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

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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.
TEACHING POINTS

The imaging 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.
Mucocele-like Lesions of the Breast: Imaging-pathologic Correlation

All Day Location: BR Community, Learning Center

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

All Day Location: BR Community, Learning Center

Participants
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TEACHING POINTS
Ultrasoundography (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, sclerosing adenosis, atypical ductal hyperplasia, fibrocystic change, usual ductal hyperplasia. 6. Physiologic uptake or pseudolesion. 7. Post operative change and seroma.
Breast Biopsy Markers: Purpose, Features, and Imaging Appearances
All Day Location: BR Community, Learning Center

Participants
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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
Breast Manifestation of Systemic Disease and Generalized Condition

All Day Location: BR Community, Learning Center

Participants
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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)
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
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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. Analyze 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, pseudoangiomatous stromal hyperplasia (PASH), also found in 25% of all benign breast biopsies.- Difficult lesions: Atypical hyperplasia, Papilary lesions
2. 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't try to diagnose everything: The main aim of core biopsy is to suggest the correct management of that lesion.

All Day Location: BR Community, Learning Center

Awards
Certificate of Merit

Participants
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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. Analyze 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
Papillary Lesions of the Breast: A Radiopathological Pictorial Review and Diagnostic Work-up

All Day Location: BR Community, Learning Center

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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 analyze 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
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;
TEACHING POINTS

1. Common areas of missed pathology on breast MRI includes the lungs, heart, liver and thoracic spine. Having a routine search pattern which includes reviewing common "blind spots" will decrease the likelihood of missing significant non-breast pathology.
2. 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, infiltrate
- Cardiac: cardiomegaly, pericardial cyst
- Liver: simple cyst, hemangioma
- Bones: hemangioma
- Soft tissue: axillary schwannoma
- Other: gastric tumor, splenic cyst
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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 malignant. In our educational exhibit more than 80 cases will be in details presented as a pictorial review with their histological proven result.
Ultrasound Elastography Pitfalls: Special Tips to Avoid Misdiagnosis!

All Day Location: BR Community, Learning Center

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TEACHING POINTS
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.
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
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TEACHING POINTS
To review usually-benign imaging findings which may hide a malignant lesion, emphasizing pitfalls, diagnostic difficulties and differential diagnosis. To analyze 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.
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
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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 Algorithm • Procedural Considerations • Fine Needle Aspiration • Ultrasound-guided Core Needle Biopsy • Vacuum-assisted Core Needle Biopsy
Demystifying Distortions: The Spectrum of Disease in Architectural Distortion Detected By Tomosynthesis

All Day Location: BR Community, Learning Center

Participants
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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.
Breast Cancer Molecular Subtypes: A Primer for Radiologists

All Day Location: BR Community, Learning Center

Participants
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Tamara Ortiz-Perez, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
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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
Molecular Imaging of Breast Cancer: Pictorial Review with Pathologic Correlation

All Day Location: BR Community, Learning Center

Participants
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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 factor2 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
Evaluation of Multiple Imaging Presentations of Mucinous Carcinoma of the Breast

All Day Location: BR Community, Learning Center

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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 Management Review of pathology findings Histologic findings Gross pathology Review of imaging findings Mammography Ultrasound MRI Cases of mucinous carcinoma demonstrating different imaging findings Summary
Unusual Male Breast Masses

All Day Location: BR Community, Learning Center

Participants
Shaza Alsharif, MD, Jeddah, Saudi Arabia (Presenter) Nothing to Disclose
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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 tumors
2. Describe the diagnostic algorithm for evaluating the male breast masses
3. 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), pilomatrixoma, invasive papillary carcinoma, sebaceous cyst among others
4. Discuss the impact of early and accurate diagnosis on the management options
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.

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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.
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

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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 screening

COMPARISON 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.
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
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Josefa Galobardes Monge, MD, Parla, Spain (Abstract Co-Author) Nothing to Disclose
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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 extramammary findings on MRI breast Identify extramammary findings Review the most common incidental findings Provide algorithms to evaluate and recommended management 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 attention was focused on the breast findings. Cases will be review, differential diagnosis and recommended management will be provide. The list of cases includes: Liver lesions Chest wall lesions Lung lesions Other lesions
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
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

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
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
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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 disease Regional nodal spread: Axillary, Retropleural, 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 disease Differences in pattern of spread between invasive ductal and invasive lobular carcinoma Summary
**Participants**
Sagine A. Berry-Tony, MD, New Hyde Park, NY (Presenter) Nothing to Disclose
Ruth D. Samiento, 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. Introduction
2. 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.
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
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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 patients 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 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.
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 anatomy. 2. Illustrate malignant pathology identified in the axilla with radiologic/pathologic correlation. 3. Discuss benign entities that may manifest in the axilla with radiologic/pathologic correlation.

TABLE OF CONTENTS/OUTLINE
Anatomy of the axilla
Imaging findings of normal vs. abnormal axillary lymph nodes
Malignancies detected on imaging of the axilla to include:
1. Metastatic disease from breast primary
2. Metastatic disease from non-breast primary
3. Lymphoma
4. Other tumors of the axilla
Benign conditions diagnosed in the axilla to include:
1. Tattoo pigment in a lymph node
2. Silicone lymphadenopathy
3. Lymphoid hyperplasia
4. Systemic inflammatory conditions
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
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
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
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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.
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.
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 mammography. 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.
2. 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.
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
Pathophysiology Clinical Presentation Imaging Findings using sample cases Mammography Sonography MRI Radiologic pathologic concordance using sample cases Conclusions-
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
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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 cancer.
2. To provide illustrative examples of CEUS compared to MRI in patients with newly diagnosed invasive carcinoma.
3. To compare and contrast qualitative and quantitative parameters of these tumors on CEUS with established parameters on MRI.
4. To correlate the findings of CEUS and MRI to histopathology and receptor status.
5. To 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 CEUS
B. Literature review
C. Review of limitations of current modalities
D. Show case examples of patients at our institution that have biopsy proven invasive breast carcinoma with an initial CEUS and MRI prior to treatment.
E. Correlate imaging findings with histopathology/receptor status.
F. Provide preliminary data comparing tumor size, percent necrosis, and enhancement patterns between CEUS and MRI.
G. Provide illustrative examples of nonenhancing invasive cancer subtypes on CEUS and their corresponding MRI findings.
H. 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.
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
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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.
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.
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 therapy.
2. 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 recurrence.
4. Treatment options for locoregional recurrent breast cancer.
5. Prevention of recurrent disease: Can we do better?
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.
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
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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.
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 basis
Learn mammographic, sonographic and MRI features
Discuss appropriated management

TABLE OF CONTENTS/OUTLINE
Definition and diagnostic criteria
Pathophysiology: diabetes is not the only associated factor
Case-based review illustrating mammographic, sonographic, MRI and clinical background features
Natural history of the disease: Biopsy could be avoided in some patients?
Suggested Management
Noncalcified Ductal Carcinoma in Situ: The Danger that Lies Beneath
All Day Location: BR Community, Learning Center

Awards
Certificate of Merit

Participants
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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
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
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 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-Introduction 2-Normal Anatomy of the male breast 3-Benign pathology of the male breast: Gynecomastia, lipomas, infections, Diabetic mastopathy 4-Malignant pathology of the male breast: carcinomas, sarcomas 5- Male breast carcinoma: a clinicopathological and immunohistochemical characterization. 6-Appearances mammography, Tomosynthesis and US in the evaluation of male breast disease 7-Diagnostic algorithm 8-Conclusion
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
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Elise Desperito, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
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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 of laser ablation therapy (LAT) for the treatment of fibroadenomas in 2007. Currently, there are ongoing clinical trials to assess the safety and efficacy of LAT for early stage breast cancer. Given the recent increase in LAT use for benign lesions and the potential for new indications in the near future, it is essential for radiologists to understand the procedure and post-ablation appearance on different imaging modalities. The purpose of this exhibit is to discuss:
1) Details of LAT technique
2) Advantages, limitations, and common complications of LAT
3) 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 images including:
a. Pre- and post-ablation mammography
b. Pre- and post-ablation ultrasound
c. Pre- and post-ablation breast MRI
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
Introduction
Definition of diagnostic error
Causes 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 Management
Role of Double Reading
Role of Tomosynthesis
Conclusion: Diagnostic errors should be considered not as signs of failure, but as learning opportunities.
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
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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 foreign 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
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
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TEACHING POINTS
1-To review the radiological features of fibroepithelial lesion of the breast and establish the radiopathological correlation
2-To discuss the main differential diagnosis of these entities

TABLE OF CONTENTS/OUTLINE
1-Introduction
2-Classification: fibroepithelial lesion of the breast: Fibroadenoma, Phyllodes tumor
Other benign fibrous lesions: Sclerosing lobular hyperplasia, Diabetic fibrous mastopathy, Focal fibrosis, Pseudoangiomatous stromal hyperplasia (PASH), Fibromatosis
3-Imaging spectrum: mammography, Tomosynthesis, conventional ultrasound, and MRI appearances
4-Correlation between imaging features and pathology findings
5-Differential diagnosis
6-Conclusion
Evolving Strategies in Breast Cancer Screening: The High Risk Patient

All Day Location: BR Community, Learning Center

Participants
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TEACHING POINTS
Review breast cancer risk factors. Review the available mathematical risk assessment models and their strengths and weaknesses. Review screening 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
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 variety 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
Avoiding Confusion Using Breast Diffusion MRI

All Day Location: BR Community, Learning Center

Participants
Amaya Martin, Sabadell, Spain (Presenter) Nothing to Disclose
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TEACHING POINTS
To show the current usefulness and future potential of diffusion-weighted imaging (DWI) in breast imaging. Adding DWI to conventional dynamic contrast-enhanced sequences improves the specificity of breast MRI. New functional imaging techniques like DWI enable us to study physiologic processes in tumors and obtain information to complement conventional techniques.

TABLE OF CONTENTS/OUTLINE
DWI allows us to observe a series of molecular processes before morphological changes become visible on conventional techniques. Well-established indications for DWI in daily clinical practice: DWI parameters can serve as surrogate biomarkers for early prediction and for monitoring the response to primary chemotherapy. DWI is also useful for differentiating benign from malignant lesions: malignant lesions have significantly lower apparent diffusion coefficients (ADC) than benign lesions. DWI can help differentiate posttreatment changes from tumor recurrence. Potential applications of DWI: Current research aims to correlate DWI parameters with tumor grade and molecular profiles. DWI may enable screening of high-risk patients without intravenous contrast agents. DWI may help detect axillary lymph node involvement in patients with breast cancer. Diffusion tensor imaging will allow breast fiber tractography.
Radiological Features of Primary and Secondary Breast Lymphoma: What Radiologists Need to Know
All Day Location: BR Community, Learning Center

Participants
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TEACHING POINTS
To review the radiological features of primary and secondary breast lymphoma in mammography, US, MR and 18F-FDG PET/CT
To 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 lymphoma
Review of imaging findings
Digital Mammogram
Ultrasound
MRI
PET
Sample cases and differential diagnosis
BI-RADS assessment and recommendations according to the 2013 5th edition
Summary
BR152-ED-X

Axillary Pathology: The Forgotten Corner of Mammography

All Day Location: BR Community, Learning Center

Participants
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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 views
2. 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/ infectious causes, iatrogenic and systemic bilateral causes. Review of more unusual non-nodal, non-breast pathologies
3. 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 mimics
Non-nodal axillary pathology
Breast: primary breast lesions/ calcification
Extra-mammary: including soft tissue sarcoma, small cell carcinoma and worm infection
Cross sectional correlates for mammography where appropriate.
Awards
Certificate of Merit

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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.
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
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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.
Imaging Spectrum of Breast Cancer Metastases and Patterns of Metastatic Spread

All Day Location: BR Community, Learning Center

Awards
Certificate of Merit
Identified for RadioGraphics

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

TABLE OF CONTENTS/OUTLINE
1. Review non-mammary sources of metastatic disease to the breast
2. Discuss hematogenous and lymphangitic dissemination of disease in regards to common imaging pitfalls
3. Identify important imaging features and their histopathology correlates through a series of cases depicting:
Rare Mesenchymal Breast Tumors: A Radiology - Pathology Correlation

All Day Location: BR Community, Learning Center

Participants
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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 breast
2. Discuss key imaging features on mammography, ultrasound and MRI
3. 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 include:
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 - Treatment 2. 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
No Cancer Left Behind: A Case-Based Review of the Utility of Pre-operative Breast MRI

All Day Location: BR Community, Learning Center

Participants
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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, multicentric, 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. - Mammogram and sono demonstrating a primary mass found to have a few subcentimeter nodules in one quadrant on MRI consistent with multifocal disease. - Mammogram demonstrating a cluster of micro calcifications consistent with DCIS, found to have multicentric invasive ductal carcinoma on MRI.
The Role of Breast MRI in the Diagnosis and Management of Papillary Lesions of the Breast

Participants
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TEACHING POINTS

To review MRI features of the different papillary lesions of the breast
The role of breast MRI for planning the surgery
Vacuum biopsy MRI-guided for histological diagnosis and its 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 make 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 a useful 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 biopsy MRI-guided constitutes an alternative to surgery for the treatment.
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
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TEACHING POINTS
1. Review the epidemiology & clinical presentation of Paget’s disease
2. Review the theories of pathogenesis of Paget’s disease
3. Review the imaging & pathologic features of Paget’s disease

TABLE OF CONTENTS/OUTLINE
1. Paget disease: Epidemiology, clinical presentation
2. Pathogenesis: Epidermotropic & intraepidermal transformation theories
3. Imaging appearance
   A. Mammography: 1. Nipple areolar complex (NAC): Skin thickening, calcifications, mass
   B. Ultrasound: 1. NAC: Skin thickening, NAC flattening
   C. MRI: 1. NAC: Skin thickening, asymmetric enhancement
   D. CT and PET/CT: Incidental or known Paget's disease
4. Pathologic features
   A. Infiltration of the nipple epidermis with Paget cells
   B. Underlying intraductal carcinoma
5. Differential diagnosis: malignant melanoma, Bowen's disease, clear keratinocytes, Toker cells, inflammatory changes
6. Management: Mastectomy +/- axillary dissection vs. breast conservation surgery, radiation +/- chemotherapy or hormonal therapy
Thinking Outside of the Breast: Secondary Findings on Diffusion Weighted MR Imaging

All Day Location: BR Community, Learning Center

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Lena A. Omar, MD, Dallas, TX (Presenter) Nothing to Disclose
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TEACHING POINTS
1. Review the role of diffusion weighted breast MRI and highlight its utility in clinical practice. 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 correlation. 4. 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 MRI. Discuss the utility of diffusion weighted imaging for MR evaluation of the breast. 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 MRI. 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.
Awards
Certificate of Merit

Participants
Ramapriya Ganti, MD, Dallas, TX (Presenter) Nothing to Disclose
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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 capsule 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
Reading Between the Lines: Magnetic Resonance Evaluation for Breast Implant Rupture

All Day Location: BR Community, Learning Center

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

All Day Location: BR Community, Learning Center

Participants
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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-Introduction
2-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 complex
4- Assessment. Mass. Distinguishing Breast Skin Lesions from Superficial Breast Parenchymal Lesions: Role of Tomosynthesis, Role of Tangential View
5- Differential Diagnosis Paget's Disease versus Ezcema. What Every Radiologist Should Know.
6-Limitations
7-Conclusion
Unilateral Breast Edema: What We Know and What We Need to Learn

All Day Location: BR Community, Learning Center

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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. Introduction
2. 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 failure
3. Review of radiologic findings a. mammography b. ultrasound c. MRI
4. Illustrative cases
5. Discussion
6. Conclusion
Uncommon But Not Forgotten: Unusual Tumors of the Breast

All Day Location: BR Community, Learning Center

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TEACHING POINTS
1-To identify clinical and imaging features of uncommon tumors of the breast
2-To appreciate the role of pathology in diagnosis
3-To describe the role of imaging in staging and follow-up

TABLE OF CONTENTS/OUTLINE
1-Introduction
2-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 tissue
3- 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.

All Day Location: BR Community, Learning Center

Awards
Cum Laude

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Hye Mi Gweon, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
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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
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
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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 density
2. Lesions: i. calcifications, ii. masses, iii. asymmetries, iv. architectural distortions
3. Examples of s2D reconstruction artifacts
4. Examples of CAD markings in s2D versus DM
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

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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
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/OPTION**

- Etiology
- Clinical features
- Common and uncommon imaging findings
- Mammography
- Ultrasound
- MRI
- Differential diagnosis
- Pathology findings
- Management and prognosis to different presentations
Comprehensive Review of Accessory Breast in Axilla: From Normal to Pathologic Findings

All Day Location: BR Community, Learning Center

Participants
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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
How to Differentiate Large Enhancing Breast Masses in MRI

All Day Location: BR Community, Learning Center

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

All Day Location: BR Community, Learning Center

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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-shell. Indeterminate calcification including crushed stone. More concerning calcification types: microcalcification; fine branching seen in DCIS and malignant (segmental) distribution patterns. Examples of more unusual mammographic calcification including manifestations of systemic disease. Outline of BI-RADs classification with examples.

TABLE OF CONTENTS/OUTLINE

Introduction to standard mammographic views and interpretation including BI-RADS scoring. Benign breast calcification patterns. Malignant patterns including morphology and distribution. Calcification mimicking breast pathology. More unusual pathology including worm infection and manifestations of systemic disease. Where appropriate, mammographic findings will be correlated with multimodality/ cross sectional imaging.
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.
Digital Breast Tomosynthesis in the Evaluation of Advanced Breast Cancer Treated by Neoadjuvant Chemotherapy: Radiologic-pathologic Correlation in the Different Pathological Responses

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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. Background
2. Description of systems for categorization of pathologic response to NC: 2.1. Complete response to therapy
2.2. Partial response to therapy
2.3. No evidence of response to therapy
3. DBT imaging evaluation: 3.1. Parameters used in DBT to monitor response to NC: 3.1.1. Changes in morphology and size
3.1.2. Residual Tumor analysis
3.1.3. Evaluation of microcalcification
3.1.4. Breast density influence
4. DBT - pathology correlation
5. DBT - pathology discordances
6. Illustration with cases of main pitfalls (over- and under-estimation) in post-NC DBT evaluation
7. Clinical implications and future directions
8. References
Image Illustration of Ten Cases of Non-palpable Breast Cancer Detected by Contrast Enhanced Spectral Mammography (CESM)

All Day Location: BR Community, Learning Center

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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.
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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 treatment.
3. 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 MRI.
B. Explain the technique/basics of CEUS.
C. 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 surgery.
D. 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 illustrated.
E. Discuss the future of CEUS and possible applications in patients undergoing NAC.
The Utility of Ultrasound MicroPure Imaging in Breast Grouped Microcalcifications: Imaging Principle and Clinical Application

All Day Location: BR Community, Learning Center

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

All Day Location: BR Community, Learning Center

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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
Microcalcification in the Breast: 50 Shades of Grey?

All Day Location: BR Community, Learning Center

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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

Background
Calcification morphology, distribution and their pathology correlate: Benign: Diffuse, layering, coarse Indeterminate: amorphous, clustered Malignant: fine linear, branching, pleomorphic, segmental Work up and biopsy techniques: Further mammographic views 14G core needle biopsy versus 10G vacuum assisted biopsy Specimen radiographs Management: Wide local excision vs mastectomy Surgical Excision versus Vacuum Assisted Excision Test cases A selection of cases for self assessment.
MRI of Benign Breast Lesions: Key Imaging Findings for Making Correct Diagnosis

All Day Location: BR Community, Learning Center

Awards
Certificate of Merit

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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
   Malignant mimickers in each benign lesion on MRI:
   Key points for correct diagnosis of common benign lesions
   MRI findings that are specific or findings that require caution
Digital Breast Tomosynthesis: Where Does it Fail

All Day Location: BR Community, Learning Center

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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 amount 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.
**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**

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 men.
3. 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.
Intraoperative Specimen Radiography- Going Beyond the Block
All Day Location: BR Community, Learning Center

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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.
Axilla: Not Everything are Lymph Nodes

All Day Location: BR Community, Learning Center

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

All Day Location: BR Community, Learning Center

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

All Day Location: BR Community, Learning Center

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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 radiation
2. 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 mammary
3. 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 elastography
4. Radiologic N staging (rN) utilizing MRI, US, CT, and PET/CT a. rN1 b. rN2 c. rN3 d. Treatment implications
5. Conclusions a. Radiologic N staging can inform treatment decisions and patient expectations
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

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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
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 outcomes. 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-Pathophysiology
2-Clinical findings
3-Diagnostic imaging correlation: Magnetic Resonance, ultrasonography and mammography
4-Pathology findings
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
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 misinterpreted

Given 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
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. Nadjaqi, 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
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

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-RADS 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
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 modalities
2. Brief review of breast MR standardized vocabulary, imaging lexicon
3. Evaluate the morphologic criteria, enhancement patterns, and kinetic characteristics of MR detected BI-RADS 4 and 5 breast masses and malignancy potential
4. 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
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.
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
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
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 search.
   b. Dense breasts:
      i. Scattered and heterogeneous 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 findings:
      i. Mass lacking suspicious secondary findings (calcifications, distortion, skin thickening, or nipple retraction).
      ii. Developing asymmetries.
      iii. Invasive Lobular Carcinoma.
3. Strategies to minimize errors in evaluating tomosynthesis images:
   a. Systematic search pattern.
   b. Awareness of areas in the breast not optimally evaluated with tomosynthesis.
   c. Recognizing suspicious secondary characteristics.
   d. Multimodality approach including ultrasound and MRI.
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 risk
II. Diagnostic imaging of the gravid patient
   A. Imaging recommendations during each trimester of pregnancy and fetal risk
   B. Case presentations
   C. Image guided biopsy
III. Breast cancer staging and fetal risk throughout pregnancy
   A. Surveillance and staging
   B. Imaging recommendations and fetal risk: CT, (CE) CT, MRI, (CE) MRI, PET CT
IV. Post-treatment imaging
   A. Recommendations and fetal risk
V. Postpartum imaging and image guided procedures
   A. Contrast agents and breast feeding
   B. Breast biopsy of the lactating breast
VI. Ethical dilemmas in treating breast cancer during pregnancy
   A. Trimester based discussion and clinical decision making
VII. Multiple choice quiz, answers and explanations reviewing critical educational objectives
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" appearance
3. Morphologic and kinetic characteristics of non-calcified DCIS at dynamic breast MRI
4. Case review
5. Role of imaging and Discussion
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 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.

**TEACHING POINTS**


2. Discordance between radiologic and pathologic CR:
   1. False negative:
      - Presenting initially as nonmass enhancement.
      - Hormone receptor positive.
      - HER2 negative tumor.
      - Pathologic correlation.
   2. Lack of enhancement in breast cancer after chemotherapy.
   3. Decreased microvascularity after neoadjuvant chemotherapy.
   4. Pathologic correlation.

3. False positive:
   1. Enhancement of fibrotic parenchymal change after chemotherapy.
   2. Enhancement pattern and kinetic curve analysis.
   3. Pathologic correlation.
   4. Intraductal lesion.
   5. Pseudo-enhancement due to artifact.
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 exist 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 cancer
Classification of molecular subtypes and evaluation the main differences
Imaging findings in metastatic disease
The role of multi-technique imaging
Targeted follow-up
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 abnormality. 3. Live demonstration of proposed system using tablet computer.
Accessory Breast Tissue (ABT) is a normal embryological variant and can be found in up to 6% of the general population. This panel will discuss embryology, general concepts, multi-modality imaging findings, cancer screening, oncological implications and management of ABT. 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. 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.
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 noncohesive 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
**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.
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 lymph node 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 metodos radioactive seed Localization 125I.
Dual Energy Contrast Enhanced Digital Mammography: A Review of How, Why and When Do We Use it?

All Day Location: BR Community, Learning Center

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

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
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

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 Población?/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
**LEARNING OBJECTIVES**

**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

**Participants**

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

Carlos Zamora, MD,PhD, Chapel Hill, NC

**LEARNING OBJECTIVES**

View learning objectives under main course title.

Objectives: 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.

**Participants**

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

**Participants**

Linei A. Urban, Curitiba, Brazil

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**Participants**

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

**Participants**

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

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**Participants**

**Carlos S. Restrepo, MD, San Antonio, TX** (Presenter) Nothing to Disclose
surveillance in patients at risk of hepatocellular carcinoma. 3) To discuss how to proceed when a liver nodule 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.
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
Michyia 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) Nothing to Disclose
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.
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 and malignant masses. For post operative cases, sensitivity was 85% and specificity was 60%. In cases on chemotherapy, sensitivity was 87% and specificity 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.
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.

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
Sahm 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
Omnia 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 heterogeneous dense (c) and the extremely dense (d) breast densities. The intensity of BPE was assessed on the subtraction high-energy images and was graded on the basis of the ACR BI-RADS criteria, as minimal, mild, moderate, or marked. Statistical correlation was calculated using the Pearson correlation coefficient.

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, 66/207 (31.9%) cases showed mild BPE. Only 2/ 207 (1%) and 1/ 207 (0.5%) cases showed moderate and marked BPE respectively.

CONCLUSION
Mammographic breast density shows a weak positive correlation with the intensity of BPE on CESM. This 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 heterogeneous dense (c) and the extremely dense (d) breast densities. The intensity of BPE was assessed on the subtraction high-energy images and was graded on the basis of the ACR BI-RADS criteria, as minimal, mild, moderate, or marked. Statistical correlation was calculated using the Pearson correlation coefficient.

CLINICAL RELEVANCE/APPLICATION
Mammographic breast density shows a weak positive correlation with the intensity of BPE on CESM. Most of the cases show lower scores of BPE irrespective of the corresponding breast density grade.

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

**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 determined 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 cancers). 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 enhancement patterns in 2 and 4 minutes may predict the nature of breast lesions.

**CLINICAL RELEVANCE/APPLICATION**
Enhancement pattern of CEBT may play a role for differentiating breast lesions.

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

**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, MBCh, 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 BI-RADS 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 (microcalcifications). 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 capabilities.

**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
CEBT and DCE-MRI showed similar diagnostic performance for architectural distortion lesions on screening mammogram. The ROC curve (AUCs) for diagnosis of malignancy were not significantly different between CEBT and DCE-MRI (all p >0.05). Pathology revealed 24 benign lesions and 8 breast malignancies. The sensitivity/specificity/accuracy between CEBT and DCE-MRI 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 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. 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.

**CONCLUSION**

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.
RESULTS

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 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.

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.

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.

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-mammography the calculated diagnostic indices were raised to 95.5%, 96.7%, 95.5%, 96.7%, 28.636 and 0.047 respectively.

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

**Background**

Francesco Luca Maria Giovanni Luigi Massimiliano Francesco

**Participants**

SSA20-05

**need for a costly superconducting magnet.**

VHF-induced thermoacoustics requires propagating powerful EM pulses, similar to B1 excitation pulses used in MRI, but without the

**CLINICAL RELEVANCE/APPLICATION**

VHF-induced thermoacoustic pulses can be detected by clinical ultrasound arrays. Quantitative imaging can be achieved using

**RESULTS**

For microcalcifications, average PC was comparable for the four systems in DM and BT mode, ranging from 78% to 84% for DM and

**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 Sobiati, 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 DiMecco, 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  
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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. BI-RADS 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 BI-RADS 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 30 mm.

**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

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Fleur Kilburn-Toppin, MBBSChir, MA, Cambridge, United Kingdom (Abstract Co-Author) Nothing to Disclose  
Matthew G. Wallis, MD, Cambridge, United Kingdom (Abstract Co-Author) Nothing to Disclose

**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. BI-RADS 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 BI-RADS 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 30 mm.

**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.
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**

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Scientific Advisor, CT Imaging GmbH CEO, CT Imaging GmbH

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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**
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.
Correlation between Intra-voxel Incoherent Motion MRI and Dynamic Contrast Enhanced MRI in Breast Cancer at 3T

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
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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=1.82x1.82x3mm², TE/TR=102/5800ms, b=0, 50, 100, 150, 200, 400, 600, 1000s/mm². DCE: voxel=0.74x0.74x2mm³, 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.

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

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...
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.

**2D Mammography, Digital Breast Tomosynthesis, and Whole Breast Sonography: Which Should be Used for the Different Breast Densities in Screening for Breast Cancer?**

**BR221-SD-SUA3**

**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.

**A Collective Review of the Imaging Characteristics of Various Common and Uncommon Skin Processes of the Breast.**

**BR101-ED-SUA5**

**Station #5**

**Participants**

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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 exams.
2. Descriptions of the mammographic, sonographic, and MRI imaging characteristics of various common and uncommon skin processes and potential artifacts.
3. 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 breast
B. 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

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
3. Late (at or after six months) benign post-treatment findings: skin thickening, skin retraction, increased parenchymal trabeculation, architectural distortion, evolved fat necrosis
4. Late malignant post-treatment findings in cases of biopsy-proven locally recurrent breast cancer: new or increasing mass or architectural distortion, new suspicious calcifications
5. Management of locally recurrent breast cancer
6. Mimics and potential pitfalls of locally recurrent breast cancer: Bovie cautery artifact, FloSeal hemostatic sealant artifact, fat necrosis
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.
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

Participants
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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

Participants
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Todd L. Siegal, MD, Camden, NJ (Abstract Co-Author) Nothing to Disclose
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).

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.

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.

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.

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.

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.
1. Discuss patient and lesion factors which pose technical challenges to successful stereotactic-, US-, and MRI-guided breast biopsy.
2. 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 scenarios.
3. 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 localization.
4. 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. Gless, 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

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 lesions 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. Mammographic/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.
MR Imaging-guided Breast Biopsy (Hands-on)

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

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@mrr.wustl.edu) (Presenter) Nothing to Disclose
Mitva J. Patel, MD, Columbus, OH (Presenter) Nothing to Disclose
Stamia 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
Colleen H. Neal, MD, New York, 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
Robert A. Jong, MD, Toronto, ON (Presenter) Nothing to Disclose
Gary J. Whittman, 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
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
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 malignancy 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.
**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) Nothing to Disclose
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.
Breast Series: Hot Topics in Breast Imaging
Monday, Nov. 30 8:30AM - 12:00PM Location: Arie Crown Theater

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

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.

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 improved cancer detection.
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**

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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 numbers and rates 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


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 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.
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 exams 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

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 BI-RADS 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 (BI-RADS 1,2). 40 cases (5%) were reported as BI-RADS 3. Only eight biopsies were recommended (BI-RADS 4, 5%) 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 BI-RADS 1,2 (75% vs 94%, p<0.0001), a decrease in the rate of BI-RADS 3 (20% vs 5%, p<0.0001), fewer biopsies recommended BI-RADS 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 10:20AM - 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. Grivegneee, MD, Linkebeek, Belgium (Abstract Co-Author) Nothing to Disclose
Mathijs D. Jong, MD, 's-Hertogenbosch, Netherlands (Abstract Co-Author) Nothing to Disclose
Nico Karssemjeier, 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 software (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 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
Nicole Hoogerbrugge, Nijmegen, Netherlands (Abstract Co-Author) Nothing to Disclose
Nico Karssemjeier, 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 rounds 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.
RC215-12  Breast MRI: Screening and Diagnostic Use

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

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

Participants
Sarah Stamler, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
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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%).
METHOD AND MATERIALS

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.

PURPOSE

Participants

Milica Medved, PhD, Chicago, IL
Federico Medved, PhD, Chicago, IL
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Naoko Abe, MD, Chicago, IL
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Gregory S. Karczmar, PhD, Chicago, IL
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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 analyzed 9,504 screening MR examinations in 2,843 women (age: 45 ± 12.09 years), including 761 BRCA patients, and 2,082 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.


Participants

Hiroyuki Abe, MD, Chicago, IL (Presenter) Consultant, Seno Medical Instruments, Inc
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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

Ritse M. Mann, MD, PhD, Nijmegen, Netherlands (Abstract Co-Author) Nothing to Disclose
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.

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

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.
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
Case-based Review of Magnetic Resonance (An Interactive Session)

Monday, Nov. 30 10:30AM - 12:00PM Location: S100AB

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.

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

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 masses 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.
Differential Upgrade Rates for Non-Definitive Image-Guided Core Needle Breast Biopsies Based on BI-RADS Features

Participants
Dipti Gupta, MD, Chicago, IL (Moderator) Nothing to Disclose

Sub-Events

**BR228-SD-MOA2**

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 Montermayor, 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.

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Dual-energy Contrast Enhanced Spectral Mammography. One Step beyond BI-RADS Score, by Adding the Power of Iodinated Contrast Media

Participants
Athanasios N. Chalazonitis, MD, MPH, Athens, Greece (Presenter) Nothing to Disclose
Alexandra Tsigginou, Athens, Greece (Abstract Co-Author) Nothing to Disclose
Christina Giaili, 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 3D. 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
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.
MOA7 Station #7

Participants
Rachel L. Delfanti, MD, San Diego, CA (Presenter) Nothing to Disclose
Haydee Ojeda-Fourier, 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 multimodality breast imaging; Algorithm for the management of metastatic disease to the breast; Test yourself with image and multiple choice questions.

BR198-ED-MOAA8 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.
BI-RADS 5th Edition Breast Density Classification: Comparison of Radiologist and Automated System

**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.

Screen Detected Breast Cancer Conspicuity on Digital Breast Tomosynthesis versus Digital Mammography

**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” (BI-RADS 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.

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

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.

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
**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 (NAC) in breast cancer.
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 Ostimov, 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
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 (Abstract Co-Author) 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

Title: Higher Background Parenchymal Enhancement at Preoperative MRI: Association with Poor Prognosis in Breast Cancer Patients Treated with Neoadjuvant Chemotherapy

Purpose:
To retrospectively investigate whether background parenchymal enhancement (BPE) of the contralateral breast at preoperative dynamic contrast material-enhanced magnetic resonance imaging (DCE-MRI) is 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.
Baseline DCE-MRI and PET-CT as a Predictor of Pathologic Response in Patients Treated with Neoadjuvant Chemotherapy (NAC) for Locally Advanced Breast Cancer

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 retrospective study. Perfusion parameters (Ktrans, Kep, Ve) and SUVmax were measured at baseline of the NAC. Imaging data were compared with tumoral and nodal pathologic response and histopathological tumor characteristics (SBR, Ki67, Hormonal Receptors [HR], HER2, and p53).

RESULTS
Response was observed in 54 patients (61%) and non-response in 34 patients. Low Ve and high SUVmax were significantly associated with tumoral response to NAC (Ve, t-test, p = 0.0035; SUVmax, t-test, p = 0.0265). Other perfusion parameters were not significantly associated with pathological response. 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.
**Evolution of a Breast Screening Program: Indicators of Efficacy**

**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.:
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**

**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 error, with 5 calcifications, 2 asymmetries and 7 mass/focal asymmetry. 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 cancer, or minimal signs. MGs were classified as false negative (FN) if initially incorrectly interpreted 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**

**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
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, 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

PURPOSE
To investigate the necessity of standard (implant-full) views in screening mammography for women with breast implants.

METHOD AND MATERIALS
1,461 mammograms with 838 silicone and 603 saline breast implants performed between November 2009 and September 2014 were...
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.
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.
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.
Breast Series: Emerging Technologies in Breast Imaging

Tuesday, Dec. 1 8:30AM - 12:00PM Location: Arie Crown Theater

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
Atsushi 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**
Although not yet able to avoid histological characterization. Unenhanced MR imaging of the breast including STIR, T2-weighted TSE and DWIBS sequences could characterize breast lesions, CLINICAL RELEVANCE/APPLICATION. DWIBS sequences allow to detect breast lesions while T2-weighted TSE sequences and ADC values could be useful for lesion characterization. Breast UE-MRI could represent an accurate diagnostic tool and a valid alternative to CE-MRI for evaluating breast lesions. STIR and T2-weighted TSE sequences and after 98%, 83%, 90%, 84% and 98%, respectively. The intra- and interobserver agreement was excellent for all of the ADC measurements, with ICCs ranging from 0.84 to 0.94.

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

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.
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±0.13 vs. 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.

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.

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**

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 Oikawa, Nagoya, 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
Kazuki 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 Horba, 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 Ari, Ashigarakami-gun, Japan (Abstract Co-Author) Employee, FUJIFILM Holdings Corporation
Tonomari 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% dose (AGD 0.87 ~ 2.7mGy). In addition, DBT + S2D images with 60% dose were generated virtually using approximately half the normal 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) Consultant, Siemens AG
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
Xiapian 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 BI-RADS final assessments were recorded and Kappa statistics assessed agreement. Recall and cancer detection rates were compared with Fisher's exact test. Multivariate logistic regression models were used to determine 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.
Synthesized 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 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 acquisition, 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.

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. Philpotte, 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 3.5 year period after tomosynthesis implementation. Diagnostic exams were performed on 2D digital mammography units (Selenium, Hologic, Bedford, MA) prior to tomosynthesis implementation and on both 2D and 3D digital breast tomosynthesis units (Dimensions, Hologic, Bedford, MA) in the 3.5 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.

Biopsy Outcomes Following Diagnostic Work-up with Digital Breast Tomosynthesis

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)). 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 and Imaging Features of Tomosynthesis Occult Breast Cancer and Reasons for Non-Detection

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

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)).
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 13 - 66 mm.

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 grade 1, 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.

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. Ambas, 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
Galaine 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 13 - 66 mm. Two 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.
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.
Materials/Methods: Between April 2010 and November 2011 we treated 61 patients after 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.

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 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%.

Intraoperative procedure showed a further decrease of local recurrence rates down to 1,75%.

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. Results: 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 histopathological 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 care for advanced breast cancer patients.

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. Results: 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 histopathological 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 care for advanced breast cancer patients.

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 ODFS 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.

**MSR032-04 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 anatomical 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 to 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.

**MSR032-06 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 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 14.36 Gy, 16.01 Gy and 16.01 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 4.94) Esophagus Mean (Gy)43.97% (SE 0.43)41.66% (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)Card Max (Gy)28.25% (SE 1.64)15.93% (SE 3.34)Thyroid Max (Gy)29.61% (SE 2.91)14.36% (SE 3.25)Larynx Max (Gy)14.24% (SE 2.15)26.26% (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)9.79% (SE 0.23)Total Lung V20Gy (%)13.04% (SE 0.61)14.06% (SE 0.49) Ipsilateral Lung Mean (Gy)3.6% (SE 0.37) 3.2% (SE 0.32) Ipsilateral Breast Mean (Gy)4.13 (SE 0.2)4.05 (SE 0.23)SE= standard error*p<0.05
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 $\geq$70) were oligometastatic which according to our criteria implied the presence of $\leq$ 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 in lung and liver, only 5 (7.9%) "in field" recurrences were observed, all occurred in lung 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).

MSR032-08 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 Ohashi, 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 analysis 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.

MSR032-09 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.
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.
Biopsies of calcifications in women ≥ 70 years yielded a greater than 5% likelihood of malignancy, including triple negative and coarse heterogeneous.

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 amorphous calcifications, with no invasive disease in the coarse heterogeneous calcifications.

Invasive disease was found in 25% (7/28) of fine linear, 18% (3/17) of round, 15% (16/105) of fine pleomorphic, and 5% (2/37) of amorphous calcifications.

The 236 biopsies resulted in 131 (56%) benign, 20 (9%) atypical, 57 (24%) in situ, and 28 (12%) invasive diagnoses. There were 50 (21%) 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, 18% (3/17) of round, 15% (16/105) of fine pleomorphic, and 5% (2/37) of amorphous calcifications. There was no malignancy detected in 9 cases of calcifications described as dystrophic.

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 discordant 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%).

Our review suggests that discordant 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.
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
Haley 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%] and two 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 Paepeke, MD, Munich, Germany (Abstract Co-Author) Advisor, SurgicEye GmbH; Advisor, NeoDynamics AB
Christian H. Pfohl, 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
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Jens-Uwe Blohmer, MD, Berlin, Germany (Abstract Co-Author) Nothing to Disclose
Thorstien 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.

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.

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
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Rosalind P. Candelaria, 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
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.
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.
**Molecular Imaging (Gynecologic Oncology)**

**Tuesday, Dec. 1 10:30AM - 12:00PM Location: S504CD**

**SSG09-01 First Clinical Trial on Ultrasound Molecular Imaging Using KDR-Targeted Microbubbles in Patients with Breast and Ovarian Lesions**

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

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**

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 Sculturiti, 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
Further work on FACBC as a radiotracer in locally advanced breast cancer is warranted.

CLINICAL RELEVANCE/APPLICATION

This pilot trial of FACBC PET/CT in locally advanced breast cancer demonstrates potential uses of FACBC PET/CT before and after neoadjuvant therapy. 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 pathologically proven to be metastases. 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

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
registrations were performed using Mirada RTx (Mirada Medical, Oxford, UK, ver. 1.4.0.23) software. Gross tumour volume (GTV) 18F-FMISO and scanning was started 240 min after injection. CT data was used for attenuation correction. PET and MR image (b=50/850 sec/mm²) and a high-resolution contrast-enhanced (CE) T1-w VIBE sequence. Patients were injected with 330 MBq after start and 3 months (FU) after treatment. MRI protocol consisted of a high-resolution isotropic T2-w SPACE, a DWI EPI 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-weighted images) of WB-PETMR.

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-weighted 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/MR for Assessment of Treatment Response to Chemo-radiation and Hypoxia Monitoring in Cervix Cancer Patients: A Feasibility Study

Tuesday, Dec. 1 11:00AM - 11:10AM Location: S504CD

Participants
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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/mm²) 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 1.02x10-3 mm²/sec increasing to 1.18x10-3 mm²/sec after 2w and to 1.27x10-3 mm²/sec after 5w and to 1.37x10-3 mm²/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
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Andrea Sorcilli, 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, p<0.01), SUVmax (14.19±7.17 versus 6.17±4.24, p<0.004), and SUVmean (8.44±4.01, p<0.004). ADC directly correlated with the degree of Ki67 expression (1019±256 for Ki67<=35%, p<0.004), and SUVmax (6.29±4 versus 11.8±7.65, p<0.046), and SUVmean (3.72±2.28 versus 7.03±4.43, p<0.04). G2 patients experienced lower Kep (6638±2391 versus 8944±1764, p<0.04) and lower SUVmax (6.83±4.73 versus 12.89±7.65, p<0.004). ADC 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.

CONCLUSION

In naïve ductal invasive breast cancers, PET-MR biomarkers correlate with molecular genetic subtypes and 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

To evaluate the impact of ER gene mutations on [18F]-fluoroestradiol uptake in breast cancer.

METHOD AND MATERIALS

Patients with ER positive breast cancer were included. ER gene mutations were identified by next generation sequencing. [18F]-fluoroestradiol uptake was measured by PET imaging. The influence of ER gene mutations on [18F]-fluoroestradiol uptake was assessed.

RESULTS

ER gene mutations were identified in 10% of patients. Patients with ER gene mutations had significantly lower [18F]-fluoroestradiol uptake compared to patients without ER gene mutations. The impact of ER gene mutations on [18F]-fluoroestradiol uptake was also assessed in patients with metastatic disease.

CONCLUSION

ER gene mutations have a significant impact on [18F]-fluoroestradiol uptake in breast cancer. This finding may have implications for the development of targeted therapies.

CLINICAL RELEVANCE/APPLICATION

The impact of ER gene mutations on [18F]-fluoroestradiol uptake in breast cancer may have implications for personalized treatment strategies.
PURPOSE
Accurately predicting therapeutic responsiveness in women with breast cancer remains challenging. Positron emission tomography (PET) imaging using [18F]-16alpha-17beta-fluorooestradiol (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; Consultant, Gamma Medica, Inc
- 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 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 no 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
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 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.
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
Chiara Coriani, Reggio Emilia, Italy (Abstract Co-Author) Nothing to Disclose
Andrea Nitrosi, PhD, Reggio Emilia, Italy (Abstract Co-Author) Nothing to Disclose
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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 women 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.

BR237-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
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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
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 Discordan Core Needle Biopsies: A Predictive Model that Identifies Low Probability (≤2%) Lesions to Safely Avoid Surgical Excision

Participants
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Yirong Wu, Madison, WI (Abstract Co-Author) Research Grant, Hologic, Inc
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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 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**

**Participants**

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**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. Luminal 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 intralasinol 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 intralasinol 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**

**Participants**

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**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-TU6
Computer-aided Diagnosis using Retrieved Images Can Improve Radiologists’ Performance in Classifying Mammographic Calcifications

Participants
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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 than 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

Participants
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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

Awards

Identified for RadioGraphics

Participants

Michyla L. Bowerson, MD, Saint Louis, MO (Presenter) Nothing to Disclose
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TEACHING POINTS

1. Review the imaging features BRCA gene mutation related tumors, including mammography, US and cross-sectional imaging
2. Discuss the epidemiology, clinical presentation and management of BRCA gene mutation related tumors

TABLE OF CONTENTS/OUTLINE

1. Imaging features of BRCA gene mutation related tumors will be discussed including A. Breast Cancer, female and male B. Ovarian Cancer C. Fallopian tube cancer and peritoneal cancer D. Prostate cancer E. Pancreatic Cancer
2. Imaging features on mammography, US, CT and MRI will be reviewed
3. Prevention, management and therapeutic options will be discussed

SUMMARY

Inherited 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
Breast Tuesday Poster Discussions

Tuesday, Dec. 1 12:45PM - 1:15PM Location: BR Community, Learning Center

**BR**

**AMA PRA Category 1 Credit ™: .50**

### Participants

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### Sub-Events

**BR246-SD-TUB1**

**Breast Density Variation Across a Screening Program**

Station #1

**Participants**

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Sue Hudson, London, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

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**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**

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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 (12.2%) were ER-negative/PR-positive, 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-negative/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

**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

**Participants**

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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 masses, the conspicuity on SM was superior while their morphology was slightly inferior to that on DM for BI-RADS assessment. For MCs, 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

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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

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Yapi 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
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%, 98.3%, 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

Participants

Prayna Bhatia, BS, Columbus, OH (Presenter) Nothing to Disclose
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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 been 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 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

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.
Adverse Effects of Drugs in the Breast and Axilla. What Every Radiologist Should Know

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
- Introduction
- List of drugs associated breast disorders
- Concepts and Mechanism of pathogenesis
- Imaging Spectrum
- Cases
- Management
- Conclusion: 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.
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.
Breast Imaging (Quantitative)

Tuesday, Dec. 1 3:00PM - 4:00PM Location: Arie Crown Theater

AMT PRA Category A+ 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, GlaxoSmiKline 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. Bumsnd, MD, MPH, Madison, WI (Presenter) Stockholder, NeuWave Medical Inc
Hui Li, MD, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
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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.

Participants
Elizabeth S. Bumsnd, MD, MPH, Madison, WI (Presenter) Stockholder, NeuWave Medical Inc
Hui Li, MD, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
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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.
CONCLUSION

that there was no difference in the segmentation performance regardless of the extent of BPE. Two sampled t-test between the scores computed for the mild and marked BPE tumors failed to reject the null hypothesis indicating 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.

RESULTS

automatically seeded grow cut method. Images. The GMM classifications are used to refine a joint segmentation generated from the individual sequences using an algorithmic process. The tumor is automatically learned using a Gaussian mixtures model (GMM) using the individual time series and the computed scalar images are computed. The algorithm is initialized with a manually delineated contour of the tumor on a single slice. A model of contrast) to generate volumetric tumor segmentation. The DCE-MR house software that combines dynamic contrast enhanced (DCE) MR images acquired at multiple time points (1 pre and 3 post contrast) to evaluate 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 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

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 pattern with each pathological 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 Dashefsky, MD, DPhil, New York, NY (Abstract Co-Author) Nothing to Disclose
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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

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 sample 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

Participants
Bo La Yun, MD, Seongnam, Korea, Republic Of (Presenter) Nothing to Disclose
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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 pattern with each pathological 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.
We retrospectively analyzed data from an entire one-year (09/01/10 to 08/30/11) screening cohort at our institution (N = 10,728). Participants were identified as women confirmed negative also at 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 age-matched to FNs based on age and race, at a 1:3 ratio (N=33). To determine the added value of our breast complexity index (BCI), controls were also matched to FNs based on BIRADS descriptors, 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
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 BI-RADS 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.

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 IDCs 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

**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  **Multiparametric 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) Speaker, Koninklijke Philips NV; Medical Advisor, MIM Software Inc  
Nelly Salem, MD, Cleveland, OH (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, MPhil, 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...
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.
Over the clinical range 0-6 cm, the MBI system demonstrated better spatial resolution than the BSGI system while yielding a 2.6-

CONCLUSION

BSGI.

spots at 4mCi were undetectable. In the 25 patient studies, 5 lesions (CNR>3) were identified on MBI whereas 3 were identified on 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. 25 patients receiving 4-8mCi doses were imaged on both systems under IRB approval. A 6-cm thick contrast detail (CD) phantom with 48 hot spots (3-10 mm diameter) was used to assess contrast-noise-ratio (CNR) registered tungsten collimators. System sensitivity, uniformity, energy and spatial resolution were measured using NEMA methods. A 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 140 keV) 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.

SS302-05 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/μCi (BSGI) and 790 cpm/μCi (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/μCi. 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-
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.
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.
### 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

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**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 convenient 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 constituents, permitting multi-parameter computer aided detection and localization of tumors. In addition to endogenous chromophores, these optical measurements are exquisitely 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 techniques. 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](http://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:**


**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**

Breast Wednesday Case of the Day

Wednesday, Dec. 2 7:00AM - 11:59PM Location: Case of Day, Learning Center

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.
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 fundamentals 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 likely to present with an interval palpable cancer between screening exams (17 times more likely in one study). Although this is a known limitation, women undergoing regular screening that develop an interval cancer may feel disenchanted 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 methodology in which to identify and apply these ancillary tests. Women with high breast density are 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.
**RC521A  Mammography Perspective**

Participants
Ehsan Samei, PhD, Durham, NC (Director) Nothing to Disclose
Douglas E. Pfeiffer, MS, Boulder, CO (Director) 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

**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 MRL. 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.
Breast Imaging (Density and Risk Assessment)

Wednesday, Dec. 2 10:30AM - 12:00PM Location: Arie Crown Theater

SSK01-01 Breast Density: Who is Informing the Patients?

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

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 breast 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

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
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 breast 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.
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, MBBC, 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 statistically significant increased risk of breast cancer development than normal weight individuals (\( p = 0.02 \)). 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 (\( p = 0.0001 \)) 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 increased risk of breast cancer 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
We computed odds ratios (OR) for breast cancer masking risk (i.e. interval versus screen detected cancer) for each of the
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

RESULTS

(VDG) was determined for each image using Volpara, Matakina Technology, New Zealand.

status in a five-fold cross validation. To assess the interaction of the texture scores with breast density, Volpara Density Grade

resemble the texture of normal tissue. The method was trained and tested on raw mammograms to determine cancer detection

that a developing cancer may not only be masked because it is obscured; it may also be masked because its mammographic signs

characterize mammographic texture. The reason for focusing on mammographic texture rather than the amount of breast density is

contralateral mammograms. We developed a novel machine learning based method called convolutional sparse autoencoder to

From the Dutch breast cancer screening program we collected 285 screen detected cancers, and 109 cancers that were screen

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. 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

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Nicolas Kanssemjejer, 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;

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 (BRADS 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
Amilia Gastounioti, Philadelphia, PA (Presenter) Nothing to Disclose
Brad M. Keller, PhD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
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Ming-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
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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
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

**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. Candelanla, 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
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Vincent Wallace, PhD, Crawley, Australia (Abstract Co-Author) Nothing to Disclose
Sarah Pinder, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Amie 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.
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

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.
CONCLUSION

Microcalcifications seem to cause an apparent strain even though the tissue is harder than normal.

with and without calcifications was 73.1% and 96.9%, respectively. As strain elastography is based on combined autocorrelation,

98.0%, respectively (P = 0.003). When the presence of microcalcifications was judged only by MMG, the sensitivity for the lesions

positive findings, the overall sensitivity was 84.6 %, while sensitivity for the lesions with and without calcifications was 74.2% and

(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

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

microscopically confirmed in 14 patients. Of the lesions without calcifications, 1 (2.0%), 15 (29.4%), 15 (29.4%), and 23 (45.1%)

METHOD AND MATERIALS

Between January 2012 and December 2014, 196 patients with pTis to pT1b breast cancer underwent surgery at our hospital. We

Participants

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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

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

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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

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PURPOSE

It is desirable to minimize wait times for surgery in patients with triple negative breast cancers.

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.

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.
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
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**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 different sonographic patterns of MFBF. Pattern A (28%): well-circumscribed, hypoechoic, avascular mass. Pattern B (72%): ill-defined, irregular, avascular, markedly hypoechogetic or spiculated localized 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. It 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
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Jong-Young Oh, Busan, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
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**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.
**BR253-SD-WEA1**
Contrast-enhanced Ultrasound Imaging in Ablation Therapy for Primary Breast Carcinoma

**Participants**
Jiyon Lee, MD, New York, NY *(Moderator)* 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 ablation 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 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.

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**BR254-SD-WEA2**
Fast Bilateral Breast Coverage with High Spectral and Spatial Resolution (HiSS) MRI at 3T

**Participants**
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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
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.

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.
to classify galactoceole-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 galactoceole-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

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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 BI-RADS 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 BI-RAD 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

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Patsy Whelehan, MSc, Dundee, United Kingdom (Abstract Co-Author) Nothing to Disclose

PURPOSE

To analyze the variation in the sensitivity of shear wave elastography (SWE) for the detection of invasive breast cancer according to histological type, using data from 1120 breast cancers.
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 represent tubular cancer should be interpreted with caution.

TEACHING POINTS

Recognize and analyze most common artifacts that condition an optimal mammographic diagnosis/ Learn to fix them to ensure high quality standards.

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 possible, take actions to eliminate them to ensure high quality standards.
Comparative Diagnostic Value of Two-dimensional Synthesized Mammogram and Conventional Full-field Digital Mammogram for Evaluation of Breast Cancer

Station #1

Participants
Jiyon Lee, MD, New York, NY (Moderator) Nothing to Disclose

Sub-Events
BR260-SD-WE1 Comparative Diagnostic Value of Two-dimensional Synthesized Mammogram and Conventional Full-field Digital Mammogram for Evaluation of Breast Cancer

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-WE2 Volumetric Breast Density and Mean Glandular Dose Estimated from Digital Breast Tomosynthesis Projections and Digital Mammograms

Station #2

Participants
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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 κ = 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 DM, 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.

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
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Paula Martinez Miravete, Zaragoza, Spain (Abstract Co-Author) Nothing to Disclose
Begona Olatzecocechea, 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.

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-Yang 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 metastastic 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.

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?

Purpo

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 auxiliary 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 II 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+ 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.

Diagnostic Performance and Reproducibility of Breast Acoustic Radiation Force Impulse (ARFI) Imaging in the Clinical Setting

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 auxiliary 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 II 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+ 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.
**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 \(~3.4 \text{ m/s}\) 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
**Breast Imaging (Practice Issues)**

**Wednesday, Dec. 2 3:00PM - 4:00PM Location: E451A**

**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 BI-RADS 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 BI-RADS 3 were available for blinded review, including 43 cases (8 malignancies) and 9 controls. The first reader assessed 18/82 (22.0%) as BI-RADS 0, 13 cases, 5 controls; 35/82 (42.7%) as BI-RADS 2, 11 cases, 24 controls; 7/82 (8.5%) BI-RADS 3, 4 cases, 3 controls; 22/82 BI-RADS 4, 15 cases, 7 controls. The second reader assessed 8/82 (9.8%) as BI-RADS 0, 4 cases, 4 controls; 27 (32.9%) BI-RADS 2, 11 cases, 16 controls; 33 (40.2%) BI-RADS 3, 19 cases, 14 controls; 14 (17.0%) BI-RADS 4, 9 cases, 5 controls. The two readers had the same BI-RADS assessment on 34/82 (41.5%) exams. Of the 8 cancers, the first reader assessed 2 as BI-RADS 0, 1 as BI-RADS 2, 1 as BI-RADS 3, and 4 as BI-RADS 4; the second reader assessed 2 as BI-RADS 2, 4 as BI-RADS 3, and 2 as BI-RADS 4. Reasons for BI-RADS 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 BI-RADS 4 assessment included suspicious morphology or documented instability.

CONCLUSION

Many BI-RADS 3 lesions were judged to have had incomplete diagnostic evaluation on blinded review. Lesions assigned to the BI-RADS 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 BI-RADS 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

Jordan 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(44%) 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.
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 biomarkers (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% and a NPV of 97.9%. 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.
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.
Breast Imaging (Ultrasound Advanced Applications)

Wednesday, Dec. 2 3:00PM - 4:00PM Location: E451B

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

Participants
Sughra Raza, MD, Boston, MA (Moderator) Nothing to Disclose
Catherine S. Giess, MD, Wellesley, MA (Moderator) Nothing to Disclose

Ah Young Park, MD, Ansan, Korea, Republic Of (Presenter) Nothing to Disclose
Bo Kyung 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
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=0.747 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

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%, 69%, 76.7% 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
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 interobserver 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.

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 intracllass 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). Intracllass 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). Heterogeneous 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


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.
Breast Thursday Case of the Day

Thursday, Dec. 3 7:00AM - 11:59PM Location: Case of Day, Learning Center

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
Michyia 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.
**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.

**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.
Radiomics Mini-Course: Oncologic Applications

Thursday, Dec. 3 8:30AM - 10:00AM Location: S103AB

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**

**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
Fast sampling allows accurate measurement of early lesion kinetic parameters, which may be diagnostically useful. Higher lesion CLINICAL RELEVANCE/APPLICATION of the center of k-space in standard protocols.

Measurement of kinetics relative to arterial TOA. Lesion conspicuity was highest at early times after injection, before the sampling sampling may show larger differences between benign and malignant lesions compared to conventional DCE-MRI, and allows malignant lesions, on average, had significantly faster signal enhancement than benign lesions, and significantly shorter TOA. Fast acquisitions. Temporal resolution for the fast scans was 6.2-9.9s, with spatial resolution of 1.5x1.5x3mm^3; standard protocol 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 'standard' 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

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; ; ;
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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
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**

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(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 dimensionality 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^{-3}mm^2/s). However, the ADC values in glandular tissue were similar across all groups(2.14-2.17x10^{-3}mm^2/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 imaging metrics can provide the foundation to relate these variables to the OncotypeDX gene array score.

**Honored Educators**

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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 Dimichs, 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

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.
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.
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.
Association of Breast Density with Breast Cancer Risk in Screening Mammography

**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
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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 mammography screening. 52,962 mammography 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 mammographic density (>50% parenchyma) had 17% breast cancer patients vs 11% controls. There was no significant difference in mammographic density between breast 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 women have low breast density. Mammography is efficient method for early detection of nonpalpable breast cancer.

**CLINICAL RELEVANCE/APPLICATION**
Mammography is the best tool for population-based breast cancer screening.

Diagnostic Performance of Hybrid PET/MR for Determination of Preoperative Lymph Node Status in Patients with Breast Cancer

**Participants**
Eun-Jung Kong, Daegu, Korea, Republic Of (Presenter) Nothing to Disclose
Ihn-He 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

Participants
Su Min Ha, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
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Hee Jung Shin, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Ki Chang 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
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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<0.001) and proximal peritumoral stroma (4.96 ± 3.19 vs. 1.31 ± 0.50, P<0.001). On multivariate analysis, odds ratio for the prediction of malignancy was 2.26 for tumor, 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 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 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 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 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 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 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 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 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 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 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 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 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).

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?

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 software (Volpara). For each parameter investigated we determined the median value, 1st, and 3rd quartiles.
For patients, the median age was 58 years (1st quartile 51; 3rd quartile 66) and median BMI was 26.8 (25.4; 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 = 0.036), 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-THAS

Readout-segmented Echo-planar Imaging Guided Proton MR Spectroscopy in the Detection of Choline Concentration in Breast Lesions

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 ratio (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

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
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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 discuss 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. Discussion The 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. Breast MRI is clinically useful in the prediction of tumor response after neoadjuvant therapy.
**Breast Thursday Poster Discussions**

**BR272-SD-THB1**

**Pure Architectural Distortion on Digital Breast Tomosynthesis with Histopathologic Correlation**

**Station #1**

**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**

**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 BI-RADS 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 BI-RADS category 4 or 5, 4 as BI-RADS category 3, and 1 as BI-RADS 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 predicted 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
Mitsuhito 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 calculations, 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 calculations, 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

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, Matakin Technology Limited; Shareholder, Matakin 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: [1.1, 1.6%]) for "pre-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: [10.8, 13.0%]) for "yes-DBT". 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 Performance and Radiation Dose with Two-view DM with or without MLO DBT

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

PURPOSE

Replacement of single-view DM with MLO DBT was performed to compare the diagnostic performance and radiation dose of synthesized mammography with or without MLO DBT.
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 TOMOSYNTHESIS (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, 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.

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), periluminal 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.
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.
Case-based Review of Breast (An Interactive Session)

Thursday, Dec. 3 1:30PM - 3:00PM Location: S100AB

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
Janie M. Lee, MD, Bellevue, WA (Director) 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.
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.
**Case-based Review of Breast (An Interactive Session)**

Thursday, Dec. 3 3:30PM - 5:00PM Location: S100AB

**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.
Participants

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.

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 tomosynthesis and clinical benefits. Review of current literature on clinical implementation of Digital Breast Tomosynthesis. Outlining how a facility may embark on DBT implementation 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 extremely 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.

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

Thursday, Dec. 3 4:30PM - 6:00PM Location: E260

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

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

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.

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

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) 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.

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
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
The Biology of Breast Cancer

Friday, Dec. 4 8:30AM - 10:00AM Location: S406B

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 comparison with clinical definitions.
2) Learn some of the main genomic features and clinical 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.

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
US-guided Interventional Breast Procedures (Hands-on)

Friday, Dec. 4 8:30AM - 10:00AM Location: E264

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

Participants
Gary J. Whitman, MD, Houston, TX (Moderator) Book contract, Cambridge University Press
Annamarie 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
Aldo 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, (rpm9@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
**Breast Imaging (Multi-modality Screening)**

Friday, Dec. 4 10:30AM - 12:00PM Location: E450B

**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?

**Participants**
Claudia R. Seuss, MD, New York, NY (Presenter) Nothing to Disclose
Samantha L. Heller, MD, 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. 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

**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 Vreeman, 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 Kanssemijer, 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 Kanssemijer, 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, MBCh, 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 includes 104,893 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 than 1 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 5.7 to 11.4 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.

SSST01-07 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 Glis, 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, 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+). 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.

SSST01-08 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
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.

**METHODS**

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 attributed to inadequate tissue acquisition. Optimal positioning maximizes 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.