of lesions (50%, 4/8) and S (50%, 5/10), rather than C (31%, 4/13) patterns.

#### CONCLUSION

CESM seems as reliable as MRI in assessing the response to NAC, especially in detection of CR. CESM may be less influenced by different shrinkage patterns, especially spotty, that might be insidious to detect and define.

#### CLINICAL RELEVANCE/APPLICATION

CESM may be an alternative technique to MRI in assessing Complete Response after Neo-Adjuvant Chemotherapy in breast cancer, a challenge with important consequences on prognosis and surgical treatment.

### BR227-SD-TUA2 Imaging-guided Core Needle Breast Biopsy: Impact of Guided Meditation and Music Interventions on Patient Anxiety, Pain, and Fatigue

Station #2

Participants
Mary S. Soo, MD, Durham, NC (*Presenter*) Nothing to Disclose
Jennifer A. Jarosz, MD, Greensboro, NC (*Abstract Co-Author*) Nothing to Disclose
Anava Wren, MA, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Adrianne E. Soo, BS, Chapel Hill, NC (*Abstract Co-Author*) Nothing to Disclose
Yvonne Mowery, MD,PhD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Karen S. Johnson, MD, Durham, NC (*Abstract Co-Author*) Research Consultant, Siemens AG
Sora C. Yoon, MD, Chapel Hill, NC (*Abstract Co-Author*) Nothing to Disclose
Connie E. Kim, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Shelley Hwang, MD,MPH, Durham, NC (*Abstract Co-Author*) Nothing to Disclose
Francis Keefe, PhD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose

Rebecca Shelby, Durham, NC (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

High levels of patient anxiety during core needle breast biopsy (CNBB) have been associated with biopsy pain and can negatively impact patient adherence to follow-up mammography, mammography practice revenues, and national mammography screening recommendations. This study evaluated the impact of guided meditation and music interventions on patient anxiety, pain, and fatigue during CNBB.

**METHOD AND MATERIALS**

In this HIPAA compliant, institutional review board approved study, 121 women presenting for CNBB provided informed consent and were randomized into 3 groups: 1) guided meditation group, 2)music group and 3)standard-care control group. During biopsy, the meditation group listened to an audio-recorded, guided loving-kindness meditation and the music group to relaxing music. The standard-care control group received supportive dialogue from the biopsy team. Immediately before and after biopsy, participants completed questionnaires measuring anxiety (State-Trait Anxiety Inventory Scale) and fatigue (modified Functional Assessment of Chronic Illness Therapy-Fatigue). After biopsy, participants completed questionnaires assessing biopsy pain (Brief Pain Inventory), radiologist-patient communication (modified Questionnaire on the Quality of Physician-Patient Interaction), demographics, and medical history. Bivariate analyses and analyses of covariance were performed.

**RESULTS**

Meditation and music groups reported significantly greater reductions in anxiety and decreased fatigue after biopsy than the standard-care control group (p-values<0.05); the standard-care control group reported increased fatigue after biopsy. The meditation group also showed a trend towards decreased pain during biopsy compared to music and standard-care control groups (p=0.077). No significant difference in patient-perceived quality of radiologist-patient communication was noted among groups (p=0.36).

**CONCLUSION**

Listening to guided meditation or music during CNBB reduced patient anxiety and fatigue without compromise in radiologist-patient communication; the guided meditation group tended towards lower biopsy pain. These simple, inexpensive interventions could improve women's experiences during CNBB.

**CLINICAL RELEVANCE/APPLICATION**

Guided meditation and music interventions during CNBB can reduce patient anxiety and fatigue, and may play a role in reducing biopsy pain, improving adherence to follow-up mammography, and positively impacting departmental revenues.

## BR241-SD-TUA3 Discordant Core Needle Biopsies: A Predictive Model that Identifies Low Probability (≤2%) Lesions to Safely Avoid Surgical Excision

Station #3

Participants
Mai A. Elezaby, MD, Madison, WI (*Presenter*) Nothing to Disclose
Finn Kuusisto, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Jude Shavlik, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Yirong Wu, Madison, WI (*Abstract Co-Author*) Research Grant, Hologic, Inc
Ines Dutra, PhD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Elizabeth S. Burnside, MD, MPH, Madison, WI (*Abstract Co-Author*) Stockholder, NeuWave Medical Inc
Heather Neuman, Madison, WI (*Abstract Co-Author*) Nothing to Disclose
Wendy B. Demartini, MD, Madison, WI (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Breast lesions deemed discordant at core needle biopsy (CNB) currently require repeat sampling to exclude malignancy, typically by surgical excision. We test whether a probabilistic model using clinical, imaging, and biopsy features can identify discordant breast lesions at CNB with sufficiently low (≤2%) probabilities of malignancy to safely avoid excision.

**METHOD AND MATERIALS**

IRB-approved retrospective analysis of all consecutive lesions that had image-guided CNBs from 1/1/2006 to 12/31/2011 and prospectively classified as discordant during routine radiology-pathology correlation. All underwent surgical excision and outcomes were determined by surgical pathology. Patient risk factors, imaging features (BI-RADS descriptors and assessment categories), and CNB information (guidance modality, number of samples, type and gauge of needle, accuracy of clip placement) were used to build a Naïve Bayes model that was trained and tested to predict malignancy. Sensitivity, specificity and positive predictive value (PPV) for malignancy for routine practice (all excised) were compared to management guided by the predictive model (>2% threshold to excise). Results were assessed with a one-sided, one-sample t-test. The imaging features most predictive of malignancy were determined using mutual information analysis.

**RESULTS**

From 1,910 consecutive CNBs, 60 lesions (3%) were classified as discordant. At surgical excision, 10 were malignant and 50 were benign. Our predictive model identified 11/60 lesions (7 masses and 4 areas of calcifications) with ≤2% probability of malignancy, all of which were benign at excision. The predictive model resulted in a statistically significant increase of 22% in specificity ($p < 0.05$) and increase in the PPV to 20.4% compared to 16.7% in routine practice ($p < 0.01$). BI-RADS assessment category was the most predictive imaging feature. In this small sample, there were no malignancies among BI-RADS 4A lesions.

**CONCLUSION**

Of discordant CNBs, our predictive model identified a subset with ≤2% probability of malignancy, increased specificity and PPV, and demonstrated that BI-RADS assessment category 4A was the imaging feature most predictive of benign outcome.

**CLINICAL RELEVANCE/APPLICATION**

A predictive model based on imaging, clinical, and biopsy variables has the potential to avoid unnecessary excision of discordant

image-guided core needle biopsies.

## BR242-SD-TUA4 Detailed Analysis of Breast Cancer Appearance on Tomosynthesis: Correlation with Molecular Profile

Station #4

Participants
Ozden Narin, MD, New Haven, CT (*Presenter*) Nothing to Disclose
Paul H. Levesque, MD, Madison, CT (*Abstract Co-Author*) Nothing to Disclose
Liva Andrejeva-Wright, MD, Wallingford, CT (*Abstract Co-Author*) Nothing to Disclose
Laura S. Sheiman, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Madhavi Raghu, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Melissa A. Durand, MD, New Haven, CT (*Abstract Co-Author*) Research Grant, Hologic, Inc
Regina J. Hooley, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Jaime L. Geisel, MD, New Haven, CT (*Abstract Co-Author*) Consultant, QView Medical, Inc; Consultant, Siemens AG
Laura J. Horvath, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Reni S. Butler, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose
Liane E. Philpotts, MD, New Haven, CT (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Improved visualization of lesions on tomosynthesis suggests that lesions may have varying characteristics than conventionally recognized. The purpose of this study was to determine the imaging characteristics of invasive cancers on tomosynthesis and assess correlation with molecular subtypes.

### METHOD AND MATERIALS

An IRB approved, retrospective review of the breast imaging database at a tertiary academic cancer center was performed to identify all pathologically proven cancers for which tomosynthesis imaging was available. Over a 3.5-year period (1/1/12 - 3/31/15), 279 cancers were imaged. Cases were retrospectively reviewed by 10 dedicated breast imaging radiologists, blinded to the pathology details. Data collection included the tomosynthesis features (shape, margins, fat content). Fat content was categorized as A(0-25%), B(25-50%), C(50-75%) and D(75-100%). Pathology records of the final surgical specimens were reviewed to determine molecular subtype. Correlation of imaging features and molecular subtype was performed.

### RESULTS

Of 279 pathology proven invasive cancers, there were 214(76.7%) IDC; 43(15.4%) ILC, 7(2.5%) tubular, 6(2.2%) mucinous cancers, and 9(3.3%) other. Molecular subtype categorization of 279 cancers demonstrated 190(68.1%) Luminal A, 43(15.4%) Luminal B, 9(3.2%) Her2 enriched, 37(13.3%) basal type cancers. The most common mammographic abnormality in all four molecular subtypes was a mass (78.5%; p=0.02). Most presented as irregular lesions 173(62%). Spiculated margin was the most common tomosynthesis margin finding in all four molecular subtypes (58.8%, p=0.006). The percent of fat content in all cancers was: A(68.1%), B(25.1%), C(6.1%), and D(0.7%). Higher pathologic grade was found to have less intralesional fat content with 79.5% of the poorly differentiated tumors fell into Category A, whereas 57.1% of the well differentiated tumors fell into Category A (p=0.015). Among 36 Basal type cancers, 32(89%) demonstrated Category A whereas 55.6% of the Her2 enriched, 65.3% of Luminal A and 67.4% of Luminal B lesions demonstrated Category A (p<0.001).

### CONCLUSION

Most cancers on tomosynthesis present as spiculated irregular masses and have fat within them. The intralesional fat decreases with the higher pathological grade of the invasive tumors, and basal type cancers.

### CLINICAL RELEVANCE/APPLICATION

Tomosynthesis permits improved assessment of malignant lesions and may lead to improved prediction of molecular subtype.

## BR243-SD-TUA5 Frequency of Discordant Lesions and False Negative Cancers at Stereotactic Vacuum Assisted Biopsy

Station #5

Participants
Samantha L. Heller, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Sonam Jaglan, New York, NY (*Presenter*) Nothing to Disclose
Hildegard B. Toth, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Linda Moy, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To determine the frequency of discordant lesions and false negative cancers at stereotactic vacuum assisted biopsy (VAB).

### METHOD AND MATERIALS

This study is an IRB approved, HIPAA compliant retrospective review of stereotactic VAB performed between 2005 and 2012 using a 9 or 11-gauge device and yielding discordant pathology results as determined by radiologist who performed the biopsy. Cases of discordance, lesion type, BI-RADS rating, size, initial biopsy histology and final excision or repeat biopsy histology were collected from institutional database. Retrospective review of biopsy/post-biopsy imaging was performed by a specialist breast radiologist.

### RESULTS

A total of 1864 stereotactic VAB core biopsies (routinely 10-12 samples) were performed at our institution during a 7-year time period. Majority (1409/1864; 76%) of biopsies involved calcifications. Pathology results yielded 969 (52%) benign, 354 (19%) high-risk or atypical and 541 (29%) malignant lesions. Of these, 27/1864 (1.4%) were considered discordant after review of imaging and histology and majority 24/27 (89%) were BI-RADS 4. (Table 1). 15/27 (56%) were calcifications, 6/27 (22%) were mass lesions, 4/27 (15%) were asymmetries, and 2/27 (7%) were distortions. Mean discordant lesion size was 1.8 cm, range 0.8-7 cm. Needle position was deemed incorrect in 3/27 (11%) of cases on retrospective review. A non-diagnostic histologic finding of normal breast tissue alone at initial biopsy was identified in 9/27 (33%) cases. Scant calcifications were seen in the specimen radiograph in 6/15 (40%) cases of targeted calcifications. All 27/27 (100%) discordant cases went on have either repeat biopsy or surgical excision.

Of these, 8/27 (30%) were false negative cancers (3 invasive ductal carcinomas; 5 ductal carcinomas in situ).

**CONCLUSION**

Relatively few cases of discordance were observed over the study period (1.4%). However, a high percentage (30%) of discordant lesions were shown to be false negatives and proved to be malignant on final surgical excision or after repeat biopsy. This study emphasizes the need for careful radiologic-pathologic review after VAB and for repeat biopsy or surgical excision in the setting of discordance.

**CLINICAL RELEVANCE/APPLICATION**

Radiologic-pathologic review is essential after stereotactic vacuum assisted biopsy. A high false negative rate among discordant biopsy results warrants repeat biopsy or surgical excision in cases of discordance.

## BR244-SD-TUA6 Computer-aided Diagnosis using Retrieved Images Can Improve Radiologists' Performance in Classifying Mammographic Calcifications

Station #6

Participants
Robert M. Nishikawa, PhD, Pittsburgh, PA (*Presenter*) Royalties, Hologic, Inc;
Yongyi Yang, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Juan Wang, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Alexandra V. Edwards, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Miles N. Wernick, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
John Papaioannou, MSc, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To measure the effect of a computer-aided diagnosis (CADx) system on radiologists' ability to judge clustered calcifications as benign or malignant.

**METHOD AND MATERIALS**

Twelve radiologists each read 100 images (50 benign, 50 malignant) consisting of a single cluster of calcifications that was marked in the image. Seven of the radiologists read less 2000 clinical cases annually (low-volume readers, LV) and the other 5 read more than 2500 (high-volume readers, HV). The CADx output consisted of 9 regions of interest that depicted a cluster of calcifications that was judged by the CADx algorithm as being similar in appearance to the cluster being classified. The CADx algorithm was trained to select similar appearing calcifications based on the subjective readings of 6 radiologists (not readers in this study) who judged the similarity of pairs of clusters. For each image, the readers gave their BI-RADS assessment, which was used to estimate sensitivity, specificity, positive-predictive value (PPV), and negative predictive value (NPV) using a BI-RADS score of 1-3 as benign and 4-5 as malignant. The readers gave a likelihood that the cluster was malignant on a 0-100% scale, which were used to compute ROC curves. Areas under the ROC curve (AUCs) were computed using MRMC ROC analysis software. Bootstrapping over images and readers was used to estimate 95% confidence intervals (CI) for the sensitivity, specificity, PPV and NPV estimates.

**RESULTS**

All 12 readers had a statistically significant increase in AUC when using CADx. The average AUC increased from 0.69 to 0.82 ($p<0.001$). Comparisons between the HV and LV readers did not produce any statistically significant differences. While the LV readers had a larger increase in sensitivity (from 0.83 to 0.91) compared to HV readers (from 0.92 to 0.96), the difference in the increase (0.038) had 95% CI that included 0, [-0.18, 0.11]. Changes due to the use of CADx were comparable between the two groups for AUC, specificity, PPV and NPV.

**CONCLUSION**

CADx can improve radiologists' ability to classify clustered calcifications on mammograms, based on viewing a small number of similar clusters with known pathology.

**CLINICAL RELEVANCE/APPLICATION**

CADx has the potential to reduce the number of cancers misclassified as benign and thereby increase the sensitivity of diagnostic or screening mammography, without an appreciable increase in false positives.

## BR245-SD-TUA7 Intraoperative 3D Navigation for Radioactive Seed Localization using Single or Multiple 125I Seeds in Breast-preserving Cancer Surgery

Station #7

Participants
Bas Pouw, Amsterdam, Netherlands (*Presenter*) Nothing to Disclose
Linda J. de Wit-van der Veen, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Frederieke van Duijnhoven, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Emiel Rutgers, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Renato Valdes Olmos, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
M P. Stokkel, MD,PHD, Leiden, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Marie-Jeanne Vrancken Peeters, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

The use of mammographic screening has led to the identification of more women with non-palpable breast cancer. For subsequent treatment adequate localization techniques are required for radical excisions. For radioactive seed localization (RSL) a radioactive Iodine-125 seed (125I-seed) is implanted in the center of the tumor and intraoperatively localized using a gamma probe. In case of extensive DCIS or multifocal carcinoma, multiple 125I-seeds can be used to delineate the borders of the involved area. For localization control of the seed, preoperative imaging is not performed in the surgical position and therefore the exact 125I-seed depth remains unknown during surgery. For this purpose, we evaluated freehand-SPECT (fh-SPECT), which facilitates 3D navigation towards the 125I-seed.

### METHOD AND MATERIALS

Ten female patients (Mean 57y) with 14 implanted 125I-seeds scheduled for RSL were included. Eight patients had 1 125I-seed implanted in the primary lesion, and 2 patients 2. In 2 patients, an additional 125I-seed was implanted as a lymph node marker. Fh-SPECT localized 125I-seeds by measuring gamma counts from different directions all registered by an optical tracking system. A reconstruction and visualization algorithm enabled 3D navigation towards the 125I-seeds. Surgeons estimated the depth of 125I-seeds after excision and compared this with the depth indicated by fh-SPECT.

### RESULTS

Fh-SPECT visualized all 125I-seeds in the primary tumors and provided pre-incision depth information. The deviation between the fh-SPECT depth and the surgical depth estimation was 2 mm (SD 1.9mm, Range 0-7mm). 3D fh-SPECT was especially useful identifying multiple implanted 125I-seeds where the conventional gamma-probe has more difficulty to discriminate 125I-seeds by transcutaneous measurements. One patient had an irradical resection; a ductal carcinoma in situ component was detected at the resection margin.

### CONCLUSION

Fh-SPECT with 3D navigation is feasible in RSL based on single or multiple implanted 125I-seeds. The modality is able to provide real-time 3D information about the depth and location of the 125I-seeds, contributing to adequate excision of non-palpable breast cancer. 3D navigation may become important in breast-preserving cancer surgery.

### CLINICAL RELEVANCE/APPLICATION

The increasing use of radioactive seed localization for breast-preserving cancer surgery emphasizes the importance of navigation techniques to optimize tumor resection.

## BR138-ED-TUA8 BRCA Gene Mutation Related Tumors

Station #8

**Awards**
**Identified for RadioGraphics**

Participants
Michyla L. Bowerson, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Michelle V. Lee, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Christine O. Menias, MD, Scottsdale, AZ (*Abstract Co-Author*) Nothing to Disclose
Khaled M. Elsayes, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Aparna Balachandran, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Venkata S. Katabathina, MD, San Antonio, TX (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1. Review the imaging features BRCA gene mutation related tumors, including mammography, US and cross-sectional imaging2. Discuss the epidemiology, clinical presentation and management of BRCA gene mutation related tumors

### TABLE OF CONTENTS/OUTLINE

CONTENT ORGANIZATION1. Imaging features of BRCA gene mutation related tumors will be discussed includingA. Breast Cancer, female and maleB. Ovarian CancerC. Fallopian tube cancer and peritoneal cancerD. Prostate cancerE. Pancreatic Cancer2. Imaging features on mammography, US, CT and MRI will be reviewed3. Prevention, management and therapeutic options will be discussedSUMMARYInherited mutations in the BRCA1 and BRCA2 gene result in loss of tumor suppressor proteins. Subsequently, DNA damage is not repaired which can lead to cancer. Most importantly, women who inherit harmful BRCA1 or BRCA2 mutations are at increased risk of developing breast and ovarian cancer. Pancreatic cancers, male breast and prostate cancers, female fallopian tube and peritoneal malignancies are also increased. Recognition of their unique presentations is crucial so that appropriate medical or surgical prevention and intervention is accomplished.

### Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Christine O. Menias, MD - 2013 Honored Educator
Christine O. Menias, MD - 2014 Honored Educator
Christine O. Menias, MD - 2015 Honored Educator
Khaled M. Elsayes, MD - 2014 Honored Educator
Venkata S. Katabathina, MD - 2012 Honored Educator

BRS-TUB

## Breast Tuesday Poster Discussions

Tuesday, Dec. 1 12:45PM - 1:15PM Location: BR Community, Learning Center

BR

*AMA PRA Category 1 Credit ™*: .50

**Participants**
Emily F. Conant, MD, Philadelphia, PA (*Moderator*) Speaker, Hologic, Inc; Scientific Advisory Board, Hologic, Inc; Consultant, Siemens AG

**Sub-Events**

### BR246-SD-TUB1 Breast Density Variation Across a Screening Program

Station #1

Participants
Samantha L. Heller, MD, PhD, New York, NY (*Presenter*) Nothing to Disclose
Laura Ward, MBBS, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Sue Hudson, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Louise S. Wilkinson, MBBCh, FRCR, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

This study aims to map density variation across a regional screening population using automated volumetric software and to perform a subset textural analysis of women with the densest breasts.

#### METHOD AND MATERIALS

This retrospective study on a screening population adheres to local confidentiality requirements. Breast density data was obtained from screening mammograms (March 2013-February 2015); density was measured using Volpara Density software (VolparaSolutions Wellington, NZ), a fully automated volumetric method. Breast volume(BV), fibroglandular tissue volume(FGV), and breast density% (%BD) were obtained. %BD was divided into preassigned categories (Grades 1-4) which accord to BI-RADS categories. BV, FGV as well as BD% and Volpara Grade were analyzed with respect to age using R statistics; breast cancer distribution was mapped with respect to %BD and age. Subset of women with highest (Grade 4) density was qualitatively categorized by a specialist breast radiologist for textural pattern based on Tabár classifications (Type IV-extensive nodular and linear densities; Type V-homogenous; or a mixed pattern).

#### RESULTS

40,760 screening records were evaluated (age range 43-90). Half of women had a breast volume between 488 and 1100 cm3. %BD was similar across age range as was FGV, but with slight downward trend. Negative trend for age versus %BD was noted in women < 56, but distribution of density measurements shifted >55; older women in our study generally had less dense breasts, but with more variability. Figure 1 shows Volpara %BD by age; cancers (yellow circles) are identified at all %BD. Subset analysis of Volpara Grade 4 cases was performed for evaluation of textural features. Majority of Volpara Grade 4 mammograms occurred in younger women (55% were in women <55). Nodular and smooth density patterns were seen in equivalent numbers across age groups.

#### CONCLUSION

As expected, age impacts on breast density. Of note, older women in our study generally had less dense breasts, but greater variability. Textural density distribution was equivalent across age groups.

#### CLINICAL RELEVANCE/APPLICATION

Age impacts on breast density. Older women in our study had generally less dense breasts, but with more variability. Longitudinal studies are warranted to determine cancer risk, especially in older women with densest breasts.

### BR247-SD-TUB2 Predictive Value of Ultrasound Posterior Acoustic Features in the Biological Behaviour of Breast Cancer

Station #2

Participants
Salvador Alandete, MD, Valencia, Spain (*Presenter*) Nothing to Disclose
Yinet Fernandez Nunez, MD, Valencia, Spain (*Abstract Co-Author*) Nothing to Disclose
Rosana Medina, MD, Valencia, Spain (*Abstract Co-Author*) Nothing to Disclose
Esther Blanc Garcia, MD, Valencia, Spain (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To correlate the sound-attenuating properties of breast cancer with tumor grade, hormone receptor status,HER2 overexpression and ki-67 biomarker as well as to assess the predicting value of these features.

#### METHOD AND MATERIALS

Our study includes 130 cases of invasive ductal carcinomas and invasive lobular carcinomas diagnosed from January to December of 2012.The predominant posterior acoustic features were retrospectively analyzed and divided into four categories:Posterior shadowing,posterior enhancement,mixed pattern and no change. The sound-attenuating properties were then correlated with tumor grade,hormone receptors,HER2 and Ki-67.

#### RESULTS

Of the 130 tumors,99 (77.6%) were ER-positive/PR-positive,16 (11.2%) were ER-positive/PR-negative and 15 (11.2%) were ER-negative/PR-negative (8 were triple negative).In tumors with posterior shadowing (n=51), 49 (96.0%) were ER-positive,having greater than four times the odds of having ER-positive/PR-positive findings (p<0.001). In tumors with posterior enhancement (n = 59), 13 (22.0%) were ER-negative/PR-negative, having greater than four times the odds of having at least one negative receptor (p<0.001) and a significantly greater probability of having triple-negative status than those without posterior enhancement.Of the lesions with posterior enhancement, 12 (20.3%) showed a high level expression of biomarker ki67 compared to tumors with posterior shadow (p<0.001).High levels of ki67 are associated with a low histological differentiation and the occurrence of lymph node metastases.There were no statistically significant differences between the presence of shadow or posterior enhancement and level of expression of ErbB2.

**CONCLUSION**

The presence of posterior shadow is strongly associated with ER+/PR+ status. Posterior enhancement is strongly associated with higher tumor grade and with higher risk of having at least one negative receptor, a triple-negative status and with higher expression of ki67 biomarker.

**CLINICAL RELEVANCE/APPLICATION**

Some of the sophisticated laboratory tests are not readily available or not cost-effective in many parts of the world. Knowing the predictive values of certain sonographic features of breast cancer may help to stratify their patients and manage them according to their own available resources. Increased diagnostic confidence in imaging can always help to develop cost-effective strategies around the world.

## BR248-SD-TUB3 BI-RADS 3 (Short-Interval Follow-Up) Assessment Rate at Diagnostic Mammography: Correlation with Recall Rates and Utilization as a Performance Benchmark

Station #3

Participants
Kristin L. Harris, DO, Chicago, IL (*Presenter*) Nothing to Disclose
Kevin J. Kirshenbaum, MD, Evanston, IL (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To evaluate the correlation between established performance benchmarks for screening mammography and the BI-RADS 3 (short-interval follow-up) assessment rate from diagnostic mammographic examinations.

**METHOD AND MATERIALS**

Retrospective analysis was performed using data collected by a centralized mammography tracking and reporting system (PenRad™, Revision 4.0). Interpretation data for screening and diagnostic mammograms were obtained for five interpreting mammographers at a single mammography facility between January 2004 and December 2014. Exclusion criteria included mammographers with less than 700 mammogram interpretations per year. Recall rates from screening mammography and BI-RADS 3 assessment rates from diagnostic mammography were analyzed by radiologist and year. Data points were represented on a scatter plot as recall rate as a function of BI-RADS 3 assessment rate and correlation coefficients were calculated.

**RESULTS**

Preliminary results involved data analysis from a total of 75,269 screening mammography examinations and 42,753 diagnostic mammography examinations with a total of 16,369 BI-RADS 3 (short-interval follow-up) assessments. 63.2% of collected data points (N = 38) demonstrate a positive linear relationship between recall rate from screening mammography and BI-RADS 3 assessment rate from diagnostic mammography (correlation coefficient, r = 0.56).Initial data presented above. Final data analysis in progress; to include interpreting mammographers from all affiliated sites using exclusion criteria, as above.

**CONCLUSION**

The use of BI-RADS-3 (short-interval follow-up) assessment category for diagnostic mammographic examinations vary considerably between radiologists. Based on preliminary data from our institution, there appears to be a positive linear relationship between the BI-RADS 3 assessment rate from diagnostic mammography and the recall rate from screening mammography, suggesting potential utility in utilizing the BI-RADS 3 assessment category as a performance measure in the future.

**CLINICAL RELEVANCE/APPLICATION**

Although well-established performance benchmarks for screening mammography exist, performance criteria for diagnostic mammography are not well-established in the current literature. The utilization of BI-RADS 3 assessment rate as a performance measure may help reduce unnecessary imaging examinations and decrease associated costs and patient anxiety in the future.

## BR249-SD-TUB4 Synthesized 2D Mammogram from Digital Breast Tomosynthesis (DBT) as a Preview Image: A Pilot Observer Study

Station #4

Participants
Jun Wei, PhD, Ann Arbor, MI (*Presenter*) Nothing to Disclose
Heang-Ping Chan, PhD, Ann Arbor, MI (*Abstract Co-Author*) Institutional research collaboration, General Electric Company
Mark A. Helvie, MD, Ann Arbor, MI (*Abstract Co-Author*) Institutional Grant, General Electric Company
Marilyn A. Roubidoux, MD, Ann Arbor, MI (*Abstract Co-Author*) Research Consultant, Delphinus Medical Technologies, Inc
Colleen H. Neal, MD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Lubomir M. Hadjiiski, PhD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Chuan Zhou, PhD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose
Ravi K. Samala, PhD, Ann Arbor, MI (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To assess the acceptability of a synthesized mammogram (SM) from DBT as a preview for DBT interpretation.

**METHOD AND MATERIALS**

With IRB approval, 56 DBT cases including 105 views (CC or MLO) were collected from a data set acquired with a prototype GE DBT system. For each DBT view, a corresponding clinical digital mammogram (DM) was retrospectively collected from the patient archive. The time interval between the DBT and the corresponding DM was 3-76 days (17.8±15.2). DMs were acquired with a GE Essential system. An experienced MQSA radiologist marked 68 microcalcification clusters (MC) on 60 views from 31 cases and 48 masses on 45 views from 25 cases, of which 65 (52 MCs and 13 masses) were malignant and 51 (16 MCs and 35 masses) were benign, as lesions of interest. A computerized method was developed that utilized the raw DBT projection and a regularized reconstructed DBT to synthesize a mammogram-like image. A pilot observer study with three MQSA radiologists was conducted to assess the acceptability of the SM as a preview image. Each reader viewed the pair of SM and DM side by side and independently rated the appearance and conspicuity of the lesion on a 10-point scale, and provided a BI-RADS assessment (1, 2, 3, 4a, 4b, 4c, 5) of the marked lesion on SM and DM.

**RESULTS**

The mean conspicuities of MCs were 7.7, 7.0, 8.0 on SM and 5.8, 5.5, 7.2 on DM for the 3 readers, respectively; the differences were significant by paired t-tests (all p-values <0.0001). In contrast, the conspicuities of masses were 4.3, 4.5, 5.0 on SM and 4.9, 5.0, 5.9 on DMs; the differences were also significant (p-values: 0.007, 0.022, 0.004). The differences between SM and DM in the BI-RADS assessment of both MCs and masses did not reach statistical significance for all readers. Of the 348 (116x3) BI-RADS assessments, 4 (3 benign masses and 1 malignant MC) were changed from ≤3 on DM to ≥4a on SM, and 17 (11 benign and 3 malignant masses, 2 benign and 1 malignant MCs) were changed from ≥4a on DM to ≤3 on SM.

**CONCLUSION**

For MCs, the conspicuity on SM was superior while their morphology was slightly inferior to that on DM for BI-RADS assessment. For masses, the interpretation on SM may be affected by the degraded conspicuity.

**CLINICAL RELEVANCE/APPLICATION**

Detection of MCs is challenging in the DBT volume. Synthesized 2D DBT by our method may be acceptable for detection and assessment of MCs but masses should be read in DBT.

## BR250-SD-TUB5 Imaging-detected Radial Scars without Associated Atypia, LCIS, or Papilloma may not Require Surgical Excision

Station #5

Participants
Mohammad Eghtedari, MD, PhD, La Jolla, CA (*Abstract Co-Author*) Research Consultant, Ziva Corporation;
H. Carisa Le-Petross, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Gildy Babiera, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Constance Albarracin, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Kenneth Hess, PhD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Gary J. Whitman, MD, Houston, TX (*Presenter*) Book contract, Cambridge University Press

**PURPOSE**

Several studies have recommended surgical excision following the diagnosis of a radial scar (RS). Our purpose was to determine if imaging and clinical follow-up are appropriate after the diagnosis of a RS without atypia on core needle biopsy.

**METHOD AND MATERIALS**

We queried our institutional pathology data base for all percutaneous breast biopsies between January 2004 and December 2010 that had the words 'radial scar' or 'complex sclerosing lesion.' Cases with a breast cancer in the same breast were excluded. We included patients for which the pathology result indicated RS and the patient had at least 24 months follow-up imaging or surgical resection. The size of the core biopsy needle, the number of cores, the length of imaging follow-up, and the final surgical pathology results were collected.

**RESULTS**

54 cases had RS with no associated high risk lesion (Group A) and 27 cases had RS with a concurrent high risk lesion in the same biopsy specimen (Group B). In Group A, 44 cases had imaging follow-up (median, 49 months) and 10 cases had surgical resection. No cases in Group A developed malignancy (95% confidence interval: 0% to 7%). 3 cases in Group B were upgraded to DCIS on surgical excision (95% confidence interval: 4% to 28%).

**CONCLUSION**

The risk of missing a breast cancer associated with a RS on percutaneous core biopsy without associated abnormalities such as atypia, a papilloma, or LCIS is minimal. Clinical and imaging follow-up of a RS diagnosed by core needle biopsy is appropriate in selected patients.

**CLINICAL RELEVANCE/APPLICATION**

The study results can be useful in decreasing the number of excisions following percutaneous biopsy of a RS without associated atypia, LCIS, or papilloma.

## BR251-SD-TUB6 Ultrafast and High Spatial DCE-MRI with CAIPIRINHA-Dixon-TWIST-VIBE Technique for Breast Lesions: Quantitative Analysis of Pharmacokinetics Parameters

Station #6

Participants
Tao Ai, MD, WuHan, China (*Presenter*) Nothing to Disclose
Yiqi Hu, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose
Mengdan Feng, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose
Xiao X. Xu, Nanchong, China (*Abstract Co-Author*) Nothing to Disclose

Xu Yan, Shanghai, China (*Abstract Co-Author*) Employee, Siemens AG
Hui Liu, Shanghai, China (*Abstract Co-Author*) Employee, Siemens AG
Liming Xia, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To investigate the feasibility of CAIPIRINHA-Dixon-TWIST-VIBE (CDT-VIBE) technique for ultrafast dynamic contrast-enhanced breast MRI with high spatial resolution, and the discrimination for breast lesions with quantitative parameters.

**METHOD AND MATERIALS**

From June 2014 to March 2015, 86 patients with 90 lesions (68 malignant and 22 benign) were included after the approval of the institutional review board. Dynamic breast MRI was performed on a 3T system (Skyra, Siemens Healthcare), using a 16-channel phased-array breast coil. The protocol was based on a work-in-progress CDT-VIBE sequence (spatial = 1 X 1 X 1.5mm; temporal = 11.24s for 35 phases), with the injection of contrast medium (Omniscan, 0.1mmol/kg·bw at 2.5ml/s). Quantitative pharmacokinetics parameters (Ktrans, Ve and Kep) were calculated for all lesions based on the Tofts model. Student's t test was performed to compare the differences of Ktrans, Ve and Kep between two groups, followed by a ROC analysis for the diagnostic accuracy.

**RESULTS**

DCE-MRI based on CDT-VIBE technique was successfully performed for each patient, with superior delineation of margins and internal characteristics of breast lesions. Quantitative parameters of Ktrans, Ve and Kep were 0.22 ± 0.11/ml, 0.44 ± 0.17/ml and 0.51 ± 0.09 for benign lesions; 0.37 ± 0.16/ml, 0.91 ±0.33/ml, and 0.42 ± 0.09 for malignant lesions. The difference was statistically significant between two groups for each quantitative parameter. Based on ROC analysis, the sensitivity, specificity, optimal cut-point and AUC were 92.3%, 58.3%, 0.193/ml and 0.808 for Ktrans; 92.3%, 75.0%, 0.546/ml and 0.922 for Kep; 83.3%, 66.7%, 0.455 and 0.743 for Ve.

**CONCLUSION**

CDT-VIBE technique can be used for ultrafast and high spatial resolution dynamic contrast-enhance breast MRI. Ktrans, Ve and Kep derived from CDT-VIBE sequence allowed for the classification of breast lesions with high sensitivity and accuracy. Kep had the best performance for the differentiation of breast lesions, followed by Ktrans and Ve.

**CLINICAL RELEVANCE/APPLICATION**

The protocol with high temporal and spatial resolution would be ideal for the quick screening and classification of breast lesions. Ultrafast DCE-MRI based on CDT-VIBE technique allows for both improved anatomic/morphological delineation and functional information of pharmacokinetics of breast lesions.

## BR252-SD-TUB7 Assessing Bone Marrow uptake changes During Breast Cancer Therapy on 18F-FLT PET/CT

Station #7

Participants
Prayna Bhatia, BS, Columbus, OH (*Presenter*) Nothing to Disclose
Jun Zhang, PhD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose
Preethi Subramanian, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose
Veena A. Nagar, MD, Dublin, OH (*Abstract Co-Author*) Nothing to Disclose
Xiaoli Liu, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose
Michael V. Knopp, MD, PhD, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose
Bhuvaneswari Ramaswamy, Columbus, OH (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

FLT-PET is being utilized and validated as a non invasive imaging approach to assess the proliferative characteristics of breast cancer lesions and their changes during therapy. While the ability to visualize the bone marrow is readily recognized in FLT-PET, no detailed assessment has yet bene performed on the observable imaging findings during response assessment FLT PET studies

**METHOD AND MATERIALS**

FLT-PET/CT was performed using a 10 mCi target dose at baseline (BL), day 7 (F1), day 14 (F2) and after three cycles (F3) of an investigational breast cancer therapy in patients with HER2 negative metastatic breast cancer. A whole-body acquisition using a Gemini 64 TF PET/CT was acquired as part of a comprehensive investigational protocol. 25 patients are included in this dedicated analysis of the bone marrow using a blinded reader visual and ROI based assessment. ROI's were placed at L1, L3 and L5, as well as the liver at each time point.Changes in SUVmax were compared against baseline or between time points.

**RESULTS**

In the majority of cases (22/25), the FLT uptake decreased immediately after therapy (F1) with similar changes in the three vertebrae locations (L1 14% (ΔSUV 1.88), L3 (ΔSUV 2.34) 16%, L5 (ΔSUV 1.79) 13%) followed by a subsequent bone marrow recovery with increasing SUV by 12%. The visual changes appear even more pronounced. The liver presented an inverse trend of proliferative uptake increasing in 62% of patients at F1 (SUV [BL] 5.94, SUV [F1] 6.84, 0.91 increase) followed by a subsequent normalization at F3 (SUV [F3] 6.41, 0.48 increase).

**CONCLUSION**

Quantitative assessment of the bone marrow uptake is feasible and allows an individualized objective assessment of the proliferative response to ongoing therapy and the extent of recovery over time. The liver proliferation revealed an inverse trend. These therapy induced changes should be considered if FLT PET is assessed by visual reads only and may be relevant for normalization of quantitative readouts for response assessment.

**CLINICAL RELEVANCE/APPLICATION**

As FLT-PET/CT is being utilized to as a proliferation marker to assess response to therapy, the impact on the bone marrow and liver can also readily be assessed as an individualized tool and those changes need to be considered for visual and quantitative assessment.

Participants

## Adverse Effects of Drugs in the Breast and Axilla. What Every Radiologist Should Know

**TUB8**

Station #8

Karina Pesce, Vicente Lopez, Argentina (*Abstract Co-Author*) Nothing to Disclose
Flavia B. Sarquis, MD, Vicente Lopez, Argentina (*Presenter*) Nothing to Disclose
Bernardo O. Blejman, MD, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Maria Jose Chico, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Roxana A. Gerosa, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Vanina Kuznicki, Vicente Lopez, Argentina (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1- To Know the drug-induced adverse effects in the breast and axilla. 2- To Describe the radiographic findings of these effects by radiological techniques: mammography, ultrasound and magnetic resonance imaging (MRI).

### TABLE OF CONTENTS/OUTLINE

IntroductionList of drugs associated breast disordersConcepts and Mechanism of pathogenesisImaging SpectrumCases ManagementConclusion: Drug-induced abnormalities in the breast are common and often undiagnosed. It is important for the radiologist to review medical records to obtain relevant information about drug use and determine whether a relationship exists between them and the findings. Knowledge of these effects and the correct interpretation of the imaging is essential for proper clinical management.

MSRO33

## BOOST: Breast-Case-based Review (An Interactive Session)

Tuesday, Dec. 1 3:00PM - 4:15PM Location: S103AB

BR RO

*AMA PRA Category 1 Credits* ™: 1.25
ARRT Category A+ Credits: 1.50

**Participants**
Steven J. Chmura, MD, PhD, Chicago, IL (*Presenter*) Nothing to Disclose
Nora M. Hansen, MD, Chicago, IL (*Presenter*) Speakers Bureau, F. Hoffmann-La Roche Ltd
Karen Y. Oh, MD, Portland, OR (*Presenter*) Nothing to Disclose
Lucy Chen, MD, Chicago, IL (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Improve basic knowledge and skills relevant to radiation therapy use in breast cancer patients. 2) Apply information learned from provided breast cancer case scenarios to clinical practice. 3) Assess technological innovations and advances which can enhance clinical practice and problem-solving in the breast cancer population. 4) Apply principles of critical thinking to ideas from breast oncology experts and peers in the radiologic sciences.

SSJ01

## Breast Imaging (Quantitative)

Tuesday, Dec. 1 3:00PM - 4:00PM Location: Arie Crown Theater

BR BQ MR

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

**Participants**
Fiona J. Gilbert, MD, Cambridge, United Kingdom (*Moderator*) Medical Advisory Board, General Electric Company; Research Grant, GlaxoSmithKline plc; Research Grant, General Electric Company
Despina Kontos, PhD, Philadelphia, PA (*Moderator*) Nothing to Disclose

**Sub-Events**

### SSJ01-01 Relationship between Computer-extracted MRI-based Phenotypes and the Risk of Breast Cancer Recurrence as Predicted by PAM50 Gene Expression Array

Tuesday, Dec. 1 3:00PM - 3:10PM Location: Arie Crown Theater

Participants
Elizabeth S. Burnside, MD, MPH, Madison, WI (*Presenter*) Stockholder, NeuWave Medical Inc
Hui Li, MD, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Charles Perou, PhD, Chapel Hill, NC (*Abstract Co-Author*) Nothing to Disclose
Karen Drukker, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Elizabeth A. Morris, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Maryellen L. Giger, PhD, Chicago, IL (*Abstract Co-Author*) Stockholder, Hologic, Inc; Shareholder, Quantitative Insights, Inc; Royalties, Hologic, Inc; Royalties, General Electric Company; Royalties, MEDIAN Technologies; Royalties, Riverain Technologies, LLC; Royalties, Mitsubishi Corporation; Royalties, Toshiba Corporation; Researcher, Koninklijke Philips NV; Researcher, U-Systems, Inc
Ermelinda Bonaccio, MD, Amherst, NY (*Abstract Co-Author*) Nothing to Disclose
Margarita L. Zuley, MD, Pittsburgh, PA (*Abstract Co-Author*) Research Grant, Hologic, Inc;
Marie A. Ganott, MD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Jose M. Net, MD, Miami, FL (*Abstract Co-Author*) Nothing to Disclose
Elizabeth J. Sutton, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Kathleen R. Brandt, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Gary J. Whitman, MD, Houston, TX (*Abstract Co-Author*) Book contract, Cambridge University Press
Suzanne Conzen, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Li Lan, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Yitan Zhu, PhD, Evanston, IL (*Abstract Co-Author*) Nothing to Disclose
Yuan Ji, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Erich Huang, PhD, Bethesda, MD (*Abstract Co-Author*) Nothing to Disclose
John B. Freymann, BS, Rockville, MD (*Abstract Co-Author*) Nothing to Disclose
Justin Kirby, Bethesda, MD (*Abstract Co-Author*) Stockholder, Myriad Genetics, Inc
C. Carl Jaffe, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Clinical teams are increasingly relying on genetic profiles for breast cancer subtyping, prognostication, and treatment decisions. We investigate the relationship between computer-extracted breast MRI phenotypes with the PAM50 gene array (which includes two methods: PAM50 Risk of Relapse Subtype [ROR-S] and PAM50 Risk of Relapse Subtype + Proliferation [ROR-P]) in order to understand MRI's potential role in assessing risk of breast cancer recurrence.

#### METHOD AND MATERIALS

We analyzed a retrospective dataset of 84 de-identified, breast MRIs contributed by 5 institutions to the NCI's "The Cancer Imaging Archive" (TCIA), along with clinical, histopathological, and genomic data from "The Cancer Genome Atlas" (TCGA). Each MRI examination imaged a biopsy proven invasive breast cancer comprised of 74 (88%) ductal; 8 (10%) lobular, and 2 (2%) mixed. Of these cancers, 73 (87%) were ER +, 67 (80%) were PR +, and 19 (23%) were HER-2 +. We performed computerized analysis on each cancer yielding computer-extracted image-based tumor phenotypes (CEIPs), quantifying size, shape, morphology, enhancement texture, kinetic curve assessment, and enhancement variance kinetics. Regression and ROC analysis were conducted to assess the predictive ability of CEIPs relative to the multi-gene assays' continuous outputs.

#### RESULTS

Multiple linear regression analyses demonstrated statistically significant Pearson correlations (0.5-0.55) between CEIP signatures and the PAM50 recurrence scores. The most important CEIPs included tumor size and enhancement texture patterns characterizing tumor heterogeneity. Use of CEIP in the tasks of distinguishing between good and poor prognosis in terms of levels of recurrence yielded area under the ROC curve values (standard error) of 0.88 (0.05), 0.73 (0.06), 0.72 (0.08), and 0.61 (0.09) for MammaPrint, Oncotype DX, PAM50 Risk of Relapse Subtype (ROR-S), and PAM50 ROR-P (subtype+proliferation), respectively, with all but the latter showing statistical difference from chance.

#### CONCLUSION

Quantitative breast MRI radiomics shows promise as a method for image-based phenotyping to assess risk of breast cancer recurrence. This work helps us begin to understand which MRI features may be most powerfully correlated with genetic recurrence risk.

#### CLINICAL RELEVANCE/APPLICATION

Computerized MRI tumor phenotyping yield quantitative predictive features that have the potential to advance precision medicine and affect patient treatment strategy.

## SSJ01-02 Dynamic Contrast Enhanced (DCE) Breast MR Features Associated with Prognostic Factors in Triple Negative Breast Cancers (TNBC)

Tuesday, Dec. 1 3:10PM - 3:20PM Location: Arie Crown Theater

Participants
Bo La Yun, MD, Seongnam, Korea, Republic Of (*Presenter*) Nothing to Disclose
Sun Mi Kim, MD, PhD, Seongnam-Si, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Mijung Jang, Seongnam, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jong Yoon Lee, MD, Seongnam-Si, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ja Yoon Jang, MD, Seongnam-Si, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To assess the association of DCE MR features including texture and histogram analysis with pathologic prognostic factors in TNBC.

### METHOD AND MATERIALS

From June 2012 to February 2015, 92 TNBC patients (mean age 53 ±13 years) based on immunohistochemical staining (IHC) enrolled our study. We excluded patient underwent primary systemic therapy. For texture (13 grey level co-occurrence matrix features) and histogram analysis using in-house program, the ROIs were drawn along the margin of the cancer in the largest diameter image at 1.5 minute after contrast injection. For dynamic enhancement pattern analysis, MR CAD system (CADstream) was used. The percentage of fast or medium initial enhancement and persistent, plateau and washout delayed enhancement were analyzed. The pathologic results of specimens were categorized according to histologic grade and axillary nodal status, and IHC result (Ki-67, cytokeratin 5/6, EGFR, p53). The correlation of texture features and enhancement patterns with each pathological prognostic factor were assessed. Interobserver agreement was also investigated.

### RESULTS

High histologic grade was associated with low angular second moment (ASM, p=0.025). Axillary nodal metastasis was associated with high maximum MR diameter (p=0.013), high entropy (p=0.024), and low ASM (p=0.026), low information measure of correlation (IMC1, p=0.046). High Ki-67 index (≥14%) tumors showed high percentage of fast initial enhancement (p= 0.015), high percentage of plateau or washout delayed enhancement (p< 0.001, p=0.001) on dynamic enhancement pattern, high entropy (p<0.001), low ASM (p=0.004) and low IMC1 (p=0.004) on texture analysis. The positivity of cytokeratin 5/6 or EGFR associated with high entropy (p=0.004), high inverse difference moment (IDM, p=0.029), low sum average (p=0.038), low IMC1 (p=0.005) and low IMC2 (p=0.038) on texture analysis, and low mean (p=0.042) and low median (p=0.037) on histogram analysis. Positivity of p53 was not associated with DCE MR features. The agreement of texture and histogram features was good (ICCs>0.9).

### CONCLUSION

Dynamic enhancement pattern, texture and histogram features in DCE MR were associated with pathologic prognosis factors in TNBC. These image features would predict aggressiveness of TNBC on preoperative MR.

### CLINICAL RELEVANCE/APPLICATION

DCE MR features would predict TNBC aggressiveness. It could be used for non-invasive evaluation of TNBC before chemotherapy or surgery.

## SSJ01-03 Automatic and Accurate Breast Cancer Volumetric Segmentation on MRI with Varying Degrees of Background Parenchymal Enhancement

Tuesday, Dec. 1 3:20PM - 3:30PM Location: Arie Crown Theater

Participants
Harini Veeraraghavan, New York, NY (*Presenter*) Nothing to Disclose
Brittany Dashevsky, MD, DPhil, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Girard Gibbons, BA, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Elizabeth A. Morris, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Joseph O. Deasy, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Elizabeth J. Sutton, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

Breast MRI background parenchymal enhancement (BPE) varies between women and can limit the radiologists ability to accurately define breast cancer extent of disease. Here we sought to develop a computer model that could automatically generate volumetric segmentations of breast cancers on MRI with varying degrees of BPE.

### METHOD AND MATERIALS

46 patients with HER2+ invasive breast cancers were included with either mild (n=23) or marked (n=23) BPE. We developed in-house software that combines dynamic contrast enhanced (DCE) MR images acquired at multiple time points (1 pre and 3 post contrast) to generate volumetric tumor segmentation. The DCE-MR images are combined through spectral embedding from which scalar images are computed. The algorithm is initialized with a manually delineated contour of the tumor on a single slice. A model of the tumor is automatically learned using a Gaussian mixtures model (GMM) using the individual time series and the computed scalar images. The GMM classifications are used to refine a joint segmentation generated from the individual sequences using an automatically seeded grow cut method.

### RESULTS

The computer-generated volumetric segmentations were compared with a radiologist-delineated segmentation by computing DICE overlap scores (1.0 -best, 0 -worst). For tumors with mild BPE, the maximum DICE score was 0.92, the lowest was 0.28 and the median was 0.79. For tumors with marked BPE, the maximum DICE score was 0.90, the lowest was 0.04 and the median was 0.71. Two sampled t-test between the scores computed for the mild and marked BPE tumors failed to reject the null hypothesis indicating that there was no difference in the segmentation performance regardless of the extent of BPE.

### CONCLUSION

Our method achieves reasonably accurate volumetric tumor regardless of the extent of BPE.

**CLINICAL RELEVANCE/APPLICATION**

Automatic and accurate segmentation of breast cancers with marked BPE can aid the radiologist in accurately defining the extent of disease and minimizing inter-observer variability.

### SSJ01-04 Association between Quantitative Measures of Breast Parenchymal Complexity and False-Positive Recall from Digital Mammography: Results from a Large Prospective Screening Cohort

Tuesday, Dec. 1 3:30PM - 3:40PM Location: Arie Crown Theater

Participants
Shonket Ray, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Brad M. Keller, PhD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Jinbo Chen, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Emily F. Conant, MD, Philadelphia, PA (*Abstract Co-Author*) Speaker, Hologic, Inc; Scientific Advisory Board, Hologic, Inc; Consultant, Siemens AG
Despina Kontos, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To investigate associations between quantitative features of breast parenchymal complexity and false-positive (FP) recall from breast cancer screening with digital mammography.

**METHOD AND MATERIALS**

Digital mammography (DM) images from an entire one-year cohort of women screened for breast cancer at our institution (Sept. 2010 - Aug. 2011) were retrospectively analyzed. A total of 10,571 screening mammography exams were acquired using either a GE Essential or Hologic Selenia full-field digital mammography (FFDM) unit. All images sets consisted of bilateral cranio-caudal (CC) and medio-lateral oblique (MLO) views and were vendor post-processed (i.e., "For Presentation" images). To characterize breast tissue complexity, thirteen texture features were extracted using a locally adaptive computerized parenchymal texture analysis algorithm. As a comparative established risk factor for FP recall, breast percent density (PD) was estimated on a per-woman basis using previously validated automated software. Logistic regression was performed to evaluate associations between FP recall and the extracted complexity features, using a case-control design where FP-recalls (N=1064) were randomly age-matched to negative screening controls (N=3192) at a 1:3 ratio. Odds ratios (OR) and area under the curve (AUC) of the receiver operating characteristic (ROC) were used to assess strength of associations.

**RESULTS**

Combining PD and texture features yielded an AUC=0.62 (95%CI: 0.60-0.64), with PD (OR=1.01; 95%CI: 1.00-1.01), texture energy (OR=1.43; 95%CI: 1.27-1.61) and sum variance (OR=1.23; 95%CI: 1.07-1.52) associated to higher risk of FP recall ($p<0.05$), while texture difference variance (OR=0.67; 95%CI: 0.58-0.78) and information correlation (OR=0.77; 95%CI: 0.69-0.85) were inversely associated to FP recall ($p<0.05$). A baseline model of PD alone yielded had AUC=0.52 (95%CI: 0.50-0.54, PD OR=1.00; 95%CI: 1.00-1.01).

**CONCLUSION**

Quantitative features of mammographic parenchymal texture complexity may be indicative of the risk for false-positive recall from screening with digital mammography.

**CLINICAL RELEVANCE/APPLICATION**

Incorporating quantitative features of breast parenchymal texture may augment breast density as a parenchymal complexity descriptor to help guide personalized breast cancer screening recommendations.

### SSJ01-05 Prediction of False-Negative Breast Cancer Screens with Digital Mammography: Preliminary evaluation of a Quantitative Breast Complexity Index

Tuesday, Dec. 1 3:40PM - 3:50PM Location: Arie Crown Theater

Participants
Andrew Oustimov, Philadelphia, PA (*Presenter*) Nothing to Disclose
Emily F. Conant, MD, Philadelphia, PA (*Abstract Co-Author*) Speaker, Hologic, Inc; Scientific Advisory Board, Hologic, Inc; Consultant, Siemens AG
Lauren Pantalone, BS, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Brad M. Keller, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Meng-Kang Hsieh, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Despina Kontos, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Breast density is a known confounder of mammographic sensitivity, and increasingly reported for guiding supplemental screening recommendations. We assess the predictive value of a refined quantitative index of dense tissue complexity in identifying women at high-risk of false-negative screens.

**METHOD AND MATERIALS**

We retrospectively analyzed data from an entire one-year (09/01/10 to 08/30/11) screening cohort at our institution (N = 10,728). Among women with negative screening, false negatives (FNs) were defined as cancer detected in a follow up period of 12 and up to 24 months prior to the next routine screening exam (N=11). Controls were identified as women confirmed negative also at subsequent screening, and were randomly selected and matched to FNs based on age and race, at a 1:3 ratio (N=33). To specifically determine the added value of our breast complexity index (BCI), controls were also matched to FNs based on BIRADS density, and on the interpreting radiologist. The BCI was derived from a range of computer-extracted parenchymal texture descriptors, including Grey-level Histogram, Haralick, and Edge-enhancement features (N=29), summarized via principal component analysis (PCA). Associations between the BCI-PCA components and the odds of FN screening were determined via univariate

logistic regression and discriminatory capacity was assessed via receiver operating characteristic (ROC) curve analysis.

**RESULTS**

The BCI was significantly associated with the odds of FN screening (OR: 0.67, 95% CI: 0.45 - 1.00, p = 0.05), while exhibiting potential to discriminate between false negative screeners and controls confirmed as negative at subsequent screening (AUC = 0.69, 95% CI: 0.48 to 0.88). The first 3 principle components accounted for 88% of the total variance in the features.

**CONCLUSION**

The significant association between BCI and the odds of FN screen, in a case-control sample with identical BIRADS density distributions, suggests that refined quantitative measures of breast complexity may be more sensitive than qualitative BIRADS density in identifying women at high-risk for a false-negative screening exam.

**CLINICAL RELEVANCE/APPLICATION**

Quantitative measures of breast complexity may result in more sensitive markers for guiding supplemental screening recommendations, than the reporting of conventional BIRADS breast density.

## SSJ01-06 Dedicated Computer Aided Detection for Automated 3D Breast Ultrasound Detects Invasive Ductal Cancers Independent of Hormonal Receptor Status

Tuesday, Dec. 1 3:50PM - 4:00PM Location: Arie Crown Theater

Participants
Jan Van Zelst, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Tao Tan, Nijmegen, Netherlands (*Abstract Co-Author*) Research Grant, QView Medical, Inc
Nico Karssemeijer, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Shareholder, Matakina Technology Limited; Consultant, QView Medical, Inc; Shareholder, QView Medical, Inc; Director, ScreenPoint Medical BV; Shareholder, ScreenPoint Medical BV;
Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Speakers Bureau, Bayer AG

**PURPOSE**

Prognostic factors such as hormonal receptor (HR) status (estrogen and progestron) in invasive ductal cancers (IDC) are associated with ultrasonographic imaging phenotypes that may limit differentiating aggressive IDC from benign masses. Therefore, in this study we compared the relative sensitivity of a commercially developed computer aided detection (CADe) program in the detection of HR+ and HR- IDCs and biopsied benign breast lesions.

**METHOD AND MATERIALS**

The local IRB waived the need for informed consent for this study. ABUS exams of 101 women with 66 IDCs and 35 biopsied benign lesions were randomly selected from a large image archive. All IDCs were examined by a pathologist on the surgical specimen and benign lesions were examined on a histological core needle biopsy specimen. For all IDCs we extracted HR status from the pathology reports. All lesions were annotated by outlining the contour of the lesion based on radiology and pathology reports. After reading the cases, the CADe program (Qview Medical Inc., Los Altos, ca., USA) generated a series of suspicious region candidates that were marked in the ABUS scans. The location of these candidates were objectively compared to the location of the annotations. Thereafter, the relative sensitivity of the CADe program was computed for the HR+ IDCs, HR- IDCs and the benign lesions. Chi-square tests were used to analyze the differences between the sensitivities of these three groups. Statistical differences are considered significant when $p < 0.05$.

**RESULTS**

CADe marked 71.2% of the IDC's as suspicious versus 45.7% of the benign lesions (p=0.012). Of the HR+ IDCs, 69.2% were marked by CADe. This is significantly higher than the marked proportion of benign lesions (p=0.028). Also the detection of HR- IDC's (78.6%) was better than that of the benign lesions (p= 0.037). The detection of HR+ IDC's did not statistically differ from the HR- IDC's that were marked by CADe (p=0.48).

**CONCLUSION**

Computer Aided Detection software can detect and mark IDCs independent from the hormonal status. Furthermore, CADe differentiates between suspicious benign breast lesions and HR negative IDC's that are known for their benign-like ultrasonographic appearance.

**CLINICAL RELEVANCE/APPLICATION**

Computer Aided Detection software has the potential to aid radiologists in detecting even the more aggressive breast cancers and may aid in differentiating between aggressive subtypes of cancer and suspicious benign lesions.

SSJ02

## Breast Imaging (Nuclear Medicine/Molecular Imaging)

Tuesday, Dec. 1 3:00PM - 4:00PM Location: E450A

BR MI MR NM

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

**Participants**
Priscilla J. Slanetz, MD, MPH, Belmont, MA (*Moderator*) Nothing to Disclose
Donna M. Plecha, MD, Strongsville, OH (*Moderator*) Advisory Board, Hologic, Inc;

**Sub-Events**

### SSJ02-01 Multiparametic Evaluation of Breast Lesions with 18-Fluorodeoxyglucose Positron Emission Tomography Magnetic Resonance Imaging

Tuesday, Dec. 1 3:00PM - 3:10PM Location: E450A

Participants
Courtney A. Garlick, MD, Cleveland, OH (*Presenter*) Nothing to Disclose
Jenny Wang-Peterman, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Peter F. Faulhaber, MD, Cleveland, OH (*Abstract Co-Author*) Speaker, Koninklijke Philips NV; Grant, Koninklijke Philips NV; Medical Advisor, MIM Software Inc
Kuan-Hao Su, Shaker Heights, OH (*Abstract Co-Author*) Research Grant, Koninklijke Philips NV
Raymond Muzic, PhD, Cleveland, OH (*Abstract Co-Author*) Research Grant, Koninklijke Philips NV
Maryam Etesami, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Nelly Salem, MD, Cleveland, AL (*Abstract Co-Author*) Nothing to Disclose
Donna M. Plecha, MD, Strongsville, OH (*Abstract Co-Author*) Advisory Board, Hologic, Inc;

#### PURPOSE

To assess the performance of multiparametric 18-Fluorodeoxyglucose positron emission tomography magnetic resonance imaging (MP PET-MRI) using dynamic contrast-enhanced MRI (DCE-MRI), diffusion weighted imaging (DWI) and FDG-PET in differentiating between benign and malignant abnormalities identified on DCE-MRI.

#### METHOD AND MATERIALS

28 newly diagnosed breast cancer patients were prospectively enrolled in this Institutional Review Board (IRB) approved study. 25 patients underwent FDG PET-MRI imaging. Breast abnormalities identified in these patients on DCE-MRI were assessed for their likelihood of malignancy for each individual parameter (DCE-MRI, DWI and PET) as well as for combinations of the parameters. Malignancy vs. benignity of each lesion was then determined by histopathology or, in some cases where final pathologic diagnosis was not available, by pre- and post-chemotherapy imaging. If an abnormality showed a response to chemotherapy, it was presumed malignant. Sensitivity, Specificity, PPV and NPV were then measured.

#### RESULTS

60 lesions were identified, of which 6 had no pathology or imaging follow-up, 11 were deemed benign and 43 malignant (6 presumed malignant). MP PET-MRI significantly improved specificity over DCE-MRI (100% vs 45%, p=0.012) and DCE-MRI combined with PET (100% vs 36%, p=0.004) or DWI (100% vs 44%, p=0.011). There was a trend toward increased PPV with MP PET-MRI vs DCE-MRI (100% vs 88%), but was not statistically significant. Further, there was no statistically significant differences in sensitivity or NPV (p>0.05).

#### CONCLUSION

Multiparameter 18FDG PET-MRI increases specificity and decreases false positives of DCE-MRI without significant loss of sensitivity.

#### CLINICAL RELEVANCE/APPLICATION

MP PET-MRI improves specificity of DCE-MRI which may lead to more accurate staging, decreasing false positives and unnecessary biopsies.

### SSJ02-02 Visualization of Primary Breast Cancer Lesions with a Dedicated PET for Hanging Breast Imaging in Comparison to PET/CT

Tuesday, Dec. 1 3:10PM - 3:20PM Location: E450A

Participants
Suzana Teixeira, MD, Amsterdam, Netherlands (*Presenter*) Nothing to Disclose
Jose Ferrer Rebolleda, MD, Valencia, Spain (*Abstract Co-Author*) Nothing to Disclose
Bastiaan Koolen, MD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Jelle Wesseling, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Raul Sanchez Jurado, Valencia, Spain (*Abstract Co-Author*) Nothing to Disclose
M P. Stokkel, MD,PHD, Leiden, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Maria Del Puig Cozar Santiago, MD, Valencia, Spain (*Abstract Co-Author*) Nothing to Disclose
Vincent van der Noort, PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Emiel Rutgers, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Renato Valdes Olmos, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Evaluate the performance of a dedicated PET for hanging breast imaging (MAMMI-PET) for the visualization of breast cancer lesions

in two European hospitals while comparing the results obtained with whole body PET/CT.

**METHOD AND MATERIALS**

After institutional review board approval we prospectively included 230 female patients (age: mean 52 y, range 24-82y) with >= 1 histologically confirmed primary breast cancer lesion (=index lesion) between March 2011 and March 2014. All patients that gave written informed consent were scanned with the MAMMI-PET (Oncovision, Valencia, Spain) after injection of 180-240 MBq and following standard whole body PET/CT. All index lesions on the MAMMI-PET scored 0, 1 or 2 for quantity of FDG uptake, which was tested in relation to histological (ductal, lobular) and molecular (ER/PR/Her2) breast cancer subtype, tumor grade, breast length, maximal tumor diameter and affected breast quadrants. We also compared the visibility score of the primary tumor between MAMMI-PET with standard PET/CT.

**RESULTS**

Totally 234 affected breasts were scanned with proven primary breast cancer lesions (diameter 5-170 mm). The MAMMI-PET sensitivity was 98.6% for lesions located within the device scanning range. Twenty-three lesions (9.8%) near the pectoral muscle did not reach the scanning range and where therefore not visualised by MAMMI-PET. Of 11 index lesions smaller than 1 cm 9 where visualised by MAMMI-PET. Lesion visibility was not influenced by tumor grade (p=0.21) or cancer subtype (p=0.8345). In comparison to PET/CT MAMMI missed 19 lesions of which 18 were outside its scanning range. However PET/CT was not able to detect 15 index lesions visualized by MAMMI (p=0.61). MAMMI-PET detected 41 additional lesions of which 16 where proven malignant (39%), 15 (36.6%) seen on other modalities, and 14 (34,2%) only visible on MAMMI-PET.

**CONCLUSION**

Without limitations due to tumor size, grade or histological subtype the MAMMI-PET is able to detect almost all breast cancer index lesions located within its scanning range and is for this lesion category more sensitive than PET/CT.

**CLINICAL RELEVANCE/APPLICATION**

With the dedicated MAMMI-PET it is possible to visualise primary breast cancer lesions in prone position without compression without the limitation known for PET/CT of tumor size and histological subtype.

## SSJ02-03 Pretreatment Prediction of Response to Preoperative Chemotherapy by Multiparametric F-18 Fluorodeoxyglucose Positron Emission Tomography - Magnetic Resonance Imaging in Breast Cancer Patients

Tuesday, Dec. 1 3:20PM - 3:30PM Location: E450A

Participants
Maryam Etesami, MD, Cleveland, OH (*Presenter*) Nothing to Disclose
Peter F. Faulhaber, MD, Cleveland, OH (*Abstract Co-Author*) Speaker, Koninklijke Philips NV; Grant, Koninklijke Philips NV; Medical Advisor, MIM Software Inc
Courtney A. Garlick, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Jenny Wang-Peterman, MD, Cleveland, OH (*Abstract Co-Author*) Nothing to Disclose
Raymond Muzic, PhD, Cleveland, OH (*Abstract Co-Author*) Research Grant, Koninklijke Philips NV
Kuan-Hao Su, Shaker Heights, OH (*Abstract Co-Author*) Research Grant, Koninklijke Philips NV
Nelly Salem, MD, Cleveland, AL (*Abstract Co-Author*) Nothing to Disclose
Donna M. Plecha, MD, Strongsville, OH (*Abstract Co-Author*) Advisory Board, Hologic, Inc;

**PURPOSE**

To assess whether multiparametric [F-18]fluorodeoxyglucose (FDG) positron emission tomography (PET) - magnetic resonance imaging (FDG-PET/MR) using dynamic contrast-enhanced MRI (DCE-MRI), diffusion-weighted imaging (DWI), and FDG-PET is able to predict response to preoperative chemotherapy in breast cancer patients. A pilot study.

**METHOD AND MATERIALS**

A prospective, IRB approved study including twenty seven female patients with biopsy proven primary breast cancer underwent breast-specific PET/MR using Philips Ingenuity TF, 3T system. Patients treated with preoperative chemotherapy followed by surgery or post chemotherapy imaging were enrolled. Patients who had evidence of systemic metastases were excluded. DCE-MRI, DWI, and FDG-PET were qualitatively and semiquantitatively analyzed. The response to chemotherapy was assessed by the pathologic analysis of surgical specimen, or post chemotherapy imaging in two patients awaiting definitive surgery, and then correlated with PET/MR data.

**RESULTS**

Eighteen patients met the criteria to be enrolled in the study. Response to chemotherapy was complete in 4 (22%), partial in 8 (44%), and no response in 6 (33%) patients. On MRI, the apparent diffusion coefficient (ADC) value for responders to chemotherapy (partial or complete) (mean=0.78 x $10^{-3}$ $mm^2/s$) was significantly higher than for non-responders (mean=0.56 x $10^{-3}$ $mm^2/s$) (p=0.45). All the responders had ADC value of greater than 0.65 x $10^{-3}$ $mm^2/s$. With FDG-PET, there was no significant difference in maximum standardized uptake value (SUVmax) in responders (mean=7.38) versus non-responders (mean= 6.87) (p=0.85). The DCE-MRI kinetic curves and morphology showed no significant difference between responders and non-responders.

**CONCLUSION**

In our pilot study, DCE-MRI with DWI was found to be valuable for pretreatment prediction of response to chemotherapy in breast cancer. Higher ADC values were associated with response. With limited number of patients, there was no proven benefit of PET/MR over DCE-MRI in the prediction of response to chemotherapy. Further studies with larger cohorts and evaluating imaging characteristic changes after an early dose of chemotherapy would be helpful.

**CLINICAL RELEVANCE/APPLICATION**

DCE-MRI with DWI may improve the ability to predict response to preoperative chemotherapy in patients with breast cancer.

## SSJ02-04 Insights in Physiology of Breast Parenchyma: Is There a Correlation of Breast Parenchymal Uptake of 18FDG, Breast Parenchymal Enhancement on DCE-MRI, Amount of Fibroglandular Tissue and Age?

Tuesday, Dec. 1 3:30PM - 3:40PM Location: E450A

Participants
Doris Leithner, Frankfurt am Main, Germany (*Presenter*) Nothing to Disclose
Pascal A. Baltzer, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Heinrich Magometschnigg, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Georg J. Wengert, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Thomas H. Helbich, MD, Vienna, Austria (*Abstract Co-Author*) Research Grant, Medicor, Inc; Research Grant, Siemens AG; Research Grant, C. R. Bard, Inc
Katja Pinker-Domenig, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To assess and correlate breast parenchymal uptake (BPU) in 18FDG PET-CT with breast parenchymal enhancement (BPE) and amount of fibroglandular tissue (FGT) with 3T DCE-MRI and to determine the influence of patient age on BPU, BPE and FGT.

**METHOD AND MATERIALS**

In this IRB-approved prospective study 129 patients with a BIRADS 4/5 lesion underwent 18FDG PET-CT and 3T DCE-MRI. Examinations were no longer than six days apart. Patients were injected with approximately 300 MBq 18FDG. After 60 min a prone PET-CT dataset over the breasts was acquired and CT data was solely used for attenuation correction. For DCE-MRI a contrast-enhanced high resolution 3D-T1-weighted sequence before and after application of a standard dose of 0.1 mmol/kg Gd-DOTA (Dotarem®) was employed. BPU and BPE were assessed in the healthy contralateral breast. BPU was calculated quantitatively using SUVmax. FGT and BPE were qualitatively assessed by two independent readers using the revised ACR BI-RADS® classification. To assess reproducibility all measurements were repeated by reader 1. Appropriate statistical tests were used to assess correlation of FGT, BPE, BPU, inter- and intra-reader agreement.

**RESULTS**

There was no BPE in 58, mild in 54, moderate in 14 and marked in 3 patients. SUVmax for patients with no BPE was 1.57 (SD 0.6), for mild BPE 1.93 (SD 0.6), for moderate BPE 2.42 (SD 0.5), and for marked BPE 1.45 (SD 0.3). There were highly significant correlations between age, BPU, BPE and FGT.Correlation coefficients ranged between moderate and strong. While BPE, BPU and FGT were positively correlated with each other, all of these parameters were negatively correlated with age (Figure 1). The intraclass correlation coefficient for BPU measurements was excellent with 0.973. Inter-reader and intra-reader agreement for BPE was very good with a Kappa-value of 0.860 and 0.822 respectively.

**CONCLUSION**

BPU of normal breast parenchyma can be reproducibly assessed using SUV metrics and is positively correlated with BPE and FGT in DCE-MRI. There is a negative correlation of BPU, BPE and FGT with age.

**CLINICAL RELEVANCE/APPLICATION**

BPU, BPE and FGT provide insights in tumor physiology and decrease with age. In patients with dense breasts a possible masking effect of lesions by BPU/BPE must be considered.

## SSJ02-05 Clinical Comparison of MBI and BSGI for Low Dose Breast Imaging

Tuesday, Dec. 1 3:40PM - 3:50PM Location: E450A

Participants
Zaiyang Long, PhD, Rochester, MN (*Presenter*) Nothing to Disclose
Carrie B. Hruska, PhD, Rochester, MN (*Abstract Co-Author*) Institutional license agreement, Gamma Medica, Inc
Michael K. O'Connor, PhD, Rochester, MN (*Abstract Co-Author*) Royalties, Gamma Medica, Inc

**PURPOSE**

Breast specific gamma imaging (BSGI) and molecular breast imaging (MBI) are promising techniques for supplemental imaging in women with dense breast tissue. This study compares the performance of such systems at administered doses of Tc-99m sestamibi that are acceptable for low dose imaging.

**METHOD AND MATERIALS**

The BSGI system comprised a single-head multi-crystal NaI system (pixel size 3.2×3.2 mm) equipped with a hexagonal-hole lead collimator. The MBI system comprised a dual-head cadmium zinc telluride detector system (pixel size 1.6×1.6 mm) equipped with registered tungsten collimators. System sensitivity, uniformity, energy and spatial resolution were measured using NEMA methods. A 6-cm thick contrast detail (CD) phantom with 48 hot spots (3-10 mm diameter) was used to assess contrast-noise-ratio (CNR) using average background count densities observed in clinical studies at 4mCi dose. 25 patients receiving 4-8mCi doses were imaged on both systems under IRB approval.

**RESULTS**

The BSGI and MBI systems had integral uniformities of 6.1% and 3.8%, and energy resolution (at 140 keV) of 13.1% and 4.3%, respectively. System sensitivity was 403 cpm/uCi (BSGI) and 790 cpm/uCi (MBI) using a standard +/-10% energy window. In clinical use, MBI employs an energy window of 110-154 keV, yielding a sensitivity of 1042 cpm/uCi. At distances of 1, 3 and 5 cm from the collimator, spatial resolution was 4.1, 5.1 and 6.2 mm on BSGI, and 2.0, 4.7 and 7.3 mm on MBI, respectively. However, with the dual head configuration of MBI, spatial resolution at 5 cm distance from one detector is equivalent to 1cm from the opposing detector for the most frequently observed compressed breast thickness of 6cm. Application of the Rose criterion for lesion detection (CNR>3) to images of the CD phantom showed that for BSGI, 9 hot spots at 4mCi were undetectable. For MBI, 5 hot spots at 4mCi were undetectable. In the 25 patient studies, 5 lesions (CNR>3) were identified on MBI whereas 3 were identified on BSGI.

**CONCLUSION**

Over the clinical range 0-6 cm, the MBI system demonstrated better spatial resolution than the BSGI system while yielding a 2.6-

fold greater sensitivity. This resulted in improved lesion detection and allows MBI to be utilized at lower doses than BSGI.

**CLINICAL RELEVANCE/APPLICATION**

Molecular breast imaging (MBI) system demonstrated better performance characteristics than BSGI system. MBI is more suitable for low dose breast imaging.

## SSJ02-06 Correlation of Semi-Quantitative Breast-Specific Gamma Imaging Findings with Dynamic Contrast-Enhanced MRI Parameters assessed by a Computer-Aided Evaluation Program and Prognostic Factors of Breast Cancers

Tuesday, Dec. 1 3:50PM - 4:00PM Location: E450A

Participants
Saemee Ahn, MD, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Hye Ryoung Koo, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jeong Seon Park, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Soo-Yeon Kim, MD, Guri, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To investigate whether a correlation exists between the semi-quantitative breast-specific gamma imaging (BSGI) findings and dynamic contrast-enhanced (DCE) MRI parameters assessed by a computer-aided evaluation program or prognostic factors of breast cancers

**METHOD AND MATERIALS**

Semi-quantitative index of lesion to non-lesion ratio (L/N) in BSGI and DCE-MRI parameters assessed by a computer-aided evaluation program and histopathologic prognostic factors of 47 invasive breast cancers were obtained. Correlation between L/N ratio and DCE-MRI parameters assessed by a computer-aided evaluation program, including tumor size (cm), angio-volume (cc), degree of initial peak enhancement (%), persistent enhancement proportion (%), washout enhancement proportion (%), or prognostic factors, including axillary nodal status, histologic grade, expression of estrogen receptor (ER), progesterone receptor (PR), human epidermal growth factor receptor 2 (HER2) and Ki-67 were analyzed.

**RESULTS**

The mean L/N ratio of 47 tumors was 3.63 ± 2.19 (range: 1-13.1). The L/N ratio was higher in tumors with larger tumor size ($P<0.001$), increased angio-volume ($P<0.001$), higher degree of initial peak enhancement ($P<0.001$), increased washout enhancement proportion ($P=0.003$), high histologic grade ($P=0.013$), and higher Ki-67 ($P=0.002$). The calculated multiple correlation coefficient was 0.80 ($P<0.001$).

**CONCLUSION**

There was a strong multiple correlation between the semi-quantitative L/N ratio in BSGI with DCE-MRI parameters assessed by a computer-aided evaluation program and prognostic factors of breast cancers.

**CLINICAL RELEVANCE/APPLICATION**

The relationship between the radiotracer uptake in molecular imaging and DCE-MRI parameters may offer an in-depth understanding into the characterization of breast cancer.

RC415

## Breast MR Imaging (An Interactive Session)

Tuesday, Dec. 1 4:30PM - 6:00PM Location: E450A

BR MR SQ

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

**Participants**

**Sub-Events**

### RC415A Image Quality and Interpretation

Participants
Debra M. Ikeda, MD, Stanford, CA (*Presenter*) Consultant, F. Hoffmann-La Roche Ltd; Consultant, Bracco Group

**LEARNING OBJECTIVES**

1) To review standard MRI acquisition parameters recommended by ACR Breast MRI BI-RADS. 2) To review MRI Interpretation according to ACR Breast MRI BIRADS terminology.

### RC415B MR BI-RADS 3

Participants
Debra L. Monticciolo, MD, Temple, TX (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) To review the current literature for BIRADS 3 in the MR setting. 2) To understand interpretations for which BIRADS 3 would or would not be appropriate.

**ABSTRACT**

Discussion will include the current literature on use of BIRADS 3, with attention to the MR setting. Cases where BIRADS 3 would be considered as well as cases not appropriate for BIRADS3 at MR will be shown.

### RC415C Challenging Cases

Participants
Sujata V. Ghate, MD, Durham, NC (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Identify challenging cases on breast MRI. 2) Recognize MR imaging findings of unusual breast lesions. 3) Review do's and don't of the breast MRI report. 4) Recommend appropriate management for difficult or esoteric lesions seen on MRI.

**ABSTRACT**

This lecture will review challenging cases on breast MRI. Participants will learn to identify MR imaging features of common breast diseases, recognize unusual and esoteric lesions, understand the importance of a clear and concise MRI report, and manage difficult cases seen on breast MRI. A total of 12 cases will be reviewed and imaging findings and appropriate management for each case will be discussed. At the conclusion of the case conference, audience participants will have the opportunity to ask questions and discuss unusual cases.

RC417

## Emerging Breast Imaging Strategies

Tuesday, Dec. 1 4:30PM - 6:00PM Location: S505AB

BR DM MR

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

**Participants**
Catherine J. Moran, PhD, Stanford, CA (*Moderator*) Research support, General Electric Company

**Sub-Events**

### RC417A Diffuse Optical Spectroscopy of Breast Cancer

Participants
David R. Busch, PhD, Philadelphia, PA, (drbusch@sdf.org) (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Describe light transport through tissue. 2) Describe the current applications of diffuse optics in medicine and technological limitations. 3) Summarize applications of diffuse optics to breast cancer, including cutting edge work and implications for future clinical applications.

**ABSTRACT**

Diffuse optics utilizes near-infrared light to probe tissue without ionizing radiation. These tools permit rapid and pain-free assessment of endogenous cancer signatures, including oxygenated and deoxygenated hemoglobin, lipid, and water concentrations. Relatively inexpensive instrumentation can monitor the progress of neoadjuvant chemotherapy in a clinic, rather than an imaging suite, using convinient hand-held probes, even in radiologically dense breasts. Very recently, similar optical monitoring tools have been developed to measure microvascular blood flow. More elaborate diffuse optical imaging systems construct three dimensional tomograms of multiple tissue constituants, permitting multi-parameter computer aided detection and localization of tumors.In addition to endogenous chromophores, these optical measurements are exquisitly sensitive to contrast agents, holding significant promise for imaging of highly specific contrast agents at pico- or femto-molar concentrations. Diffuse optical instrumentation can readily be combined with other imaging techinques. These multi-modality data sets provide the opportunity to combine the advantageous aspects of both techniques. We will discuss recent advances in optical monitoring, imaging, and combinations with other modalities.

**URL**

www.sas.upenn.edu/~drbusch/rsnaHandout-DiffuseOptics-Breast.pdf

### RC417B Contrast Enhanced Mammography and Tomosynthesis

Participants
John M. Lewin, MD, Denver, CO (*Presenter*) Consultant, Hologic, Inc; Research Grant, Hologic, Inc; Consultant, Novian Health Inc

**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.

**Active Handout:John Morton Lewin**

http://abstract.rsna.org/uploads/2015/13029341/RC417B.pdf

**Active Handout:John Morton Lewin**

http://abstract.rsna.org/uploads/2015/13029341/Active RC417B.pdf

### RC417C High Resolution Dynamic Contrast Enhanced Breast MRI

Participants
Catherine J. Moran, PhD, Stanford, CA (*Presenter*) Research support, General Electric Company

**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.

**ABSTRACT**

This talk will provide an overview of high-resolution breast MRI techniques. Initially, MRI concepts including parameter tradeoffs, contrast mechanisms, and parallel imaging will be reviewed. Fat suppression techniques are essential for high-quality breast MRI, and include further tradeoffs. Finally, techniques for high spatiotemporal resolution sampling to resolve rapid contrast kinetics while also offering sharp images will be described.

**URL**

ED001-WE

## Breast Wednesday Case of the Day

Wednesday, Dec. 2 7:00AM - 11:59PM Location: Case of Day, Learning Center

**BR**

*AMA PRA Category 1 Credit ™*: .50

**Participants**
Susan O. Holley, MD, PhD, Saint Louis, MO (*Presenter*) Research Consultant, Biomedical Systems
Michelle V. Lee, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Eugene Y. Kim, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Michyla L. Bowerson, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Wendi A. Owen, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Catherine M. Appleton, MD, Saint Louis, MO (*Abstract Co-Author*) Scientific Advisory Board, Hologic, Inc; Royalties, Oxford University Press;
Whitney A. Manlove, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Onalisa D. Winblad, MD, Kansas City, KS (*Abstract Co-Author*) Nothing to Disclose
Jill A. Jones, MD, Kansas City, KS (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1) Identify, characterize, and analyze abnormal findings on multimodality breast imaging studies. 2) Develop differential diagnostic considerations based on the clinical information and imaging findings. 3) Recommend appropriate management for the patients based on imaging findings.

RC515

## Breast Imaging: Politics and Practice

Wednesday, Dec. 2 8:30AM - 10:00AM Location: E450A

BR

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

**Participants**

**LEARNING OBJECTIVES**

1) To understand the basis for the evidence supporting screening mammography as it is currently practiced in the US, and how changes to that paradigm based on risk or density lack the same level of rigorous scientific support. 2) To understand the issue of overdiagnosis of breast cancer through screening and why the estimates of the rate of this phenomenon vary so widely and how we might actually resolve this controversy. 3) To understand why the study of screening for breast cancer in high risk women with MRI and US is not readily generalizable to average risk women and the risks we take if we do apply these technologies more broadly.

**Sub-Events**

### RC515A Current Controversies

Participants
Etta D. Pisano, MD, Charleston, SC (*Presenter*) Founder, NextRay, Inc CEO, NextRay, Inc Research Grant, Koning Corporation Research Grant, Koninklijke Philips NV Research Grant, Zumatek, Inc Research Grant, FUJIFILM Holdings Corporation Equipment support, Siemens AG Research Grant, Siemens AG Equipment support, Koninklijke Philips NV Research Grant, Koninklijke Philips NV

**LEARNING OBJECTIVES**

1) To understand the basis for the evidence supporting screening mammography as it is currently practiced in the US, and how changes to that paradigm based on risk or density lack the same level of rigorous scientific support. 2) To understand the issue of overdiagnosis of breast cancer through screening and why the estimates of the rate of this phenomenon vary so widely and how we might actually resolve this controversy. 3) To understand why the study of screening for breast cancer in high risk women with MRI and US is not readily generalizable to average risk women and the risks we take if we do apply these technologies more broadly.

### RC515B Economic Challenges

Participants
Geraldine B. McGinty, MD,MBA, New York, NY (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand the funfdamentals of healthcare payment policy as they impact breast imaging. 2) Understand recent developments in payment policy for breast imaging. 3) Understand possible future direction of payment policy for breast imaging.

### RC515C Breast Density

Participants
Jennifer A. Harvey, MD, Charlottesville, VA, (jharvey@virginia.edu) (*Presenter*) Researcher, Hologic, Inc; Researcher, VuCOMP, Inc; Researcher, Matakina Technology Limited; Shareholder, Matakina Technology Limited; Shareholder, Hologic, Inc

**LEARNING OBJECTIVES**

1) Be familiar with the grassroots political efforts of women with dense breast tissue. 2) Understand imaging options for women with dense tissue. 3) Understand implications of breast cancer risk due to breast density.

**ABSTRACT**

The sensitivity of mammography is reduced in women with dense breast tissue. Women with extremely dense breasts are more likley to present with an interval palpable cancer between screening exams (17 times more likely in one study). Althoug this is a known limitation, somen undergoing regular screening that develop an interval cancer may feel disinfranchised from mammography. Grassroots efforts have initiated 'density laws' in at least 19 states, and a federal law may ultimately be passed. These laws vary, but informing women of their density is a uniform component. Many laws also mandate discussion of offering additional screening. The efficacy and cost of additional imaging is controversial as is the methodd in which to identify and apply these ancillary tests. Women with high breast density are also at about 4 fold increased risk for developing breast cancer compared with women with fatty breasts, emphasizing that the need to provide better screening strategies may potentially improve overall breast cancer mortality.

RC521

# Medical Physics 2.0: Mammography

Wednesday, Dec. 2 8:30AM - 10:00AM Location: N226

BR DM PH

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

**Participants**
Ehsan Samei, PhD, Durham, NC (*Director*) Nothing to Disclose
Douglas E. Pfeiffer, MS, Boulder, CO (*Director*) Nothing to Disclose

**Sub-Events**

## RC521A Mammography Perspective

Participants
Douglas E. Pfeiffer, MS, Boulder, CO (*Presenter*) Nothing to Disclose

### 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.

## RC521B Mammography 1.0

Participants
Melissa C. Martin, MS, Gardena, CA (*Presenter*) Nothing to Disclose
Eric A. Berns, PhD, Denver, CO (*Presenter*) Nothing to Disclose

### 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.

### Active Handout:Melissa Carol Martin

http://abstract.rsna.org/uploads/2015/13010862/rc521b.pdf

## RC521C Mammography 2.0

Participants
Andrew Karellas, PhD, Worcester, MA (*Presenter*) Research collaboration, Koning Corporation

### 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.

MSES42

## Essentials of Breast Imaging

Wednesday, Dec. 2 10:30AM - 12:00PM Location: S100AB

BR DM

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

**Participants**

**Sub-Events**

### MSES42A Update on Breast US BI-RADS

Participants
Marcela Bohm-Velez, MD, Pittsburgh, PA (*Presenter*) Consultant, Koninklijke Philips NV; Researcher, Siemens AG; Researcher, Dilon Technologies, Inc;

**LEARNING OBJECTIVES**

1) Discuss the need to optimize the sonographic technique and understand breast anatomy for best use of the US lexicon. 2) Discuss the descriptors that are used in assessing a lesion and the need for consistent and standardized terminology. 3) Discuss integration of US findings with mammographic, MRI and MBI studies and the subsequent management options.

**ABSTRACT**

The ACR BI-RADS for US is designed to standardize reporting, providing an organized approach to image interpretation and management. Understanding breast anatomy and optimizing the sonographic image is crucial for using the lexicon, which enables better communication of results to other physicians and their patients.This will also facilitate data collection for audits to monitor results and determine accuracy of image interpretation.Use and examples of the descriptors will be discussed.

### MSES42B Imaging the Post-Surgical Breast

Participants
Ellen B. Mendelson, MD, Chicago, IL, (emendels@nm.org) (*Presenter*) Medical Advisory Board, Delphinus Medical Technologies, Inc; Research support, Siemens AG; Consultant, Siemens AG; Speaker, Siemens AG; Medical Advisory Board, Quantason, LLC; Consultant, Quantason, LLC;

**LEARNING OBJECTIVES**

1) Recognize postsurgical changes on mammography, US, and MRI. 2) Define the time course of posttherapy changes, which slowly resolve after radiation therapy. 3) Describe surgical and reconstructive procedures used in treatment of breast cancer.

**ABSTRACT**

### MSES42C Tomosynthesis - Is It Ready for Screening?

Participants
Fiona J. Gilbert, MD, Cambridge, United Kingdom (*Presenter*) Medical Advisory Board, General Electric Company; Research Grant, GlaxoSmithKline plc; Research Grant, General Electric Company

**LEARNING OBJECTIVES**

1) To learn about the evidence from retrospective studies for screening with Digital Breast Tomosynthesis. 2) To learn about the evidence from prospective studies for screening with Digital Breast Tomosynthesis. 3) To appreciate the information that is still required before adoption into routine screening.

SSK01

## Breast Imaging (Density and Risk Assessment)

Wednesday, Dec. 2 10:30AM - 12:00PM Location: Arie Crown Theater

BR DM

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

FDA Discussions may include off-label uses.

**Participants**
Jennifer A. Harvey, MD, Charlottesville, VA (*Moderator*) Researcher, Hologic, Inc; Researcher, VuCOMP, Inc; Researcher, Matakina Technology Limited; Shareholder, Matakina Technology Limited; Shareholder, Hologic, Inc
Emily F. Conant, MD, Philadelphia, PA (*Moderator*) Speaker, Hologic, Inc; Scientific Advisory Board, Hologic, Inc; Consultant, Siemens AG
Martin J. Yaffe, PhD, Toronto, ON (*Moderator*) Research collaboration, General Electric Company Founder, Matakina International Ltd Shareholder, Matakina International Ltd Co-founder, Mammographic Physics Inc

**Sub-Events**

### SSK01-01 Breast Density: Who is Informing the Patients?

Wednesday, Dec. 2 10:30AM - 10:40AM Location: Arie Crown Theater

Participants
Shadi Aminololama-Shakeri, MD, Sacramento, CA (*Presenter*) Nothing to Disclose
Machelle D. Wilson, Sacramento, CA (*Abstract Co-Author*) Nothing to Disclose
Kathleen A. Khong, MD, Sacramento, CA (*Abstract Co-Author*) Nothing to Disclose
Jonathan B. Hargreaves, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Karen K. Lindfors, MD, Sacramento, CA (*Abstract Co-Author*) Research Grant, Hologic, Inc

#### PURPOSE

To assess the impact of California's Breast Density law on radiology technologists.

#### METHOD AND MATERIALS

Attendees of an educational conference targeted to radiology technologists in California were surveyed anonymously and voluntarily. Fisher's Exact Test was used to test for association between practice responses and technologist characteristics. Data were analyzed using SAS® software version 9.3 (SAS Institute, Cary, NC). A p-value of <=0.05 was considered significant.

#### RESULTS

110 of 133 attendees (83% response rate) completed the survey. 67% of respondents have noticed a change in patients' level of concern about breast density with 53% answering breast density related questions daily. The majority of respondents reported being asked what breast density means and what dense breasted patients should do subsequently (82%); specifically, 59% reported the topic of supplemental screening tests due to dense breasts as a common patient concern. More than half refer the patient to her doctor (63%) and explain that the patient may need additional imaging (55%). While 71% reported being completely/mostly comfortable, 22% were only somewhat comfortable and 5% were not comfortable in answering patient questions about breast density (2% reported not receiving any density questions). As expected, technologist level of comfort answering these questions was higher for those with >20 years of experience (79%) in comparison to those with <=20 years of work experience (57%,p=0.02) and was independent of dedicated mammography work time (p=0.304). 88% of technologists expressed an interest in further education regarding breast density.

#### CONCLUSION

Although the California breast density law recommends that patients discuss their breast density and supplementary screening tests with their primary care physicians, women are seeking information from radiology technologists about breast density daily. While technologists with more than 20 years of experience are more comfortable answering these questions, the majority of technologists regardless of years of experience are interested in further education about breast density and its impact on breast cancer screening.

#### CLINICAL RELEVANCE/APPLICATION

Breast density is of great concern to patients and providers. Radiology technologists are often the first provider the patient encounters for breast cancer screening. There is a need for additional technologist education.

### SSK01-02 National Trends in Reporting of Breast Density in Response to Breast Density Notification Legislation

Wednesday, Dec. 2 10:40AM - 10:50AM Location: Arie Crown Theater

**Awards**
**Trainee Research Prize - Fellow**

Participants
Manisha Bahl, MD, MPH, Durham, NC (*Presenter*) Nothing to Disclose
Jay A. Baker, MD, Durham, NC (*Abstract Co-Author*) Research Consultant, Siemens AG
Mythreyi Bhargavan-Chatfield, PhD, Reston, VA (*Abstract Co-Author*) Nothing to Disclose
Eugenia K. Brandt, Washington, DC (*Abstract Co-Author*) Nothing to Disclose
Sujata V. Ghate, MD, Durham, NC (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Since 2009, a total of 21 states have enacted laws that mandate notification of patients and their referring physicians if the patient's breast density is interpreted as heterogeneously dense or extremely dense on mammography. The purpose of this study is to evaluate trends in the reporting of breast density in response to breast density notification legislation.

**METHOD AND MATERIALS**

Using the American College of Radiology's National Mammography Database (NMD), we collected state-level data, month-by-month over a 20-month period, on the percentage of mammograms reported as heterogeneously dense or extremely dense and the breast cancer detection rate. Z -tests were used to calculate differences in proportions, and p -values less than 0.05 were considered statistically significant.

**RESULTS**

Thirteen of 17 states that had breast density notification legislation in place as of 2014 had submitted data to the NMD before and after law enactment and were thus included in the analysis. 959,648 mammograms were performed over a 20-month period, ten months before and after law enactment. There was a statistically significant decrease in the percentage of mammograms reported as dense in the month after law enactment compared to the month before (40.0% vs 43.0%, p <0.001). The percentage of mammograms reported as dense reached its nadir two months after law enactment (39.3%) but increased to 42.8% by ten months after law enactment. There was no statistically significant difference in the percentage of mammograms reported as dense in the month before law enactment compared to ten months after law enactment (43.0% vs 42.8%, p =0.65). There were no statistically significant differences in the breast cancer detection rate in the month before and after law enactment (3.9/1000 vs 3.8/1000, p =0.79) or in the month before law enactment compared to ten months after law enactment (3.9/1000 vs 4.2/1000, p =0.55).

**CONCLUSION**

The percentage of mammograms reported as dense decreased immediately after enactment of breast density notification legislation but then returned to pre-legislation percentages during the study period.

**CLINICAL RELEVANCE/APPLICATION**

Enactment of breast density notification legislation has an immediate but not long term impact on the reporting of dense breasts on mammography.

## SSK01-03 Body Mass Index, Breast Density and the Risk of Breast Cancer Development

Wednesday, Dec. 2 10:50AM - 11:00AM Location: Arie Crown Theater

Participants
Rasha M. Kamal, MD, Cairo, Egypt (*Presenter*) Nothing to Disclose
Dorria S. Salem, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Sarah A. Maksoud, MBBCh, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Rasha Wessam, MD, PhD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Soha T. Hamed, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Ahmed M. Hatw, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

The relationship between body mass index (BMI), mammographic breast density and breast cancer is complex.BMI is negatively correlated with mammographic density and in the same time they are both accused of increasing the risk of breast cancer.Therefore, the aim of this study is to assess the relationship between BMI, mammographic density and breast cancer in a screened population.

**METHOD AND MATERIALS**

The study included 117,636 women, above the age of 45 years, who joined a National Breast Cancer Screening Program in the period from October 2007 to April 2014. All patients performed a mammography examination and the breast density was reported by 3 independent readers. The breast density was classified according to the ACR BI-RADS lexicon breast density classification from a completely fatty breast (a) to an extremely dense breast (d). The weight and height were measured and the BMI was calculated. Individuals with a BMI> 25 are considered overweight and above 30 as obese. Categorical data was expressed as frequencies and relative frequencies, measures of association were verified by calculating the relative risk (RR), Odds Ratio (OR) and confidence interval (CI). The p value was calculated using the chi square test..

**RESULTS**

The study included 117,636 women out of which 1048 (0.89%) cases had breast cancer. Increased BMI was associated with statisticaly significant increased risk of breast cancer development than normal weight individuals (p value: 0.02). The calculated RR is 1.4 (95% CI: 1.0355 - 1.896) and odds ratio is 1.4 (95% CI: 1.036 - 1.905). The mammographic breast density was not associated with an increased risk of breast cancer development were the RR is 0.959 (95%CI: 0.59 - 1.57) and OR is 0.95 (95% CI: 0.58 - 1.57). High BMI was associated with a fatty breast parenchyma (p value: 0.0001) and the calculated RR was 13.9 (95% CI: 6.4 -30.1)

**CONCLUSION**

A strong negative correlation exists between BMI and breast density where as the BMI increases the breast density decreases. In the current study increased BMI was associated with an indreased risk of breast camcer development while an increased breast density was not.

**CLINICAL RELEVANCE/APPLICATION**

Obesity is a strong risk factor for breast cancer development. Breast cancer preventive strategies should be applied with higher concern for obese women and strict weight control strategies should be implemented especially for women at higher age risks of developing breast cancer.

## SSK01-04 Quantifying the Potential Masking Risk of Breast Density in Mammographic Screening

Wednesday, Dec. 2 11:00AM - 11:10AM Location: Arie Crown Theater

Participants
Stamatia V. Destounis, MD, Scottsville, NY (*Presenter*) Research Grant, FUJIFILM Holdings Corporation; Research Grant, Hologic, Inc; Research Grant, QT Ultrasound LLC
Ariane Chan, PhD, Wellington, New Zealand (*Abstract Co-Author*) Employee, Matakina Technology Limited;
Andrea L. Arieno, BS, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose
Renee Morgan, RT, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose
Lisa R. Johnston, PhD, Wellington, New Zealand (*Abstract Co-Author*) Consultant, Matakina Technology Limited
Ralph P. Highnam, PhD, Wellington, New Zealand (*Abstract Co-Author*) CEO, Matakina Technology Limited; CEO, Volpara Solutions Limited

**PURPOSE**

To compare the current method of reporting on reduced mammographic sensitivity, using the American College of Radiology (ACR) BI-RADS density categories, with quantitatively assessed volumetric breast density (VBD).

**METHOD AND MATERIALS**

This IRB-approved, retrospective study included histologically confirmed DCIS, invasive ductal or invasive lobular breast cancers detected at screening (SC; n = 654) or in the interval between screens (IC; n = 120), in women (aged > 40 y) diagnosed at a community based breast center between Jan 2009 and Dec 2012. Women with bilateral cancer, prior breast surgery or missing raw digital images were excluded from the analysis. Density was determined according to the ACR BI-RADS 4th edition density categories 1-4, and an automated equivalent, Volpara Density Grade (VDG), which uses preset thresholds of VBD to assign each category (i.e. <4.5, 4.5-7.5, 7.5-15.5, >15.5%). Sensitivity (SC/[SC + IC]) was compared between the two density measures and within each VDG category, by dividing each category into high and low using the mid-point of each VDG thresholds (i.e. 3.75, 6, 11 and 25.5%, for VDG 1, 2, 3 and 4, respectively).

**RESULTS**

The decreasing sensitivity of double-reading mammographic screening across increasing ACR density categories 1 to 4 was clear for automated BI-RADS (95/89/83/66% ) but less so for visual BI-RADS, apart from 1 versus 4 (82/90/84/67%). Further dichotomization of each VDG category showed a striking linear relationship between VBD and sensitivity (R2=0.97). Sensitivity was similar between low versus high VDG1 (100% and 94%, respectively) and low versus high VDG2 cases (89% and 89%, respectively), but decreased more dramatically between low versus high VDG3 and low versus high VDG4 cases (87% to 75% and 68% to 53%, respectively).

**CONCLUSION**

Quantitative VBD captures the potential masking risk of breast density more precisely compared to the widely used BI-RADS density classification system. In the US, women with dense breasts (BI-RADS 3 and 4 density categories) comprise ~50% of all women, and our results indicate that within these categories there is a large range in sensitivity that is not being captured using the BI-RADS system.

**CLINICAL RELEVANCE/APPLICATION**

Volumetric breast density shows a linear relationship with mammographic sensitivity and can be used to more accurately determine the effect of density on masking compared to BI-RADS density categories.

## SSK01-05 Assessing Breast Cancer Masking Risk with Automated Texture Analysis in Full Field Digital Mammography

Wednesday, Dec. 2 11:10AM - 11:20AM Location: Arie Crown Theater

Participants
Michiel Kallenberg, Copenhagen, Denmark (*Presenter*) Former Employee, Matakina Technology Limited; Employee, Biomediq A/S; Employee, Screenpoint Medical BV
Martin Lillholm, PhD, Copenhagen, Denmark (*Abstract Co-Author*) Employee, Biomediq A/S Shareholder, Biomediq A/S
Pengfei Diao, Copenhagen, Denmark (*Abstract Co-Author*) Nothing to Disclose
Kersten Petersen, Copenhagen O, Denmark (*Abstract Co-Author*) Employee, Biomediq A/S
Katharina Holland, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Nico Karssemeijer, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Shareholder, Matakina Technology Limited; Consultant, QView Medical, Inc; Shareholder, QView Medical, Inc; Director, ScreenPoint Medical BV; Shareholder, ScreenPoint Medical BV;
Christian Igel, Copenhagen, Denmark (*Abstract Co-Author*) Research funded, Biomediq A/S
Mads Nielsen, PhD, Copenhagen, Denmark (*Abstract Co-Author*) Stockholder, Biomediq A/S Research Grant, Nordic Bioscience A/S Research Grant, SYNARC Inc Research Grant, AstraZeneca PLC

**PURPOSE**

The goal of this work is to develop a method to assess the risk of breast cancer masking, based on image characteristics beyond breast density.

**METHOD AND MATERIALS**

From the Dutch breast cancer screening program we collected 285 screen detected cancers, and 109 cancers that were screen negative and subsequently appeared as interval cancers. To obtain mammograms without cancerous tissue, we took the contralateral mammograms. We developed a novel machine learning based method called convolutional sparse autoencoder to characterize mammographic texture. The reason for focusing on mammographic texture rather than the amount of breast density is that a developing cancer may not only be masked because it is obscured; it may also be masked because its mammographic signs resemble the texture of normal tissue. The method was trained and tested on raw mammograms to determine cancer detection status in a five-fold cross validation. To assess the interaction of the texture scores with breast density, Volpara Density Grade (VDG) was determined for each image using Volpara, Matakina Technology, New Zealand.

**RESULTS**

We grouped women into low (VDG 1/2) versus high (VDG 3/4) dense, and low (Quartile 1/2) versus high (Quartile 3/4) texture risk score. We computed odds ratios (OR) for breast cancer masking risk (i.e. interval versus screen detected cancer) for each of the

subgroups. The OR was 1.63 (1.04-2.53 95%CI) for the high dense group (as compared to the low dense group), whereas for the high texture score group (as compared to the low texture score group) this OR was 2.19 (1.37-3.49). Women who were classified as low dense but had a high texture score had a higher masking risk (OR 1.66 (0.53-5.20)) than women with dense breasts but a low texture score.

**CONCLUSION**

Mammographic texture is associated with breast cancer masking risk. We were able to identify a subgroup of women who are at an increased risk of having a cancer that is not detected due to textural masking, even though their breasts are non-dense.

**CLINICAL RELEVANCE/APPLICATION**

Automatic texture analysis enables assessing the risk that a breast cancer is masked in regular mammography, independently of breast density. As such it offers opportunities to further enhance personalized breast cancer screening, beyond breast density.

## SSK01-06 Agreement between Breast Density Estimates from Standard versus Synthetic Digital Mammograms

Wednesday, Dec. 2 11:20AM - 11:30AM Location: Arie Crown Theater

Participants
Brad M. Keller, PhD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Jinbo Chen, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Lauren Pantalone, BS, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Shonket Ray, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Marie Synnestvedt, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Emily F. Conant, MD, Philadelphia, PA (*Abstract Co-Author*) Speaker, Hologic, Inc; Scientific Advisory Board, Hologic, Inc; Consultant, Siemens AG
Despina Kontos, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Mammographic density is an established risk factor for breast cancer, with legislation now mandating the reporting of a woman's breast density in many states. However, as synthetic 2D mammograms are being used to reduce dose when screening is performed with digital breast tomosynthesis (DBT), standard-dose mammograms that have commonly been used to evaluate breast density may no longer be acquired. As such, the purpose of this study is to evaluate the agreement between breast density estimates from standard dose versus synthetic mammograms.

**METHOD AND MATERIALS**

We retrospectively analyzed 755 negative (BIRADS 1 or 2) DBT screening exams consecutively acquired over a four week period at our institution for which both standard dose and synthetic mammograms were available. All mammograms were acquired on a Hologic Selenia Dimensions system, and synthetic mammograms were generated using the FDA-approved Hologic "C-View" software. The "For Presentation" standard-dose and synthetic mammograms were analyzed using a publically available algorithm developed at our institution that provides validated, reproducible breast percent density (PD%) estimates from digital mammograms. Agreement between PD% estimates from the two modalities was assessed via Pearson's correlation and linear regression, and Student's paired t-test was used to evaluate the presence of a systematic difference in density estimates between the two mammogram types.

**RESULTS**

Breast PD% estimates made on the synthetic and standard dose mammograms were highly correlated ($r=0.92$, $p<0.001$). However, a significant difference was observed between the two mammogram types, with synthetic mammograms yielding larger PD% estimates by an average of 2.0% higher than standard dose mammograms ($p<0.001$), with larger disagreement in highly dense women.

**CONCLUSION**

Breast density estimates made from synthetic mammograms are comparable to those made from standard dose mammograms. Furthermore, fully-automated analysis of breast density from synthetic mammograms is feasible, which may become important as standard dose images are increasingly no longer required when screening with DBT.

**CLINICAL RELEVANCE/APPLICATION**

Synthetic mammograms may allow for accurate estimation of a woman's breast density if standard dose mammograms are not obtained in DBT screening, particularly if automated software is utilized.

## SSK01-07 Associations of Dense and Fatty Breast-Tissue Heterogeneity with Breast Cancer Risk: Preliminary Evaluation Using Parenchymal Texture Measurements Driven by Breast Anatomy

Wednesday, Dec. 2 11:30AM - 11:40AM Location: Arie Crown Theater

Participants
Aimilia Gastounioti, Philadelphia, PA (*Presenter*) Nothing to Disclose
Brad M. Keller, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Lauren Pantalone, BS, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Meng-Kang Hsieh, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Andrew Oustimov, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
Emily F. Conant, MD, Philadelphia, PA (*Abstract Co-Author*) Speaker, Hologic, Inc; Scientific Advisory Board, Hologic, Inc; Consultant, Siemens AG
Despina Kontos, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

We investigate the potential different contributions of dense versus fatty breast tissue in breast cancer risk assessment, using quantitative descriptors of parenchymal heterogeneity driven by breast anatomy.

**METHOD AND MATERIALS**

Contralateral, raw mediolateral-oblique (MLO) view digital mammograms (DMs) from 106 women with unilateral invasive breast cancer and 318 age- and side-matched controls were retrospectively analyzed. DMs were acquired with either a GE Healthcare 2000D or DS FFDM system and the "For Processing" images were used. A previously validated algorithm was used to automatically segment the dense and fatty tissue areas within the breast and estimate percent density (%PD). Parenchymal heterogeneity analysis was performed using a breast-anatomy-driven framework, in which a polar grid following the anatomy of the breast parenchyma was overlaid on the DM. Established tissue-heterogeneity descriptors were extracted (i.e., a total of 15 gray-level, non-uniformity, contrast, correlation, etc. texture features), aligned with the structure of the polar grid. The mean values of these texture descriptors over the dense and fatty breast sub-regions were estimated. Associations between heterogeneity features and breast cancer were evaluated using logistic regression and the area under the receiver operating characteristic (ROC) curve (AUC) was used to assess discriminatory capacity, where model performance was compared using the DeLong's test.

**RESULTS**

Individual tissue heterogeneity features had different discriminatory capacity in dense versus fatty parenchyma. Multivariable models were equally associated with breast cancer for both dense and fatty tissue (AUC: 0.82, $p<0.001$), though different texture features were deemed significant for each tissue type. There was no performance improvement by adding %PD, while the strongest association was achieved when dense and fatty tissue heterogeneity features were combined (AUC: 0.87, $p<0.001$).

**CONCLUSION**

Heterogeneity features for dense and fatty parenchymal patterns, as measured using a breast-anatomy-driven framework, may hold a promising role in breast cancer risk prediction.

**CLINICAL RELEVANCE/APPLICATION**

Inherent biological factors, which are associated with the risk of breast cancer, might be expressed in parenchymal tissue as an interplay between dense and fatty tissue heterogeneity.

## SSK01-08 Background Parenchymal Uptake (BPU) at Molecular Breast Imaging as a Novel Breast Cancer Risk Factor

Wednesday, Dec. 2 11:40AM - 11:50AM Location: Arie Crown Theater

Participants
Carrie B. Hruska, PhD, Rochester, MN (*Presenter*) Institutional license agreement, Gamma Medica, Inc
Christopher G. Scott, MS, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Deborah J. Rhodes, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Amy L. Conners, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Dana H. Whaley, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Michael K. O'Connor, PhD, Rochester, MN (*Abstract Co-Author*) Royalties, Gamma Medica, Inc
Celine M. Vachon, Rochester, MN (*Abstract Co-Author*) Consultant, Pfizer Inc

**PURPOSE**

In prior evaluations of molecular breast imaging (MBI) for supplemental screening in dense breasts, we observed wide variability in background parenchymal uptake (BPU), which refers to the relative uptake of Tc-99m sestamibi within normal fibroglandular tissue compared to fat. In women with similar mammographic density, BPU varied from photopenic (fibroglandular uptake less intense than fat uptake) to marked (fibroglandular uptake >2 times as intense as fat uptake). Here, we investigated whether BPU is associated with subsequent breast cancer development.

**METHOD AND MATERIALS**

We conducted a nested case-control study among women with MBI examinations performed between the years 2005-2014. Women with breast cancer history or diagnosis within 60 days after MBI were excluded. A total of 77 incident breast cancer cases were identified through linkage our institution's tumor registry; 225 controls were matched to cases on age, MBI date, menopausal status, and follow-up. While blinded to case-control status, BPU was assessed by an expert reader according to a validated MBI lexicon into one of 4 categories: photopenic, minimal-mild, moderate, or marked. Conditional logistic analysis was performed.

**RESULTS**

Women with high BPU at MBI (moderate or marked) had a greater risk of breast cancer compared to women with low BPU (photopenic or minimal-mild); odds ratio (OR (95% CI) = 5.5 (2.6,11.6)). Results were unchanged with adjustment for BI-RADS density (OR = 5.5 (2.6, 11.6)) and BMI (OR = 5.4 (2.6, 11.4)). The association of BPU and breast cancer was stronger for cases diagnosed <3 years (OR=10.6) compared to cases diagnosed ≥3 years (OR=4.2), although power was limited.

**CONCLUSION**

BPU at MBI is associated with breast cancer risk. The odds of developing breast cancer was 5.5 times greater for women with high BPU compared to women with low BPU.

**CLINICAL RELEVANCE/APPLICATION**

Over 40% of the screening-eligible population have mammographically dense breasts. BPU is a breast cancer risk factor, based on functional behavior of fibroglandular tissue, that may help identify the subset of women with dense breasts who are most likely to benefit from supplemental screening and risk-reduction options.

## SSK01-09 Volumetric Breast Density a Strong Independent Predictor of Interval Cancer Risk

Wednesday, Dec. 2 11:50AM - 12:00PM Location: Arie Crown Theater

Participants
Stamatia V. Destounis, MD, Scottsville, NY (*Presenter*) Research Grant, FUJIFILM Holdings Corporation; Research Grant, Hologic, Inc; Research Grant, QT Ultrasound LLC
Ariane Chan, PhD, Wellington, New Zealand (*Abstract Co-Author*) Employee, Matakina Technology Limited;
Andrea L. Arieno, BS, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose

Renee Morgan, RT, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose
Ralph P. Highnam, PhD, Wellington, New Zealand (*Abstract Co-Author*) CEO, Matakina Technology Limited; CEO, Volpara Solutions Limited
Lisa R. Johnston, PhD, Wellington, New Zealand (*Abstract Co-Author*) Consultant, Matakina Technology Limited

**PURPOSE**

Breast density (BD) is a key factor limiting the sensitivity of mammographic screening. We sought to evaluate which patient factors might best predict the risk of being diagnosed with an interval cancer.

**METHOD AND MATERIALS**

This IRB-approved, retrospective analysis included histologically confirmed DCIS, invasive ductal or invasive lobular breast cancers detected at screening (SC; n = 514) or in the interval between screens (IC; n = 82). Patient histories were reviewed for women aged over 40 y, diagnosed between January 2009 and December 2012, and with raw mammographic images available. In addition to BD categories assessed visually (BI-RADS 1-4) and automatically (Volpara Density Grade; VDG 1-4), BD was assessed using a continuous measure of volumetric breast density (VBD). Univariate analyses and multivariate logistic regression (adjusting for age and menopausal status) were used to identify predictors of IC risk.

**RESULTS**

BD was the only independent predictor of IC risk in the multivariate analyses. Women with BI-RADS4 and VDG4 breasts were at 3.6-fold [CI 1.7 - 7.7] and 3.9-fold [CI 2.0 - 7.6] more likely to be diagnosed with an IC versus a SC, compared to women with non-dense breasts (BI-RADS/VDG 1 and 2), or 4.0-fold [CI 1.8 - 8.8] for women in the highest quartile of VBD versus the lowest. Restricted to invasive cancers only (n = 456), VDG, VBD and BI-RADS were all independent risk factors for IC versus SC (i.e. 4.7-fold [CI 2.3 - 9.7] for VDG4 versus VDG1/2; 4.5-fold [CI 1.9 - 10.6] for the highest quartile of VBD versus the lowest quartile; and 3.5-fold [CI 1.6 - 8.1] for BI-RADS4 versus BI-RADS1/2).

**CONCLUSION**

Although VBD, and visual and automated assessments of BI-RADS density categories are all strongly associated with being diagnosed with an IC versus a SC, volumetric methods were stronger predictors of invasive IC risk and could be used to accurately identify which women may benefit the most from supplementary imaging.

**CLINICAL RELEVANCE/APPLICATION**

Volumetric breast density is a strong independent predictor of interval cancer risk and, due to its continuous nature, can be used to better identify women who might benefit from adjunctive screening.

SSK02

## Breast Imaging (Ultrasound Diagnostics)

Wednesday, Dec. 2 10:30AM - 12:00PM Location: E450A

BR US

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

FDA Discussions may include off-label uses.

**Participants**
Susan Weinstein, MD, Philadelphia, PA (*Moderator*) Consultant, Siemens AG
Regina J. Hooley, MD, New Haven, CT (*Moderator*) Nothing to Disclose

**Sub-Events**

### SSK02-01 Incremental Cancer Detection Utilizing Breast Ultrasound versus Breast MRI in the Evaluation of Newly Diagnosed Breast Cancer Patients

Wednesday, Dec. 2 10:30AM - 10:40AM Location: E450A

Participants
Jeri Sue Plaxo, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Hongying He, MD, PhD, Houston, TX (*Presenter*) Nothing to Disclose
Lei Huo, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Wei Wei, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Rosalind P. Candelaria, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Wei T. Yang, MD, Houston, TX (*Abstract Co-Author*) Researcher, Hologic, Inc
Henry M. Kuerer, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To determine the incremental detection of breast cancer utilizing bilateral whole breast ultrasound (BWBUS) versus dynamic contrast enhanced MRI in patients with biopsy proven primary breast cancer.

#### METHOD AND MATERIALS

A retrospective database search in a single institution identified 259 patients with newly diagnosed breast cancer from 1/ 2011 to 8/2014, who underwent mammography, BWBUS and MRI before surgery. Patient demographics, tumor characteristics, lesions seen on mammography, BWBUS, and MRI were recorded. Histopathology of each lesion was used to determine the incremental cancer detection rate by BWBUS and MRI and to calculate the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of mammography, BWBUS, and MRI. Multifocal, multicentric and contralateral disease were recorded and compared among the three imaging modalities. Effect on surgical planning was obtained from the medical records.

#### RESULTS

A total of 539 lesions were seen on at least one modality (mammography, BWBUS, or MRI) with histopathology, of which 393 (73%) were malignant and 146 (27%) benign. The sensitivity and specificity of mammography, BWBUS, and MRI were 77%, 89%, and 93%, and 75%, 67%, and 39%, respectively. PPV and NPV of mammography, BWBUS, and MRI were 89%, 88%, and 80%, and 55%, 69%, and 69%, respectively. MRI was significantly more sensitive than BWBUS ($p=0.02$). However, there was no significant difference in sensitivity between mammography plus BWBUS and MRI. In addition, mammography and BWBUS had significantly higher specificity than MRI ($p<0.0001$). Mammography plus BWBUS and mammography plus MRI significantly improved the detection of additional malignant foci (multifocal, multicentric or contralateral) ($p<0.0001$) compared to mammography alone. All three modalities combined further significantly improved the detection of additional malignant foci. However, surgical planning was not changed in the majority of the patients with multicentric disease found on MRI.

#### CONCLUSION

Breast MRI is more sensitive than BWBUS beyond mammography in breast cancer detection. Mammography and BWBUS are more specific than MRI. Addition of MRI improved the detection of multifocal, multicentric and contralateral disease, without altering surgical planning in the majority of patients with multicentric disease.

#### CLINICAL RELEVANCE/APPLICATION

The exact role of breast MRI in breast cancer detection and management needs to be further defined.

### SSK02-02 The Breast Tumor Strain Ratio Is a Predictive Parameter for Axillary Lymph Node Metastasis in Patients with Invasive Breast Cancer

Wednesday, Dec. 2 10:40AM - 10:50AM Location: E450A

Participants
Jin You Kim, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Shinyoung Park, MD, Busan, Korea, Republic Of (*Presenter*) Nothing to Disclose
Jin Il Moon, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ji Won Lee, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Suk Kim, MD, Pusan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To evaluate the association between the breast tumor strain ratio and axillary lymph node metastasis in patients with invasive breast cancer.

**METHOD AND MATERIALS**

Between 2013 and 2014, 284 consecutive patients (mean age, 52.2 years; range, 24-78 years) diagnosed with invasive breast cancer (mean size, 2.3 ± 1.5 cm; range, 0.2-9.0 cm) underwent ultrasound (US) elastography before surgery. The strain ratio, defined as the fat-to-lesion ratio and indicative of the relative stiffness of the breast lesion, was calculated using dedicated software within the US equipment. The associations of axillary node metastasis with the tumor strain ratio and clinicobiological variables were evaluated using univariate and multivariate logistic regression analyses.

**RESULTS**

Among 284 tumors, 85 (29.9%) showed axillary lymph node metastasis by surgical histopathology. The strain ratio was significantly higher in tumors with a node-positive status than in those with a node-negative status (5.19 ± 1.28 vs. 4.17 ± 1.30, respectively; $P < 0.001$). A receiver operating characteristic curve demonstrated that a tumor strain ratio of 3.89 was the optimal cutoff for predicting axillary nodal involvement in breast cancer (sensitivity, 91.8%; specificity, 45.7%; area under the curve, 0.701; SE, 0.032; $P < 0.001$). On univariate analysis, a higher strain ratio (> 3.89), larger tumor size (>2 cm), higher histologic grade (grade 3), presence of lymphovascular invasion, palpability, and higher expression of Ki-67 (≥ 14%) were associated with a higher probability of axillary node metastasis. On multivariate analysis, a higher strain ratio (> 3.89) (odds ratio (OR): 14.208; $P < 0.001$), presence of lymphovascular invasion (OR: 17.437; $P < 0.001$), and higher expression of Ki-67 (≥ 14%) (OR: 3.744; $P = 0.002$) maintained independent significance for predicting axillary lymph node metastasis.

**CONCLUSION**

The breast tumor strain ratio on US elastography is associated independently with axillary lymph node metastasis in patients with invasive breast cancer.

**CLINICAL RELEVANCE/APPLICATION**

Preoperative prediction of axillary nodal status is valuable. Implementation of US elastography during preoperative US evaluation could help predict axillary node metastasis in breast cancer patients.

## SSK02-03 Differentiating Benign and Malignant Breast Tissue Using a Handheld Terahertz Probe

Wednesday, Dec. 2 10:50AM - 11:00AM Location: E450A

Participants
Maarten Grootendorst, MSc, London, United Kingdom (*Presenter*) Nothing to Disclose
Susan Brouwer de Koning, BSC, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Anthony J. Fitzgerald, Cambridge, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Alessia Portieri, PhD, Cambridge, United Kingdom (*Abstract Co-Author*) Senior Scientist, Teraview Ltd
Aida Santa Olalla, MSc, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Massi Cariati, MBChB,PhD, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Michael Pepper, PhD, London, United Kingdom (*Abstract Co-Author*) Chief Scientific Officer, TeraView Ltd
Vincent Wallace, PhD, Crawley, Australia (*Abstract Co-Author*) Nothing to Disclose
Sarah Pinder, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Arnie Purushotham, MD,PhD, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To develop histopathological methods to analyse breast tissue samples scanned with a handheld TeraHertz (THz) probe, and evaluate the ability of THz time and frequency domain pulses and parameters to discriminate between benign and malignant tissue, with the aim of developing a technique to assess tumour resection margins in breast-conserving surgery.

**METHOD AND MATERIALS**

In all, 15 breast tissue samples (13 patients) from freshly excised wide local excision and mastectomy specimens were scanned using a handheld THz probe with a bandwidth of 0-2.0 THz (Teraview Ltd., UK). For each sample detailed pathology, including type of predominant tissue (tumour and tumour type, fibrous or adipose), type of background tissue, and cell density were obtained at 1.0mm-intervals, and correlated with THz data. Samples with a predominant tissue cell density of >= 60% were included. The full THz time and frequency domain pulses, as well as individual parameters, were evaluated. An area under the receiver operating characteristic curve (AUROC) analysis was performed to quantify the performance of each parameter in discriminating between tumour and fibrous tissue. Parameters with an AUROC value >0.75 were included. A Mann-Whitney U test was performed to determine whether the differences in parameter values were statistically significantly different.

**RESULTS**

In all, 6 invasive ductal carcinomas, 1 invasive lobular carcinoma, 4 fibrous and 4 adipose samples were used. Adipose tissue could be readily discriminated from tumour/fibrous tissue using the full time-domain pulse (Fig. 1). Tumour could be discriminated from fibrous tissue using a total of 35 parameters; all these parameters had parameter values that were statistically significantly different between tumour and fibrous ($p<0.001$). Especially, the power at frequency 0.18-0.29THz proved to be a strong discriminator (AUROC >= 0.97).

**CONCLUSION**

Time-domain pulses and parameters from handheld THz probe measurements can accurately discriminate between benign breast and malignant tissue in an ex vivo setting. More high-dense tumour samples from different tumour types and low-dense samples are needed to further evaluate this technique prior to in vivo patient studies.

**CLINICAL RELEVANCE/APPLICATION**

THz pulsed imaging distinguishes malignant from benign breast tissue and can potentially assess tumour margins intraoperatively in breast-conserving surgery, aiming to achieve lower re-excision rates

## SSK02-04 Association of US Features and the 21-gene Recurrence Score Assays in Estrogen Receptor-Positive Invasive Breast Cancers

Wednesday, Dec. 2 11:00AM - 11:10AM Location: E450A

Participants
Eun Young Chae, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Hak Hee Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Woo Kyung Moon, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Won Hwa Kim, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Joo Hee Cha, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hee Jung Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Woo Jung Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sei Hyun Ahn, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To identify the relation of imaging features on ultrasound (US) and the recurrence score (RS) of the 21-gene expression assay in patients with estrogen receptor (ER) positive breast cancer.

**METHOD AND MATERIALS**

Institutional review board approved this study, and the requirement for informed consent was waived. 267 patients with ER-positive invasive breast cancer who underwent US and Oncotype Dx assay were included in this study. US images were independently reviewed by dedicated breast radiologists who were blind to the RS, according to BI-RADS lexicon. In addition, tumor roundness was measured by a laboratory-developed software program. The pathological data were also reviewed including immunohistochemistry results. Univariate analysis was done to assess the associations between the RS and each variables. Multiple logistic regression analysis was used to identify independent predictors of high RS (≥31).

**RESULTS**

Of 267 patients, 147 (55%) had low, 96 (36%) intermediate, and 24 (9%) had high RS. In univariate analysis, the parallel orientation, circumscribed margin, posterior acoustic enhancement, presence of calcification in the mass and tumor roundness was positively associated with high RS. Multiple logistic regression analysis showed that parallel orientation (OR=5.525) and tumor roundness (OR=1.699 per 10 increase) remained independent variables associated with high RS. The area under the ROC curve from the model was 0.78 in distinguishing high RS from low or intermediate RS and increased to 0.88 when combined with pathological data.

**CONCLUSION**

The tumor roundness and parallel orientation were independent variables that may predict a high RS in patients with ER-positive breast cancer.

**CLINICAL RELEVANCE/APPLICATION**

ER-positive breast cancers have distinguishing US features according to recurrence score. US can help to differentiate candidates for adjuvant chemotherapy in ER-positive cancer.

## SSK02-05 Tumor Growth Rate during Wait Times for Surgery in Women with Breast Cancers Assessed by Ultrasonography

Wednesday, Dec. 2 11:10AM - 11:20AM Location: E450A

Participants
Su Hyun Lee, MD,PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Sung Ui Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jung Min Chang, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Nariya Cho, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Woo Kyung Moon, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To evaluate tumor growth rate (TGR) during the wait times for surgery in women with invasive breast cancers and to identify clinicopathologic factors associated with TGR.

**METHOD AND MATERIALS**

This study was approved by our institutional review board and the requirement for written informed consent was waived. A retrospective chart review in a tertiary care center identified 1,580 women who had breast surgery for invasive carcinoma between August 1, 2013 and August 31, 2014. Among them, a total of 307 consecutive women (mean age, 53 yrs; range, 27-81 yrs) with T1-2 breast cancers eligible for TGR assessment by using ultrasonography (US) were included. All women underwent serial breast US at the time of initial diagnosis and one day before surgery as a routine protocol in our hospital. The three perpendicular diameters of tumors were measured on US images at each time point and the maximum diameter and volume of tumors were compared using paired samples t-test. TGR was quantified using the parameter of specific growth rate (SGR; %/day) and was compared with clinicopathologic variables using univariate and multivariate analyses.

**RESULTS**

The median time from diagnosis to surgery was 31 days (range, 8-78 days). The maximum diameter and volume of tumors at surgery (mean, 15.8 ± 6.8 mm and 1.73 ± 2.6 cc) were significantly larger than those at diagnosis (15.0 ± 6.5 mm and 1.47 ± 2.3 cc) ($P<0.001$, both). Tumor subtype (ER-positive [n=206], HER2-positive [n=35], and triple negative cancers [n=66]) was the only independent clinicopathologic factor associated with SGR on multivariate analysis ($P=0.006$). Triple negative cancers showed the highest SGR (0.980 ± 1.071) followed by HER2-positive (0.550 ± 1.219) and ER-positive cancers (0.192 ± 0.995) ($P < 0.001$). Clinical T stage was not significantly changed between diagnosis and surgery in ER- and HER2-positive cancers, however, higher T stage at surgery was more frequent in triple negative cancers ($P=0.027$).

**CONCLUSION**

Triple negative cancers showed the highest TGR during the wait times for surgery and clinical T stage can be upgraded between diagnosis and surgery in triple negative cancers.

**CLINICAL RELEVANCE/APPLICATION**

It is desirable to minimize wait times for surgery in patients with triple negative breast cancers.

## SSK02-06 Diagnostic Yield of Axillary Ultrasound and Fine-Needle Aspiration during Screening Breast Ultrasound

Wednesday, Dec. 2 11:20AM - 11:30AM Location: E450A

Participants
Inyoung Youn, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Min Jung Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun-Kyung Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hee Jung Moon, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jung Hyun Yoon, MD, Seongnam, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jieun Koh, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

**PURPOSE**

The purpose of our study was to assess the positive predictive value (PPV), as a measure of the diagnostic yield, of ultrasound (US)-guided fine-needle aspiration (US-FNA) and cancer detection rate for incidentally detected abnormal axillary lymph node (LN) in patients who underwent screening US.

**METHOD AND MATERIALS**

We retrospectively reviewed 72 LNs of 69 patients (mean age, 44.9 years) who underwent US-FNA for incidentally detected abnormal axillary LNs on 50,488 screening US during January 2005 to December 2011. The PPV of US-FNA and cancer detection rate were calculated. We evaluated US images for LN size, abnormal findings (hilum loss, eccentric cortical thickening, round shape, extranodal extension or marked hypoechoic cortex), and mammography for the identification of abnormal LNs. The PPV of each finding were also calculated.

**RESULTS**

The PPV of US-FNA and cancer detection rate was 2.8% (2/72) and 0.004% (2/50,488). The mean measurements for long axis, short axis, and cortical thickening of the LNs were 14.9±5.9 mm, 8.5±3.5 mm, and 5.8±2.8 mm. Of the positive LNs, US findings of hilum loss, eccentric cortical thickening, and extranodal extension were found, and each corresponding PPV was 6.3% (1/16), 1.8% (1/56), and 14.3% (1/7), respectively. The PPV of mammography was 14.3% (1/7).

**CONCLUSION**

Our results suggest that the PPV of US-FNA and the cancer detection rate for incidentally detected abnormal axillary LNs during screening US are too low to recommend axillary US during breast US screening and that follow-up is acceptable for abnormal LNs detected during screening breast US that do not have extranodal extension or are negative on mammography.

**CLINICAL RELEVANCE/APPLICATION**

Follow-up US would be acceptable for abnormal LNs detected during screening breast US that did not have extranodal extension or were negative in mammography.

## SSK02-07 Microcalcifications in Breast Cancers Affect Ultrasound Dtrain Elastography

Wednesday, Dec. 2 11:30AM - 11:40AM Location: E450A

Participants
Yumi Kashikura, MD,PhD, Tsukuba, Japan (*Presenter*) Nothing to Disclose
Ei Ueno, MD, PhD, Tsukuba, Japan (*Abstract Co-Author*) Nothing to Disclose
Eriko Tohno, MD, Tsukuba, Japan (*Abstract Co-Author*) Nothing to Disclose
Takeshi Umemoto, MD, Tsukuba, Japan (*Abstract Co-Author*) Nothing to Disclose
Isamu Morishima, Tsukuba, Japan (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Some non-palpable breast cancer lesions may exhibit false-negative findings on ultrasound strain elastography. This study aims to investigate the causes of such false-negative findings.

**METHOD AND MATERIALS**

Between January 2012 and December 2014, 196 patients with pTis to pT1b breast cancer underwent surgery at our hospital. We retrospectively divided the patients into 2 groups by the presence or absence of microcalcifications and compared their elastography data. The presence or absence of calcifications was confirmed by mammography (MMG), and negative lesions were reconfirmed by microscopy. Elastography was performed by several experienced physicians and sonographers, and each physician classified the images according to the 1 to 5 scale of the Tsukuba Elasticity Score. Considering the effect of previous interventions, patients with a history of core needle biopsy and vacuum-assisted biopsy were excluded from the study. Accordingly, 79 patients were excluded and 117 cases were included.

**RESULTS**

Microcalcifications were absent in 51 (43.6 %) lesions and present in 66 (56.4 %) lesions. The presence of calcifications was microscopically confirmed in 14 patients. Of the lesions without calcifications, 1 (2.0%), 15 (29.4%), 15 (29.4%), and 23 (45.1%) showed elasticity scores of 2, 3, 4, and 5, respectively, while of those with calcifications, 3 (4.5%), 14 (21.2%), 16 (24.2%), 16 (24.2%), and 17 (25.8%) showed elasticity scores of 1, 2, 3, 4, and 5, respectively. Assuming that scores of 3, 4, and 5 indicate positive findings, the overall sensitivity was 84.6 %, while sensitivity for the lesions with and without calcifications was 74.2% and 98.0%, respectively (P = 0.003). When the presence of microcalcifications was judged only by MMG, the sensitivity for the lesions with and without calcifications was 73.1% and 96.9%, respectively. As strain elastography is based on combined autocorrelation, microcalcifications seem to cause an apparent strain even though the tissue is harder than normal.

**CONCLUSION**

Although breast ultrasound elastography shows high sensitivity, our study revealed an obvious difference in sensitivity between the lesions with and without microcalcifications.

**CLINICAL RELEVANCE/APPLICATION**

Clinicians should be careful while evaluating breast ultrasound strain elastography findings for lesions with microcalcifications on mammography.

## SSK02-08 Mass-like Focal Breast Fibrosis - A Benign Entity Mimicking Malignancy on Ultrasonography

Wednesday, Dec. 2 11:40AM - 11:50AM Location: E450A

Participants
Eleonora Horvath, MD, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose
Aleen V. Altamirano, MD, Masaya, Nicaragua (*Presenter*) Nothing to Disclose
Eduardo Soto, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose
Marcela Uchida, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose
Miguel A. Pinochet, MD, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose
Claudio S. Silva Fuente-Alba, MD, MSc, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose
Marcela Gallegos, Santiago, Chile (*Abstract Co-Author*) Nothing to Disclose
Jocelyn Galvez, Vitacura, Chile (*Abstract Co-Author*) Nothing to Disclose
Maria Flavia Pizzolon, MD, Vitacura, Chile (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To determine the sonographic characteristics of core biopsy-proven Mass-like Focal Breast Fibrosis (MFBF).

**METHOD AND MATERIALS**

IRB approved, retrospective study. Between April 2007 and January 2015, 3051 US-guided breast biopsies with 14G core needle, were performed, 251 of them with a diagnosis of stromal breast fibrosis. We excluded 128 cases where fibrosis was not the primary histologic diagnosis. Only MFBF cases were included, histopathologically defined as a localized area of dense fibrous tissue associated with hypoplastic mammary ducts and lobules, without vascular structures and inflammatory changes. Imaging features were tabulated and analyzed. Follow-up imaging was reviewed to document lesion stability.

**RESULTS**

In 121 women (median age: 50 years, range: 25-83) we found 123 cases of MFBF (incidence: 4%). Lesion size ranged from 4 to 35 mm (median: 10 mm), non-palpable in 94% of the cases. Eighty-seven (71%) of them developed in highly or heterogeneously dense breast (ACR 4 and 3). Only 7 (6%) were evident on mammography. We identified two distinct sonographic patterns of MFBF. Pattern A (28%): well-circumscribed, hypoechoic, avascular mass. Pattern B (72%): ill defined, irregular, avascular, markedly hypoechogenic or spiculated lesion with or without a definable mass and markedly shadowing, located intraparenchymatous or under Cooper ligament. Sixty-seven (54%) lesions were reported as BI-RADS 5, 4C or 4B. MRI study was performed in 7 patients with negative outcome. One lesion was surgically removed and in 4 patients a new large (8G) core biopsy was performed due to radio-histological discordance, obtaining the same results. Patients remain in follow-up (median: 30 months, range: 2 to 94 months), without malignancy.

**CONCLUSION**

The mass-like focal breast fibrosis is a benign entity with the potential to mimic malignancy. Is important that radiologists know the specific US patterns and if proven on core needle biopsy, it may be taken as a concordant diagnosis.

**CLINICAL RELEVANCE/APPLICATION**

We report a large series of MFBF, detailing its US-pattern. Should these US patterns be identified, it is reasonable to accept this benign histopathological diagnosis postbiopsy as concordant.

## SSK02-09 Hypoechoic Non-mass Lesion on Screening Breast Ultrasound

Wednesday, Dec. 2 11:50AM - 12:00PM Location: E450A

Participants
Jin Hwa Lee, MD, Busan, Korea, Republic Of (*Presenter*) Nothing to Disclose
Cherie M. Kuzmiak, DO, Chapel Hill, NC (*Abstract Co-Author*) Research Grant, FUJIFILM Holdings Corporation;
Ji Hyun Lee, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jong-Young Oh, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hee-Jin Kwon, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

The current ACR BI-RADS lexicon only covers mass lesions. The purpose of this study is to determine the significance of hypoechoic non-mass lesion (HNML) which is recognized during screening breast ultrasound (SBUS).

**METHOD AND MATERIALS**

An IRB approved retrospective database review was performed from March 2008 to June 2012 of patients who had SBUS. The indications of SBUS at our institution were asymptomatic patients with dense breast tissue on mammography, routine follow-up of a BI-RADS category 3 lesion with 2 years of stability or a biopsy-proven benign lesion on prior examination, and postoperative screening after surgery for breast cancer. We included patients with HNML on ultrasound and with no suspicious finding on mammography. Excluded from the study were lesions related to the past history of biopsy or operation at the area of HNML. A HNML was defined as a hypoechoic area that does not conform to the definition of a mass and has different character from that of surrounding glands or the same area in the contralateral breast. The final diagnoses were based on pathology results and clinical or sonographic follow-up more than 12 months. We calculated the incidence and likelihood of malignancy of the HNML on SBUS.

**RESULTS**

A total of 17868 SBUS were performed on 8856 asymptomatic patients. Ninety-six HNMLs were detected in 89 patients (1.0%). On final pathology or follow-up of HMLs, three (3.1%) lesions were malignant, 78 (81.3%) lesions were benign, and two (2.1%) lesions were high risk. In addition, there were 13 (13.5%) lesions that were lost to follow-up or without final surgical pathology. The likelihood of malignancy of a HNML on SBUS was 3.1%.

## CONCLUSION

The likelihood of malignancy for a hypoechoic non-mass lesion on SBUS was greater than 2%. Therefore, it should be classified as a BI-RADS category 4 lesion and tissue diagnosis is warranted.

## CLINICAL RELEVANCE/APPLICATION

Large prospective studies are needed to further validate which management recommendation is most appropriate for the HNML on SBUS.

BRS-WEA

## Breast Wednesday Poster Discussions

Wednesday, Dec. 2 12:15PM - 12:45PM Location: BR Community, Learning Center

BR

*AMA PRA Category 1 Credit ™*: .50

FDA Discussions may include off-label uses.

**Participants**
Jiyon Lee, MD, New York, NY (*Moderator*) Nothing to Disclose

**Sub-Events**

### BR253-SD-WEA1 Contrast-enhanced Ultrasound Imaging in Ablation Therapy for Primary Breast Carcinoma

Station #1

Participants
Toshikazu Ito, MD, PhD, Izumisano City, Japan (*Presenter*) Nothing to Disclose

**PURPOSE**

This study was performed to evaluate the usefulness of contrast-enhanced ultrasound in assessing the therapeutic response of percutaneous radiofrequency (RF) ablation therapy in patients with breast carcinoma. To evaluate therapeutic efficacy of percutaneous ultrasound guided ablation therapy for primary breast cancer using contrast-enhanced ultrasound.

**METHOD AND MATERIALS**

Between January 2012 and December 2014, 33 patients with biopsy-confirmed breast carcinoma 2.0cm or less in diameter underwent contrast-enhanced ultrasound using the microbubble contrast agent Perflubutane before and after percutaneous RF ablation therapy. We examined 33 patients with 33 breast cancer lesions by contrast-enhanced ultrasound and MRI before and after RF ablation therapy. Ultrasound guided RF abltion therapy was performed using a 17-gauge internally cooled electrode (Cool-TipTM, Valleylab, Boulder, CO, USA) under general anesthesia. Therapeutic success was defined as a lack of contrast enhancement by contrast-enhanced ultrasound, MRI and non-viable cancer tissue by ultrasound guided vacuum-assisted biopsy (VAB).

**RESULTS**

Before treatment, all examined 33 breast carcinoma nodules were detected to be hypervascular on contrast-enhanced ultrasound and MRI. Contrast-enhanced ultrasound four weeks after RF ablation therapy showed ablation zones and adequate tumor necrosis in all 33 cancer lesions treated. Contrast-enhanced ultrasound made it possible to see that tumor vessels of treated lesions had disappeared after RF ablation therapy. Contrast enhanced ultrasound and MRI showed a ablation zone and non-viable cancer tissue were seen by VAB in 33 ablation zones.

**CONCLUSION**

Contrast-enhanced ultrasound using Perflubutane may provide an alternative approach that has high diagnostic agreement with MRI in assessing the therapeutic effect of RF ablation therapy in primary breast carcinomas.

**CLINICAL RELEVANCE/APPLICATION**

Contrast-enhanced ultrasound using Perflubutane may provide an alternative approach that has high diagnostic agreement with MRI in assessing the therapeutic effect of RF ablation therapy in primary breast carcinomas.

### BR254-SD-WEA2 Fast Bilateral Breast Coverage with High Spectral and Spatial Resolution (HiSS) MRI at 3T

Station #2

Participants
Milica Medved, PhD, Chicago, IL (*Presenter*) Nothing to Disclose
William Weiss, BS, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Hiroyuki Abe, MD, Chicago, IL (*Abstract Co-Author*) Consultant, Seno Medical Instruments, Inc
Gillian M. Newstead, MD, Chicago, IL (*Abstract Co-Author*) Medical Advisory Board, Bayer AG; Consultant, Three Palm Software LLC; Consultant, VuCOMP, Inc; Medical Advisor, Quantitative Insights, Inc
Olufunmilayo I. Olopade, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Maryellen L. Giger, PhD, Chicago, IL (*Abstract Co-Author*) Stockholder, Hologic, Inc; Shareholder, Quantitative Insights, Inc; Royalties, Hologic, Inc; Royalties, General Electric Company; Royalties, MEDIAN Technologies; Royalties, Riverain Technologies, LLC; Royalties, Mitsubishi Corporation; Royalties, Toshiba Corporation; Researcher, Koninklijke Philips NV; Researcher, U-Systems, Inc
Gregory S. Karczmar, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

High spectral and spatial resolution (HiSS) MRI is a small-voxel implementation of echo-planar spectroscopic imaging (EPSI), with fat and water the resonances of interest. It provides excellent diagnostic images of breast cancer and normal breast even without contrast enhancement by separating the water and fat signal in the spectral domain and visualizing lesion morphology without contrast agent-induced artifacts. Here we further improve imaging speed and in-plane resolution, at higher field strength (3T) and quantify fat suppression.

**METHOD AND MATERIALS**

Thirty six subjects (18 healthy volunteers, 8 patients with suspicious findings, and 10 cancer patients) were scanned using a 16-channel dedicated breast coil, on a Philips Achieva 3T-TX magnet. High-resolution EPSI was implemented (384 mm FOV, 0.8x0.8x3

mm³ voxels in 50-60 slices, TR/TE 2350/23 ms, 23 echoes, 23.9 Hz spectral resolution, scan time 6.5-7.5 min, SENSE factor 3 (L/R)) via a software patch and complex SENSE-accelerated images of individual echoes were reconstructed on the scanner console. HiSS MRI was acquired prior to contrast administration. During off-line data processing, the fat peak in each voxel was fit to a Lorentzian and the fit and baseline subtracted from the full water and fat proton spectrum. The remaining pure water spectrum was analyzed to obtain images proportional to water resonance peak height and integral.

**RESULTS**

Average parenchymal signal to suppressed fat signal ratio was 3.9±0.6 in fat-suppressed T1-weighted images and 7.6±2.1 in water peak height images, yielding 94% improvement in parenchymal conspicuity ($p < 0.001$). 10 out of 12 malignant lesions found in 10 patients were visualized on HiSS images.

**CONCLUSION**

Fast, high resolution HiSS images were acquired at 3T in 6.5-7.5 minutes. The T2*-weighted HiSS sequence could potentially replace the existing T2-weighted pre-contrast sequence, and could provide high-resolution fat-suppressed pre-contrast morphologic imaging of lesions, eliminating artifacts resulting from contrast agent administration. HiSS MRI allows detection and characterization of small quantities of water-bearing tissue, and could be used to improve calculation of breast density in risk-assessment studies.

**CLINICAL RELEVANCE/APPLICATION**

Fast HiSS MRI could replace T2-weighted sequences, while providing excellent unenhanced diagnostic images of breast lesions and potentially better quantitative measurement of breast density.

## BR255-SD-WEA3 Diagnostic Accuracy of Digital Breast Tomosynthesis - Thick versus Thin Slices

Station #3

Participants
Alexander Stork, Dusseldorf, Germany (*Presenter*) Consultant, General Electric Company;
Dietmar Seitz, MD, Duesseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose
Eckhard Wegjan, Duesseldorf, Germany (*Abstract Co-Author*) Nothing to Disclose
Philipp G. Begemann, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose
Joern K. Kemper, MD, Hamburg, Germany (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To compare clinical performance of digital breast tomosynthesis (DBT) reviewed in thick slices versus the combination of thick and thin slices.

**METHOD AND MATERIALS**

276 consenting women with indication of work-up were enrolled in a HIPAA-compliant prospective trial and imaged with DBT (MLO view) on the suspected breast(s). 49 patients had malignancies and 227 benign lesions, all proven through histopathology or 1-year follow-up. DBT volumes were reconstructed from 9 exposures equally distributed around a 25° angle. DBT image sets included 0.5mm-spaced (thin) slices and 1cm-thick slices. Thick slices were obtained by combination of 20 adjacent thin slices. Five independent breast radiologists (experience 10-15 years), blinded on truth, assessed the cases using BI-RADS® categories (1-5). DBT images were scored in two sequential steps: thick slices (DBTS) first, then combined with thin slices (DBTSS). Areas under the ROC curves (AUCs) were evaluated and t-test used to check differences. Mean file sizes were calculated.

**RESULTS**

AUCs across readers were 0.817 and 0.816 for DBTSS and DBTS, respectively. Mean AUC difference and related 95% confidence interval (CI) for DBTSS versus DBTS were 0.001 [-0.009, 0.012]. The difference was not statistically significant (p=0.738). Mean patient file size was 116Mb and 1,265Mb for DBTS and DBTSS, respectively.

**CONCLUSION**

There was no statistical difference in ROC AUC across readers between DBT displayed as thick slices or as the combination of thick and thin slices, but there was a 10 times reduction of image file size with thick slices only.

**CLINICAL RELEVANCE/APPLICATION**

DBT interpretation may be limited to thick slices only with a large potential for patient file size reduction.

## BR256-SD-WEA4 Training Effect on Screening Breast Ultrasound for Women at Average Risk of Breast Cancer: Improvement in the Positive Test Rate and Biopsy Rate over 3 Years

Station #4

Participants
Sooyeon Kim, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Min Jung Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hee Jung Moon, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jung Hyun Yoon, MD, Seongnam, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun-Kyung Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

We investigated whether training reduced the positive test rate without loss of the cancer detection rate on screening US for women at average risk of breast cancer.

**METHOD AND MATERIALS**

3171 women at average risk of breast cancer who underwent screening US adjuvant to mammographically dense breast from March 2010 to February 2013 - 918, 1173, and 1020 women at the first, second, and third year - were included. Since 2010, we trained

to classify galactocele-like lesions and circumscribed oval-shaped solid nodules of a short diameter of 5mm or smaller as Breast Imaging Reporting and Data System (BI-RADS) category 2. Reference standard information was a combination of biopsy and surgical results within 1 year after screening US, and a follow-up US performed at least 12 months after screening US. BI-RADS category 3, 4, and 5 on screening US were considered as screening test positive. Interval cancers were defined as those diagnosed because of clinical abnormalities occurring in an interval less than 1 year after the last screening US. PPVs, total and invasive cancer yield per 1000 exams, and biopsy rates were calculated. Mantel-Haenszel Chi-square test was used to evaluate the trends in BI-RADS categories, PPVs and biopsy rates. Chi-square or Fisher's exact test was used to evaluate the differences in total and invasive cancer yields.

**RESULTS**

This training significantly reduced the percentage of BI-RADS 3 from 28.3% to 12.6%, BI-RADS 4 from 5.6% to 2.1%, BI-RADS 3-5 from 33.9% to 14.7%, and the biopsy rate from 8.4% to 2.8% over 3 years (All, p<0.001). PPVs did not significantly increase. Total and invasive cancer yield was 2.8 and 2.2 cancers per 1000 exams, respectively. Interval cancers were not detected. No US-detected cancer had lymph node metastasis. Of these, 77.8% (7 of 9) were invasive, and the median size was 8mm.

**CONCLUSION**

Training to downgrade galactocele-like lesions and circumscribed oval-shaped solid nodules of a short diameter of 5mm or smaller without any suspicious US features into BI-RADS category 2 lesions on screening US was effective in reducing the positive test rate and biopsy rate, without significant loss of the cancer detection rate.

**CLINICAL RELEVANCE/APPLICATION**

The training reduced the percentage of BI-RADS category 3 and 4 lesions and the biopsy rate, without significant loss of the cancer detection rate.

## BR258-SD-WEA6 Impact of the New Density Reporting Laws: Radiologist Perceptions and Actual Behavior

Station #6

Participants
David Gur, PhD, Pittsburgh, PA (*Presenter*) Nothing to Disclose
Jules H. Sumkin, DO, Pittsburgh, PA (*Abstract Co-Author*) Scientific Advisory Board, Hologic, Inc
Amy Klym, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Jill L. King, MS, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose
Andriy I. Bandos, PhD, Pittsburgh, PA (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To assess radiologists' perceptions of how the Breast Density Notification Act (BDNA) of Pennsylvania would affect their breast density reporting and their actual reporting patterns after implementation.

**METHOD AND MATERIALS**

IRB approval was obtained. We surveyed 21 radiologists about their belief as to how the new law affected their breast density reporting patterns and analyzed actual data for 16 respondents at three different times: 12 and 3 months pre- and between 1 and 5 months post the law taking effect. Three hundred consecutive reports were assessed for each radiologist at each period. Distributions of reported density BI-RADS ('1'-'4') were compared using a type III test in the context of an ordinal mixed model accounting for between-reader variability and adjusting for age (proc glimmix, SAS v9.3) using a two-sided 0.05 significance level.

**RESULTS**

Seventeen radiologists responded to the survey. One retired shortly thereafter. Of the 16 practicing respondents, 56% (9/16) did not favor the law, 13% (2/16) were in favor, and 31% (5/16) were neutral. The fraction of radiologists who perceived that after implementation they rated more, equally, or less frequently breasts as BI-RADS 2 versus BI-RADS 3 was, 50% (8/16), 44% (7/16) and 6% (1/16), respectively. Actual BIRADS 2 rates were 0.43 (2074/4800), 0.48 (2522/4800) and 0.53 (2522/ 4800), for 12 months prior, 3 months prior, and one to 5 months post, respectively. Comparing actual 3 months pre to post implementation, 69% (11/16) performed differently than their survey answers with an average overall shift of 5% of cases from BIRAD 3 to BIRAD 2 (p<0.001), with three radiologists changing their individualized reporting by 10% or more (p<0.001). Comparing 12 months pre- to post implementation, 44% (7/16) performed differently than their survey answers and 14 of 16 radiologists increased the frequency of reported BI-RADS 2 scores after the BDNA implementation with seven having statistically significant (p<0.001) increases.

**CONCLUSION**

Radiologists' reporting patterns changed after the density reporting law and for some radiologists in an unexpected way, at least for a short duration.

**CLINICAL RELEVANCE/APPLICATION**

Radiologists' reporting patterns changed after the new density reporting law, at least for a short duration, and for some in a different manner than their own reported expectation.

## BR259-SD-WEA7 Variation in the Sensitivity of Shear Wave Elastography (SWE) for the Detection of Invasive Breast Cancer According to Histological Type: Findings from 1120 Breast Cancers

Station #7

Participants
Andrew Evans, MRCP, FRCR, Dundee, United Kingdom (*Presenter*) Research Grant, SuperSonic Imagine Speakers Bureau, SuperSonic imagine
Colin Purdie, MBChB,PhD, Dundee, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Lee Jordan, Dundee, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Sarah J. Vinnicombe, MRCP, FRCR, Dundee, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Kim Thomson, Dundee, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Patsy Whelehan, MSc, Dundee, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Previous studies of SWE of invasive breast cancers have included less than 300 tumours so the numbers of special histological type tumours included have been low. The aim of this study is to ascertain the sensitivity of SWE of breast cancer according to histological subtype in a large dataset.

**METHOD AND MATERIALS**

The mean elasticity values of 1120 invasive breast cancers were compared according to histological subtype. The patients were recorded on a prospectively collected database of all US visible lesions in our breast unit over 5 years. It includes both screen detected and symptomatic lesions. The frequency of abnormal stiffness (mean kPa of >50) and the average mean stiffness of special tumour types with 8 or more cases were compared with ductal carcinomas of no specific type (DNST).

**RESULTS**

Seven hundred and ninety one of 846 (93.5%) DNST tumours were stiff at SWE (average mean stiffness 132 kPa). Tubular cancers were significantly less likely to be stiff compared to DNST tumours (32 of 43 (74.4 %) p=0.0002 (average mean stiffness 103kPa).Lobular cancers (146 of 155 (94.2%), p=0.71, average mean stiffness 132 kPa), mucinous cancers ((26 of 26(100%), p=0.06, average mean stiffness 153 kPa), papillary cancers (25 of 26 (96%), p=0.57, average mean stiffness 134 kPa) and metaplastic cancer (8 of 8 (100%), p=0.3, average mean stiffness 140 kPa) had frequencies of stiffness similar to that seen in DNST tumours.

**CONCLUSION**

Tubular cancers are significantly less likely to be stiff at SWE compared to other tumour types. Other tumour types notably lobular cancer, papillary and mucinous cancers have similar frequencies of stiffness as DNST tumours.

**CLINICAL RELEVANCE/APPLICATION**

SWE findings in small spiculate lesions which may reprent tubular cancer should interpeted with courtion

## BR154-ED-WEA8 Common Artifacts and Positioning Mistakes to be Avoided in Digital Mammography

Station #8

Participants
Maria Soledad Nocetti, MD, Vicente Lopez, Argentina (*Abstract Co-Author*) Nothing to Disclose
Lucia I. Beccar Varela, MD, Vicente Lopez, Argentina (*Abstract Co-Author*) Nothing to Disclose
Bernardo O. Blejman, MD, Buenos Aires, Argentina (*Abstract Co-Author*) Nothing to Disclose
Karina Pesce, Vicente Lopez, Argentina (*Presenter*) Nothing to Disclose
Gabriela Ladeiro, Vicente Lopez, Argentina (*Abstract Co-Author*) Nothing to Disclose

**TEACHING POINTS**

Recognize and analyze most common artifacts that condition an optimal mammographic diagnosis/ Learn to fix them to ensure high quality standads.

**TABLE OF CONTENTS/OUTLINE**

Evaluation of digital mammography artifacts is essential for optimizing image quality.Radiologists and technologists should be familiar with them, to avoid creating pseudolesions or masking true abnormalities.Artifacts may be related to: the mammography unit (field inhomogeneity, detector artifacts, underexposure, grid lines, grid misplacement, vibration artifact, loss of edge), the technologist (improper use of the equipment or positioning mistakes) or the patient (motion, superimposed objects or substances, as body parts, clothing, hair, medical devices, foreign bodies or cosmetics on the skin).The aim of mammography is to obtain an optimum image along with maximum breast tissue visualization.The purpose of this work is that the reader is able to identify and understand the causes of digital mammographic artifacts so, when posible, take actions to eliminate them to ensure high quality standards.

BRS-WEB

## Breast Wednesday Poster Discussions

Wednesday, Dec. 2 12:45PM - 1:15PM Location: BR Community, Learning Center

BR

*AMA PRA Category 1 Credit ™*: .50

**Participants**
Jiyon Lee, MD, New York, NY (*Moderator*) Nothing to Disclose

**Sub-Events**

### BR260-SD-WEB1 Comparative Diagnostic Value of Two-dimensional Synthesized Mammogram and Conventional Full-field Digital Mammogram for Evaluation of Breast Cancer

Station #1

Participants
Ok Hee Woo, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Gayoung Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hye Seon Shin, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Seonah Jang, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Kyu Ran Cho, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Bo Kyoung Seo, MD, PhD, Ansan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To compare diagnostic efficacy of two-dimensional synthesized mammogram (2D SM) from digital breast tomosynthesis (DBT) and conventional full-field digital mammogram (FFDM) in patients undergone DBT for evaluation of breast cancer

#### METHOD AND MATERIALS

A retrospective observer performance study on blindly paired 2D SM from DBT and FFDM was performed by 3 radiologists specialized in breast imaging (12 years, 5 years, and 3 years of experience each). Images of biopsy confirmed 258 breast lesions in 229 patients were collected from 21st April, 2014 to 28th February, 2015 in our institution. The diagnostic sensitivities of both 2D SM and FFDM were calculated and compared by McNemar's test and the interobserver agreement on both exams was evaluated by kappa value. Also, detailed lesion characterization by DBT, 2D SM, FFDM, US, and MRI was done according to BI-RADS 2013 and each observer chose better modality between 2D SM and FFDM blindly.

#### RESULTS

All patients were female and the mean age was 51.6 years (ranged 22-87 years). Among total 258 lesions, 208 were malignant and 49 were benign. The diagnostic sensitivity for malignant lesion of 2D SM was 92.2% and FFDM was 91.1%, and specificity was 91.3% and 87.5% each. AUC of diagnostic accuracy for 2D SM was 0.917 and FFDM was 0.89 which showed no statistically significant difference (p-value 0.573). Kappa values for the interobserver agreement evaluation were 0.973 for observer 1 and 2, 0.944 for 2 and 3, and 0.972 for 1 and 3 which showed almost perfect interobserver agreement. The observers chose 2D SM as a better modality in 20.54%, FFDM in 3.49%, and equal in 75.97%, and especially spiculated margin and architectural distortion were more clearly detectable in 2D SM (p-value <0.05).

#### CONCLUSION

2D SM showed equivalent diagnostic values as compared with FFDM. Overall characterization of the lesion was better in 2D SM, and especially 2D SM showed statistically significant superiority in evaluation of spiculated margin and architectural distortion.

#### CLINICAL RELEVANCE/APPLICATION

Evaluation with 2D SM in symptomatic patients with suspicious breast lesion and indicated for DBT might help to avoid additional radiation exposure.

### BR261-SD-WEB2 Volumetric Breast Density and Mean Glandular Dose Estimated from Digital Breast Tomosynthesis Projections and Digital Mammograms

Station #2

Participants
Susie Lau, Kuala Lumpur, Malaysia (*Abstract Co-Author*) Nothing to Disclose
Kwan Hoong Ng, PhD, Kuala Lumpur, Malaysia (*Abstract Co-Author*) Nothing to Disclose
Yang Faridah Abdul Aziz, Kuala Lumpur, Malaysia (*Abstract Co-Author*) Nothing to Disclose
Ralph P. Highnam, PhD, Wellington, New Zealand (*Presenter*) CEO, Matakina Technology Limited; CEO, Volpara Solutions Limited
Ariane Chan, PhD, Wellington, New Zealand (*Abstract Co-Author*) Employee, Matakina Technology Limited;

#### PURPOSE

To compare the volumetric breast density (VBD) and mean glandular dose (MGD) assessments using an automated VBD measurement system on digital breast tomosynthesis (DBT) projections and digital mammograms (DM) obtained on a DBT system.

#### METHOD AND MATERIALS

An automated VBD measurement system (Volpara Version 1.5.1) was used to analyze and compare the fibroglandular tissue volume (FGV), breast volume (BV), VBD and MGD from DBT projections and DM, including cranial-caudal (CC) and mediolateral oblique (MLO) views, for 315 women (mean age: 58±10 years) acquired with the combo procedure on a DBT system (Hologic Selenia Dimensions).

**RESULTS**

The mean FGV, BV, VBD and MGD estimated using DBT projections were 49.6±30.7 cm3, 591.2±338.0 cm3, 9.6±5.1 % and 2.1±0.6 mGy, respectively. While using DM, the mean FGV, BV, VBD and MGD estimated were 50.2±30.6 cm3, 593.2±338.7 cm3, 9.9±5.4 % and 1.9±0.8 mGy, respectively. There were strong, positive correlations between FGV, BV, VBD and MGD estimated from DBT projections and those from DM, which were highly statistically significant ($p<0.0001$), with $r = 0.95$, 1.00, 0.94 and 0.85, respectively. There was substantial agreement between the density grades (VDG 1, VDG 2, VDG 3, VDG 4 ) evaluated using DBT projections and DM with weighted $\kappa = 0.79$ ($p<0.0001$). The MGD reported by the DBT system were found to be generally lower than those estimated by the automated VBD measurement system for both DBT projections and MD, respectively.

**CONCLUSION**

Our study showed the results obtained from the DBT projections agreed well with those obtained from DM. Hence, the automated VBD measurement system can be used to assess volumetric and MGD measurements on both DBT projections and DM acquired on a DBT system.

**CLINICAL RELEVANCE/APPLICATION**

VBD can be estimated from both DBT projections and DM by using the automated VBD measurement system. Though in good agreement, the MGD reported by the DBT system are generally lower than those estimated by the automated VBD measurement system for both DBT projections and DM.

## BR263-SD-WEB4 Which Additional Technique after Negative Mammography Detects More Cancers in Dense Breasts: Tomosynthesis or US?

Station #4

Participants
Maite Millor, MEd, Pamplona, Spain (*Presenter*) Nothing to Disclose
Paula Garcia Barquin, MD, Pamplona, Spain (*Abstract Co-Author*) Nothing to Disclose
Luis Pina, MD, PhD, San Sebastian, Spain (*Abstract Co-Author*) Nothing to Disclose
Arlette Elizalde, Pamplona, Spain (*Abstract Co-Author*) Nothing to Disclose
Paula Martinez Miravete, Zaragoza, Spain (*Abstract Co-Author*) Nothing to Disclose
Begona Olartecoechea, Pamplona, Spain (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

It is well known that the sensitivity of Digital Mammography (DM) drops in dense patterns (c and d). Both US and Digital Breast Tomosynthesis (DBT) can detect additional cancers in these patterns. Our aim was to evaluate which additional technique (DBT and/or US) can detect more cancers in dense patterns (c and d).

**METHOD AND MATERIALS**

We retrospectively reviewed 110 breast cancers in 84 patients. All of them underwent DM (using conventional 45º MLO and CC views) as well as complementary DBT (45º MLO view using a wide angle acquisition technique) and hand held US. 60 cancers were detected by DM and the remaining 50 cancers (not seen on DM) were detected by additional DBT, US, MRI or surgical specimen. Out of these 50 additional cancers, 36 were diagnosed in dense breasts (ACR patterns "c" and "d"). These 36 cancers were evaluated by one single reader, blinded to the final diagnosis. Initially the reader evaluated all the DBT studies as positive or negative. Four weeks later the same reader assessed the US exams. The sensitivities of both techniques were calculated and compared using a McNemar test (SPSS 20.0).

**RESULTS**

DBT detected 13/36 cancers (36.1%), US detected 22/36 cancers (61.1%), DBT + US detected 26/36 cancers (72.2%). The remaining 10/36 cancers were detected by preoperative MRI and or by the pathologist in the surgical specimen. Comparing the additional tumors detected by DBT and US, the sensitivity of US was significantly superior to the sensitivity of DBT ($p=0.035$).

**CONCLUSION**

According to our results, additional US had a higher sensitivity than DBT in dense breasts.

**CLINICAL RELEVANCE/APPLICATION**

Breast cancers can be occult in dense patterns "c" and "d". Additional techniques such as Ultrasound and Tomosynthesis have proven to detect additional cancers. In our experience, US is superior to Tomosynthesis to detect cancers that are not visible on digital mammography.

## BR264-SD-WEB5 US Evaluation for Axillary Lymph Node in Breast Cancer Patients with Clinically Negative Axilla

Station #5

Participants
Ga Ram Kim, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Young Ko, MD, PhD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Boo-Kyung Han, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Sook Ko, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ji Soo Choi, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To investigate the role of US evaluation for the axillary lymph nodes in the patients with T1 or T2 stage breast cancers and clinically negative axilla

**METHOD AND MATERIALS**

In this study, we reviewed the clinical records, US reports, and surgical results and 5-year follow up data of 1463 patients underwent breast cancer surgery from January to December 2009. We excluded 309 patients who received neoadjuvant

chemotherapy before surgery or who had ductal carcinoma in situ, or had recurrent breast cancer after previous axillary surgery. Among the remaining 1154 patients, 1105 patients had T1 or T2 breast cancers and included in this study. We reviewed the records of physical examination for axillary status by breast surgeons and selected the patients with clinically negative axilla, US assessment for their axillary lymph node status, and pathology of the surgical results.

**RESULTS**

Among the 1105 patients with T1 or T2 stage of breast cancers, 142 had palpable axillary lymph nodes and 963 had clinically negative axilla. In 963 patients with clinically negative axilla, 305 patients (31.7%) had metastatic axillary lymph nodes. US detected suspicious lymph nodes in 119/305 (39%) patients among them. Patients with suspicious lymph nodes on US (n=250) had metastatic axillary lymph nodes in 47.6% (119/250), the mean number of metastatic lymph nodes after axillary dissection was 4.8, and 42% of the patients had 3 or more metastatic lymph nodes. On the other hand, patients with negative US findings (n=713) had metastatic axillary lymph nodes in 26.1% (186/713), the mean number of metastatic lymph nodes was 2.7, and 28% of the patients had 3 or more metastatic lymph nodes.

**CONCLUSION**

In patients with T1 or T2 stage of breast cancer and clinically negative axilla, positive US finding suggested 39% probability and large number (4.8) of metastatic axillary lymph nodes, which needs subsequent axillary dissection. Metastatic lymph nodes in patients with clinically and sonographically negative axilla were small in number (2.7).

**CLINICAL RELEVANCE/APPLICATION**

The results of this study will provide the basis of preoperative sonographic evaluation for the axillary lymph node in the patients with T1 or T2 stage breast cancers.

## BR265-SD-WEB6 Pre-treatment Cross-sectional Imaging to Evaluate for N3 Disease in Breast Cancer Patients Undergoing Neoadjuvant Therapy: Can We Predict Pathologic Nodal Stage and Tailor Locoregional Therapy?

Station #6

Participants
Tara L. Anderson, MD, Rochester, MN (*Presenter*) Nothing to Disclose
Tina Hieken, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Brittany Murphy, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Katrina N. Glazebrook, MBChB, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose
Lyndsay D. Viers, MD, Rochester, MN (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Cross-sectional imaging is performed in breast cancer patients undergoing neoadjuvant therapy (NAC) and may identify extra-axillary and level III axillary disease. Our aim was to investigate the effect of radiologic nodal staging on pathological N stage at operation and to explore how this might aid surgical and radiotherapy treatment planning.

**METHOD AND MATERIALS**

With IRB approval, we reviewed pre-NAC breast MRI, PET/CT, and CT imaging and clinicopathologic data on 348 breast cancer patients with imaging available for review undergoing NAC followed by operation at our institution 1/2008-9/2013. We defined abnormal lymph node findings on MRI, CT, and PET/CT to include cortical thickening, FDG-avidity, and loss of fatty hilum. Patients were assigned a radiologic N (rN) stage based on imaging findings. Statistical analysis was performed using JMP 10.1 software.

**RESULTS**

Pre-NAC imaging included axillary ultrasound in 338 patients (97%), breast MRI in 305 (88%), and PET/CT or CT in 215 (62%). 213 (61%) were biopsy-proven axillary lymph node-positive (LN+) pre-NAC. cT stage was T1 in 9%, T2 in 49%, T3 in 29%; median tumor size was 4 cm. 163 were ER+/HER2-, 64 ER+/HER2+, 31 ER-/HER2-, and 89 ER-/HER2-. Pre-NAC rN stage was rN0 in 92 (26%), rN1 in 167 (48%), and rN3 in 89 (26%). rN3 disease included level III axillary, supraclavicular, and suspicious internal mammary LNs in 47 (53%), 32 (37%), and 45 (52%), respectively. Of patients LN+ at diagnosis, 78 (37%) were rN3. After NAC, 162 patients (47%) were LN+ at operation with a median (mean) of 3 (5.9±0.4) positive LNs including 128/213 (60%) LN+ at diagnosis. Pre-NAC rN stage correlated with the likelihood and extent of axillary disease at operation, p=0.002. 54 of 89 rN3 patients (61%) were LN+ at operation with a median (mean) of 5 (8±1) LN+. rN3 patients had larger metastasis (median 9 vs 6 mm) and more extranodal extension (61% vs 43%) both p<0.03.

**CONCLUSION**

Information on rN stage from pre-NAC cross-sectional imaging informs the likelihood and extent of axillary nodal disease at operation. This information may be used to inform patient expectations and for surgical and radiotherapy treatment planning.

**CLINICAL RELEVANCE/APPLICATION**

The benefit of MRI or PET/CT prior to neoadjuvant therapy to assess level III and extra-axillary nodal disease in breast cancer patients is unknown. These modalities predicted pN stage at operation.

## BR266-SD-WEB7 Diagnostic Performance and Reproducibility of Breast Acoustic Radiation Force Impulse (ARFI) Imaging in the Clinical Setting

Station #7

Participants
Panagiotis Kapetas, Vienna, Austria (*Presenter*) Nothing to Disclose
Ramona Woitek, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Paola Clauser, MD, Udine, Italy (*Abstract Co-Author*) Nothing to Disclose
Maria Adele Marino, MD, Messina, Italy (*Abstract Co-Author*) Nothing to Disclose
Mukta D. Mahajan, MBBS, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose
Katja Pinker-Domenig, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose

Maria Bernathova, Wien, Austria (*Abstract Co-Author*) Nothing to Disclose
Thomas H. Helbich, MD, Vienna, Austria (*Abstract Co-Author*) Research Grant, Medicor, Inc; Research Grant, Siemens AG; Research Grant, C. R. Bard, Inc
Pascal A. Baltzer, MD, Vienna, Austria (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To evaluate breast acoustic radiation force impulse (ARFI) imaging within the clinical setting regarding its diagnostic performance and its reproducibility.

**METHOD AND MATERIALS**

One hundred and eleven patients (mean age 50.7 years) with one hundred and thirteen breast lesions receiving ARFI imaging (Virtual Touch IQ ™, Siemens Acuson S3000, 9 MHz transducer) as part of their diagnostic ultrasound workup were investigated between June 2013 and October 2014. Two independent ARFI measurements of identified lesions were performed by two out of a pool of seven experienced radiologists. Regions of Interest (ROI) were placed into the lesion and the shear wave velocities (SWV) were measured. The overall examination time was below 1 minute for each examiner. ROC-analysis was used for calculating diagnostic performance of SWV measurements, whereas the intraclass correlation coefficient (ICC) was used to evaluate the reproducibility of the measurements.

**RESULTS**

There were 69 benign and 44 malignant lesions. All measurements showed equal diagnostic performance as measured by the Area under the ROC curve (0.863 and 0.858 for each examiner respectively; $p>0.05$). A cut-off value of ~3.4 m/s revealed a sensitivity and specificity of 81.8/82.6% (examiner 1) and 72.7/94.2% (examiner 2. The SWV measurements of both observers showed almost perfect agreement (ICC= 0.97, CI 0.96-0.98).

**CONCLUSION**

ARFI provides quantitative data valid for differentiation between benign and malignant breast lesions. The measurements acquired are reproducible by different investigators.

**CLINICAL RELEVANCE/APPLICATION**

ARFI measurements are fast and can help differentiate benign from malignant lesions and can thus be implemented into routine ultrasound workup of breast lesions.

## BR156-ED-WEB8 The Autologously Reconstructed Breast

Station #8

Participants
Jane L. Hur, MD, Philadelphia, PA (*Presenter*) Nothing to Disclose
Alexander B. Sevrukov, MD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose

**TEACHING POINTS**

Understand clinical indications for, anatomy of, and surgical technique involved in creating the autologously reconstructed breast. Understand normal imaging appearance of the autologously reconstructed breast on mammogram, ultrasound, and MRI. Become familiar with the clinical presentation of, risk factors for, and imaging appearance of recurrence in a reconstructed breast. Recognize clinical features and imaging findings related to complications unique to the reconstructed breast. Learn how anatomy and vasculature of a flap affects biopsy considerations.

**TABLE OF CONTENTS/OUTLINE**

Clinical and surgical considerations for flap formation Clinical indications and contraindications Preoperative planning: CTA and MRA protocols Anatomy of flap reconstruction Surgical technique Normal sonographic, mammographic, and MRI appearance TRAM DIEP Latissimus Dorsi SGAP Imaging features of malignancy within a flap Clinical presentation and risk factors Locations of recurrence: skin, nipple-areolar complex, chest wall Knowledge of vascular anatomy for biopsies Discussion of imaging for monitoring after mastectomy Clinical presentation and imaging findings of complications unique to flap reconstruction Infection Seroma Hematoma Fat necrosis Radiation changes Scarring

SSM01

## Breast Imaging (Practice Issues)

Wednesday, Dec. 2 3:00PM - 4:00PM Location: E451A

BR

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

**Participants**
Mary S. Newell, MD, Atlanta, GA (*Moderator*) Nothing to Disclose
Jiyon Lee, MD, New York, NY (*Moderator*) Nothing to Disclose

**Sub-Events**

### SSM01-01 Evaluation and Outcomes of Patients Presenting with Focal Breast Pain

Wednesday, Dec. 2 3:00PM - 3:10PM Location: E451A

Participants
Wendi A. Owen, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Hilary A. Brazeal, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Hillary L. Shaw, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Susan O. Holley, MD, PhD, Saint Louis, MO (*Abstract Co-Author*) Research Consultant, Biomedical Systems

#### PURPOSE

1. Determine number/characteristics of breast cancers found in women undergoing imaging evaluation for focal breast pain.2. Determine the optimal imaging evaluation of focal breast pain.

#### METHOD AND MATERIALS

We performed a chart review of 4720 women who underwent imaging evaluation of focal breast pain from 2001-2013. Women ages 18 and over with breast pain isolated to a single focus, quadrant, or two separate foci were included. Exclusion criteria were concurrent symptoms (palpable lump, nipple discharge/retraction); recent trauma; breast surgery in the last 6 months; lactation; and personal history of breast cancer. 944 patients met criteria.We recorded the type of imaging work-up, whether there was a focal finding corresponding to their site of pain, type of finding described, BI-RADS™ assessment, whether biopsy was performed, and pathologic outcomes. Subsequent imaging/clinical follow up was recorded.

#### RESULTS

Patients ranged in age from 18-90 (mean 47). Imaging evaluation consisted of sonogram (US) alone in 286 women, mammogram (MG) alone in 231 women, and both US/MG in 427 women. Mammographic parenchymal densities were 7% extremely; 41% heterogeneously; 43% scattered; 9% fatty. 111 women had an imaging finding at the site of pain, 99 of which were benign. 12 biopsies of corresponding findings were performed: 9 were benign (1 papilloma, 3 fibroadenomas, 5 other); 3 were malignant (1 invasive lobular, 1 invasive ductal, 1 ductal carcinoma in situ). The malignancies were diagnosed in three women, ages 56, 57, and 61. Two women had a family history of breast cancer. All three malignancies were seen on MG; 2 had an US correlate. At initial evaluation, 4 breast cancers were diagnosed remote from the site of pain. Follow up evaluation demonstrated subsequent breast cancers at the site of pain in 6 women, ranging from 1-10 years after initial presentation.

#### CONCLUSION

A corresponding imaging finding is seen in 11% of patients with focal breast pain. Neither breast density nor age correlates with focal breast pain. Focal breast pain rarely signifies malignancy (3/944 patients). No cancers were detected in women younger than 56; all cancers were visible on mammogram.

#### CLINICAL RELEVANCE/APPLICATION

Focal breast pain is common, but is rarely associated with malignancy (0.3% in our study). Optimal workup of focal pain may be guided by patient's age; targeted ultrasound may not be necessary if the mammogram is negative.

### SSM01-02 Inter-observer Variability in Upgraded and Non-Upgraded BIRADS 3 Lesions and Common Reasons for Misclassification

Wednesday, Dec. 2 3:10PM - 3:20PM Location: E451A

Participants
Aya Michaels, MD, Boston, MA (*Presenter*) Nothing to Disclose
Chris S. Chung, MD, Kensington, MD (*Abstract Co-Author*) Nothing to Disclose
Elisabeth P. Frost, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Robyn L. Birdwell, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Catherine S. Giess, MD, Wellesley, MA (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To evaluate if mammographic lesions initially assessed as BIRADS 3 but upgraded during imaging surveillance had appropriate initial evaluation, and to determine possible factors in lesion misclassification.

#### METHOD AND MATERIALS

An IRB approved retrospective review of the mammography database from 1/1/04-12/31/08 identified 1188 screen detected lesions assessed as BIRADS 3 on diagnostic workup, 60 (5.1%) upgraded to BIRADS 4 or 5 during surveillance (cases). Cases were matched by lesion type, laterality, and year to 60 non-upgraded BIRADS 3 lesions (controls). Available studies were assessed separately by

2 blinded breast radiologists using the BIRADS lexicon, with only index lesion and patient age identified. Assessments were recorded and compared to the original prospective interpretation.

**RESULTS**

82 studies prospectively assessed as BIRADS 3 were available for blinded review, including 43 cases (8 malignancies) and 39 controls. The first reader assessed 18/82 (22.0%) as BIRADS 0, 13 cases, 5 controls; 35/82 (42.7%) as BIRADS 2, 11 cases, 24 controls; 7/82 (8.5%) BIRADS 3, 4 cases, 3 controls; 22/82 BIRADS 4, 15 cases, 7 controls. The second reader assessed 8/82 (9.8%) as BIRADS 0, 4 cases, 4 controls; 27 (32.9%) BIRADS 2, 11 cases, 16 controls; 33 (40.2%) BIRADS 3, 19 cases, 14 controls; 14 (17.0%) BIRADS 4, 9 cases, 5 controls. The two readers had the same BIRADS assessment on 34/82 (41.5%) exams. Of the 8 cancers, the first reader assessed 2 as BIRADS 0, 1 as BIRADS 2, 1 as BIRADS 3, and 4 as BIRADS 4; the second reader assessed 2 as BIRADS 2, 4 as BIRADS 3, and 2 as BIRADS 4. Reasons for BIRADS 0 assessment included incomplete mammographic views, lack of ultrasound for masses or asymmetries, and failure to include the lesion on follow up imaging. On blinded review, reasons for BIRADS 4 assessment included suspicious morphology or documented instability.

**CONCLUSION**

Many BIRADS 3 lesions were judged to have had incomplete diagnostic evaluation on blinded review. Lesions assigned to the BIRADS 3 category are, by definition, challenging to evaluate. There is a large amount of inter-observer variability in assessment of these challenging mammographic lesions.

**CLINICAL RELEVANCE/APPLICATION**

Internal practice audits of upgraded and non-upgraded BIRADS 3 lesions may improve consistency in interpretation as much inter-observer variability exists in assessment of lesions as probably benign.

**Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Catherine S. Giess, MD - 2015 Honored Educator
Robyn L. Birdwell, MD - 2015 Honored Educator

## SSM01-03 Patient Preferences and Understanding of the Breast Imager's Role in Performing and Communicating Biopsy Results

Wednesday, Dec. 2 3:20PM - 3:30PM Location: E451A

Participants
Jordana Phillips, MD, Boston, MA (*Presenter*) Nothing to Disclose
Hannah Perry, MD,MS, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Nancy Littlehale, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Vandana M. Dialani, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Valerie J. Fein-Zachary, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Euguenia Karimova, MD, Memphis, TN (*Abstract Co-Author*) Nothing to Disclose
Priscilla J. Slanetz, MD, MPH, Belmont, MA (*Abstract Co-Author*) Nothing to Disclose
Shambhavi Venkataraman, MD, Boston, MA (*Abstract Co-Author*) Nothing to Disclose
Richard E. Sharpe JR, MD, MBA, Denver, CO (*Abstract Co-Author*) Nothing to Disclose
Tejas S. Mehta, MD, MPH, Boston, MA (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

As the health care model transforms to a value-based system, radiologists may potentially add value by communicating biopsy results directly to patients. However, limited data is available in this area. Our purpose was to evaluate from whom patients want to hear results after image-guided breast biopsy procedures.

**METHOD AND MATERIALS**

An anonymous survey was offered to patients undergoing any image- guided breast biopsy before meeting the breast radiologist (BR) and after the procedure from March 16, 2015 - March 27, 2015 using SurveyMonkey, as part of a preliminary analysis. At our academic institution, the procedure team includes a technologist, radiology resident or breast imaging fellow, nurse practitioner, and attending BR.

**RESULTS**

27/41(66%) patients responded. 18/41(64%) thought the BR was a physician, 7/41(25%) a technologist, and 2/41(7%) were unsure. 27(100%) felt that the BR was an essential part of the breast care team. For normal results, before and after the procedure respectively, 14(52%) and 16(60%) wanted to hear from the ordering provider, 6(22%) and 5(19%) from the performing BR, 0(0%) and 1(4%) from anyone in breast imaging, and 7(26%) and 5(19%) from whoever would give results the soonest. (p=NS). For abnormal results, before and after the procedure respectively, 17(62%) and 22(82%) wanted to hear from the ordering provider, 6(22%) and 0(0%) from the performing BR, 0(0%) and 1(4%) from anyone in breast imaging, and 4(15%) and 4(15%) from whoever would give results the soonest ($p<0.05$).

**CONCLUSION**

Although patients perceive the BR to be an essential part of their care, most prefer to hear results from their ordering provider, especially if abnormal. Many patients did not know the BR was a physician, suggesting the need for better communication and further patient education.

**CLINICAL RELEVANCE/APPLICATION**

Although a BR may add value by giving biopsy results; patients prefer to hear from the ordering provider. Further study is needed to understand patient preferences and understanding of the BR role.

## SSM01-04 Proteomics at Work: Can a Protein-based Blood Assay Help Detect Breast Cancer in Women Aged 25-75 with BI-RADS 3 or 4 Imaging Findings?

Wednesday, Dec. 2 3:30PM - 3:40PM Location: E451A

Participants
Ana P. Lourenco, MD, Providence, RI (*Presenter*) Nothing to Disclose
David E. Reese, PhD, New York, NY (*Abstract Co-Author*) Employee, Provista Diagnostics, Inc
Christa Corn, MD, Scottsdale, AZ (*Abstract Co-Author*) Employee, Provista Diagnostics, Inc
Michael Silver, MS, Scottsdale, AZ (*Abstract Co-Author*) Employee, Provista Diagnostics, Inc
Rao Mulpuri, Scottsdale, AZ (*Abstract Co-Author*) Employee, Provista Diagnostics, Inc
Kasey Benson, PhD, Scottsdale, AZ (*Abstract Co-Author*) Employee, Provista Diagnostics, Inc
Elias Letsios, Scottsdale, AZ (*Abstract Co-Author*) Employee, Provista Diagnostics, Inc

### PURPOSE

To determine if a blood assay can improve breast cancer detection in patients ages 25-75 with BI-RADS 3 or 4 imaging findings.

### METHOD AND MATERIALS

This IRB approved, HIPAA compliant prospective multi-center study enrolled patients aged 25-75 with BI-RADS 3 or 4 imaging findings. Informed consent was obtained. Eligible patients included women ages 25 - 75 with BI-RADS 3 or 4 imaging, no history of cancer and no prior breast biopsy in the last six months. Patients not undergoing biopsy had imaging follow-up at 6 months. Multiple algorithms for the detection of cancer were developed in the training set. These were validated and the data from the training was combined to perform a full prospective/ retrospective analysis to optimize model sensitivity and specificity.

### RESULTS

508 patients were enrolled and randomized; 300 in the training set and 208 in the validation set. Serum protein biopmarkers (SPBs) and tumor associated autoantibodies (TAAbs) identified in prior proteomic screens were measured prior to biopsy. Pathology results were recorded for all patients undergoing biopsy, and imaging results were recorded for all patients undergoing 6 month follow-up imaging. Individual biomarker concentrations and patient data were evaluated using logistic regression models developed from prior studies. The most robust of these models utilized 5 SPBs together with 13 TAAbs to generate an initial sensitivity of 82.2%, specificity of 82.5%, PPV of 28.4% with a NPV of 97.5%. This model also produced an AUC of 0.8485 in a ROC analysis. 6-month follow-up is ongoing, and some patients presumed benign may be diagnosed with invasive cancer and/or DCIS at follow-up. Of the 508 BI-RADS 3 or 4 patients, 344 were biopsied resulting in the diagnosis of 51 malignancies (14.8%). By comparison, the protein based blood assay identified 148 patients to be biopsied and identified 42 malignancies (28.4%).

### CONCLUSION

This multi-center study suggests that blood assays combining SPBs and TAAbs can differentiate benign from malignant breast disease in women aged 25-75 with BI-RADS 3 or 4 imaging findings with high sensitivity and negative predictive value.

### CLINICAL RELEVANCE/APPLICATION

Blood assays that could distinguish benign from malignant breast disease may help decrease the number of benign breast biopsies performed, thus decreasing healthcare costs and patient morbidity.

## SSM01-05 Focal Breast Pain: Does Breast Density Affect the Need for Ultrasound?

Wednesday, Dec. 2 3:40PM - 3:50PM Location: E451A

Participants
Michael W. Cho, MD, MPH, Durham, NC (*Presenter*) Nothing to Disclose
Lars J. Grimm, MD, Durham, NC (*Abstract Co-Author*) Advisory Board, Medscape, LLC;
Karen S. Johnson, MD, Durham, NC (*Abstract Co-Author*) Research Consultant, Siemens AG

### PURPOSE

To evaluate the utility of ultrasound in women with focal breast pain who are categorized as low breast density (predominantly fatty and scattered fibroglandular) on digital mammography.

### METHOD AND MATERIALS

This study retrospectively reviewed 2176 cases of breast pain imaged between 12/6/06 and 3/15/13. Of these, 248 met inclusion criteria for primary focal breast pain: women (mean age 53 years) with focal, non-axillary, non-radiating pain isolated to one quadrant. Women who were pregnant or lactating or who had associated symptoms of palpable lump, skin changes, history of trauma or infection were excluded. Digital mammogram and directed ultrasound were performed at initial presentation. Breast density, mammogram, ultrasound, biopsy findings (when applicable), and follow up imaging results (mean: 3.8 years, range: 2.0-8.1 years) were collected.

### RESULTS

Fourteen percent (35/248) of cases demonstrated a lesion at the site of focal pain by directed ultrasound. Nine percent (23/248) of lesions were seen only by ultrasound and had no correlate on digital mammography. Lesions detected only by ultrasound (ultrasound-only lesions) occurred in women categorized in the following breast density categories on digital mammography: 0% predominantly fatty, 22% (5/23) scattered fibroglandular, 44% (10/23) heterogeneously dense, and 35% (8/23) extremely dense. Ultrasound-only lesions prompted four biopsies, which all resulted in benign histology. Additionally, 2% (4/248) of cases reported incidental ultrasound-only lesions, triggering either additional (benign) biopsies or a two year course of imaging follow up. At two-year follow-up, one patient developed breast cancer in the same quadrant as the site of primary focal pain, where no findings were initially detected by either digital mammography or ultrasonography. This occurred in a woman with heterogeneously dense breast tissue. No subsequent cases of breast cancer occurred in women with low breast density.

### CONCLUSION

No cancers would have been missed by excluding directed ultrasound in the evaluation of focal breast pain in low breast density

women with a negative digital mammogram.

**CLINICAL RELEVANCE/APPLICATION**

Digital mammography alone without directed ultrasound appears to be a reasonable approach in evaluating primary focal breast pain in women whose breast density is categorized as either scattered fibroglandular or predominantly fatty.

## SSM01-06 Is Ultrasound Effective in the Detection of Breast Cancer in Patients Presenting with Breast Pain?

Wednesday, Dec. 2 3:50PM - 4:00PM Location: E451A

Participants
Andrea X. Gallo, MD, Toronto, ON (*Presenter*) Nothing to Disclose
Monali Warade, MD, MBBS, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Franklin Goldberg, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose
Derek Muradali, MD, Toronto, ON (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

The purpose of this study is to determine if the routine use of ultrasound is appropriate for cancer detection in patients presenting with breast pain.

**METHOD AND MATERIALS**

All consecutive patients presenting to our department with a sole complaint of breast pain, who underwent a breast ultrasound, over a 4 year period, were included in this IRB-approved retrospective study. Patients with a history of breast cancer or palpable lumps were excluded. Breast ultrasounds were performed by technologists with 7-12 years experience and reviewed by one of two fellowship trained radiologists with 20 -25 years experience. All follow up imaging and pathology reports were reviewed.

**RESULTS**

422 patients were entered into the study (mean age 45 years). After the initial ultrasound, 368/422 patients were classified as BI-RADS 1 or 2, 40/422 as BI-RADS 3, 5/422 as BI-RADS 0 and 9/422 as BI-RADS 4. Follow up imaging tests included 5 mammograms, 236 ultrasounds and 5 MRI's over a 56 month period. At total of 26 image guided biopsies (20 core biopsies, 7 fine needle aspiration biopsies) and 1 surgical biopsy were performed for final diagnosis. All cases were classified as benign as a final diagnosis. There were no cases of invasive or non-invasive breast cancer.

**CONCLUSION**

Our data suggests that the prevalence of breast cancer in patients presenting with breast pain as a sole complaint is low. Breast ultrasound also resulted in a substantial number of unnecessary follow up imaging tests, potentially resulting in more harm than benefit in this patient population.

**CLINICAL RELEVANCE/APPLICATION**

The use of breast ultrasound to detect breast cancer in patients with breast pain as the sole presenting symptom may result in more harm than benefit, as the prevalence of breast cancer in this population is low.

SSM02

## Breast Imaging (Ultrasound Advanced Applications)

Wednesday, Dec. 2 3:00PM - 4:00PM Location: E451B

BR US

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

FDA Discussions may include off-label uses.

**Participants**
Sughra Raza, MD, Boston, MA (*Moderator*) Nothing to Disclose
Catherine S. Giess, MD, Wellesley, MA (*Moderator*) Nothing to Disclose

**Sub-Events**

### SSM02-01 The Utility of Ultrasound Superb Microvascular Imaging for Evaluation of Vascularity in Solid Breast Masses: Comparison with Color and Power Doppler Imaging-Interobserver Variability and Diagnostic Performance

Wednesday, Dec. 2 3:00PM - 3:10PM Location: E451B

Participants
Ah Young Park, MD, Ansan , Korea, Republic Of (*Presenter*) Nothing to Disclose
Bo Kyoung Seo, MD, PhD, Ansan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Kyu Ran Cho, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ok Hee Woo, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Kyoonsoon Jung, Anyang, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jaehyung Cha, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Seon Jeong Oh, MD, Ansan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To investigate the utility of ultrasound Superb Microvascular Imaging (SMI) for evaluation of solid breast masses by comparing with conventional Doppler imaging.

#### METHOD AND MATERIALS

A total of 191 solid breast masses in consecutive 169 patients were prospectively evaluated with color Doppler (CDI), power Doppler (PDI) and SMI before core needle biopsy between February 2014 and March 2015. Three breast radiologists analyzed number, distribution (peripheral, central, or both), and morphology (dot, linear, branching or tortuous/penetrating) of vessels within the masses, and assessed BI-RADS categories on gray-scale images and all vascular images of each mass. These features were correlated with pathological results. We evaluated interobserver variability in imaging analyses with intraclass correlation and compared diagnostic performance between gray-scale imaging only and combined use of gray-scale and each vascular imaging, CDI, PDI, and SMI for discrimination between benign and malignant masses with receiver operating characteristic (ROC) curve analysis. In addition, we used Kruskal-Wallis test to determine whether three vascular imaging techniques had significant difference.

#### RESULTS

Pathological diagnoses revealed 92 cancers and 99 benign lesions. Interobserver variability was excellent in assessment of BI-RADS categories and analyses of vascular images (range of intraclass correlation coefficients, 0.86-0.98). SMI showed more number of vessels and more frequent central or both distribution and branching or tortuous/penetrating morphology than CDI and PDI (P<.0001). In the diagnostic performance, the area under the ROC curve (AUC) was the best in combined use of gray-scale and SMI (AUC=0.815) when compared with other modalities (AUC=0.774 for gray-scale only, 0.789 for combined use of gray-scale and CDI, and 0.791 for combined use of gray-scale and PDI) and this was statistically significant (P<.0001).

#### CONCLUSION

SMI is superior to CDI or PDI in the demonstration and characterization of vascularity in solid breast masses. The combined use of gray-scale and SMI can improve the diagnostic performance for the differentiation of benign and malignant breast masses.

#### CLINICAL RELEVANCE/APPLICATION

SMI is a recommendable technique for evaluation of tumor vascularity in the breast and could be a supportive tool for the differentiation between benign and malignant breast masses.

### SSM02-02 Shear Wave Elastography Assessed with Maximum Visual Color Stiffness in Breast Lesions: The Role as a Complementary Study on B-mode US

Wednesday, Dec. 2 3:10PM - 3:20PM Location: E451B

Participants
Shin Ho Kook, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Seon Hyeong Choi, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Yoon Jung Choi, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jung Eun Lee, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Inyoung Youn, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To evaluate the diagnostic performance of shear-wave elastography (SWE) with maximum visual color elasticity assessment in addition to B-mode US and the value as a complementary study on B-mode US in breast lesions.

**METHOD AND MATERIALS**

From Jan 2011 to Dec 2013, 1621 lesions (1293 benign, 328 malignant) of 1561 patients (mean age, 50.5) who underwent B-mode US and SWE before biopsy were included. The size and BI-RADS final assessment of B-mode US features of each lesion were recorded. Color SWE was retrospectively assessed with maximum color stiffness, using the color scale. Two cut-off values as blue (<40kPs, group 1) or blue to green (<80kPs, group 2) were used as benign reference points to differentiate from malignant lesions. Diagnostic performance (sensitivity, specificity, PPV, NPV and diagnostic accuracy) of each B-mode US, color SWE, and combination of two modalities were statistically evaluated.And they were also evaluated according to the lesion size (<1cm, 1-2 cm, 2-3cm, 3cm <).

**RESULTS**

SWE with maximum visual color elasticity assessment showed improvement of 1.3 and 0.9% in specificity and 8.5 and 5.1% in PPV by adding color SWE on B-mode US in group 1 and 2 ($p<0.001$), without improvement of overall diagnostic accuracy. The sensitivity, specificity, PPV, NPV and diagnostic accuracy are as follows; 75.5%, 95.9%, 84.5%, 93% and 91.3% for B-mode only, and 38.3%, 97.2%, 93%, 61.9% and 68.2% in group 1, 52.8%, 96.8%, 89.6%, 79.7% and 81.7% in group 2 for combination of B-mode and color SWE respectively. Combination of B-Mode US and SWE results, according to the lesion size showed improvement of 1.1-1.8% in specificity and 5.1-17.8% in PPV in group 1 and 2. There was statistical significance in the lesions less than 2 cm in group 1 and 2 ($p<0.001$).

**CONCLUSION**

SWE with maximum visual color elasticity assessment added to B-mode US revealed improvement of specificity and PPV ($P<0.001$), without improvement of overall diagnostic accuracy. And it could be helpful as a complementary study to reduce the false positive diagnosis with confidence before making the decision of biopsy.

**CLINICAL RELEVANCE/APPLICATION**

B-mode US shows high sensitivity and relatively low specificity. SWE can decrease false positive by adding on B-mode US as a complementary tool with higher specificity and PPV than B-mode US

## SSM02-03 Downclassification of Suspicious Breast Masses Using Opto-Acoustic Imaging

Wednesday, Dec. 2 3:20PM - 3:30PM Location: E451B

Participants
Erin I. Neuschler, MD, Chicago, IL (*Presenter*) Nothing to Disclose
A. Thomas Stavros, MD, San Antonio, TX (*Abstract Co-Author*) Advisor, Devicor Medical Products, Inc; Advisor, General Electric Company; Advisor, SonoCine, Inc; Owner, Ikonopedia, LLC; Medical Director, Seno Medical Instruments, Inc;
Philip T. Lavin, PhD, Framingham, MA (*Abstract Co-Author*) Research Consultant, Seno Medical Instruments, Inc
Michael J. Ulissey, MD, Auburn, WA (*Abstract Co-Author*) Consultant, Seno Medical Instruments, Inc; Stockholder, Tractus Company Limited

**PURPOSE**

Diagnostic specificity remains disappointingly low for methodologies optimized to achieve near 100% sensitivity. Seno Medical's opto-acoustic (OA) imaging fuses real time co-registered, interleaved laser optic and ultrasound imaging showing dual functional findings (hemoglobin de-oxygenation) and morphology (angiogenesis) for breast masses using a hand-held probe. A 100 subject pilot study, conducted as part of a larger pivotal study, was evaluated for the potential ability of OA to downgrade BI-RADS (BR) scores in benign masses, specifically whether masses originally scored BR 4a or 4b could be downgraded to either BR 3 or 2 and if masses coded BR 3 could be downgraded to 2.

**METHOD AND MATERIALS**

7 independent readers (IRs) and the expert radiologist (ER) trainer blindly assessed all 102 masses from the 100 pilot study cases using only OA without any knowledge of clinical data or outcome. There were 75 biopsied masses (39 benign, 36 malignant). Gray-scale ultrasound images were taken with the OA device immediately prior to the OA exam. Later, the IRs assigned a BR score to these images, the internal ultrasound control (IUC). IRs were trained by the ER to identify and score three OA internal features and two OA external features for all masses. They were then immediately offered the results of two nomograms (that were calculated from their OA feature scores) to help predict the Probability of Malignancy (POM). A 2% or less POM was used as the threshold to define a mass that could be down classified to BR 3. A 0% POM was used to downgrade a mass to BR 2.

**RESULTS**

Using OA, the IRs were able to downgrade site-CDU classified BR 3 masses to BR 2 in 33% of cases, BR 4a masses to BR 2 or 3 in 53% of cases, and BR 4b masses to BR 3 or 2 in 33% of cases. Using OA, the IRs downgraded IUC-classified BR 3 masses to BR 2 in 43% of cases, BR 4a to either BR 3 or 2 in 43% of cases, and BR 4b masses to either BR 3 or 2 in 13% of cases. OA (IRs) had 97.6% sensitivity and 44.4% specificity.

**CONCLUSION**

Benign masses classified as BR 3, 4a and 4b could be potentially downgraded to BR 3 or 2 by using OA with the aid of nomograms. The multi-center 2097 subject pivotal study will allow for confirmation.

**CLINICAL RELEVANCE/APPLICATION**

Downgrading BR 3, 4a and 4b masses without missing cancers is an unmet need. If verified, these findings could prevent not only biopsies but multiple follow-up ultrasound exams over 2 years.

## SSM02-04 Prediction of Invasive Breast Cancer Using Shear-wave Elastography in Patients with Biopsy-confirmed Ductal Carcinoma in Situ

Wednesday, Dec. 2 3:30PM - 3:40PM Location: E451B

Participants
Jae Seok Bae, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose

Jung Min Chang, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Su Hyun Lee, MD,PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sung Ui Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Woo Kyung Moon, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To investigate whether lesion stiffness measured by shear-wave elastography (SWE) could predict histologic upgrade of ductal carcinoma in situ (DCIS) confirmed by ultrasound (US)-guided core needle biopsy (CNB).

**METHOD AND MATERIALS**

This retrospective study was conducted with institutional review board approval, and informed consent was waived. From January 2012 to February 2015, database search revealed 120 biopsy-confirmed DCIS in patients (mean age 52.4 ± 9.8) who underwent B-mode US and SWE prior to surgery. Clinicopathologic results, B-mode findings, size on US, mean and maximum elasticity values on SWE were recorded. Three radiologists independently analyzed qualitative color scores on SWE images using 5 point scale. To identify the preoperative factors associated with upgrade to invasive cancer, B-mode US findings, SWE information, and clinical variables were analyzed using univariate and multivariate logistic regression analysis. Qualitative color scores assessed by individual radiologists were analyzed to identify correlation with clinicopathologic variables, lesion size, and findings on B-mode US using multiple linear regression analysis. Interobserver agreements among radiologists on qualitative color score were assessed using multi-rater kappa statistic.

**RESULTS**

The overall upgrade rate was 41.7% (50 of 120). Mean, maximum stiffness values, qualitative color scores, and lesion size showed significant differences in upgrade and non-upgrade groups. Multivariate logistic regression analysis revealed mean (P=0.012), maximum stiffness (P=0.039), and lesion size (P<0.001) were significantly correlated with histologic upgrade. In reader study, color scores were correlated with the histologic upgrade, mammographic density, and B-mode category in all three radiologists (P value <0.04). The overall interobsever agreement for elasticity score was excellent (κ= 0.814 -0.887).

**CONCLUSION**

Breast lesion stiffness measured by SWE could be helpful to predict the upgrade to invasive cancer in US-guided biopsy proven DCIS patients.

**CLINICAL RELEVANCE/APPLICATION**

For patients with DCIS confirmed by US-guided CNB, stiffness values on SWE can lead patient to undergo a proper one-step operation when surgical excision is performed.

## SSM02-05 Is Contrast Enhanced Ultrasound as Good or Better than MRI in Evaluation of Breast Cancer Patients Receiving Neoadjuvant Chemotherapy?

Wednesday, Dec. 2 3:40PM - 3:50PM Location: E451B

Participants
Sandy C. Lee, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose
Edward G. Grant, MD, Los Angeles, CA (*Abstract Co-Author*) Research Grant, General Electric Company ; Medical Advisory Board, Nuance Communications, Inc
Pulin A. Sheth, MD, Santa Monica, CA (*Abstract Co-Author*) Nothing to Disclose
Bhushan Desai, MBBS, MS, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Steven Cen, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Darryl Hwang, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Mary W. Yamashita, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Linda Hovanessian-Larsen, MD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

The purpose of this pilot study is to evaluate the performance of Contrast Enhanced Ultrasound (CEUS) versus Contrast Enhanced MRI (CE-MRI) in monitoring treatment response in breast cancer (BC) patients receiving preoperative neoadjuvant chemotherapy (NAC) by comparing tumor visibility and size.

**METHOD AND MATERIALS**

We prospectively studied 18 women diagnosed with invasive BC and receiving NAC, who had CEUS and CE-MRI as part of their preoperative imaging to detect tumor response. Each woman had three CEUS scans and at least two CE-MRI scans: (1) baseline prior to initiating NAC, (2) 3 weeks after initiation of NAC, and (3) after completion of NAC prior to surgery. The breast imager interpreting the CEUS or the CE-MRI was blinded to results of the other study. The presence of a lesion, tumor size, percent necrosis, and peak intensity were recorded. Results of the two techniques were compared to each other and to the gold standard histopathology obtained at surgery. Spearman correlation and intraclass correlation with absolute agreement were used to evaluate the findings.

**RESULTS**

All 18 women have biopsy proven invasive ductal carcinoma. The mean size of enhancing tumor at baseline on CEUS is 3.4 cm (range 1.5-6.9 cm) and on CE-MRI is 4.3 cm (range 2.5-7.7 cm). The results demonstrate a strong correlation in tumor size between CEUS and CE-MRI r=0.87 (p<0.01). Intraclass correlation also shows good absolute agreement, icc=0.78 (p<0.01). When comparing percent tumor necrosis between CEUS vs. CE-MRI, there is 80% agreement (95% CI of 40%, 98%). Comparable quantitative parameters, namely "peak intensity (tumor - normal)" for CEUS and "peak enhancement at one minute" for CE-MRI, demonstrate correlation with r=0.46 (p=0.05). Trends suggest that CEUS has a better degree of correlation and agreement than CE-MRI with tumor size at surgical pathology.

**CONCLUSION**

CEUS is comparable to CE-MRI in evaluating treatment response of breast cancer in patients receiving NAC. In our pilot series, CEUS was found to be a valuable imaging modality for determining the tumor size, percent necrosis, and peak intensity, and is

comparable to the results of CE-MRI.

**CLINICAL RELEVANCE/APPLICATION**

Further investigation with a larger cohort may prove that CEUS can be a better, more cost effective method than CE-MRI in monitoring treatment response in breast cancer patients receiving NAC.

## SSM02-06 Impact of Real-time MRI Navigated Ultrasound in Preoperative Breast Cancer Patients

Wednesday, Dec. 2 3:50PM - 4:00PM Location: E451B

Participants
Ah Young Park, MD, Ansan , Korea, Republic Of (*Presenter*) Nothing to Disclose
Bo Kyoung Seo, MD, PhD, Ansan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Kyu Ran Cho, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ok Hee Woo, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jaehyung Cha, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To evaluate the utility of real-time MRI navigated ultrasound (US) for second-look examination in preoperative breast cancer patients.

**METHOD AND MATERIALS**

Between October 2013 and February 2015, 55 consecutive breast cancer patients who underwent second-look US examination with real-time MRI navigated US to identify MRI-detected lesions on preoperative evaluation were enrolled. Of a total of 67 breast lesions, 41 lesions were detected on conventional US, 23 were additionally detected on MRI navigated US, and the remaining two were not found. The detection rates of conventional US and MRI navigated US were compared with McNemar test. We evaluated clinical data (age and change of surgical plan), and US findings (background echotexture, distance from nipple, and mass characteristics) and MRI findings (size, depth, type, characteristics, and kinetics of lesions) based on the BI-RADS lexicon. We compared these features between two groups with student T test, chi-square, or Fisher's exact test; 41 lesions detected with both conventional US and MRI navigated US (Group 1) and 23 lesions detected with only MRI navigated US (Group 2).

**RESULTS**

The detection rates of conventional US and MRI navigated US were statistically different, 61.2% (41/67) vs 95.5% (65/67) (P<.0001). Hetergeneous background echotexture (69.6% [16/23] vs 34.1% [14/41], P=.012), isoechoic masses on US (65.2% [15/23] vs 7.3% [3/41], P<.0001), and deep location on MRI (26.1% [6/23] vs 14.6% [6/41], P=.041) were more common in Group 2. The proportion of change in surgical plan was higher in Group 2 although there was less statistical significance (43.5% [10/23] vs 22.0% [9/41], P=.071). In 10 patients with change of surgical plan in Group 2, four underwent mastectomy due to multicentric cancers and six underwent additional excision due to concurrent high-risk lesions.

**CONCLUSION**

Real-time MRI navigated US improves identification of MRI-detected lesions during second-look US examination for preoperative evaluation in breast cancer patients. Background echotexture, echo pattern of breast lesions, and lesion depth on MRI can affect the detection of breast lesions in second-look US examination.

**CLINICAL RELEVANCE/APPLICATION**

Real-time MRI navigated US is useful to identify breast lesions on second-look US examination for MRI-detected additional lesions in breast cancer patients, which can affect treatment plan.

ED001-TH

## Breast Thursday Case of the Day

Thursday, Dec. 3 7:00AM - 11:59PM Location: Case of Day, Learning Center

**BR**

*AMA PRA Category 1 Credit ™*: .50

**Participants**

Susan O. Holley, MD, PhD, Saint Louis, MO (*Presenter*) Research Consultant, Biomedical Systems
Michelle V. Lee, MD, Saint Louis, MO (*Presenter*) Nothing to Disclose
Eugene Y. Kim, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Michyla L. Bowerson, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Wendi A. Owen, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Catherine M. Appleton, MD, Saint Louis, MO (*Abstract Co-Author*) Scientific Advisory Board, Hologic, Inc; Royalties, Oxford University Press;
Whitney A. Manlove, MD, Saint Louis, MO (*Abstract Co-Author*) Nothing to Disclose
Onalisa D. Winblad, MD, Kansas City, KS (*Abstract Co-Author*) Nothing to Disclose
Jill A. Jones, MD, Kansas City, KS (*Abstract Co-Author*) Nothing to Disclose

### TEACHING POINTS

1) Identify, characterize, and analyze abnormal findings on multimodality breast imaging studies. 2) Develop differential diagnostic considerations based on the clinical information and imaging findings. 3) Recommend appropriate management for the patients based on imaging findings.

RC615

# BI-RADS (An Interactive Session)

Thursday, Dec. 3 8:30AM - 10:00AM Location: E450A

BR DM MR US

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

**Participants**

**Sub-Events**

## RC615A BI-RADS: Mammography

Participants
Edward A. Sickles, MD, San Francisco, CA (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Understand and use the new approach to classifying breast density. 2) Properly use current BI-RADS assessment categories. 3) Report discordances between assessment category and management recommendation.

## RC615B Ultrasound

Participants
Ellen B. Mendelson, MD, Chicago, IL (*Presenter*) Medical Advisory Board, Delphinus Medical Technologies, Inc; Research support, Siemens AG; Consultant, Siemens AG; Speaker, Siemens AG; Medical Advisory Board, Quantason, LLC; Consultant, Quantason, LLC;

### LEARNING OBJECTIVES

At the conclusion of this session on BI-RADS for US, learners will be able to 1. Understand inseparability of image quality and interpretability. 2. Assess breast masses using a trio of feature categories: shape, margin, orientation. 3. Apply the principle of multiple benign masses to address low PPV's of breast US. 4. Recognize architectural distortion and other Associated Features.

### ABSTRACT

## RC615C MRI

Participants
Elizabeth A. Morris, MD, New York, NY (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Understand the new MRI BI-RADS® descriptors including background parenchymal enhancement (BPE). 2) Properly apply the Final Assessment categories, particularly BI-RADS® 0 for MRI. 3) Apply the audit recommendations to your breast MRI practice.

RC625

## Radiomics Mini-Course: Oncologic Applications

Thursday, Dec. 3 8:30AM - 10:00AM Location: S103AB

BR CH NR BQ CT NM OI RO PH

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

**Participants**
Sandy Napel, PhD, Stanford, CA (*Director*) Medical Advisory Board, Fovia, Inc; Consultant, Carestream Health, Inc; Scientific Advisor, EchoPixel, Inc

**Sub-Events**

### RC625A Breast Cancer with PET-CT

Participants
Richard L. Wahl, MD, Saint Louis, MO (*Presenter*) Research Consultant, Nihon Medi-Physics Co, Ltd;

**LEARNING OBJECTIVES**

1) Describe the FDG pet uptake characteristics before therapy of 'triple - negative' breast cancers vs other subtypes.

**ABSTRACT**

**Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Richard L. Wahl, MD - 2013 Honored Educator

### RC625B Radiogenomics of Lung Cancer

Participants
Michael D. Kuo, MD, Los Angeles, CA (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) To discuss the principles behind lung cancer radiogenomics. 2) Highlight clinical applications of lung cancer radiogenomics.

**ABSTRACT**

### RC625C Brain Cancer: Radiomics, Radiogenomics, and Big Data

Participants
Rivka R. Colen, MD, Houston, TX, (rcolen@mdanderson.org) (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Define the field of radiomics and imaging genomics. 2) Apply radiomics and imaging genomics in brain tumors. 3) Describe the use of MRI as a biomarker for genomic signatures and profiles. 4) Define role of MRI in personalized medicine for target discovery of therapeutic targets. 5) Explain the use of MRI in drug development and clinical trials. 6) Assess the research available in imaging genomics and radiomics. 7) Define and describe the integration of radiomics and imaging genomics into big data platforms.

**ABSTRACT**

This objective of this course is to introduce the recently emerged field of radiomics and imaging genomics (radiogenomics) in brain tumors, specifically glioblastoma (GBM). Emphasis will be on radiomics with regards to the high-dimensional, high-throughput feature extraction of imaging features from medical images, specifically MRI; the second emphasis will be on the use of imaging in relation to underlying tumor genomics, how to use MRI as a biomarker, surrogate and correlate of tumor genomics as well as the use of MRI as a genomic target discovery tool and its application in therapeutic discovery and drug development. The role of radiomics and imaging genomics in the era of big data and how we can leverage the imaging-omic data will also be discussed.

SSQ01

## Breast Imaging (MR Diagnostics)

Thursday, Dec. 3 10:30AM - 12:00PM Location: E450A

BR MR

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

FDA Discussions may include off-label uses.

**Participants**
Linda Moy, MD, New York, NY (*Moderator*) Nothing to Disclose
Janice S. Sung, MD, New York, NY (*Moderator*) Nothing to Disclose

**Sub-Events**

### SSQ01-01 Correlation between MR Imaging and Level of Tumor Infiltrating Lymphocyte (TIL) in Triple Negative Breast Cancer (TNBC)

Thursday, Dec. 3 10:30AM - 10:40AM Location: E450A

Participants
Su Hee Baek, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Hak Hee Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
You Jin Ku, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Joo Hee Cha, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hee Jung Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Young Chae, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Woo Jung Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Triple negative breast cancer (TNBC) is a heterogeneous disease with varying prognosis. Recently, the importance of tumor-infiltrating lymphocyte (TILs) has been determined. That is, increased TIL positively correlated with the pathologic complete response rate and increased patient survival. The purpose of this study is to investigate associations between TIL and magnetic resonance (MR) imaging in TNBC.

#### METHOD AND MATERIALS

This retrospective study was approved by the institutional review board, and informed consent was waived. From February 2006 to December 2014, 112 consecutive women (mean age; 47 years, range ; 25-73 years) with TNBC who had undergone MR imaging were selected.All lesions were evaluated according to Breast Imaging Reporting and Data System (BI-RADS) lexicon by two radiologists. Apparent diffusion coefficient (ADC) values, lymph node involvement and multifocality were also assessed.According to the level of TIL, we divided into two groups: low TIL ; <50% and high TIL ; 50-100%. Associations between TIL and imaging features were evaluated.Statistical analysis was performed by using independence test.

#### RESULTS

One hundred twelve malignant lesions (range, 9-73mm; mean, 27.8mm) were evaluated, of which 62 (55.4 %) were in low TIL and 50 (44.6%) were in high TIL.Tumors with high TIL shows more round shape (n = 23, 46%), circumscribed margin (n = 38, 76%), homogenous enhancement (n = 16, 32%) and absence of multifocality (n = 44, 88%) (p <0.005).Low TIL group shows more irregular shape (n = 43, 69.3%), not circumscribed margin (n = 49, 79.0%), heterogeneous enhancement (n = 47, 75.8%) and multifocality (n = 44, 70.9%) (p <0.005).All lesions show typical washout kinetic findings of malignancy without significance. ADC value was higher in high TIL group without reaching significance.

#### CONCLUSION

MR imaging features of round shape, circumscribed margin, homogenous enhancement and lack of multifocality are typical pattern of TNBC with high TIL.

#### CLINICAL RELEVANCE/APPLICATION

TNBC with high TIL shows characteristic features and it may provide added diagnostic benefit in identifying TNBC with relatively good prognosis.

### SSQ01-02 Contralateral Parenchymal Enhancement in DCE-MRI of Patients with Unilateral Node-negative ER+/HER2-breastcancer: Potential Value for Chemotherapy Selection

Thursday, Dec. 3 10:40AM - 10:50AM Location: E450A

Participants
Bas H. van der Velden, MSc, Utrecht, Netherlands (*Presenter*) Nothing to Disclose
Claudette E. Loo, MD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Ruud Pijnappel, MD, PhD, Groningen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Kenneth G. Gilhuijs, PhD, Amsterdam, Netherlands (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Low parenchymal enhancement in the contralateral breast at dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) has been associated with inferior invasive disease-free survival (IDFS) of patients with estrogen-receptor positive and human-epidermal-growth-factor-receptor-2 negative (ER+/HER2-) breast cancer. The aim of this retrospective study is to explore whether contralateral parenchymal enhancement has complementary value to existing guidelines to identify patients who may benefit from

chemotherapy.

**METHOD AND MATERIALS**

Between 2000 and 2008, 531 consecutive patients eligible for breast-conserving therapy based on conventional imaging and physical examination received a preoperative DCE-MRI in study context. Two-hundred-and-sixty-five patients had ER+/HER2- breast cancer and negative lymph nodes, of whom 66 received hormonal therapy. Forty-two of these patients did not receive chemotherapy.In this group, high-risk and low-risk patients for IDFS were identified based on parenchymal enhancement in the contralateral breast, using a previously reported method. In short, parenchyma was automatically segmented in 3D, enhancement was calculated as the mean of the top-10% of the relative signal increase over time, which was associated with IDFS. The MRI-based risk groups were compared with the Dutch guidelines for systemic therapy based on Adjuvant! Online. Kaplan-Meier estimators and log-rank tests were used.

**RESULTS**

The average age at diagnosis in the subgroup treated with hormonal therapy without chemotherapy was 58 years (range: 35-79). The median follow-up was 86 months (range: 37-146). An event occurred in 4/42 (10%) patients. Twenty-one patients (50%) were in the high-risk MRI group. All events occurred in this group (P=.034). Thirty-three patients (88%) were indicated for chemotherapy based on the Dutch guidelines, which was not found to be specific for IDFS (P=.320). Eighteen patients (43%) were in the high-risk MRI group and were indicated by the guidelines, containing all events (P=.009).

**CONCLUSION**

Parenchymal enhancement in the contralateral breast may have potential as a prognostic biomarker to complement clinical indication for chemotherapy in patients who receive hormonal therapy.

**CLINICAL RELEVANCE/APPLICATION**

Contralateral parenchymal enhancement may have prognostic potential to complement clinical indication for chemotherapy in node negative ER+/HER2- breast cancer patients receiving hormonal therapy.

## SSQ01-03 Characterization of Breast Lesion Kinetics with Accelerated DCE-MRI Using Conventional Sampling Methods

Thursday, Dec. 3 10:50AM - 11:00AM Location: E450A

**Awards**
**Trainee Research Prize - Resident**

Participants
Federico Pineda, BS, Chicago, IL (*Presenter*) Nothing to Disclose
Keiko Tsuchiya, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Hiroyuki Abe, MD, Chicago, IL (*Abstract Co-Author*) Consultant, Seno Medical Instruments, Inc
Milica Medved, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Shiyang Wang, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Xiaobing Fan, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
David V. Schacht, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Aytekin Oto, MD, Chicago, IL (*Abstract Co-Author*) Research Grant, Koninklijke Philips NV; ; ;
Gillian M. Newstead, MD, Chicago, IL (*Abstract Co-Author*) Medical Advisory Board, Bayer AG; Consultant, Three Palm Software LLC; Consultant, VuCOMP, Inc; Medical Advisor, Quantitative Insights, Inc
Gregory S. Karczmar, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To characterize the kinetics of breast lesions in DCE-MRI with high temporal resolution during the first minute post contrast injection using conventional sampling methods.

**METHOD AND MATERIALS**

23 women with known enhancing lesions (17 malignant and 18 benign lesions) underwent a combined high temporal/standard protocol DCE-MRI. Patients were imaged on a Philips Achieva 3T-TX with a bilateral breast coil and a protocol consisting of 8 fat-suppressed fast acquisitions after injection of contrast media (0.1mM/kg MultiHance) followed by 5 fat-suppressed 'standard' acquisitions. Temporal resolution for the fast scans was 6.2-9.9s, with spatial resolution of 1.5x1.5x3mm^3; standard protocol temporal resolution was 58-79s and 0.8x0.8x1.6mm^3 spatial resolution. Percent signal enhancement data were fit to a 2-parameter (uptake only) empirical mathematical model (EMM). Time-of-arrival (TOA) was defined as the time at which a lesion enhanced by 20%, relative to the time when arterial enhancement in the breast first reached 20%. Time to 90% of maximum enhancement (T90) and initial area under the contrast curve (iAUC) were calculated from the EMM parameters. Lesion conspicuity was defined as the ratio of lesion signal increase to background parenchymal enhancement (BPE).

**RESULTS**

Significant differences ($p<0.005$) between benign and malignant lesions were measured for: uptake rate, initial slope, iAUC, TOA, and T90. The average TOA of malignant lesions was 7.2 ± 3.7s, and 25 ± 18.7s for benign lesions. T90 was 50 ± 34s and 191 ± 127s for malignant and benign lesions respectively. Average initial uptake rate was 34 ± 64%/s for malignancies and 2 ± 3%/s for benign lesions. Lesion conspicuity was highest in 4th fast time-point when its average was 11:1, compared to 4.4:1 by the final fast acquisition.

**CONCLUSION**

Malignant lesions, on average, had significantly faster signal enhancement than benign lesions, and significantly shorter TOA. Fast sampling may show larger differences between benign and malignant lesions compared to conventional DCE-MRI, and allows measurement of kinetics relative to arterial TOA. Lesion conspicuity was highest at early times after injection, before the sampling of the center of k-space in standard protocols.

**CLINICAL RELEVANCE/APPLICATION**

Fast sampling allows accurate measurement of early lesion kinetic parameters, which may be diagnostically useful. Higher lesion

conspicuity in early fast images may be beneficial in cases with marked BPE.

**Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Aytekin Oto, MD - 2013 Honored Educator

## SSQ01-04 Novel Informatics Modeling Using Clinical and Radiological Imaging Metrics for Characterization of Breast Tumors with the OncotypeDX Gene Array

Thursday, Dec. 3 11:00AM - 11:10AM Location: E450A

Participants
Michael A. Jacobs, PhD, Baltimore, MD (*Presenter*) Research Grant, Siemens AG
Katarzyna J. Macura, MD, PhD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Christopher Umbricht, MD,PhD, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Vishwa Parekh, MS, Baltimore, MD (*Abstract Co-Author*) Nothing to Disclose
Riham H. El Khouli, MD, PhD, Silver Spring, MD (*Abstract Co-Author*) Nothing to Disclose
Antonio C. Wolff, MD, Baltimore, MD (*Abstract Co-Author*) Research Grant, F. Hoffmann-La Roche Ltd

**PURPOSE**

Emerging data on breast cancer suggest that different breast cancer subtypes (phenotypes) may respond differently to available adjuvant therapies. Optimal use of established and novel imaging methods, such as multiparametric magnetic resonance imaging(MRI) can simultaneously identify key functional parameters and provide unique imaging phenotypes of breast cancer. We have developed a new informatics tool that integrates clinical variables, derived from imaging and clinical workup, to compare with the 21-gene array assay, OncotypeDX, which stratifies patients into three risk groups: low, medium, and high risk.

**METHOD AND MATERIALS**

We tested our informatics modeling in a group of 86 patients who were ER+ and candidates for the OncotypeDX gene array test and underwent breast MRI imaging at 3T. The clinical and imaging parameters included, breast density, morphology, lesion volume, mass enhancement, Ki-67, Pharmacokinetic(PK)-DCE MRI, ADC mapping, and others. There were 36 patients with OncotypeDX gene array scores of low risk(0-17), 40 patients with intermediate risk(18-31), and 10 patients with high risk(>31). Our non-linear dimensionally reduction(NLDR) informatics algorithm computes the similarity matrix using a hybrid k-means algorithm. We then employed multidimensional scaling to embed the similarity matrix into a two-dimensional representation via random forest decision trees to model the clinical parameters to the risk groups. T-tests were used to determine statistical significance.

**RESULTS**

There was no age difference(51-56y/o) between groups. The PK-DCE parameters, Ktrans for the high and intermediate risk groups were higher (0.45 and 0.50 (1/min)) compared to the low-risk group (0.35(1/min)) with similar results for the extra vascular fraction(EVF). The ADC values for high and intermediate risk groups were significantly lower than those for the low-risk group(1.09 vs 1.38x10-3mm2/s). However, the ADC values in glandular tissue were similar across all groups(2.14-2.17x10-3mm2/s). These results are visualized in our novel informatics heat map.

**CONCLUSION**

The most important surrogate imaging and histological parameters determined from the informatics model were the ADC values, the PK-DCE parameters, lesion size, Ki-67, and breast lesion volume.

**CLINICAL RELEVANCE/APPLICATION**

Informatics modeling of clinical and radiological variables can provide the foundation to relate these variables to the OncotypeDX gene array score.

**Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Katarzyna J. Macura, MD, PhD - 2012 Honored Educator
Katarzyna J. Macura, MD, PhD - 2014 Honored Educator
Riham H. El Khouli, MD, PhD - 2012 Honored Educator

## SSQ01-05 The Impact of Pre-operative Breast MRI on Surgical Waiting Time

Thursday, Dec. 3 11:10AM - 11:20AM Location: E450A

Participants
Michelle Zhang, MD, Montreal, QC (*Presenter*) Nothing to Disclose
Simon Sun, MD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose
Ann E. Aldis, MD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose
Sarkis Meterissian, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose
Benoit D. Mesurolle, MD, Montreal, QC (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

The purpose of this project is to assess the impact of pre-operative breast MRI on surgical waiting time (defined as from the time of biopsy to the time of surgery), and to identify possible factors contributing to the delay in management, specifically in a publicly

funded healthcare system.

**METHOD AND MATERIALS**

This is a retrospective cohort study that includes 1265 patients. Patients evaluated for pre-operative planning for newly diagnosed breast cancer from 2007 to 2013 at a tertiary center were divided into 2 groups: those who had a pre-operative MRI and those who did not (control group). Linear regression using matched populations was then used to compare the surgical waiting time between the 2 patient groups. Potential influences on surgical waiting time and subgroup analysis of the pre-operative MRI patient group were obtained using median regression analysis and Kruskal-Wallis test respectively.

**RESULTS**

There was a statistically significant increase ($p < 0.001$) in the surgical waiting time for the MRI group, after matching for confounding characteristics such as age, pathology and surgeon. The mean surgical waiting time for patients having had a pre-operative breast MRI was 57.9 days (95% CI: 55.6-60.1) compared to the control group which was 47.0 days (95% CI: 45.1-48.9). Increased surgical waiting time was associated with more favorable pathology (i.e. DCIS), later year of diagnosis (e.g. 2013 vs. 2007) and older patient age. Second-look ultrasound and subsequent biopsies were also associated with a statistically significant increase in surgical waiting time ($p=0.001$). Within the different subgroups of patients who underwent pre-operative MRI, surgical waiting time was mostly affected by the waiting time from MRI to the time of surgery, rather than from time of cancer diagnosis to MRI ($p<0.0005$).

**CONCLUSION**

Pre-operative breast MRI increased surgical waiting time on average from 47.0 to 57.9 days. The waiting time length also correlated with histology, year of diagnosis, patient's age and second-look US/biopsy. A main contributor to the waiting time was the delay between completion of the MRI to surgery, rather than from the delay between initial diagnosis to MRI.

**CLINICAL RELEVANCE/APPLICATION**

Pre-operative breast MRI in a publicly funded system may increase surgical waiting time; this increase is in large part due to the wait time from MRI to surgery, rather than the MRI waitlist time.

## SSQ01-06 Integrated Axillary Lymph Node (ALN) Screening during Pre-operative Breast MRI

Thursday, Dec. 3 11:20AM - 11:30AM Location: E450A

Participants
Sabine M. Detering, Aachen, Germany (*Presenter*) Nothing to Disclose
Simone Schrading, MD, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose
Timm Dirrichs, Aachen, Germany (*Abstract Co-Author*) Nothing to Disclose
Christiane K. Kuhl, MD, Bonn, Germany (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

According to the ACOSOG Z001 trial, axillary lymph node dissection (ALND) does not improve survival in women with positive sentinel lymph nodes (SLN). Therefore, an increasing number of women with positive SLNB do not proceed to ALND. However, this could lead to (axillary) relapse in patients with undetected advanced ALN disease. Purpose of this study was to analyze whether a short additional pulse sequence, integrated into our routine pre-operative breast MRI protocol, is sufficient to detect such ALN disease.

**METHOD AND MATERIALS**

218 women with biopsy-proven invasive breast cancer underwent preoperative MRI at 1.5 T. The standardized protocol included a pre-contrast coronal T1w-TSE-sequence acquired with the system's built-in body coil and prescribed to cover the axilla, TR/TE 550/15ms, FOV: 370 mm, scan time: 3 min. Two radiologists rated the likelihood of ALN metastasis on a 4 point scale ranging from 1 = definitely absent to 4 = definitely positive. Results of axillary surgery served as standard of reference.

**RESULTS**

Histology revealed that 80/218 (37%) patients were node-positive, 138/218 (63%) were node-negative. Of the 80 node-positive, 52 (65.0%) were staged pN1 (up to 1-3 ALN with micromets or 1 macrometastasis > 2 mm), whereas 28 (35.0%) had significant nodal disease, defined as all pN stages > pN1. Of the 28 patients with significant nodal disease, MRI classified 25 (89.3%) correctly as node positive. Stratified by nodal stages, MRI had a sensitivity of 7% (1/15) for pN1mic, 54% (22/41) for pN1a-c, 86% (12/14) for pN2 and of 100% (10/10) for pN3. MRI correctly excluded presence of ALN metastases in 127/138 patients (specificity: 92.0%).

**CONCLUSION**

A fast, 3-minute, additional T1-w MRI of the axilla as part of routine pre-operative breast MRI seems useful for complimentary staging of the axilla in addition to SLNB: MRI has predictably a poor sensitivity for ALN micrometastases - i.e. information on disease that is needed for accurate stage categorization, but not requiring specific treatment, and information that will be provided by SLNB. SLNB alone will, in turn, be unable to detect clinically significant ALN disease outside the sentinel node - a task that appears to be accomplished by MRI.

**CLINICAL RELEVANCE/APPLICATION**

A fast MRI of the axilla, as part of routine pre-operative breast MRI, seems suitable to complement SLNB in order screen the axilla for clinically important axillary node disease.

## SSQ01-07 Kinetic Analysis of the Ultra Early Phase on Breast MRI: Comparison between Benign and Malignant Lesions using Ultrafast Dynamic Contrast Enhanced MRI

Thursday, Dec. 3 11:30AM - 11:40AM Location: E450A

Participants
Hiroyuki Abe, MD, Chicago, IL (*Presenter*) Consultant, Seno Medical Instruments, Inc
Naoko Mori, MD, PhD, Sendai, Japan (*Abstract Co-Author*) Nothing to Disclose

Keiko Tsuchiya, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Kirti M. Kulkarni, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Deepa Sheth, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
David V. Schacht, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Federico Pineda, BS, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose
Gregory S. Karczmar, PhD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To evaluate the kinetic data of benign and malignant breast lesions in ultra early phase after contrast injection, using a whole breast ultrafast scanning technique.

**METHOD AND MATERIALS**

15 patients (10 benign and 10 malignant breast lesions) were scanned with an acquisition protocol of Ultrafast MRI, consisting of 5 pre and 8 post-contrast bilateral, fat-suppressed T1 weighted images of whole breasts, with temporal resolution of 7 second followed by four regular whole breast acquisitions with temporal resolution of 75 second with Philips Achieva 3T-TX with a dedicated 16 channel bilateral breast coil. Spatial resolution of the ultrafast scan was 1.5 x 1.5 x 3 mm3; for the standard protocol spatial resolution was 0.8 x 0.8 x 1.6 mm3. Kinetic curves of each lesion during the ultrafast phase (0 - 56 sec) were assessed with a commercially available CAD system (Dynacad) in terms of initial enhancement ratio (IER), peak enhancement ratio (PER) and curve shape (persistent, plateau, or wash-out). IER was obtained at the second phase after the lesion was visualized. To make the kinetic curve, the time-point for the early phase was set at the second phase after the lesion was visualized, and the late phase was set at the last phase of ultrafast scan.

**RESULTS**

Statistically significant differences between benign and malignant lesions were obtained. IER of benign lesions ranged from 32% to 117% (mean 68%), and that of malignant lesions ranged from 107% to 241% (mean 149%) (p<.001). PER ranged from 48% to 163% (mean 107%), and that of malignant lesions ranged from 147% to 268% (mean 184%) (p<.001). As for curve shape, all benign lesions showed persistent type kinetics except for one lesion that had plateau type kinetics. For malignant lesions, 6 had persistent type kinetics and 3 had plateau type kinetics.

**CONCLUSION**

Kinetic analysis of the ultra early phase is useful for differentiation between benign and malignant lesions.

**CLINICAL RELEVANCE/APPLICATION**

Ultrafast MRI, which is less influenced by background parenchymal enhancement, could be more clinically useful with the inclusion of kinetic assessment.

## SSQ01-08 Prediction of Indolent Hormone Receptor-Positive Breast Cancer Using Perfusion Parameters and Apparent Diffusion Coefficient

Thursday, Dec. 3 11:40AM - 11:50AM Location: E450A

Participants
SoHee Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Hee Jung Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hak Hee Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ki Chang Shin, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Joo Hee Cha, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Young Chae, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Woo Jung Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To investigate whether perfusion parameters and apparent diffusion coefficient (ADC) were useful for the prediction of indolent tumor with very favorable prognostic factors.

**METHOD AND MATERIALS**

This prospective study was approved by institutional review board and the informed consent was obtained. We enrolled 87 patients with 91 tumors patients (mean, 49.6 years; range, 29-74 years) who underwent definitive surgery. We defined estrogen receptor-positive tumors with low histologic grade, low Ki67 (<14%), and negative lymph node metastasis as an indolent tumor. We compared these indolent tumors (n=33; 36%) with the others (n=58; 64%) using perfusion and diffusion parameters. Statistical analysis was performed using Fisher's exact test, Chi-square test, and t test. Receiver operating characteristic (ROC) curve and logistic regression analysis was performed to evaluate the diagnostic performance of perfusion and diffusion parameters for the prediction of indolent tumors.

**RESULTS**

On univariate analysis, wash-in and iAUCqualitative values were significantly different according to the histologic grade, estrogen receptor, HER-2, Ki67 and lymphovascular invasion (P<.05 for all variables). ADCdiff was significantly different according to the histologic grade, HER-2, and Ki67 (P=.010, .007, and .013). On multivariate analysis, Ktrans, iAUCqualitative, and ADCdiff were the significant variables for the prediction of indolent tumors, and the AUC was 0.78, which was higher than those of individual parameter. Mean ADC was positively correlated with wash-out (r=0.350, P=.001), and negatively correlated with Kep (r= -0.207, P=.048). ADCdiff was positively correlated with wash-in (r = 0.263) and iAUCqualitative (r = 0.245) (P=.012 and .019), respectively.

**CONCLUSION**

The prediction model using Ktrans, iAUCqualitative, and ADCdiff on DCE-MRI and DWI could be helpful for the identification of indolent tumors and may be used as an imaging biomarker to guide treatment plan.

**CLINICAL RELEVANCE/APPLICATION**

Prediction of indolent tumors with very favorable prognostic features using preoperative breast MRI could help oncologists or

surgeons to decide the treatment plan such as neoadjuvant endocrine therapy or immediate surgery omitting chemotherapy.

## SSQ01-09 Early-stage Invasive Breast Cancer: Association of Tumor Apparent Diffusion Coefficient Values with Axillary Lymph Node Metastasis

Thursday, Dec. 3 11:50AM - 12:00PM Location: E450A

Participants
Jin You Kim, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Shinyoung Park, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Jin Il Moon, MD, Busan, Korea, Republic Of (*Presenter*) Nothing to Disclose
Ji Won Lee, MD, Busan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Suk Kim, MD, Pusan, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

### PURPOSE

To evaluate any association between tumor apparent diffusion coefficient (ADC) values and axillary node metastasis in early-stage breast cancer.

### METHOD AND MATERIALS

The institutional review board approved this retrospective study, and waived the need for informed consent. Between May 2013 and November 2014, the records of 270 patients (mean age, 51.3 years; range, 23-85 years) with stages T1 and T2 breast cancer (mean tumor size, 2.2 cm; range, 0.5-5.0 cm) who underwent preoperative breast magnetic resonance imaging, including diffusion-weighted (DW) imaging with b values of 0 and 1,000 s/mm2 were reviewed. The ADC values of the breast tumors were measured and compared with clinicopathological variables. Receiver operating characteristic (ROC) curve and multivariate regression analyses were used to test the predictive power of the tumor ADC values with regard to axillary node metastasis.

### RESULTS

Of the 270 patients, 58 (21.5%) experienced axillary lymph node metastasis. The mean tumor ADC values were significantly lower in patients with axillary node metastasis versus those without metastasis (0.880×10-3 vs. 0.999×10-3 mm2/s; $P < 0.001$). A ROC curve demonstrated a tumor ADC value of 0.991×10-3 mm2/s to be the optimal cut-off for predicting axillary node metastasis. Multivariate regression analysis revealed that lower tumor ADC value (≤ 0.991×10-3 mm2/s; adjusted odds ratio (OR) = 5.861, $P < 0.001$) was an independent variable associated with axillary node metastasis, along with large tumor size (> 2 cm; adjusted OR = 3.156, $P = 0.002$) and presence of lymphovascular invasion (adjusted OR = 4.125, $P < 0.001$). When tumor ADC value was added to known risk factors (i.e., tumor size and lymphovascular invasion) a significant improvement in the accuracy of risk prediction for axillary node metastasis was shown (c-statistic = 0.758 vs. 0.816, $P = 0.026$).

### CONCLUSION

Tumor ADC values obtained at DW imaging may be an independent predictive factor for axillary lymph node metastasis in patients with early-stage breast cancer.

### CLINICAL RELEVANCE/APPLICATION

In early-stage breast cancer, tumor ADC values may be a predictor of axillary node metastasis, which may assist selection of therapeutic strategies regarding management of axillary nodes.

BRS-THA

## Breast Thursday Poster Discussions

Thursday, Dec. 3 12:15PM - 12:45PM Location: BR Community, Learning Center

BR

*AMA PRA Category 1 Credit ™*: .50

FDA Discussions may include off-label uses.

**Participants**
Sarah M. Friedewald, MD, Chicago, IL (*Moderator*) Consultant, Hologic, Inc; Research Grant, Hologic, Inc

**Sub-Events**

### BR267-SD-THA1 Association of Breast Density with Breast Cancer Risk in Screening Mammography

Station #1

Participants
Natasa Katavic, MD, Zagreb, Croatia (*Presenter*) Nothing to Disclose
Kristina Bojanic, MD, Osijek, Croatia (*Abstract Co-Author*) Nothing to Disclose
Kristina Kralik, Osijek, Croatia (*Abstract Co-Author*) Nothing to Disclose
Tibor Santo, Osijek, Croatia (*Abstract Co-Author*) Nothing to Disclose
Kristina Vidacic, Osijek, Croatia (*Abstract Co-Author*) Nothing to Disclose
Mirta A. Pacovski, MD, Osijek, Croatia (*Abstract Co-Author*) Nothing to Disclose
Miroslav Sikora, Osijek, Croatia (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

The purpose of this study was to assess the distribution of breast density of the patients with detected breast cancer during mammography screening, and to evaluate the association of high mammographic density and breast cancer.

#### METHOD AND MATERIALS

We used data from National Breast Screening Programme in a single county. Women age 50-69 years have been invited every two years for mamography screening. 52962 mamography exams have been done during 5 years at 5 mammography units.Density analysis was performed from one craniocaudal and one mediolateral view from both breasts. The percent of the area of the mammogram occupied by radiologically dense breast tissue was determined by two independent radiologists who estimated visually the proportion of the occupied area.According to ACR (American College of Radiology) criteria breast density has been categorized into four groups: 1-almost entirely fatty, 2-scattered fibro-glandular densities, 3- heterogeneously dense, 4-extremely dense.Each woman with detected carcinoma was added her matching control: the woman of same age and same place of living.Patients were divided into low density breast tissue group (ACR density group 1-2) and high density breast tissue group (ACR 3-4) and data was compared between these two groups.

#### RESULTS

Out of 230 detected breast cancers, 6% were stage 0, 47% stage I, 17% stage II and 28% stage III/IV, according to AJCC criteria.Mammographic density distribution in breast cancer patients was as following: 47.64% in ACR1 group; 36.32% ACR2; 13.21% ACR3 and 2.83% ACR4.Low mammographic density (<50% parenchyma) had 83% patients in breast cancer group vs 89% controls; high mamographic density (>50% parenchyma) had 17% breast cancer patients vs 11% controls.There was no significant difference in mamographic density between brast cancer and control group: Fisher's exact test p=0.083 (OR=1.65 95% CI=0.97-2.81; z=1.85, p=0.064).

#### CONCLUSION

Our results suggest that higher mammographic densities were not associated with higher risk of breast cancer among menopausal women. Majority of screened woman have low breast density. Mamography is efficient method for early detection of nonpalpabile breast cancer.

#### CLINICAL RELEVANCE/APPLICATION

Mamography is the best tool for population-based breast cancer screening.

### BR268-SD-THA2 Diagnostic Performance of Hybrid PET/MR for Determination of Preoperative Lymph Node Status in Patients with Breast Cancer

Station #2

Participants
Eun-Jung Kong, Daegu, Korea, Republic Of (*Presenter*) Nothing to Disclose
Ihn-Ho Cho, Daegu, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

The aim of the study was to evaluate diagnostic performance of hybrid PET/MRI for determining preoperative lymph node status.

#### METHOD AND MATERIALS

Two hundred thirty-six women with histologically proven breast cancer were recruited to undergo preoperative PET/MR imaging. Among them, 184 patients fulfilled the inclusion criteria (invasive carcinoma, no previous operation, no neoadjuvant chemotherapy). MR Imaging of the breast including a dynamic contrast enhanced series and diffusion weighted imaging (DWI) was performed with a dedicated breast coil according to ACR guidelines. PET data was acquired simultaneously for 8 minutes. Axillary lymph nodes were

identified on obtained images and following parameters were evaluated: long axis, cortical thickness, shape, presence of fat hilum, apparent diffusion coefficient (ADC) and FDG avidity. Histologic results served as the gold standard.

**RESULTS**

Sentinel lymph node biopsy was performed in 122 cases, axillary dissection in 62 cases. 70 patients exhibited ALN metastases, of whom 15 were classified as micrometases. Mean size of breast mass was 2.1 ±1.5 cm. Macrometastatic ALN showed high FDG uptake, longer axis, thicker cortex, more frequent morphologic abnormalities, higher signal intensity at DWI and higher ADC values with statistical significance. No significant difference between micrometastatic ALN and benign ALN in PET/MR imaging. The sensitivity, specificity and accuracy of PET for determining ALN metastasis were 84%, 58% and 68%, respectively. Those are 77%, 84% and 82% in considering both PET with morphologic change and 81%, 66% and 72% in considering PET, morphologic change and DWI, respectively.

**CONCLUSION**

PET/MR imaging techniques showed high accuracy in the preoperative evaluation of axillary status in patients with breast cancer. Additional information by DWI is unlikely to be useful in predicting metastatic ALN.

**CLINICAL RELEVANCE/APPLICATION**

(dealing with PET/MR) 'PET/MR imaging techniques for metabolism and anatomic change showed high accuracy in the preoperative evaluation of axillary status. Additional information by DWI is unlikely to be useful in predicting metastatic ALN. PET/MR scan is recommended in the initial evaluation of breast cancer.'

## BR269-SD-THA3 Role of Peritumoral Stromal Tissue Stiffness Obtained on Shear Wave Elastography for the Prediction of Malignancy

Station #3

Participants
Su Min Ha, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Hye Sun Park, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hee Jung Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Ki Chang Shin, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hak Hee Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Joo Hee Cha, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Young Chae, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Woo Jung Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To evaluate the role of tumor and peritumoral stromal tissue stiffness obtained using shear wave elastography (SWE) for the prediction of malignancy.

**RESULTS**

There were 85 (64%) malignant and 48 (36%) benign lesions. Normalized Emean of tumor, border, and peritumoral stroma of malignant lesions were significantly higher than those of benign lesions (P<0.001). This difference of Emean between two groups was highest in the border (median ± interquartile range; 3.375 ± 1.728 vs. 1.594 ± 0.686, P<.001) and proximal peritumoral stroma (4.96 ± 3.19 vs. 1.31 ± 0.50, P<.001).On multivariate analysis, odds ratio for the prediction of malignancy was 2.26 for tumor border, 5.93 for 1st peritumoral stroma, 4.06 for 2nd peritumoral stroma, and 2.57 for 3rd peritumoral stroma (P <.001 for all). Odds ratio of intratumoral Emean was 1.64, which didn't reach statistical significance (P=.064). Slope of curve through inner tumor to peritumoral stroma was 0.607 for malignant lesions and -4.16 for benign lesions, which shows significant difference.

**CONCLUSION**

Stiffness of inner tumor, border, and peritumoral stroma obtained on SWE was significantly different between benign and malignant lesions, and the difference was highest in the border and proximal stroma.

**CLINICAL RELEVANCE/APPLICATION**

On SWE, stiffness of peritumoral stromal tissue in addition to inner tumor could provide a valuable information to predict malignancy.

## BR271-SD-THA4 Do Women with Dense Breasts Have Higher Radiation Exposure During Screening Mammography?

Station #4

Participants
Jonathan Nguyen, MD, Boston, MA (*Presenter*) Nothing to Disclose
James Patrie, MS, Charlottesville, VA (*Abstract Co-Author*) Nothing to Disclose
Jennifer A. Harvey, MD, Charlottesville, VA (*Abstract Co-Author*) Researcher, Hologic, Inc; Researcher, VuCOMP, Inc; Researcher, Matakina Technology Limited; Shareholder, Matakina Technology Limited; Shareholder, Hologic, Inc

**PURPOSE**

The maximum phantom dose in mammography is 3.0 mGy. However, actual dose to patients can vary widely. Specifically, the association of patient factors such as breast density with dose is not well documented in the literature.

**METHOD AND MATERIALS**

Patient demographics and x-ray techniques were collected for 434 sequential patients undergoing screening mammography at our institution over one month. Information included patient age, weight, height, compression thickness, radiographic technique, and mean glandular dose (MGD) were collected for each exposure. Breast density was calculated quantitatively using volumetric density software (Volpara). For each parameter investigated we determined the median value, 1st, and 3rd quartiles.

**RESULTS**

For patients, the median age was 58 years (1st quartile 51; 3rd quartile 66) and median BMI was 26.8 (23.3; 31.7). Median volumetric breast density was 5.6 mm3 (3.9; 8.7). Median compression thickness was 63.0 mm (53.5; 73.5). Median glandular doses for the left and right breasts were 1.68 mGy and 1.75 mGy, respectively.Multivariate regression analysis demonstrated a statistically significant correlation between radiation dose and all of the follow variables: age (p 0.021), breast laterality (p <0.001), BMI (p 0.038), breast density (p <0.001), and compression thickness (p <0.001). The covariate adjusted estimates between the 3rd and 1st quartiles showed that compression thickness was the primary determinant of radiation dose accounting for approximately 80% of dose, followed by breast density (10%), age (<5%), and BMI (<5%).

**CONCLUSION**

Increasing compression thickness had the greatest effect on increasing the MGD per exposure. Breast density has a minor impact, and BMI and age have minimal impact on MGD.

**CLINICAL RELEVANCE/APPLICATION**

Breast density is a minor determinant of patient dose in screening mammography.

## BR270-SD-THA5 Readout-segmented Echo-planar Imaging Guided Proton MR Spectroscopy in the Detection of Choline Concentration in Breast Lesions

Station #5

Participants
Kun Sun, Shanghai, China (*Presenter*) Nothing to Disclose
Caixia Fu, Shenzhen, China (*Abstract Co-Author*) Employee, Siemens AG
Fuhua Yan, MS, Shanghai, China (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To qualitatively and quantitatively investigate the feasibility and effectiveness of Readout-segmented Echo-planar Imaging guided proton MR Spectroscopy for characterizing breast lesions.

**METHOD AND MATERIALS**

This study was institutional review board approved, and informed consent was obtained from each patient. Between February 2014 to July 2014, 258 female patients (mean age, 50 years; age range, 25 ~ 82 years) with 258 lesions larger than 1 cm were performed readout-segmented Echo-planar Imaging guided single-voxel MRS with external reference solution and retrospectively analyzed. The qualitative approach was identified as total composite choline compounds (tCho) peak of signal- to-noise (SNR) of ≥2 to represent malignancy. The quantitative approach was identified as tCho concentration equal to or greater than the cut-off value to represent malignancy. All lesions were retrospectively divided into two groups (mass- and non-mass-type lesions) based on the dynamic contrast enhanced images.

**RESULTS**

Histologically, 183 lesions were malignant; 75 were benign. The mean tCho SNR in malignant lesions was 6.23 ± 3.30 AU/ml, compared with 1.26 ±1.75 AU/ml in benign lesions. With a tCho SNR threshold level of 2.0 AU/ml, the sensitivity, and specificity for MRS was 95% (174/183), 85% (64/75). The area under the ROC curve was 0.93. The mean tCho concentration was 3.17 ± 2.03 mmol/kg for malignancy, 0.86 ± 0.83 mmol/kg for benignancy. With a cut-off level of 1.76 mmol/kg, the sensitivity and specificity for MRS was 74.9% (137/183), 93.3% (70/75). The area under the ROC curve was 0.90. There was no significant difference between qualitative and quantitative approaches in the area of ROC curve (P = .12). There was also no significant difference in the detection of tCho between mass group and non-mass group, not only in malignant lesions (qualitatively: P = .506 and quantitatively: P = .066), but also in benign lesions (qualitatively: P = .199 and quantitatively: P = .690).

**CONCLUSION**

Readout-segmented Echo-planar Imaging guided MRS for the detection of Choline Concentration is feasible, and can be used for the differentiation of benign and malignant breast lesions in both enhanced mass lesions and non-mass lesions.

**CLINICAL RELEVANCE/APPLICATION**

Improved imaging quality of DWI based on Readout-segmented Echo-planar Imaging will allow for better positioning the ROI for MRS acquisition in both enhanced mass lesions and non-mass lesions.

## BR164-ED-THA6 The MRI Features of Breast Cancer: Intrinsic Subtypes and Response to Neoadjuvant Therapy

Station #6

Participants
Kazunori Kubota, MD, PhD, Bunkyo-Ku, Japan (*Presenter*) Nothing to Disclose
Tomoyuki Fujioka, MD, PhD, Bunkyo-ku, Japan (*Abstract Co-Author*) Nothing to Disclose
Kaori Okazawa, MD, Bunkyo-ku, Japan (*Abstract Co-Author*) Nothing to Disclose
Emi N. Yamaga, MD, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Akira Toriihara, Bunkyo-Ku, Japan (*Abstract Co-Author*) Nothing to Disclose
Yukihisa Saida, MD, Bunkyo-Ku, Japan (*Abstract Co-Author*) Nothing to Disclose
Ukihide Tateishi, MD, PhD, Setagaya-Ku, Japan (*Abstract Co-Author*) Nothing to Disclose

**TEACHING POINTS**

The purpose of this exhibit is:1. To review and understand the MRI features of each intrinsic subtype and the characteristics of response to neoadjuvant therapy.2. To disscuss the new evaluation method after neoadjuvant therapy.

**TABLE OF CONTENTS/OUTLINE**

A. Introduction - Definition of intrinsic subtypes - Neoadjuvant therapy and response evaluation methodB. MRI features of each intrinsic subtype - Luminal type breast cancers - HER 2 positive breast cancers - Triple negative breast cancersC. MRI characteristics of response to the neoadjuvant therapy and prediction of the pathological CR - Luminal type breast cancers - HER 2 positive breast cancers - Triple negative breast cancersD. DisucussionThe major teaching points of this exhibit are:1. Imaging

characteristics of the intrinsic subtypes differ, and the response to the adjuvant therapy also differs within the subtypes.2. Breast MRI is clinically useful in the prediction of tumor response after neoadjuvant therapy.

BRS-THB

## Breast Thursday Poster Discussions

Thursday, Dec. 3 12:45PM - 1:15PM Location: BR Community, Learning Center

BR

*AMA PRA Category 1 Credit ™*: .50

**Participants**
Sarah M. Friedewald, MD, Chicago, IL (*Moderator*) Consultant, Hologic, Inc; Research Grant, Hologic, Inc

**Sub-Events**

### BR272-SD-THB1 Pure Architectural Distortion on Digital Breast Tomosynthesis with Histopathologic Correlation

Station #1

Participants
Jamie Hui, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Lilian Wang, MD, Chicago, IL (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To evaluate cases of pure architectural distortion on digital breast tomosynthesis (DBT) with histopathologic correlation.

#### METHOD AND MATERIALS

In this institutional review board approved, HIPAA compliant single institution study, a retrospective query of digital mammograms with adjunct DBT from January 2014 to December 2014 reporting the finding of architectural distortion without associated mass was performed. DBT images were reviewed to determine lesion size, 1 view or 2 view visualization, and lesion conspicuity compared to 2D mammography. Available ultrasound (US) and MRI exams were also reviewed for presence of a corresponding abnormality. Final BIRADS assessment, biopsy pathology, surgical pathology, and patient demographics were recorded for each patient.

#### RESULTS

In this study, 32 cases of pure architectural distortion on DBT were identified in 31 patients. Architectural distortion was seen on 2 views (27/32) and demonstrated an US correlate (19/32) in the majority of cases. On diagnostic evaluation, 27 were assessed as BIRADS category 4 or 5, 4 as BIRADS category 3, and 1 as BIRADS category 2. Core needle biopsy or surgical excision was performed in 26 cases. Histologic findings were malignant in 13 of 26 (50%) lesions: 11/13 (85%) invasive and 2/13 (15%) DCIS. All malignancies were either pathologic nuclear grade 1 or 2. Visualization of malignant lesions was either equivalent (2/13) or better visualized (11/13) by DBT compared to 2D mammography. An US correlate was seen in 11 of 13 (85%) malignant lesions. Four of the 13 benign lesions were radial scar or complex sclerosing lesion, all better visualized by DBT. No definite correlation was identified between DBT lesion size and presence of an US correlate or between presence of an US correlate and nuclear grade. Of invasive carcinomas, DBT overestimated tumor size while ultrasound, when measurement included the echogenic rim, most accurately predicated pathologic tumor size.

#### CONCLUSION

Architectural distortion without associated mass on DBT is malignant in 50% of cases, all of low or intermediate nuclear grade. Improved visualization of distortion on DBT may favor detection of low grade malignancies associated with desmoplastic reaction.

#### CLINICAL RELEVANCE/APPLICATION

DBT enhances the visualization of pure architectural distortion and detection of low grade malignancies.

### BR273-SD-THB2 Breast MRI as a Problem-solving Study in the Evaluation of Microcalcifications; Is It Worth Performing?

Station #2

Participants
Akiko Shimauchi, MD, Sendai, Japan (*Presenter*) Nothing to Disclose
Youichi Machida, MD, PhD, Chuo-City, Japan (*Abstract Co-Author*) Nothing to Disclose
Mitsuhiro Tozaki, MD, PhD, Kamogawa, Japan (*Abstract Co-Author*) Nothing to Disclose
Ichiro Maeda, Kawasaki, Japan (*Abstract Co-Author*) Nothing to Disclose
Naoko Mori, MD, PhD, Sendai, Japan (*Abstract Co-Author*) Nothing to Disclose
Kei Takase, MD, PhD, Sendai, Japan (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To investigate utility of problem-solving breast MRI for calcifications found at mammography (MG).

#### METHOD AND MATERIALS

A HIPPA compliant IRB approved retrospective review of our database from 1/2010 to 12/2011 identified 173 breast MRI studies performed for evaluation of mammographic calcifications before percutaneous biopsy. All malignant lesions were proven by biopsy and women who did not undergo tissue sampling were followed up for at least 2 years.

#### RESULTS

Of the 173 calcifications, final assessments were positive (BI-RADS category(C) 4 or 5) for 77 cases and negative (C2 or 3) for 96 cases by MG, positive (C4 or 5) for 44 cases and negative (C1, 2, or 3) for 129 cases by MRI. 38 cases (22%) were proven to be malignant (27 ductal carcinoma in situ (DCIS), 8 invasive cancers, 3 DCIS with microinvasion) and 135 (78%) were benign. Sensitivity, specificity, positive predictive value and negative predictive value were 86.8% (33/38), 67.4% (44/135), 42.9% (33/77)

and 94.8% (5/96) for MG, and 86.8% (33/38), 91.9% (124/135), 75.0 (33/44) and 96.1% (124/129) for MRI. Of the 69 C4 cases (25 malignant, 44 benign), MRI led to correct benign diagnoses in 39 cases (89%, 39/44). Of the 88 C3 cases (5 malignant, 83 benign), MRI upgraded 11 cases to C4, five of which were proven to be DCIS (5.6%, 5/88) (3 intermediate grade, 2 high-grade), and the rest were benign (6.8%, 6/88). MRI depicted 8 additional findings at different locations from the calcifications, three of which were diagnosed as cancers (1.7%, 3/173) (1 IDC, 1 ILC with IDC, and 1 low-grade DCIS), and the rest were benign (4.6%, 5/173). The false negative rate of MRI was 13.2% (5/38) due to 1 non-enhancing low-grade DCIS, 1 low- grade and 1 intermediate- grade DCIS likely obscured by moderately or markedly enhancing parenchyma, and 1 low- grade and 1 intermediate-grade DCIS seen as benign-appearing linear NME that were judged as C3 by MRI reading. All of the MR false-negative malignancies were judged as C4 by MG.

**CONCLUSION**

MRI may be a useful tool as a non-invasive work-up of mammographic calcifications; MRI would have avoided 89% of benign biopsies, helped correctly upgrade C3 calcifications to C4 in 5 women, and identified 2 additional invasive carcinomas in our series. All MRI-negative carcinomas were non high-grade DCIS.

**CLINICAL RELEVANCE/APPLICATION**

MRI could help confirm the presence and absence of breast carcinoma, for women with mammographic calcifications.

## BR274-SD-THB3 Tomosynthesis Increases the Use of BI-RADS Category 3

Station #3

Participants
Allison Lippert, MD, Charlottesville, VA (*Abstract Co-Author*) Nothing to Disclose
Heather R. Peppard, MD, Charlottesville, VA (*Abstract Co-Author*) Consultant, Siemens AG; Research Grant, Hologic, Inc
Carrie M. Rochman, MD, Charlottesville, VA (*Abstract Co-Author*) Nothing to Disclose
Jennifer A. Harvey, MD, Charlottesville, VA (*Abstract Co-Author*) Researcher, Hologic, Inc; Researcher, VuCOMP, Inc; Researcher, Matakina Technology Limited; Shareholder, Matakina Technology Limited; Shareholder, Hologic, Inc
James Patrie, MS, Charlottesville, VA (*Abstract Co-Author*) Nothing to Disclose
Brandi T. Nicholson, MD, Charlottesville, VA (*Presenter*) Consultant, Siemens AG

**PURPOSE**

Tomosynthesis (DBT) improves sensitivity and specificity of screening mammograms (sMG). This study assessed the impact of DBT on the rate of Breast Imaging Reporting and Data System (BI-RADS) category 3 (BR3) after recall for BI-RADS category 0 (BR0) sMG.

**METHOD AND MATERIALS**

Retrospective, HIPAA-compliant, and IRB approved. Women, age 18 and older, were included in the study if they had a BR0 sMG from April 1, 2009 - March 27, 2015 and were given a BR3 at diagnostic (Dx) evaluation. Women evaluated for axillary adenopathy were excluded. Patients were divided into three groups based on the date of the sMG and the use of DBT. sMG from April 1, 2009 - March 31, 2012 were 'pre-DBT'. sMG from April 1, 2012 - March 27, 2015 without DBT were "no-DBT" and with DBT were 'yes-DBT". The electronic medical record was used to obtain the total number of sMG, BR0 sMG, BR3 after recall, finding type, use or not of DBT, use or not of ultrasound (US), and patient's age and breast density. The Kruskal Wallis and Pearson's Chi-Square Tests were used.

**RESULTS**

A total of 89,010 sMG were performed from April 1, 2009 - March 27, 2015 with 284 patients and 299 lesions meeting inclusion criteria with 17 lesions in 17 patients excluded for axillary adenopathy. For BR0 lesions, in the "pre-DBT" group (n=6523), 1.3% (n=87) (95% CI: [1.1, 1.6%]) became BR3, in the "no-DBT" group (n=7359), 1.9% (n=141) (95% CI: [1.6, 2.3%]) became BR3, and in the "yes-DBT" group (n=385), 10.1% (n=39) (95% CI: [7.3, 13.6%]) became BR3. The odds that a BR0 sMG lesion became BR3 at Dx was 1.45 times greater (95% CI: [1.11, 1.89]) for "no-DBT" than for "pre-DBT" (p=0.007), 8.33 times greater (95% CI: [5.55, 12.50]) for "yes-DBT" than for "pre-DBT" (p<0.001), and 5.88 times greater (95% CI: [4.00, 5.00]) for "yes-DBT" than for "no-DBT" (p<0.001). The recall rates (RR) were 15.4% (95% CI: [15.2, 15.9%]) for "pre-DBT", 16.8% (95% CI: [16.4, 17.2%]) for "no-DBT" and 11.8% (95% CI: [10.7, 13.0%]) for "yes-DBT" sMG. The RR differed between three groups (p<0.001 for all). Frequency of focal asymmetry (71.4%, p=0.011) and use of US (100%, p=0.010) was highest in the "yes-DBT" group. There were no differences in age or breast density.

**CONCLUSION**

The use of DBT was associated with increased use of BR3 in patients who were recalled from an abnormal sMG, with decreased RR at sMG, in our practice.

**CLINICAL RELEVANCE/APPLICATION**

The use of DBT increased the frequency of BI-RADS category 3, highlighting an area for future investigation.

## BR276-SD-THB4 Replacement of Single-view Mediolateral Oblique (MLO) Digital Mammography to Synthesized Mammography with Digital Breast Tomosynthesis (DBT) Images: Comparison of Diagnostic Perfomance and Radiation Dose with Two-view DM with or without MLO DBT

Station #4

Participants
Hyo-Jin Kang, MD, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Jung Min Chang, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sung Eun Song, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Joongyub Lee, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Won Hwa Kim, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Sung Ui Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Min Sun Bae, MD, PhD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

Woo Kyung Moon, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To evaluate the diagnostic performance and radiation dose of single-view cranio-caudal (CC) digital mammography (DM) plus mediolateral oblique (MLO) synthesized mammography (SM) with digital breast tomosyntehsis (DBT) in comparison with two-view digital mammography (DM) and two view DM with MLO DBT.

**METHOD AND MATERIALS**

This study was approved by our institutional review board and informed consent was obtained in all patients. Between October and November 2014, paired two-view DM and single MLO DBT images were obtained from 130 women (median age, 52.1 years). Four independent retrospective reading sessions (two-view DM, single-view CC DM with MLO SM, two-view DM with DBT, and single-view CC DM and MLO SM with DBT) were performed in random order by 3 blinded radiologists and the likelihood of malignancy (%) and BI-RADS categories of each lesion were assessed. Areas under receiver operating characteristic curve (AUC), sensitivities, and specificities were compared for each arm using histopathologic results as the reference standard. Average glandular dose (AGD) of DM and MLO DBT were calculated from DICOM headers for images obtained with automatic exposure settings.

**RESULTS**

Among 159 lesions in 130 patients, 27 were malignant (mean tumor size, 3.27±2.5cm). When using MLO SM and DBT instead of MLO DM, mean AGD revealed a less than 10% increase (mean±SD, 5.78 mGy±1.07). A slight higher mean AUC was noted compared to two-view DM, but it was statistically not significant (P=0.302). Mean AGD of two-view DM with MLO DBT was 8.45 mGy±1.32 per patient, which was 60% higher than that of two-view DM alone (5.3 mGy±0.6, P<0.001). Mean AUCs for two-view DM and DM+SM was 0.881 and 0.848, respectively (P=0.142). When DBT was added, the mean AUC increased to 0.914 (P=0.016) and 0.907 (P=0.073), and sensitivities increased to 82.7%, and 81.5%, respectively (all P<0.009), albeit with minimal specificity increment (P>0.05).

**CONCLUSION**

Combined use of single-view CC DM and MLO SM with DBT showed similar diagnostic performance to two-view DM with minimal radiation dose increment. Two-view DM with MLO DBT showed highest diagnostic performance among all, but a significant radiation dose increment was observed.

**CLINICAL RELEVANCE/APPLICATION**

Diagnostic performance can be improved with the addition of MLO DBT to two-view DM. Replacement of MLO DM with SM and DBT showed a small increase in radiation dose, but no gain in diagnostic performance.

## BR275-SD-THB5 Relationship of Apparent Diffusion Coefficient and Tumor Inflammatory Cell Infiltrate in Patients with Estrogen Receptor-Positive Breast Cancer

Station #5

Participants
SoHee Kim, Seoul, Korea, Republic Of (*Presenter*) Nothing to Disclose
Hee Jung Shin, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hee Jin Lee, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Gyungyub Gong, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Hak Hee Kim, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Joo Hee Cha, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Eun Young Chae, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose
Woo Jung Choi, MD, Seoul, Korea, Republic Of (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To determine the relationship of apparent diffusion coefficient (ADC) and tumor inflammatory cell infiltrate as prognostic predictor in patients with estrogen receptor (ER)-positive breast cancer.

**METHOD AND MATERIALS**

Institutional review board was obtained. From July 2014 to October 2014, we reviewed 80 consecutive patients (range, 28-77 years; mean, 52 years) with ER-positive breast cancer who underwent preoperative breast MRI and definitive surgery. All patients underwent read-out segmented diffusion-weighted imaging (DWI) at 3T scanner. One radiologist drew the region-of-interest (ROI) in the tumor on DWI and obtained minimum, maximum, and mean tumor ADCs including ADC difference. On pathology, we reviewed tumor-infiltrating lymphocyte (TIL), peritumoral lymphocyte infiltrate, tumor cellularity, central fibrosis, stromal pattern, and Ki-67. Mann-whitney, Kruskal-Wallis test and spearman's correlation coefficient were used for the statistical analysis.

**RESULTS**

Patients with peritumoral lymphocyte infiltrate at invasive margin had higher ADC difference and minimum tumor ADC (P= .045 and .006) than those without peritumoral lymphocyte infiltrate. Tumors with high tumor cellularity and high Ki-67 had significantly lower mean ADC (0.98 vs. 0.90 x 10-3 mm2/sec, P=.017; 1.00 vs. 0.90 x 10-3 mm2/sec, P=.012). Tumors with high Ki-67 had higher ADC difference and lower minimum ADC than those with low Ki-67 (P=.029, and .018). TIL ranged from 1% to 60% and the mean was 9.4%. However, any of ADC parameter was not different between low and high TIL groups (P>.05). Mean ADC was negatively correlated with tumor cellularity (r=-0.246; P=.028) and Ki-67 (r=-0.262, P=.022). Minimum ADC was also negatively correlated with Ki-67 status (r=-0.231, P=.039).

**CONCLUSION**

In ER-positive breast cancer, tumor ADC parameters were significantly different according to peritumoral lymphocyte infiltrate, tumor cellularity, and Ki-67 status.

**CLINICAL RELEVANCE/APPLICATION**

Tumor ADC parameters obtained on DWI would reflect the prognostic information and biological features in patients with ER-positive breast cancer.

## BR181-ED-THB6 Molecular Breast Imaging: An Adjunct Diagnostic Modality for Breast Cancer Evaluation

Station #6

Participants
Gaiane M. Rauch, MD, PhD, Houston, TX (*Presenter*) Nothing to Disclose
Beatriz E. Adrada, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Monica L. Huang, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Rosalind P. Candelaria, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Elsa M. Arribas, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Wei T. Yang, MD, Houston, TX (*Abstract Co-Author*) Researcher, Hologic, Inc
Kelly Cox, BS, RT, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Lumarie Santiago, MD, Houston, TX (*Abstract Co-Author*) Nothing to Disclose
Srinivas C. Kappadath, PhD, Houston, TX (*Abstract Co-Author*) Research Grant, General Electric Company

### TEACHING POINTS

Molecular Breast Imaging (MBI) generates functional images based on physiological processes within breast tissue, while conventional breast diagnostic imaging is based on anatomy and morphology. MBI can improve detection of multifocal and multicentric breast cancer, allow detection of contralateral breast cancer and may lead to change in patient's management. MBI can be used for an early assessment of tumor's response to neoadjuvant chemotherapy (NAC) and indicate if treatment should be altered or prolonged in order to achieve optimal response prior to surgery. MBI can be used for assessment of residual cancer burden after NAC and help in correct surgical planning, segmentectomy versus mastectomy.

### TABLE OF CONTENTS/OUTLINE

MBI principles, physiological mechanisms, imaging techniques. MBI lexicon, diagnostic accuracy and radiation dose. Role of MBI for initial staging of the breast cancer. Use of MBI for assessment of tumor response to NAC and residual disease before surgery. Comparison of MBI with other breast imaging modalities. MBI challenges and advantages.

MSCB51

## Case-based Review of Breast (An Interactive Session)

Thursday, Dec. 3 1:30PM - 3:00PM Location: S100AB

BR DM

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

**Participants**
Janie M. Lee, MD, Bellevue, WA (*Director*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Identify the appropriate application of multimodality breast imaging for routine screening, supplemental screening, and diagnostic indications. 2) Select appropriate methods for performing imaging-guided percutaneous breast biopsy and post-biopsy radiologic-pathologic correlation. 3) Calculate performance measure values for a breast imaging audit and compare with appropriate benchmarks.

**Sub-Events**

### MSCB51A Screening: Digital Mammography and Tomosynthesis

Participants
Helen Anne D'Alessandro, MD, Boston, MA (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) To review the current role of screening digital mammography and tomosynthesis. 2) To demonstrate digital mammography and tomosynthesis use for evaluating screening callbacks of masses, calcifications, architectural distortion and summation artifacts. 3) To discuss tomosynthesis for decreasing callback rates, evaluating extent of disease and increasing cancer detection rates.

**ABSTRACT**

This case based review will demonstrate digital mammography and tomosynthesis use for evaluating callbacks of masses, calcifications, architectural distortion and summation artifacts. Practical considerations of digital mammography and tomosynthesis will also be discussed, including the effect of digital tomosynthesis on screening callback rates, evaluating extent of disease and increasing cancer detection rates.

### MSCB51B Supplemental Screening in an Era of Breast Density Notification Legislation

Participants
Janice S. Sung, MD, New York, NY (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**ABSTRACT**

This talk will focus on the various imaging modalities that are available for supplemental screening for intermediate and high risk patients, including ultrasound, MRI, and contrast enhanced digital mammography. The clinical evidence supporting their use for supplemental screening will be reviewed. The advantages and disadvantages of each modality will also be reviewed during this case based session.

### MSCB51C Evaluating the Symptomatic Patient

Participants
Catherine M. Appleton, MD, Saint Louis, MO (*Presenter*) Scientific Advisory Board, Hologic, Inc; Royalties, Oxford University Press;

**LEARNING OBJECTIVES**

1) To understand the clinical presentation of benign and malignant breast conditions. 2) To review current guidelines for evaluating the symptomatic patient. 3) To discuss specific imaging approaches for evaluating breast symptoms.

SPSH55

## Hot Topic Session: Cancer Screening: Breast Tomosynthesis, CT Colonography, Lung Cancer

Thursday, Dec. 3 3:00PM - 4:00PM Location: E451A

BR CH GI CT OI

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

**Participants**
Paul P. Cronin, MD, MS, Ann Arbor, MI (*Moderator*) Nothing to Disclose

**Sub-Events**

### SPSH55A Imaging in Breast Cancer Screening

Participants
Elizabeth S. Burnside, MD, MPH, Madison, WI (*Presenter*) Stockholder, NeuWave Medical Inc

**LEARNING OBJECTIVES**

1) To review the foundation and evolution of scientific investigation that supports evidence-based breast cancer screening. 2) To critically evaluate the methodologies currently being used to construct screening guidelines. 3) To understand the outcomes by which successful screening programs are measured. 4) To review and assess the current controversies of breast cancer screening.

**ABSTRACT**

**URL**

### SPSH55B Imaging in Lung Cancer Screening

Participants
Ella A. Kazerooni, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

**Honored Educators**

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Ella A. Kazerooni, MD - 2014 Honored Educator

### SPSH55C Imaging in Colon Cancer Screening

Participants
David H. Kim, MD, Madison, WI (*Presenter*) Consultant, Viatronix, Inc; Co-founder, VirtuoCTC, LLC; Medical Advisory Board, Digital ArtForms, Inc; Stockholder, Cellectar Biosciences, Inc

**LEARNING OBJECTIVES**

1) Be able to compare/contrast image-based screening by CT colonography (CTC) against the other screening options for colorectal cancer. 2) Be familiar with the major trials that establish the performance profile of CTC. 3) Understand the rationale for the selective polypectomy strategy at CT colonography.

MSCB52

## Case-based Review of Breast (An Interactive Session)

Thursday, Dec. 3 3:30PM - 5:00PM Location: S100AB

BR SQ

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

**Participants**
Janie M. Lee, MD, Bellevue, WA (*Director*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Identify the appropriate application of multimodality breast imaging for routine screening, supplemental screening, and diagnostic indications. 2) Select appropriate methods for performing imaging-guided percutaneous breast biopsy and post-biopsy radiologic-pathologic correlation. 3) Calculate performance measure values for a breast imaging audit and compare with appropriate benchmarks.

**Sub-Events**

### MSCB52A Percutaneous Breast Biopsies

Participants
Wendy B. Demartini, MD, Madison, WI (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Understand the advantages and limitations of percutaneous breast biopsy. 2) Compare the different potential methods of core needle biopsy. 3) Apply techniques for the biopsy of routine and challenging cases using mammography, ultrasound and MRI guidance.

**ABSTRACT**

### MSCB52B Radiologic-Pathologic Correlation

Participants
Heidi R. Umphrey, MD, Birmingham, AL (*Presenter*) Research support, General Electric Company

**LEARNING OBJECTIVES**

View learning objectives under main course title.

### MSCB52C Performance Measures

Participants
Janie M. Lee, MD, Bellevue, WA (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Identify the data to be collected and calculate performance measures for the basic clinically relevant breast imaging audit. 2) Compare audit results with appropriate performance benchmarks. 3) Understand additional data and calculations needed to perform a comprehensive breast imaging audit.

RC715

# Digital Breast Tomosynthesis

Thursday, Dec. 3 4:30PM - 6:00PM Location: N228

BR DM

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

**Participants**

**Sub-Events**

## RC715A Basics and Implementation

Participants
Liane E. Philpotts, MD, New Haven, CT (*Presenter*) Nothing to Disclose

### LEARNING OBJECTIVES

1) Define the essential steps involved in initiating tomosynthesis into practice. 2) Identify the key elements needed to implement tomosynthesis including educating patients and referring providers, marketing, and reimbursement issues. 3) Discuss performance issues such as interpretation time, learning curve, and workflow with tomosynthesis. 4) Anticipate changes in practice over time as a result of tomosynthesis, including fewer patients requiring follow up (BIRADS 3) and improved PPVs for biopsy recommendations, which may lead to changes in staffing or equipment needs.

### ABSTRACT

Initiating tomosynthesis into practice requires some important considerations. These include training requirements for technologists and radiologists, equipment needs, workstation essentials, PACS storage and retrieval, dose considerations and scheduling. Educating patients and physicians is important to permit weighing benefits versus increased dose. Marketing can be an important factor for some practices looking to increase services and volumes. Coding is now available and reimbursement issues will be considered. Changes in workflow can be profound and unanticipated initially. In addition to reduced recalls from screening, fewer patients will require close diagnostic follow-up therefore diminishing the diagnostic pool over time. Diagnostic exams are also streamlined, all leading to expediting the imaging workflow of patients. This can lead to changes in total equipment or staffing needs. Overall there is a net benefit as more patients will need less imaging and get more accurate reads.

## RC715B Clinical Utility of DBT

Participants
Stamatia V. Destounis, MD, Scottsville, NY (*Presenter*) Research Grant, FUJIFILM Holdings Corporation; Research Grant, Hologic, Inc; Research Grant, QT Ultrasound LLC

### LEARNING OBJECTIVES

1) Principles of Digital Breast tomosynthesis (DBT). 2) Initial implementation of DBT in a clinical practice and living in a hybrid Full Field Digital Mammography (FFDM) and Digital Breast Tomosynthesis (DBT) environment. 3) Initial training and education of physicians and technologists within the practice and changes in workflow. 4) Education of patients and referring health care providers. 5) Financial concerns with initiation and implementation of DBT. 6) Synthetic view implementation and reimbursement changes.

### ABSTRACT

Review of basic principles of Digital Breast Tomosynthesisand clinical benefits. Review of current literature on clinical implementation of Digtal Breast Tomosynthesis. Outlining how a facility may embark on DBT implementaiton in a private practice setting. The costs and shortcomings of utilizing two modalities Full Field Digital and Digital Breast Tomosynthesis daily as the facility/department transitions from one modality to another.Educating your team of the changes that will be implemented is extemely important. The need for strong leadership from your technologists on required education and training, requirements of strong IT and PACS support, the issues and costs of archiving and storage of the large DBT files will be reviewed. Education of referring health care providers and the patients on the new technology is key to making a successful transition to a new modality. Marketing in the community through presentations, brochures and the facility's website will bring awareness and help implementation initiation and acceptance.Review of the synthetic view and its importance in answering radiation concerns . Recent reimbursement approval and its meaning in the clinical practice.

## RC715C Challenging Cases

Participants
Catherine M. Appleton, MD, Saint Louis, MO (*Presenter*) Scientific Advisory Board, Hologic, Inc; Royalties, Oxford University Press;

### LEARNING OBJECTIVES

1) List appropriate clinical applications of digital Breast tomosynthesis using a cases based approach. 2) Review problem solving techniques to resolve challenging findings in screening and diagnostic digital Breast tomosynthesis cases. 3) Recognize common pitfalls in digital breast tomosynthesis using a case based approach.

### ABSTRACT

Using an enriched case set, common findings encountered using DBT in the screening and clinical settings will be reviewed - to include challenging diagnostic findings, calcifications, pitfalls, and multi modality correlation.

RC750

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

Thursday, Dec. 3 4:30PM - 6:00PM Location: E260

BR MR

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

**Participants**

Peter R. Eby, MD, Seattle, WA, (peter.eby@virginiamason.org) (*Moderator*) Consultant, Devicor Medical Products, Inc
Beatriz E. Adrada, MD, Houston, TX (*Presenter*) Nothing to Disclose
Sandra Brennan, MBBCh, MSc, West Harrison, NY (*Presenter*) Nothing to Disclose
Selin Carkaci, MD, Columbus, OH (*Presenter*) Author with royalties, Reed Elsevier
Chloe M. Chhor, MD, New York, NY (*Presenter*) Nothing to Disclose
Mark J. Dryden, MD, Houston, TX (*Presenter*) Nothing to Disclose
Sujata V. Ghate, MD, Durham, NC (*Presenter*) Nothing to Disclose
Vilert A. Loving, MD, Gilbert, AZ, (vloving@mdanderson.org) (*Presenter*) Nothing to Disclose
Michelle D. McDonough, MD, Jacksonville, FL, (McDonough.michelle@mayo.edu) (*Presenter*) Nothing to Disclose
Virginia M. Molleran, MD, Cincinnati, OH (*Presenter*) Nothing to Disclose
Habib Rahbar, MD, Seattle, WA (*Presenter*) Research grant, GE Healthcare
Jean M. Seely, MD, Ottawa, ON (*Presenter*) Nothing to Disclose
Stephen J. Seiler, MD, Dallas, TX, (stephen.seiler@utsouthwestern.edu) (*Presenter*) Nothing to Disclose
Laura B. Shepardson, MD, Cleveland, OH (*Presenter*) Nothing to Disclose
Tanya W. Moseley, MD, Houston, TX (*Presenter*) Nothing to Disclose
Roberta M. Strigel, MD, MS, Madison, WI, (rstrigel@uwhealth.org) (*Presenter*) Research support, General Electric Company
Janice S. Sung, MD, New York, NY (*Presenter*) Nothing to Disclose
Lilian Wang, MD, Chicago, IL (*Presenter*) Nothing to Disclose
Annamaria Wilhelm, MD, Jacksonville, FL (*Presenter*) Nothing to Disclose
Simone Schrading, MD, Aachen, Germany (*Presenter*) Nothing to Disclose
Bethany L. Niell, MD, Boston, MA (*Presenter*) Nothing to Disclose
Jocelyn A. Rapelyea, MD, Washington, DC (*Presenter*) Consultant, General Electric Company

## LEARNING OBJECTIVES

1) Explain why MR-guided breast biopsy is needed for patient care. 2) Identify relative and absolute contraindications to MR-guided breast biopsy. 3) Describe criteria for MR-guided breast biopsy patient selection. 4) Debate risks and benefits of pre-biopsy targeted ultrasound for suspicious MRI findings. 5) Understand basic MR-guided biopsy parameters and requirements for appropriate coil, needle and approach selection. 6) Manage patients before, during and after MR-guided breast biopsy. 7) Define benefits and limitations of MR-guided vacuum assisted breast biopsy. 8) Apply positioning techniques to challenging combinations of lesion location and patient anatomy for successful MR-guided biopsy.

## ABSTRACT

This course is intended to provide basic didactic instruction and hands-on experience for MR-guided breast biopsy. 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 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 using provided phantoms. Various combinations of full size state-of-the-art breast MRI coils, biopsy localization equipment and needles from multiple different vendors will be available for hands-on practice. Some stations will have monitors loaded with targeting software. Expert breast imagers from around the world will be at each of 10 stations to provide live coaching, tips, techniques and advice.

**Active Handout:Peter R. Eby**

http://abstract.rsna.org/uploads/2015/6005779/RC750.pdf

RC753

## Computer Aided Diagnosis (Development and Clinical Applications)

Thursday, Dec. 3 4:30PM - 6:00PM Location: E350

BR CT OI IN

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

FDA Discussions may include off-label uses.

**Participants**
Emanuele Neri, MD, Pisa, Italy (*Moderator*) Nothing to Disclose
Hiroyuki Yoshida, PhD, Boston, MA (*Moderator*) Patent holder, Hologic, Inc; Patent holder, MEDIAN Technologies;

### LEARNING OBJECTIVES

1) Understand needs of CAD in radiologic image interpretation. 2) Understand basic concept of CAD in assisting radiologists' image reading. 3) Understand the usefulness of CAD in improving radiologists' performance. 4) Learn historical review of CAD developments. 5) Learn CAD for detection and differential diagnosis of common cancers. 6) Learn ROC analysis of radiologists' performance without and with CAD in observer studies.

### ABSTRACT

Computer-aided diagnosis (CAD) has become one of the major topics in medical imaging and diagnostic radiology. In this refresher course, the principles of CAD will be presented, together with current developments as well as clinical applications of CAD.CAD aims at improving radiologists' diagnostic accuracy, and it can be used as primary, concurrent, or second reader. In principle, the CAD performs a morphological recognition of the pathology (nodule, focal lesion, polyp, etc.) combined with quantitative information (MR signal intensity, CT density, contrast enhancement, volume, etc.)Many different types of CAD schemes have been developed for detection and/or characterization of various lesions in different imaging modalities, including conventional projection radiography, CT, MRI, and ultrasound imaging. Organs that are subjected to research for CAD include the breast, lung, colon, brain, liver, kidney, and the vascular and skeletal systems.For detection of breast cancer on mammograms, more than 10,000 commercial CAD systems have been used clinically in assisting radiologists worldwide. For detection of lung cancer, CAD schemes have been developed for detection of pulmonary nodules on chest radiographs and CT images. In addition, CAD schemes have been developed for differential diagnosis of distinction between malignant and benign lesions. For colon cancer, CAD schemes have been developed for detection of polyps in CT colonography. Observer performance studies with use of ROC analysis indicated an improved performance in radiologists' task for detection and/or classification of these lesions.

### URL

**Sub-Events**

### RC753A Development of a CAD: From Benchtop to Clinic

Participants
Ronald M. Summers, MD, PhD, Bethesda, MD, (rms@nih.gov) (*Presenter*) Royalties, iCAD, Inc; Research funded, iCAD, Inc;

#### LEARNING OBJECTIVES

1) To understand what radiology problems are amenable to computer aided detection. 2) To understand the steps required to develop and validate a radiology computer-aided detection product. 3) To understand the current performance and future trends in computer-aided detection with respect to indications, algorithms, sensitivity, false positive rates and pitfalls.

#### ABSTRACT

### RC753B CAD for CT Colonography: Where Do We Stand?

Participants
Daniele Regge, MD, Candiolo, Italy, (daniele.regge@ircc.it) (*Presenter*) Speakers Bureau, General Electric Company

#### LEARNING OBJECTIVES

1) Review interpretation pitfalls of CT colonography that could be overcome with CAD. 2) Present different reading paradigms of CAD for CT colonography and analyze their performances. 3) Summarize advantages and limitations of the use of CAD for CT colonography in different clinical settings.

### RC753C CAD for Breast Cancer Detection: Where Do We Stand?

Participants
Ulrich Bick, MD, Berlin, Germany, (Ulrich.Bick@charite.de) (*Presenter*) Equipment support, Hologic, Inc; License agreement, Hologic, Inc; Royalties, Hologic, Inc; Equipment support, Toshiba Corporation; Institutional research collaboration, Siemens AG

#### LEARNING OBJECTIVES

1) To learn about different applications of computer-aided diagnosis (CAD) in breast imaging. 2) To understand the potential and risks of using CAD in mammography screening. 3) To realize the impact of CAD on soft-copy reading and work-flow

## RC753D CAD for Lung Cancer Detection: Where Do We Stand?

Participants
Kunio Doi, PhD, Chicago, IL, (k-doi@uchicago.edu) (*Presenter*) Shareholder, Hologic, Inc; License agreement, Hologic, Inc; License agreement, Deus Technologies, LLC; License agreement, Riverain Technologies, LLC; License agreement, Mitsubishi Corporation; License agreement, MEDIAN Technologies; License agreement, General Electric Company; License agreement, Toshiba Corporation; Research support, Deus Technologies, LLC; Research support, E. I. du Pont de Nemours & Company; Research support, Elcint Medical Imaging Ltd; Research support, FUJIFILM Holdings Corporation; Research support, General Electric Company; Research support, Hitachi, Ltd; Research support, Eastman Kodak Company; Research support, Konica Minolta Group; Research support, Mitaya Manufacturing Co, Ltd; Research support, Mitsubishi Corporation; Research support, Koninklijke Philips NV; Research support, Hologic, Inc; Research support, Riverain Technologies, LLC; Research support, Seiko Corporation; Research support, Siemens AG; Research support, 3M Company; Research support, Toshiba Corporation

### LEARNING OBJECTIVES

View learning objectives under main course title.

### ABSTRACT

RC815

## The Biology of Breast Cancer

Friday, Dec. 4 8:30AM - 10:00AM Location: S406B

BR BQ

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

**Participants**

**Sub-Events**

### RC815A Breast Cancer Genomics

Participants
Cherie M. Kuzmiak, DO, Chapel Hill, NC (*Presenter*) Research Grant, FUJIFILM Holdings Corporation;

**LEARNING OBJECTIVES**

1) Understand the molecular classification of breast cancer and comparisont with clinical definitions. 2) Learn some of the main genomic features and clincial and treatment outcomes that stratify with the molecular subtypes.

### RC815B Genetic Risk and Cancer Biology with Imaging

Participants
Elizabeth S. Burnside, MD, MPH, Madison, WI (*Presenter*) Stockholder, NeuWave Medical Inc

**LEARNING OBJECTIVES**

1) Understand the different types of genetic information that are being measured and used for the clinical care of breast cancer. 2) Convey that cancer development and evolution depends on both genetics and environment influences. 3) Demonstrate that imaging has the potential to better understand biology, capturing the complex combined influence of genetics and environment. 4) Illustrate the move toward personalized medicine in breast cancer and the role of imaging.

**ABSTRACT**

### RC815C Imaging Breast Cancer Subtypes

Participants
Sheryl G. Jordan, MD, Chapel Hill, NC, (Sheryl_jordan@med.unc.edu) (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Master the move beyond classifying breast cancer as DCIS, IDC, ILC, or Other/Rare. 2) Understand imaging features for four breast cancer molecular subtypes, namely luminal A, luminal B, HER2-enriched, and basal subtypes. 3) Recognize molecular subtypes' clinical patterns and outcomes in case-based presentations, to include sufficient length of patient follow-up as to reinforce prognosis.

**ABSTRACT**

RC852

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

Friday, Dec. 4 8:30AM - 10:00AM Location: E264

BR US

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

**Participants**

Gary J. Whitman, MD, Houston, TX (*Moderator*) Book contract, Cambridge University Press
Annamaria Wilhelm, MD, Jacksonville, FL (*Presenter*) Nothing to Disclose
Michael N. Linver, MD, Albuquerque, NM (*Presenter*) Scientific Advisory Board, Hologic, Inc; Scientific Advisory Board, Real Imaging Ltd
Stamatia V. Destounis, MD, Scottsville, NY (*Presenter*) Research Grant, FUJIFILM Holdings Corporation; Research Grant, Hologic, Inc; Research Grant, QT Ultrasound LLC
Anna I. Holbrook, MD, Atlanta, GA (*Presenter*) Nothing to Disclose
Alice S. Rim, MD, Cleveland, OH, (rima@ccf.org) (*Presenter*) Nothing to Disclose
Alda F. Cossi, MD, Boston, MA (*Presenter*) Nothing to Disclose
Eren D. Yeh, MD, Boston, MA, (eyeh@partners.org) (*Presenter*) Nothing to Disclose
Gary W. Swenson, MD, Mason City, IA (*Presenter*) Nothing to Disclose
Catherine W. Piccoli, MD, Voorhees, NJ (*Presenter*) Stockholder, VuCOMP, Inc;
Michael P. McNamara JR, MD, Cleveland, OH, (mpm9@case.edu) (*Presenter*) Nothing to Disclose
Selin Carkaci, MD, Columbus, OH (*Presenter*) Author with royalties, Reed Elsevier
Jean M. Seely, MD, Ottawa, ON (*Presenter*) Nothing to Disclose
Phan T. Huynh, MD, Houston, TX (*Presenter*) Research Grant, Siemens AG; Consultant, Siemens AG
Basak E. Dogan, MD, Houston, TX (*Presenter*) Nothing to Disclose
Jiyon Lee, MD, New York, NY, (jiyon.lee@nyumc.org ) (*Presenter*) Nothing to Disclose
Tanya W. Moseley, MD, Houston, TX (*Presenter*) Nothing to Disclose
Michelle D. McDonough, MD, Jacksonville, FL, (McDonough.michelle@mayo.edu) (*Presenter*) Nothing to Disclose
Peter R. Eby, MD, Seattle, WA, (peter.eby@virginiamason.org) (*Presenter*) Consultant, Devicor Medical Products, Inc
William R. Poller, MD, Pittsburgh, PA (*Presenter*) Consultant, Devicor Medical Products, Inc;
Alexis V. Nees, MD, Ann Arbor, MI (*Presenter*) Nothing to Disclose

## 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

## Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Eren D. Yeh, MD - 2015 Honored Educator

SST01

## Breast Imaging (Multi-modality Screening)

Friday, Dec. 4 10:30AM - 12:00PM Location: E450B

BR DM MR

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

**Participants**
Michael N. Linver, MD, Albuquerque, NM (*Moderator*) Scientific Advisory Board, Hologic, Inc; Scientific Advisory Board, Real Imaging Ltd
Stamatia V. Destounis, MD, Scottsville, NY (*Moderator*) Research Grant, FUJIFILM Holdings Corporation; Research Grant, Hologic, Inc; Research Grant, QT Ultrasound LLC

**Sub-Events**

### SST01-01 Should Screening Breast MRI be Performed in Women with a History of Lobular Neoplasia?

Friday, Dec. 4 10:30AM - 10:40AM Location: E450B

Participants
Claudia R. Seuss, MD, New York, NY (*Presenter*) Nothing to Disclose
Samantha L. Heller, MD, PhD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Jennifer Chun, MPH, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Shira Schwartz, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Freya Schnabel, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Linda Moy, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

Women with lobular neoplasia (LN), defined as a history of LCIS and/or ALH, have an elevated breast cancer risk, yet the benefit of screening MRI is unclear. The purpose of our study is to determine the cancer detection rates with mammography alone versus mammography plus MRI in this population.

#### METHOD AND MATERIALS

This IRB approved retrospective study identified 80 women with LN who underwent a screening MRI and mammogram from 2003 - 2014. Comparison was made to 412 women with LN who underwent mammography alone. Screening MRI was performed at the discretion of the referring physician.

#### RESULTS

2,168 mammograms were performed in 412 women, median 5 exams. 167 (7.7%) biopsies and 149 (6.9%) follow-up exams were performed. 28/412 (6.8%) cancers were detected by mammography, 9 (32.1%) were DCIS and 19 (67.9%) were invasive carcinomas. Median time from LCIS diagnosis to cancer detection was 57 months (range 18 -128 months). An additional 26 (6.3%) interval cancers were detected, 7 (37%) DCIS and 19 (73%) were invasive cancers, 10 carcinomas were stage 2 or higher.245 MRIs were performed in 80 women, median of 2 exams. 41 (16.7%) biopsies and 25 (10.2%) follow-up exams were performed. 9/80 (11.3%) cancers were detected on MRI of which 5 (55.6%) were DCIS and 4 (44.4%) were IDC. Two (2.5%) women developed interval cancers (both Stage 1 IDC's) that were found on follow-up mammogram. Median time from LCIS diagnosis to cancer detection was 48 months (range 6-120 months).Later stage carcinomas were detected on women with LN who were screened with mammogram alone. Cancer detection rate was higher (11.3%) in women who had screening MRI compared to mammography alone (6.8%), although the rates were not significant (p=0.12). Although the rate of follow up exams did not differ (p=.64), more biopsies were performed in the MRI group (p=.02).

#### CONCLUSION

Our study cautiously supports screening MRI for women with a history of LN.

#### CLINICAL RELEVANCE/APPLICATION

Although cancer detection rates were similar between both groups, more interval cancers at an advanced stage were seen in women with LN who underwent mammography alone.

### SST01-02 Outcome of Screening Breast MRI in Pre-menopausal Women as a Function of Week of Menstrual Cycle

Friday, Dec. 4 10:40AM - 10:50AM Location: E450B

Participants
Yolanda Bryce, MD, New York, NY (*Presenter*) Nothing to Disclose
Carol H. Lee, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Junting Zheng, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Elizabeth J. Sutton, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Janice S. Sung, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose
Elizabeth M. Morris, MD, New York, NY (*Abstract Co-Author*) Nothing to Disclose

#### PURPOSE

To determine if there is an association between the outcome of screening breast MRI and the week of the menstrual cycle in pre-menopausal women.

#### METHOD AND MATERIALS

The reports of consecutive screening MRI examinations in pre-menopausal women done from January 2011 through December 2012 were reviewed. Cases for which the stage of the menstrual cycle was documented were included. The week of the menstrual cycle, the degree of background parenchymal enhancement (BPE), final BI-RADS assessment, and positive predictive value of any subsequent biopsy (PPV3) were noted. Rao-Scott Chi square test and Fishers exact test were used to determine statistical significance.

**RESULTS**

A total of 1537 MRI examinations in 1240 women were performed. 334 studies were done in week 1, 620 in week 2, 354 in week 3 and 229 in week 4. There was a significant difference in BPE with fewer cases of marked BPE in weeks 1 and 2 compared to weeks 3 and 4 (p=0.026). However, there was no statistically significant difference in final BI-RADS assessment (p=0.412) or PPV3 by either week of menstrual cycle (p=.180) or by amount of BPE (0.195). Detailed results are presented in Table 1.

**CONCLUSION**

There is no significant difference in outcome of screening MRI examinations by week of menstrual cycle in which the study is performed. Therefore, aiming to perform screening MRI in week 2 is not necessary.

**CLINICAL RELEVANCE/APPLICATION**

Timing screening breast MRI for the second week of the menstrual cycle does not make a difference in outcome and is not necessary.

## SST01-03 Breast Cancers not Detected by MRI in a High and Intermediate Risk Screening Program

Friday, Dec. 4 10:50AM - 11:00AM Location: E450B

Participants
Suzan Vreemann, MSc, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Albert Gubern-Merida, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Susanne Lardenoije, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Bram Platel, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Nico Karssemeijer, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Shareholder, Matakina Technology Limited; Consultant, QView Medical, Inc; Shareholder, QView Medical, Inc; Director, ScreenPoint Medical BV; Shareholder, ScreenPoint Medical BV;
Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Speakers Bureau, Bayer AG

**PURPOSE**

The purpose of this study was to evaluate the visibility of MR screen detected cancers on prior MR examinations in a population with an elevated risk for breast cancer.

**METHOD AND MATERIALS**

An IRB approved, retrospective review of patient files from women screened with breast MRI between 2003 and 2013 was conducted at our academic center. We selected all cases detected in MRI with a prior negative MR examination performed between 6 and 24 months before a cancer was revealed (mean: 12.8 ± 3.7 months). This yielded 43 cancers (3 invasive lobular-, 33 invasive ductal carcinomas, 5 ductal carcinoma in situ and 2 others) in 41 patients (age: 49 ± 9.8 years, 21 BRCA patients). The MR scans where the cancers were detected (diagnostic MR scan) and the prior MR scans were evaluated side-by-side in consensus by two dedicated breast radiologists. The visibility of the cancers on prior scans was rated as: visible (BIRADS 4/5), minimal sign (BIRADS 2/3), or invisible (BIRADS 1). Chi-square tests were used to test the correlation between patient and cancer characteristics, image quality (IQ), background parenchymal enhancement (BPE), and visibility of the tumor in the prior MR scan.

**RESULTS**

All lesions were retrospectively evident on the diagnostic MR scan. Review of the prior examinations of the 43 cancers detected in follow-up rounds revealed that 11 lesions (26%) were visible in the prior MRI and should have been recalled at the time of this scan. 15 lesions (35%) showed a minimal sign in the prior MRI. Only 17 lesions (40%) were completely invisible. High grade, ER negative, and PR negative tumors were more often invisible in the prior scan (p=0.016, p=0.005, and p=0.002). Moreover, tumors in BRCA patients were more likely to be invisible in the prior scan, than in non-BRCA carriers (p=0.025). IQ and BPE were not significantly related to the visibility of tumors in the prior scan.

**CONCLUSION**

About 26% of the breast cancers could have been recalled earlier and only 40% of the breast cancers were invisible in retrospect.

**CLINICAL RELEVANCE/APPLICATION**

To prevent screening errors regular auditing of clinical practice is indicated. Moreover, like in mammography, structural double reading of MRI screening examinations may be recommended.

## SST01-04 Consistency of Density Categories over Multiple Screening Rounds Using Volumetric Breast Density

Friday, Dec. 4 11:00AM - 11:10AM Location: E450B

Participants
Katharina Holland, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Carla H. van Gils, PhD, Utrecht, Netherlands (*Abstract Co-Author*) Software support, Matakina Technology Limited
Johanna O. Wanders, Utrecht, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Speakers Bureau, Bayer AG
Nico Karssemeijer, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Shareholder, Matakina Technology Limited; Consultant, QView Medical, Inc; Shareholder, QView Medical, Inc; Director, ScreenPoint Medical BV; Shareholder, ScreenPoint Medical BV;

**PURPOSE**

As a result of the breast density laws, clinicians in many states are obliged to inform women about their breast density and the increased risk that is associated with dense breasts. An increasing number of women with dense breasts decides to have

supplemental screening. Using an automated software system, we investigated the consistency of the classification of serial screening mammograms in non-dense and dense classes over time.

**METHOD AND MATERIALS**

Full field digital mammograms from a breast cancer screening program were used in which women are invited every two years, starting at the age of 50. The initial screening exam and three subsequent screening exams were available for 2504 women. The average screening interval was 24.4 months. All images were processed by Volpara 1.5.0 (Matakina, Wellington, New Zealand); volumetric percent breast density (PDV) was calculated and averaged over both MLO images. Using the thresholds of the Volpara Density Grade (VDG), all exams were classified as non-dense (PDV<7.5, VDG1+2) or dense (PDV>7.5, VDG3+4). Additionally, to avoid class switches due to small fluctuations of PDV, we defined a gated threshold as follows: For a change to the dense category a PDV greater than 8.3 was required, for a decrease a threshold of 6.7 was used. The gate width was based on noise measures.

**RESULTS**

The majority of women stayed in the same category for the whole period, 38.9% non-dense and 34.5% dense, using the fixed threshold. In 18.1% of the women density decreased and the class changed from dense to non-dense; The deviating patterns were as follows: For 2.4% of the women one intermediate exam was classified as non-dense, while all other exams were dense. Three non-dense and one dense exam were observed in 3.8%. In 2.4% two exams were classified as dense and two as non-dense. Use of the gated threshold reduced the number of women with a deviating pattern.

**CONCLUSION**

Classification into dense and non-dense classes gives stable results over time. Only in a small fraction of the population do we need to assume that an exam was not assigned to the proper class. Use of a gated threshold to separate the non-dense from the dense class reduces the percentage of misclassified exams.

**CLINICAL RELEVANCE/APPLICATION**

A consistent classification in non-dense and dense classes is important, as women and clinicians might lose confidence in the stratification process when supplemental screening is offered in deviating pattern.

## SST01-05 The Relation between Diabetes, Hypertension, Obesity and the Risk of Breast Cancer Development- Results from a Population-based Breast Cancer Screening Program

Friday, Dec. 4 11:10AM - 11:20AM Location: E450B

Participants
Dorria S. Salem, MD, Cairo, Egypt (*Presenter*) Nothing to Disclose
Rasha M. Kamal, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Sarah A. Maksoud, MBBCh, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Rehab M. El Sheikh, MD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Asmaa Abdel Magied, MD, PhD, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose
Iman Adel, MA, Cairo, Egypt (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

The aim of this study is to evaluate the relation between diabetes, hypertension, obesity and the development of breast cancer in a population- based screening program.

**METHOD AND MATERIALS**

The studied population includes104,893 female patients who were enrolled in a population-based Breast Cancer Screening Program in the period from November 2007 to November 2013. All patients performed a mammography examination and were classified according to mammography examination into: Group 1 (BI-RADS 1, 2 and 3 categories) and Group 2 (BI-RADS 4 and 5 categories according to the Mammography Bi-RADS lexicon. Blood pressure (BP), random blood sugar (RBS) and body mass index were measured and compared between females in both groups. Descriptive statistics (frequencies and percentages for categorical variables) were calculated in both groups. Comparison between both groups was performed using Chi square test. P values less than 0.05 were considered statistically significant.

**RESULTS**

The studied population included 104,893 females screened for breast cancer ; 2125/104,893 (2%) of which were scored as BIRADS4 and BIRADS5 categories. Group 2 showed statistically higher elevated random blood sugar levels (652/2125, 30 %), higher blood pressure levels (873/2125, 2125, 41%) and higher BMI (1768/2125, 83.2%) than group 1. The calculated p-values were 0.064, <0.001 and 0.005 respectively.

**CONCLUSION**

The findings of the current study provide evidence in support of a statistically significant association between elevated blood sugar levels, hypertension, body mass index and breast cancer risk among screened population.

**CLINICAL RELEVANCE/APPLICATION**

The incidence of breast cancer, diabetes, hypertension and obesity on the rise. They all carry high burden of morbidity and mortality. Breast cancer preventive strategies should be applied with higher concern for those with hypertension, elevated blood sugar levels and overweight population.

## SST01-06 The Impact of Making 3D Mammography Available to a Rural Population

Friday, Dec. 4 11:20AM - 11:30AM Location: E450B

Participants
Christin S. Reisenauer, MD, Moscow, ID (*Presenter*) Nothing to Disclose
Mark D. Hiatt, MD, MBA, Salt Lake City, UT (*Abstract Co-Author*) Medical Director, Regence BlueCross BlueShield; Board Member, RadSite ; Former Officer, HealthHelp, LLC

**PURPOSE**

To assess the impact of making digital breast tomosynthesis, or 3D mammography, available to a rural population (previously with access to only conventional 2D digital mammography).

**METHOD AND MATERIALS**

The impact of adding 3D mammography on May 5, 2014, as interpreted by 3 board-certified (but not fellowship-trained) radiologists at a 25-bed community hospital serving a rural area in the U.S. encompassing a population of 24,500 (but affecting an extended area encompassing more than1 million), was ascertained by analyzing data (compiled via MRS tracking software) from 5,387 screening and diagnostic mammographic exams (comprised of 2,426 2D studies performed between 5/5/13 and 3/31/14 and 2,961 3D studies performed between 5/5/14 and 3/31/15) regarding (a) compliance with annual screening mammography, (b) the rate of breast-cancer detection per 1,000 screened, (c) the call-back rate for screening exams, and (d) community embracement of 3D technology (as evidenced by its acquisition by nearby facilities).

**RESULTS**

After 3D installation, (a) screening exams increased by 26% (from 2,128 to 2,685), despite no significant rise in population, (b) the rate of breast-cancer detection increased by 98% (from 4.70 to 9.31 per 1,000), (c) the call-back rate declined by 18% (from 8.18 to 6.67%), and (d) of the 9 major hospitals in the area, all but 2 are slated to acquire 3D mammography within one year of the initial installation.

**CONCLUSION**

Following the addition of 3D mammography in a small community, the compliance with screening mammography, rate of breast-cancer detection, and rate of community embracement of 3D technology increased, while the call-back rate decreased.

**CLINICAL RELEVANCE/APPLICATION**

Making 3D mammography available to a rural population may improve key metrics of breast-cancer imaging and entice yet more providers in the region to offer this technology.

## SST01-07 How Can We Identify Women at Risk for a Masked Cancer, Who May Benefit from Supplemental Screening?

Friday, Dec. 4 11:30AM - 11:40AM Location: E450B

Participants
Katharina Holland, Nijmegen, Netherlands (*Presenter*) Nothing to Disclose
Carla H. van Gils, PhD, Utrecht, Netherlands (*Abstract Co-Author*) Software support, Matakina Technology Limited
Johanna O. Wanders, Utrecht, Netherlands (*Abstract Co-Author*) Nothing to Disclose
Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Speakers Bureau, Bayer AG
Nico Karssemeijer, PhD, Nijmegen, Netherlands (*Abstract Co-Author*) Shareholder, Matakina Technology Limited; Consultant, QView Medical, Inc; Shareholder, QView Medical, Inc; Director, ScreenPoint Medical BV; Shareholder, ScreenPoint Medical BV;

**PURPOSE**

The sensitivity of mammograms is low for women with dense breasts, since cancers may be masked by dense tissue. In this study, we investigate methods to identify women with density patterns associated with a high masking risk. Three methods based on quantitative volumetric breast density analysis are compared to an area based density measure.

**METHOD AND MATERIALS**

We used the last negative screening mammograms of 87 women who subsequently presented an interval cancer (IC) and, as controls, 870 randomly selected normal screening exams from women without cancer. Volumetric breast density maps (VBDMs) were computed using software provided by Matakina (Wellington, New Zealand). These maps provide dense tissue thickness for each pixel location. We used the VBDMs to compute three masking measures: 1) Volume of glandular tissue (VGT), 2) Percent dense volume (PDV), and 3) Percent area where dense tissue thickness exceeds 1cm (PA1). In addition, we determined percentage dense area (PDA) after classifying pixels automatically in dense and nondense classes (random forest classifier). Methods were applied to MLO views and averaged per exam. For each method, we selected cases with the highest masking measure (by thresholding) and computed the fraction of ICs as a function of the fraction of controls selected. We used the Volpara Density Grade (VDG, threshold on PDV) to distinguish women with nondense breasts from dense breasts (VDG3+4). In practice women with dense breasts are offered supplemental screening. We determined the fraction of controls corresponding to this categorization, and determined sensitivity of our masking measures to select women with masked cancers.

**RESULTS**

Using VDG, 38% of the controls have dense breasts. When offering 38% of the women supplemental screening, 55%, 66%, 71% and 60% of the women with IC would be included using VGT, PDV, PA1 and PDA respectively. The sensitivity of PA1 was significantly higher compared to VGT and PDA (p-value <0.05).

**CONCLUSION**

Measures based on volumetric density maps are a promising tool to identify women with a high risk for a masked cancer. Novel masking risk measures have a higher sensitivity than often used measures such as percent dense volume and area.

**CLINICAL RELEVANCE/APPLICATION**

When offering supplemental screening to women with a high risk for masked cancer, the response of this group should be as high as possible to make supplemental screening feasible and cost efficient.

## SST01-08 Comparison of Visibility of Screen Detected Cancers on One-View versus Two-View Digital Breast Tomosynthesis and Full Field Digital Mammography

Friday, Dec. 4 11:40AM - 11:50AM Location: E450B

Participants

Asif Iqbal, MBBS, London, United Kingdom (*Presenter*) Nothing to Disclose
Rema Wasan, MBBCh, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Juliet C. Morel, MBChB, MRCP, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
David Evans, MBBS, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Rumana Rahim, MBBS, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Clare Peacock, MBBS, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Jane E. Goligher, FRCR, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Michael J. Michell, MBBCh, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Keshthra Satchithananda, MBBS, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Published data from large randomized trial (Wald NJ et al, 1995) indicates significantly increased sensitivity for cancer detection with two-view versus one-view mammography in routine screening. This resulted in implementation of bilateral two-view, medio-lateral-oblique (MLO) and cranio-caudal (CC) rather than one-view mammographic screening. With the advent of digital breast tomosynthesis (DBT) which allows better tissue visualization, we wanted to assess the difference between two-view versus one-view DBT on cancer detection.

**METHOD AND MATERIALS**

Study group included women who were diagnosed with cancers following recall after routine screening. Cases were identified by their initial film-screen mammography for a suspected lesion. At assessment all subjects underwent bilateral DBT and full field digital mammography (FFDM) examinations as combo in two views (MLO and CC projections), ensuring that DBT and FFDM reconstructed images were co-registered. The process involved first reviewing FFDM followed by DBT mammograms. In each session all readers initially read and rated MLO view of both breasts then read and scored bilateral CC view. Each of the projections (MLO and CC) was interpreted separately. Readers were not allowed to revert to the previous view. This prevented changing of scores of already marked lesions.

**RESULTS**

Of 358 cancers (in 345 women) imaged on DBT, 19 (5.3%) lesions were visible only on the MLO examination and 2 (0.5%) were only seen on the CC examination; compared to FFDM, 27 (7.5%) were visible only on the MLO view and 15 (4.2%) were seen only on the CC view. Five (1.4%) cancers were only detected on DBT. The projection view of the imaging modality influenced the predictive value for malignancy. The difference in the distribution of cancers detected on MLO-alone and CC-alone was statistically significant (p-value < 0.035 on Fisher's exact test). This suggested that detection of malignant lesions on DBT was more likely than on FFDM.

**CONCLUSION**

The study results demonstrated that obtaining both views is necessary to ensure that a malignancy will be optimally visualized and derive the potential benefit from DBT.

**CLINICAL RELEVANCE/APPLICATION**

Two-view DBT detects more cancers than two-view FFDM and more than one-view DBT. Therefore DBT imaging in both CC and MLO positions should be performed.

## SST01-09 The Influence of Environment on Optimal Image Acquisition during Mammography

Friday, Dec. 4 11:50AM - 12:00PM Location: E450B

Participants
Shakira Sarquis, Boca Raton, FL (*Presenter*) Nothing to Disclose
Kathy J. Schilling Colletta, MD, Delray Beach, FL (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

The purpose of mammography is early detection of breast cancer, therefore image quality is essential. Proper breast positioning is a key factor affecting mammographic quality. Proper positioning maximizes the amount of breast tissue imaged thus potentially increasing the sensitivity of the mammogram. We sought to investigate the effect of a multi-modal sensory stimulating environment on the quantity of breast tissue imaged and the compression force used during mammography when compared to a typical setting.

**RESULTS**

The quantity of additional breast tissue obtained in the SR was significantly improved when compared to the TR in all four standard projections ($p<=.04$). Mean percentage of additional tissue obtained in the SR versus TR was 5.0%. There were no significant differences present in the compression force utilized to obtain the additional tissue ($p>=.14$).

**CONCLUSION**

In summary, a multi-modal sensory stimulating environment positively impacts optimal mammographic image acquisition by maximizing tissue visualized radiographically with no significant change in compression force when compared to typical mammography room. Incorporating a sensory stimulating environment during mammography may serve to increase the sensitivity of the mammogram by reducing false negatives attibuted to inadequate tissue acquisition. Optimal positioning maximizes of amount of breast tissue imaged. The rationale behind these findings may be understood by previous research that reported decreased anxiety and decreased discomfort during mammography when completed in this same sensory-stimulating environment.

**METHODS**

A retrospective analysis was conducted of women who underwent mammography (n=303) for two consecutive years with their last mammogram being completed in a sensory-stimulating mammography room (SR) and the prior mammogram being completed in a typical mammography room (TR). Specifically, the SR attempted to induce relaxation through simultaneous stimulation of the olfactory, sight, and auditory senses by infusing the air with a light aroma while wall monitors displayed soothing videos of varying environmental themes, and projected relaxing sounds. The amount of tissue imaged was calculated measuring the posterior nipple line on the two MLO and two CC images for both years. Additionally, the compression force was measured for each projection.